ENVIRONMENTAL HEALTH: BRIDGING THE GAPS

James A. Listorti and Fadi M. Doumani

PART 1: HARMONIZING SECTORAL PRIORITIES: A NEW APPROACH TO ENVIRONMENTAL HEALTH

PART 2: ENVIRONMENTAL HEALTH ASSESSMENT GUIDELINES

PART 3: PUTTING THEORY INTO PRACTICE: A CASE STUDY IN GHANA
# Table of Contents

*(The Table of Contents serves also as an Index)*

**Foreword** ........................................................................................................................................... xv

**Abstract** ............................................................................................................................................. xvi

**Acknowledgments** ............................................................................................................................. xviii

**How to Use This Volume** .................................................................................................................... xviii

  - *Part 1: Harmonizing Sectoral Priorities* .................................................................................................... xviii
  - *Part 2: Environmental Health Assessment Guidelines* ........................................................................... xviii
  - *Part 3: Putting Theory into Practice* ....................................................................................................... xix

**Exclusions to this Volume** .................................................................................................................... xix

**Acronym List** ......................................................................................................................................... xxi

**Executive Summary** ............................................................................................................................ xxii

**Part 1: Harmonizing Sectoral Priorities: A New Approach to Environmental Health** ............. 1

**Chapter 1: Challenges of Environmental Health in Developing Countries** ......................... 3
  - *Inadvertent Bias in Neglecting Environmental Health* ........................................................................... 3
  - *How the Health Picture Differs in Developing Countries* ................................................................... 5
  - *The Changing Face of Disease and the Developing World* .................................................................... 7
    - *Vector-Related Diseases* ......................................................................................................................... 7
    - *The Double Burden of Disease in Developing Countries* ................................................................... 8
    - *Global Change* ....................................................................................................................................... 8
  - *Multisectoral Approaches and the Challenges they Present* .................................................................. 9
  - *The Role of Knowledge Management* .................................................................................................... 13

**Chapter 2: Developing Solutions through Targeted Collaboration** ........................................ 15

  - *Objectives of Harmonizing Sectoral Priorities* ...................................................................................... 17
  - *Methodologies of Targeted Multisectoral Collaboration* ..................................................................... 19
    - *Identifying and Prioritizing Measures Outside the Health Care System* ........................................ 19
    - *Devising “Entry Points”* ......................................................................................................................... 20
    - *Establishing Mutual Benefits for Sustainability* ................................................................................... 21
    - *Identifying the Stakeholders* ..................................................................................................................... 22
    - *Establishing Mutual Benefits through Mapping* ................................................................................ 23
  - *Quantifying Untapped or Missed Health Benefits* .................................................................................. 24
    - *Improved Service Delivery* ..................................................................................................................... 26
    - *Estimating Beneficiaries* ........................................................................................................................ 27

**Chapter 3: Socioeconomic Justification and Challenges** ............................................................... 29

  - *Why Do Mainstream Environmental Health in Development Work?* ........................................... 30
  - *Understanding Environmental Health Attributes* ................................................................................ 33
  - *Harmonizing Environmental Health with Environment Policies, Law, Institutions, and Monitoring Systems* ......................................................................................................................... 36
  - *Policy Failures* ....................................................................................................................................... 37
    - *Structural and Sectoral Adjustment Lending: Macroeconomic Matrix* ......................................... 38
    - *Structural and Sectoral Adjustment Lending and Strategic Environmental Assessment: Action Impact Matrix* ................................................................................................................. 40
  - *Public Expenditures Review* .................................................................................................................. 41
    - *Country Assistance Strategy Environmental Analysis Matrix* ......................................................... 42
    - *Comprehensive Development Framework Matrix* ............................................................................... 43
    - *Poverty Reduction Strategy, Environmental Health, and Poverty Linkages* ................................ 44
Chapter 4: Gathering and Analyzing Information for Environmental Health ........................................ 67
  An Overview of EHAs .................................................................................................................. 67
  EHAs and Alternatives ............................................................................................................... 69
    Environmental Health Profiles ............................................................................................... 69
    Adapting an Existing Environmental Assessment as an EHA .............................................. 70
    Adapting an Existing Health Assessment as an EHA ............................................................ 70
    Adapting an Existing Social Assessment as an EHA ............................................................. 72
    Adapting an Existing Poverty Assessment as an EHA ......................................................... 72
    Conducting a Complete EHA .............................................................................................. 73

Chapter 5: Preparing an “Environmental Health Profile” ................................................................ 75
  Preparing Sectoral Profiles .................................................................................................... 78
    Poverty Profile ..................................................................................................................... 79
    Agriculture and Rural Development Profile .................................................................... 79
    Energy Profile .................................................................................................................... 80
    Environment Profile .......................................................................................................... 80
    Health Profile ................................................................................................................... 81
    Industry Profile ................................................................................................................ 83
    Infrastructure Profile ....................................................................................................... 83
    Demographic Profile ........................................................................................................ 84
    Institutional Profile .......................................................................................................... 84
    Development Assistance Profile ...................................................................................... 84
  Analyzing the Data ................................................................................................................ 85

Chapter 6: Adapting Environmental Assessments or Preparing Environmental Health Assessments .......................................................................................................................... 89
  Adapting Existing Environmental Assessments to Serve as EHAs ....................................... 89
  Conducting a Complete EHA ................................................................................................. 96
    Environmental Health Analyses ....................................................................................... 97
      Broad Picture and Overall Context .................................................................................. 97
      Definition of Key, Confusing, and Misused Terms ......................................................... 99
      Individual Sector Factors and Issues ............................................................................ 99
      Typical Loans from the Sector ....................................................................................... 99
    Environmental Health Assessment Outline .................................................................... 100
      The Proposed Project .................................................................................................... 100
      Institutional Strengths and Weaknesses ........................................................................ 100
      Occupational, High Risk, and Vulnerable Groups ....................................................... 100
      Hot Spots, Special Cases, and Key Pollutants ............................................................... 101
      Inadvertent Professional Biases ..................................................................................... 101
      On the Horizon .............................................................................................................. 102
      Research and Information Gaps ................................................................................... 102
Part 2: Environmental Health Assessment Guidelines .......................................................... 103

Chapter 7: Environmental Health Background Analyses .......................................................... 105

Leading Health Problems ........................................................................................................ 105

Malnutrition ................................................................................................................................. 106
Respiratory Diseases, Tuberculosis, and Diseases Related to Air Pollution ......................... 107

About Air Pollutants .................................................................................................................... 108
Gastroenteric Diseases ................................................................................................................. 110

Diarrheas .................................................................................................................................... 110
Intestinal Parasites ....................................................................................................................... 112
Malaria and Vector-Related Diseases .......................................................................................... 112

About Mosquitoes ........................................................................................................................ 113
Vector Control ............................................................................................................................... 115
Injuries and Accidents ................................................................................................................... 119
Physical and Mental Stress .......................................................................................................... 120

Diseases for Special Consideration ................................................................................................ 120

AIDS .......................................................................................................................................... 120
Epidemic Cholera .......................................................................................................................... 121
Guinea Worm Infection ................................................................................................................ 121

Key Cross-Cutting Issues .............................................................................................................. 122

Pesticide Use ............................................................................................................................... 122
Biological Diversity and Traditional Medicines ......................................................................... 126

Chapter 8: Cross-Sectoral Linkages: Agriculture and Rural Development Sector .................. 129

Key Environmental Health Issues ............................................................................................. 129

Human Settlements ...................................................................................................................... 130

Housing ...................................................................................................................................... 131
Energy Use and Generation .......................................................................................................... 132

Traditional Fuels ........................................................................................................................ 132
Modern Fuels ............................................................................................................................... 133
Power Generation .......................................................................................................................... 133

Periurban Agriculture and Livestock .......................................................................................... 134

Land Use and Natural Resource Management ........................................................................ 134

Food Production, Processing, Storage, and Transport ................................................................. 134

Crops, Food Security, and Nutrition .......................................................................................... 134
Use of Pesticides and Fertilizers .................................................................................................. 136
Livestock and Animal Husbandry ............................................................................................... 138

Fisheries and Aquaculture .......................................................................................................... 140
Food Processing, Storage, and Transport .................................................................................. 140

Land Clearing for Agriculture or Settlement ............................................................................. 142
Forestry, Biodiversity, and Traditional Medicines ..................................................................... 143

Water and Waste Management .................................................................................................. 145

Rural Community Drinking Water Supply ................................................................................ 145
Irrigation and Drainage ................................................................................................................ 147

Potential Impacts from Increased Agriculture .......................................................................... 147
Potential General Ecological Disturbances ................................................................................ 148
Marshes and Other Wetlands ...................................................................................................... 149

ReUse of Wastewater ................................................................................................................... 149
Agricultural Waste Management ............................................................................................... 149
Domestic Waste Management .................................................................................................... 149

Wastewater .................................................................................................................................. 149
Periurban Waste .......................................................................................................................... 150

Rural Transportation ................................................................................................................ 150

Roads, Trails, and Paths ............................................................................................................... 150
River Transport ............................................................................................................................ 151

Environmental Health Assessment Checklist ............................................................................ 151
Annexes.................................................................................................................................283
Annex A: Environmental Health Assessments: Rapid Checklists ........................................285
Annex B: Basic Information on Important Diseases .................................................................313

**Individual Diseases**...........................................................................................................313

- Cholera .................................................................................................................................313
- Dengue Fever ........................................................................................................................314
- Diarrheas and Dysentery ......................................................................................................315
  - Diarrheas: Undifferentiated (Childhood and Traveler’s) ..................................................315
  - Diarrheas: Specific ..............................................................................................................316
  - Dysentery: Amebic ..............................................................................................................317
  - Dysentery: Shigellosis ........................................................................................................318
- Filariasis ..................................................................................................................................318
- Food Poisoning ......................................................................................................................320
- Giardiasis ................................................................................................................................320
- Guinea Worm Disease .........................................................................................................321
- Hepatitis .................................................................................................................................322
- Intestinal Worms (Ascaris and Hookworm) .........................................................................323
  - Intestinal Worms: Ascariasis ...........................................................................................323
  - Intestinal Worms: Hookworms .......................................................................................324
- Malaria ...................................................................................................................................325
- Onchocerciasis ......................................................................................................................326
- Respiratory Diseases (Acute, Flu, and Pneumonia) .............................................................327
  - Respiratory Disease: Acute Respiratory Illnesses (Short-Term and Mild) ..................327
  - Respiratory Disease: Influenza .......................................................................................327
  - Respiratory Disease: Pneumonias ..................................................................................328
- Salmonelloses (Salmonella and Typhoid) .........................................................................329
  - Salmonelloses: Salmonellosis (see also Dysentery) .......................................................329
  - Salmonelloses: Typhoid and Paratyphoid .....................................................................329
- Schistosomiasis ...................................................................................................................330
- Tetanus ...................................................................................................................................332
- Trachoma ..............................................................................................................................332
- Trypanosomiases (African Sleeping Sickness and Chagas’ Disease) ...............................333
  - Trypanosomiases: African Sleeping Sickness ................................................................333
  - Trypanosomiases: Chagas’ Disease (American) .............................................................334
- Tuberculosis ..........................................................................................................................334

**References**..........................................................................................................................337

**Glossary**...............................................................................................................................343

**Terms on Environmental, Health, and Risk Assessments**................................................349

- Environmental Health ........................................................................................................349
- Assessment ............................................................................................................................350
- Environmental Health Impact Assessment .........................................................................350
- Health Impact Assessment .................................................................................................351
  - (Health impact assessment within an environmental impact assessment) .....................351
- Environmental Assessment and Environmental Impact Assessment .............................351
  - Environmental Assessment ............................................................................................351
  - Environmental Assessment (Regional) .........................................................................352
  - Environmental Assessment (Sectoral) ............................................................................352
  - Environmental Impact Assessment .................................................................................352
- Risk and Hazard Assessment ...............................................................................................354
  - Hazard and Risk Assessment ..........................................................................................354

**Bibliography** .......................................................................................................................357

- Environmental Assessment Resources ..............................................................................357
- Environmental and Health Resources ................................................................................359
- Environmental Health Links on the Internet .......................................................................361
Boxes

Box 1-1: The Case of Lead ................................................................................................................................. 4
Box 1-2: Key Confusing and Misused Terms on Diseases and Statistics .......................................................... 5
Box 1-3: Urbanization in Sub-Saharan Africa ................................................................................................... 8
Box 1-4: The Health Situation in Sub-Saharan Africa ...................................................................................... 9
Box 1-5: A Near Miss in an Environmental Assessment ................................................................................ 12
Box 1-6: The Contributions of an Environmental Health Approach ................................................................... 14
Box 2-1: Mainstreaming the New Approach into Bank Development Work .................................................. 16
Box 2-2: Environmental Health Defined ........................................................................................................ 17
Box 2-3: Key, Confusing, and Misused Terms on “Medicine” and “Health” .................................................... 18
Box 3-1: Working Definition of Environmental Health .................................................................................. 30
Box 3-2: Key, Confusing, and Misused Economic Terms on Environmental Health .................................... 32
Box 3-3: Example of Legislation Adapted for Environmental Health ............................................................ 46
Box 3-4: Key, Confusing, and Misused Terms on Goods and Services .......................................................... 46
Box 3-5: Measuring the Burden of Disease: The DALY Concept .................................................................... 51
Box 3-6: Partnerships to Manage Vector-Related Diseases in an Urban Setting ............................................. 62
Box 4-1: Key, Confusing, and Misused Terms on Assessments and Plans ....................................................... 67
Box 4-2: Clarifying the Objectives of Assessments and Projects ........................................................................ 68
Box 4-3: Sample Outline for a Health Impact Assessment ............................................................................... 70
Box 4-4: Sample Sequence of the EHIA Process ............................................................................................ 72
Box 5-1: A Word of Caution ............................................................................................................................... 79
Box 5-2: A Note on Sub-Saharan Africa ....................................................................................................... 81
Box 5-3: Truckers in SSA and AIDS ................................................................................................................ 82
Box 5-4: “Drop-Dead” Data ............................................................................................................................ 82
Box 5-5: Employing an EHP in Ghana .............................................................................................................. 86
Box 6-1: Core Outline for an Environmental Health Assessment ..................................................................... 97
Box 7-1: Potential Risks Associated with Pesticide Use in Malaria Control in SSA ...................................... 117
Box 7-2: Key, Confusing, and Misused Terms on Pesticides .......................................................................... 122
Box 7-3: Health Aspects of World Bank Policy on Pest Management (OP 4.09) .......................................... 123
Box 8-1: Key, Confusing, and Misused Terms on Human Settlements ............................................................. 131
Box 8-2: Key, Confusing, and Misused Terms about Rural Energy ............................................................... 132
Box 8-3: Drought in Sub-Saharan Africa ...................................................................................................... 135
Box 8-4: Key, Confusing, and Misused Terms on Agriculture ....................................................................... 136
Box 8-5: Key, Confusing, and Misused Terms on Fertilizers ....................................................................... 138
Box 8-6: Medicinal Plants and Ghana ............................................................................................................ 143
Box 8-7: Two Successes in Eradicating Guinea Worm Disease and River Blindness .................................... 145
Box 8-8: The Stressful Facts about Rural Water Supply .................................................................................. 146
Box 11-1: Key, Confusing, and Misused Terms on the Heath Sector ................................................................ 167
Tables

Table ES-1: Sample Linkages and Synergies to Harmonize Infrastructure Sectoral Priorities ........................................ xxv
Table 1-1: Top Ten Diseases and Conditions (1998) by Indicative DALYs ................................................................. 6
Table 1-2: Environmental Factors and the Global Burden of Disease: Proportion of Global DALYs
Associated with Environmental Exposures (1990) .......................................................................................... 6
Table 1-3: Death and Disability of Top Ten Vector-Borne Diseases (1998) ................................................................. 8
Table 1-4: Rank and Share of Burden of Disease in SSA (1990) ........................................................................... 9
Table 1-5: Rank and Share of the Burden of Disease in SSA (1990-98) ............................................................... 10
Table 1-6: Possible Consequences from the Absence of Health in Decisionmaking ........................................... 13
Table 2-1: Sample Environmental Health Determinants and Consequences ......................................................... 17
Table 2-2: Infrastructure Measures for Top Five Burdens of Disease in SSA ....................................................... 19
Table 2-3: Top Ten Diseases in Ghana by Infrastructure Intervention (1994) ....................................................... 20
Table 2-4: Sample Linkages and Synergies to Harmonize Sectoral Priorities ....................................................... 21
Table 2-5: Stakeholders at Risk and Potential Partnerships for Entry Points in Ghana ........................................ 22
Table 2-6: Ghanaian Recommendations for Entry Points Based on Multisectoral Collaboration ....................... 23
Table 2-7: Burden of Disease in SSA by Main Remedial Measures (1990) ............................................................... 25
Table 2-8: Burden of Disease Relieved by Remedial Measures (1998) ................................................................. 26
Table 2-9: Possible Health Benefits Missed by Focusing on a Single Disease .................................................... 26
Table 2-10: Sample of Increased Health Benefits in Long-Term Water Sector Project in Senegal .................... 27
Table 3-1: Back-of-the-Envelope Burden of Disease (BOD) Breakdown in SSA, 1998 ........................................... 31
Table 3-2: Health Risks Attributable to Natural Disasters in SSA, 1990-2000 ...................................................... 34
Table 3-3: Environmental Health Externalities Usually Neglected in Valuation ................................................... 35
Table 3-4: Macro Policies Impact on Environment and Environmental Health ...................................................... 39
Table 3-5: Example of an Action Impact Matrix (AIM) ......................................................................................... 41
Table 3-6: CAS Environmental and Environmental Health Analysis Matrix ....................................................... 43
Table 3-7: CAS Country Program Matrix ........................................................................................................... 43
Table 3-8: Example of Environmental Health Monitoring System Targeting Poverty ........................................ 49
Table 3-9: Back-of-the-Envelope SSA Environmental Health Quantification, 1998 (DALY and $Billion) .......... 54
Table 3-10: Back-of-the-Envelope SSA Environmental Health Valuation, 1998 (DALY and $Billion) ........... 58
Table 3-11: Policies and Instruments for Sustainable Development ................................................................. 65
Table 5-1: Summary of Sectoral Problems, Strategies, and Actions for Ghana .................................................... 76
Table 5-2: Sample Sectoral Problems and Strategies/Actions from Ghana ........................................................... 76
Table 6-1: The World Bank’s Safeguard Policies ................................................................................................... 89
Table 6-2: Adapting Bank EA Procedures to an EHA or Equivalent ................................................................. 90
Table 6-3: Adapting EA Content to an EHA ........................................................................................................ 90
Table 6-4: Adapting an EA Environmental Management Plan to an EHA ........................................................... 91
Table 6-5: Adapting EA Checklists to an EHA or Equivalent Analysis .............................................................. 92
Table 6-6: Environmental Health in NEAPs ......................................................................................................... 95
Table 6-7: Sample Environmental Health Linkages of Bank Lending by Sector ................................................... 98
Table 6-8: Main EHA Points for SSA Infrastructure ........................................................................................... 99
Table 6-9: Sample Occupational, High Risk, and Vulnerable Groups ................................................................. 101
Table 7-1: Major Risk Factors in Less Developed Countries (LDCs) ................................................................. 106
Table 7-2: Air-Pollution-Related Respiratory Illness ......................................................................................... 109
Table 7-3: Major Components of Air Pollution ................................................................................................. 109
Table 7-4: Multiple Sources of Lead ................................................................................................................ 110
Table A-6: Industry Sector Environmental Health Checklist ................................................................. 296
Table A-7: Housing and Urban Development Sector Environmental Health Checklist ....................... 298
Table A-8: Telecommunications Sector Environmental Health Checklist ........................................... 301
Table A-9: Transport Sector Environmental Health Checklist ............................................................. 302
Table A-10: Water Supply and Sanitation Environmental Health Checklist ......................................... 306

Map

Map 5-1: Environmental Health Needs Assessment Map for Sekondi-Takoradi, Ghana .................... 87
Health cannot be attained by the health sector, 
either alone or even primarily.

Pan American Conference on Health, 
Environment and Sustainable Development; 
(The first conference of international agencies convened 
among ministers of environment, health and finance.) 
October 1995
FOREWORD

Environmental health remains at the periphery of sustainable development, because it is inadequately defined, rarely quantified, and institutionally fragmented. Failing to address environmental health amplifies the burden of disease, which impinges on Sub-Saharan Africa’s (SSA) overall economic performance and well-being of its population, especially the poor. The Environmental Health: Bridging the Gaps program is a phased effort developed under the World Bank’s SSA Initiative on Urban Environmental Management with additional support from the Norwegian, Swedish, and Swiss governments. The program strives to highlight missing links among infrastructure, environment, and health by identifying health problems outside the health care system and proposing solutions. Environmental Health: Bridging the Gaps is a work in progress. It addresses these issues by mainstreaming environmental health at the macro, sectoral, and project levels. It also provides practical guidance on how to tackle such issues through a multisectoral approach and weave the program’s three phases together, each with a different lesson.

• Phase I focused on urban infrastructure and published the three-volume Bridging Environmental Health Gaps. This phase (a) contained guidance on incorporating environmental health into urban infrastructure projects and policy, (b) proposed that enormous potential to relieve the SSA burden of disease remains untapped, and (c) estimated that up to 44 percent of that burden may be amenable to infrastructure improvements.

• Phase II put into practice lessons of phase I in a pilot in Ghana (1999), which proposed new ways to reduce poverty by increasing the efficiency of investments through collaboration based on institutional complementarity, synergies, and mutual benefits, rather than additional budgets. Health priorities are re-evaluated to maximize solutions outside the health sector through Intersectoral collaboration. Phase II estimates that infrastructure projects conceivably could relieve as much of the burden of disease as the health sector, about 20 percent, for a fraction of the cost, because infrastructure projects have already been justified on other grounds. Moreover, the environmental health burden of disease affecting the poorest of the poor represents 10 percent of SSA’s total burden of disease. Associated lower bound social costs of environmental health problems are equivalent to 6 percent of SSA’s 1998 GDP.

• Phase III addresses rural infrastructure by complementing and expanding the prior urban focus (1999). Multisectoral linkages with urban and rural infrastructure are incorporated to include factors such as food production, pesticide use, irrigation, and so on.

The implications of infrastructure in improving health need additional epidemiological and economic analyses. Until then, we must act on professional judgment to help fill in the gaps based on the tools we have available. Environmental Health: Bridging the Gaps tries to help.

Praful Patel, Sector Director
Private Sector and Infrastructure Group, Africa Region
ABSTRACT

*Environmental Health: Bridging the Gaps*, which is divided into three parts, is a work in progress, aiming to help fill a void in economic development thinking as well as procedures to address multisectoral problems that require multisectoral responses. Intended for policymakers and practitioners alike, this discussion paper makes a modest step in helping address those problems by: (i) proposing a new approach of targeted collaboration among different sectors; (ii) devising new tools or enhancing existing ones to facilitate the contributions of different sectors to help relieve health problems; and (iii) putting theory into practice through a pilot in Ghana.

**Part 1: Harmonizing Sectoral Priorities.** After laying out the foundations and challenges of environmental health, the discussion paper tries to tap, quantify and value health benefits systematically outside the health sector, and prioritize as well as monitor interventions through a harmonized multisectoral collaboration. Back-of-the-envelope calculations are worked out showing that environmental health measures can target at least an equal share of the burden of disease than the health sector, that is, roughly 20 percent (10 percent affecting the poorest of the poor). Moreover, many health benefits are missed by being aggregated under the general rubric of “health benefits” in economic discussions, and by dealing with single diseases, when several diseases may be addressed simultaneously by remedial measures outside the health system, such as reducing indoor air pollution.

**Part 2: Environmental Health Assessment Guidelines.** In addition to discussing back-of-the-envelope economic valuation of the burden of disease, three sets of new tools are proposed to help policymakers, Task Managers and other practitioners make sound decisions, devise entry points, and establish mutual benefits from targeted collaboration. First, an “Environmental Health Profile” (EHP) as means to derive a shortlist of potentially important issues through a desk review comparing priorities from several sectors without necessarily incurring the costs of more ambitious studies. Second, procedures to adapt existing environmental, social or poverty assessments to serve as environmental health assessments. Third, a set of *Environmental Health Assessment Guidelines* and checklists, which relate to Bank projects and components, propose remedial measures for multisectoral health problems, many of which could and do otherwise fall between the cracks in single sector projects.

**Part 3: Putting Theory into Practice.** A pilot in Ghana, which could be developed as a case study for replication, puts theory into practice. Many cities in developing countries are facing difficulties because of efforts to decentralize or privatize services that were the responsibility of national governments and which fall on the shoulders of regional or municipal agencies. Unfortunately, many such governments and agencies do not have the in-house capacity and budgets to take on these added responsibilities, nor do they have adequate laws, bylaws and other regulatory measures. The pilot, which took six months from preparing an Environmental Health Profile and an institutional needs assessment to making recommendations to an ongoing project, puts into practice the ideas and tools that were developed above. After identifying multisectoral problems together with the government and the stakeholders, three entry points were prioritized (urban malaria, AIDS prevention and proper management of waste from health care facilities), and recommendations were fed into the project.
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James A. Listorti
This volume is intended for use by staff from various agencies involved with economic development and are divided into different parts for different audiences. The guidelines are intended to fill a void in the literature by bridging gaps—in particular, gaps between environmental assessments, which are supported by a vast literature, and health assessments, which is only in a nascent state and by providing background on the set of environmental health problems associated with various sectors. The guidelines cover six broad sectoral areas, stressing the environmental health dimensions of each:

- Agriculture and rural development
- Energy
- Environment
- Health
- Industry
- Infrastructure
- Multisectoral global issues

The guidelines can help prioritize investments by:

- Defining realistic expectations of projects to improve health, given the myriad of factors at play and the time it takes to improve health
- Identifying areas in which piggybacking of resources can lead to broader health impacts than would otherwise be possible and multisectoral links can be forged based on institutional complementarity
- Illustrating that health is not merely a sector for investments, but also a goal of the entire process of sustainable development.

Part 1: Harmonizing Sectoral Priorities

Intended for policymakers and practitioners alike, part 1 of this volume explains the foundations of environmental health and proposes a new approach that taps health benefits systematically outside the health sector through multisectoral collaboration. Chapter 1 details the differences and challenges of environmental health in developing countries. The new approach introduced in chapter 2 addresses these challenges by harmonizing sectoral approaches through targeted collaboration and partnerships to maximize health benefits outside the health sector. Chapter 3 asserts that environmental health measures can target a greater share of the burden of disease as the health sector, that is, roughly 20 percent for a fraction of the cost of health sector interventions. Chapters 4 through 6 compare and contrast six alternatives to making sound decisions, devising entry points, and establishing mutual benefits from targeted collaboration.

Part 2: Environmental Health Assessment Guidelines

Intended for Bank Task Managers and practitioners in the field, part 2 of this volume provides basic tools to identify, prioritize, and propose remedial measures for many multisectoral health problems, many of which could and do otherwise fall between the cracks in single sector projects. Chapter 7 provides basic environmental health background pertinent to all sectors covered in part 2. Chapters 8–14 provide guidance on environmental health linkages within and among sectors, which are summarized in a checklist at the end of each chapter. This edition of Environmental Health: Bridging the Gaps focuses particular attention on cross-sectoral linkages with infrastructure interventions between the agriculture and rural development sector (chapter 8) and the infrastructure sector (chapter 13). The other chapters briefly review linkages in the energy (chapter 9), environment (chapter 10), health (chapter 11), and industry (chapter 12) sectors and with global
issues, that is, those that affect the planet as a whole (chapter 14), because many of the issues have already been addressed in chapters 7, 8, and 13.

Part 3: Putting Theory into Practice

Chapters 15, 16, and 17 summarize the findings and present background material from a workshop in Ghana, “Targeted Collaboration among Line Agencies, Local Communities and the Ministry of Health,” putting into practice the ideas of parts 1 and 2. Innovations included a multisectoral environmental health needs assessment, as well as suggestions for remedial measures. The summaries can be useful for policymakers and the details, process, and recommendations can be useful for practitioners in the field. Annex A provides a rapid checklist on environmental health for practitioners and task managers. Annex B provides one-page summaries of about twenty major diseases (description, transmission, and intervention).

A glossary and bibliography of resources available on environmental health and other forms of assessments may be found among other back matter for the volume.

Exclusions to this Volume

This volume does not deal with the several important issues described below.

Individual industries. Pertinent environmental health issues are generally dealt with under the overall general best practice for “occupational health and safety.” These practices are amply covered in the literature and materials are readily available, for example, Pollution Prevention and Abatement Handbook 1998: Toward Cleaner Production (World Bank 1998). In general, however, occupational health and safety guidelines tend to focus on the workspace itself and in-house employees and do not cover residential areas surrounding individual plants or industrial zones. This leaves an important gap in coverage by such guidelines.

Nutrition. Nutrition is dealt with only indirectly in three sets of linkages: (a) pesticide and fertilizer use in food production, (b) deficiencies of sanitation that contribute to diarrheas and anemia, and (c) the broad housing environment with respiratory diseases in infants and children. In addition, the debate over meat (animal fat) is a new and rapidly evolving field that cannot be dealt with adequately in this volume. The debate revolves around the notion that production of meat for human consumption is not the least-cost solution to meet increasing global nutritional needs. (It is far less efficient to produce grains for animal food than grain for direct human consumption, and diets high in animal fat can be unhealthy.)

Genetic engineering. Research is evolving so rapidly, much of it highly controversial, that it is difficult for this volume to make practical recommendations.

Mental health. According to the World Health Organization (WHO), mental health problems are on the rise and constitute an increasing share of the burden of disease. This volume only calls attention to the existence of such problems in the context of rural to urban migrations, but do not propose remedial measures.

Disasters. Pertinent material can be found through the Bank’s “Disaster Management Facility,” which concentrates on prevention and mitigation of the effects of disasters. (The extreme degradation created by warfare, especially the plight of refugees, is beyond the scope of this volume, especially because the Bank is not a relief agency.) This volume could, however, be appropriate

in projects that deal with (a) reconstruction in the aftermath or provision of basic infrastructure for displaced persons and (b) efforts to derive economic estimates of health damages, which now tend to report and valuate property damage, but only cite death rates.

_Nuclear energy._ The Bank does not lend for nuclear energy, except in selected cases that might involve mitigating measures for cleanup or reduction of hazards.

_Formal education._ Although training is considered essential in this volume, they do not address proposals for adapting curricula in formal education. A proper understanding of environmental health, especially long-term and indirect effects, should eventually be incorporated into primary, secondary, and university education.
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AGETIP</td>
<td>Agence d’Exécution des Travaux d’Intérêt Public</td>
</tr>
<tr>
<td>AIDS</td>
<td>Acquired immunodeficiency syndrome</td>
</tr>
<tr>
<td>APOC</td>
<td>African Programme for Onchocerciasis Control</td>
</tr>
<tr>
<td>BOD</td>
<td>Biological oxygen demand</td>
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<tr>
<td>BOD</td>
<td>Burden of disease</td>
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<tr>
<td>BP</td>
<td>Bank Procedure</td>
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<tr>
<td>CAS</td>
<td>Country assistance strategy</td>
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<tr>
<td>CBO</td>
<td>Community-based organization</td>
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<tr>
<td>CDF</td>
<td>Comprehensive development framework</td>
</tr>
<tr>
<td>CFC</td>
<td>Chlorofluorocarbon</td>
</tr>
<tr>
<td>COD</td>
<td>Chemical oxygen demand</td>
</tr>
<tr>
<td>DALY</td>
<td>Disability-adjusted life year</td>
</tr>
<tr>
<td>DDT</td>
<td>Dichlorodiphenyltrichloroethane</td>
</tr>
<tr>
<td>EA</td>
<td>Environmental assessment</td>
</tr>
<tr>
<td>EHA</td>
<td>Environmental health assessment</td>
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<tr>
<td>EHP</td>
<td>Environmental health profile</td>
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<tr>
<td>EMP</td>
<td>Environmental management plan</td>
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<tr>
<td>ENSO</td>
<td>El Niño Southern Oscillation</td>
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<tr>
<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
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<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic information system</td>
</tr>
<tr>
<td>GP</td>
<td>Good Practice</td>
</tr>
<tr>
<td>GWh</td>
<td>Gigawatt hour</td>
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<tr>
<td>HA</td>
<td>Health assessment</td>
</tr>
<tr>
<td>HIA</td>
<td>Health impact assessment</td>
</tr>
<tr>
<td>HIPC</td>
<td>Heavily indebted poor countries</td>
</tr>
<tr>
<td>HIV</td>
<td>Human immunodeficiency virus</td>
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<tr>
<td>IBRD</td>
<td>International Bank for Reconstruction and Development</td>
</tr>
<tr>
<td>IDA</td>
<td>International Development Agency</td>
</tr>
<tr>
<td>IDWSSD</td>
<td>International Drinking Water Supply and Sanitation Decade</td>
</tr>
<tr>
<td>IFC</td>
<td>International Finance Corporation</td>
</tr>
<tr>
<td>IMF</td>
<td>International Monetary Fund</td>
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<tr>
<td>IMO</td>
<td>International Maritime Organization</td>
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<tr>
<td>IPCC</td>
<td>International Panel on Climate Change</td>
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<tr>
<td>IPCS</td>
<td>International Programme on Chemical Safety</td>
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<tr>
<td>IPM</td>
<td>Integrated pest management</td>
</tr>
<tr>
<td>LEAP</td>
<td>Local environmental action plan</td>
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<tr>
<td>LPG</td>
<td>Liquefied petroleum gas</td>
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<tr>
<td>MARPOL</td>
<td>International Convention for the Prevention of Pollution from Ships</td>
</tr>
<tr>
<td>MIGA</td>
<td>Multilateral Investment Guarantees Agency</td>
</tr>
<tr>
<td>MLGRD</td>
<td>Ministry of Local Government and Rural Development</td>
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<tr>
<td>MOA</td>
<td>Ministry of Agriculture</td>
</tr>
<tr>
<td>MOH</td>
<td>Ministry of Health</td>
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<tr>
<td>NEAP</td>
<td>National environmental action plan</td>
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<tr>
<td>NEHAP</td>
<td>National environmental health action plan</td>
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<tr>
<td>NGO</td>
<td>Nongovernmental organization</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Cooperation and Development</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>Operations and maintenance</td>
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<tr>
<td>OCP</td>
<td>Onchocerciasis Control Programme</td>
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<td>OP</td>
<td>Operational Policies</td>
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<tr>
<td>ORT</td>
<td>Oral rehydration therapy</td>
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<tr>
<td>PA</td>
<td>Poverty assessment</td>
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</tbody>
</table>
PAH  Polychromatic hydrocarbon
PAHO  Pan-American Health Organization
PER  Public expenditures review
PM  Particulate matter
POP  Persistent organic pollutant
ppb  Parts per billion
ppm  Parts per million
PPS  Public-private sectors and stakeholders
PRSP  Poverty reduction strategy paper
QALY  Quality-adjusted life year
SA  Social assessment
SAEMA  Shama-Ahanta East Metropolitan Area
SAL  Structural Adjustment Lending
SDC  Swiss Development Corporation
SIA  Social impact assessment
SIDA  Swedish International Development Cooperation Agency
SPM  Suspended particulate matter
SSA  Sub-Saharan Africa
STD  Sexually transmitted disease
TB  Tuberculosis
TOR  Terms of reference
TOR  Tema OH Refinery
TPM  Total particulate matter
TSP  Total suspended particulate
UESP  Urban Environmental Sanitation Project
UNEP  United Nations Environment Programme
VIP  Ventilated improved pit
VOC  Volatile organic compound
VRD  Vector-related disease
WHO  World Health Organization
EXECUTIVE SUMMARY

*Environmental Health: Bridging the Gaps* is part of an effort by the World Bank’s Environmental Health: Bridging the Gaps program to mainstream environmental health into World Bank operations, particularly into environmental assessments. Part 1 of this volume provides background on environmental health and introduces a new, more effective approach to reducing poverty by addressing environmental health problems. Part 2 provides the basic tools needed to implement this approach. Part 3 presents findings of and background for a workshop in Ghana that puts into practice some of the ideas of parts 1 and 2. A glossary and bibliography of resources available on environmental health and other forms of assessments may be found among other back matter for the volume.

**Part 1**

Intended for policymakers and practitioners alike, part 1 of this volume explains the foundations of environmental health and proposes a new approach that taps health benefits systematically outside the health sector through multisectoral collaboration. Chapter 1 details the differences and challenges of environmental health in developing countries. The new approach introduced in chapter 2 addresses these challenges by harmonizing sectoral approaches through targeted collaboration to tap health benefits outside the health care system, benefits that tend to be missed. Chapter 3 asserts that environmental health measures can target at least an equal share of the burden of disease than the health sector, that is, roughly 20 percent for a fraction of the cost of health sector interventions. Chapters 4 through 6 compare and contrast six alternatives to making sound decisions, devising entry points, and establishing mutual benefits from targeted collaboration and provide practitioners with checklists related to Bank projects and components, proposing remedial measures.

**Chapter 1: Challenges of Environmental Health in Developing Countries**

- A great deal of the underlying causes of disease, injury, and death in developing countries lie outside the purview of the health care system and cover physical (inadequate sanitation, water, drainage, waste removal, housing, and household energy) and behavioral factors (personal hygiene, sexual behavior, driving habits, alcoholism, and tobacco smoking). Many of these turn into public health problems when they become widespread, a factor aggravated by inadequate public health infrastructure.

- Yet, policies in the sectors responsible for negative health impacts are often not based on health criteria. The health sector itself tends to focus on interventions within the health care delivery system, not necessarily sectors that are the sources of the problem. The enormity of health benefits possible through interventions outside the health sector are only partially tapped.

- Many analyses of environmental health issues in developing countries reflect an inadvertent bias. Much information on environmental health is based on conditions in developed countries, particularly ambient air pollution from vehicular and industrial sources. Poorly addressed is indoor air pollution from cooking, heating, and lighting, the more serious threat to human health in developing countries. Mosquitoes and snails, at best, considered nuisances in industrialized countries, remain major health problems in developing countries.
• Dispersal of responsibilities for environmental health among non-collaborating agencies has made environmental health an institutional “orphan,” adopted by few multidisciplinary agencies as a priority or focal point.

• Multisectoral problems clearly require multisectoral solutions. Yet, how can agencies be motivated to take on increased costs if they benefit society at large without furthering the sector’s own priorities? Streamlining projects for administrative feasibility may also neglect many health risks or promote the wrong mix of investments.

• Finding the right mixture of broad objectives tempered with administrative feasibility faces interrelated obstacles: (a) lack of attention to the whole picture, (b) absence of or insufficient procedures to cope with multisectoral issues and environmental health, (c) inadequate budget, (d) poor availability and reliability of data, especially for monitoring and evaluation, (e) technologies not adapted to developing countries, (f) inadvertent professional bias (described above), and (g) inadequate input of health personnel in decisionmaking outside the health sector.

Chapter 2: Developing Solutions Through Targeted Collaboration

• Environmental Health: Bridging the Gaps helps identify opportunities for productive interventions outside the health sector. It should encourage a multidisciplinary approach to analyzing projects, one that ensures that investments in single sectors, especially for pollution management, also produce long-term health benefits. The intention is to alert staff to low-cost, often neglected measures that could anchor and enhance the health benefits of such investments.

• The main objectives of this new approach are, first, to enhance the Bank’s chief goal of poverty reduction by mainstreaming environmental health into World Bank operations and, second, to achieve multisectoral collaboration by harmonizing health and other sectoral priorities.

• Instead of focusing analysis on the statistical levels of death, disease, and disability, this volume shifts the focus to remedial measures outside the health care system to solve health problems. Harmonizing sectoral priorities depends on a process that targets collaboration among those sectors and on those measures that, tempered by administrative considerations, have the best chance of generating health and other benefits, generally at a lower cost for all. The process involves identifying and prioritizing measures, devising entry points, and enhancing mutual benefits for the sectors involved.

• The new approach has two prongs that develop (a) methodologies to target and facilitate multisectoral collaboration among a critical mass of players and stakeholders needed to solve the problems and (b) instruments to mainstream multisectoral collaboration in decisionmaking and integrate it into operations.

• Harmonizing sectoral priorities depends on a process that targets collaboration among those sectors and on those measures that, tempered by administrative considerations, have the best chance of generating health and other benefits, generally at a lower cost for all. The process involves (a) identifying and prioritizing measures outside the health care system that will enhance efforts of the health care system, (b) quantifying missed or untapped health benefits, (c) devising entry points based on institutional capability to collaborate, and (d) enhancing the mutual benefits for the sectors that agree to collaborate.
Table ES-1: Sample Linkages and Synergies to Harmonize Infrastructure Sectoral Priorities*

<table>
<thead>
<tr>
<th>Sector</th>
<th>Environmental Priority</th>
<th>Health Priority</th>
<th>Health Linkages</th>
<th>Possible Entry Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>Providing access to water, sanitation, and waste management facilities; pollution control; and drainage</td>
<td>Diarrheal diseases, traffic injuries, malaria, and respiratory diseases</td>
<td>Water, air, and land pollution; traffic safety; and mosquito breeding</td>
<td>Diarrheal diseases, traffic injuries, medical waste disposal, urban malaria, traffic-related air pollution, and AIDS in transport, construction work crews, and markets</td>
</tr>
</tbody>
</table>

* See table 6-7 on “Sample Environmental Health Linkages of Bank Lending by Sector” for more detail.

Chapter 3: Socioeconomic Justification and Challenges

Relative to the other chapters, Chapter 3 is written with a greater emphasis on technical issues. Many ideas being presented are new, particularly those of health benefit valuations that have often been missed. These new ideas have not been subjected to analyses from several sectors. As a result, greater attention has been placed on explaining methodology than on its application.

- Over the 1990-99 period, the burden of disease growth outpaced the population growth in SSA (26 against 21 percent respectively over the period). This increase is a stern reminder that communicable diseases (+41 percent), mainly HIV/AIDS, malaria, respiratory diseases and water-related diseases, which have different growth rates over the period, represent a growing portion of SSA’s burden of disease in relative terms (73 percent in 1999 against 66 percent in 1990).

- More than 20 percent of SSA’s burden of disease is attributable to environmental health problems (mainly attributable to communicable diseases), and 10 percent affect the poorest of the poor. The environmental health problems, whose underlying causes lie outside the purview of the health care delivery system, impinge on SSA’s population wellness, especially the poor; overall economic performance; and health care delivery systems. The latter inherit by default any disregarded environmental health problems. An environmental health approach is multisectoral and preventive in nature. It is intended to complement health care delivery system interventions by promoting a systematic approach to determining the environmental health attributes—that is, ecological, man-made, and behavior-prone health risks—and to mainstream environmental health concerns in development work in a cost-effective manner.

- Identifying environmental health attributes, including environmental health externalities, helps determine policy, institutional, and market failures. Harmonizing a cross-sectoral enabling environment subsequently helps formulate environmental health policies in line with cross-sectoral policies (e.g., regulations, financial mechanisms, and budget allocation), designate a lead agency (health and/or environment and determine institutional responsibility and accountability), and forge partnerships and devise cross-sectoral monitoring systems to achieve outcome-based results. To this end, macro and sectoral Bank instruments, institutional and market concerns, as well as monitoring indicators are reviewed to identify options for integrating environmental health concerns.

- To help formulate an “environmental health–friendly” policy response, the SSA environmental health burden of disease is quantified, apportioned in terms of environmental burden of disease borne by the poorest of the poor, and valued in terms of lower-bound social cost. More specifically, the burden of disease is dis-aggregated and re-aggregated.
in terms of targetable environmental health (20 percent) and health care system (18 percent) interventions. Back-of-the-envelope calculations are performed to determine possible infrastructure-based intervention efficiency ratios.

- Prioritizing a cluster of infrastructure interventions to relieve the burden on the population in general and the poor in particular should be associated with a critical need to bring awareness and educate the people to understand the full significance, impacts, and linkages of environmental, environmental health, and health issues on their well-being, livelihoods, and development options. Despite the intractable multisectoral issues that need to be carefully assessed at the Bank and in member countries, linking infrastructure with environmental health remains promising, yet fundamental: environmental health interventions could have long-lasting positive results, only if a cross-sectoral and public-private-community mechanism is devised to internalize necessary behavioral change and insure a steady flow of resources for adequate and continuous asset management, upkeep, and monitoring to improve service delivery to the population.

**Chapter 4: Gathering and Analyzing Information for Environmental Health**

- Six different options exist for identifying entry points or prioritizing environmental health collaboration, all based on or relating to an environmental health assessment (EHA), a planning tool that helps prevent, mitigate, or manage health risks by gauging environment-based risks and proposing remedial measures.
- An EHA is not merely a health assessment within an EA, nor is it limited to pollution. It blends techniques from separate, but related fields, such as EAs, social assessments (SAs), health assessments (HAs), national or local environmental action plans (NEAPS/LEAPS), and comparative risk assessments of pollutants. Neither EHAs nor HAs have gained as much acceptance as the EA process.
- No standardized reference texts, outlines, formats, or procedures have been accepted as international norms for EHAs, which have no set definition or criteria. Techniques used in EHAs are still evolving. They may, nonetheless, be confused with other types of assessments and action plans.
- Because many EHA users will probably not have background in health or environment and possibly neither, an EHA, environmental health profile, or equivalent analysis should include background material that is easily skimmed and absorbed (i.e., avoiding technical jargon and complicated tables and calculations).
- The six options to identifying entry points or prioritizing environmental health collaboration are (a) preparing an environmental health profile (EHP), (b–d) adapting an existing EA, HA, SA, or poverty assessment (PA) to serve as an EHA, and (e) conducting a complete EHA. Of these options, this volume recommends the first, preparing an EHP, a technique specifically developed for this volume.

**Chapter 5: Preparing an “Environmental Health Profile”**

- An EHP may be prepared by sectoral specialists not used to working with information outside their own sector, or, especially in the Bank, by economists who work on poverty reduction without focusing on any one sector.
- A multidisciplinary team drafts an EHP by first compiling sectoral profiles as background information and then analyzing the data for sectoral linkages. Sectoral profiles facilitate the EHP process by noting key players and stakeholders, facilitating intersectoral collaboration within agencies, fostering public-private stakeholder partnerships and helping to make decisions using incomplete data.
- The team may confront two complementary problems in preparing these profiles: a paucity of reliable data on environmental health and staff without background in environment and/or health. This chapter and chapter 6 address these difficulties by identifying
existing sources of data in World Bank documents from several sectors or similar sources in bilateral or government agencies. This reduces the need for basic research or data gathering.

- The team then “cuts and pastes” from these different reports, helping to compensate for the team’s lack of specialization in health and environment. Analysis of the information requires such background, which may be overcome through joint discussion and analysis.
- Analysis of the data is then reviewed from the team’s multiple perspectives, which should ideally include public health or epidemiology, sociology or anthropology, economics, environment, and infrastructure.

Chapter 6: Adapting Environmental Assessments and Preparing EHAs

- Multisectoral teams may decide to prepare a complete environmental health assessment, whether as a first step or following preparation of environmental health profiles. The four other options to environmental health profiles differ from EHPs in that they result in a complete environmental health assessment. They are adapting an existing EA, HA, SA, or PA to serve as an environmental health assessment and conducting a complete EHA. The advantages and disadvantages of each are described at the end of chapter 4. This chapter describes the steps involved for each.

Adapting an existing assessment. Existing EAs or even NEAPs can be tapped for information that may not be readily available in health agencies, especially because HAs are scarce, compared with EAs. Tables 6-2 through 6-5 in chapter 6 outline the contents of key Bank documents concerning EAs that illustrate how existing assessments can be adapted to serve as an EHA.

- Adaptation is likely to remain the case in the Bank, because environmental health considerations are cross-sectoral and already partially addressed in various Bank policies. It could be considered administratively cumbersome to add another tier of analyses for developing country borrowers, when it may be possible to integrate environmental health analyses into projects by adapting EA procedures that are already in place.

Conducting a complete EHA. The process of preparing an environmental health assessment is new and rapidly changing, with no established procedures to follow. The process should, above all, identify the broad picture, on which to base priorities among practicable remedial measures for a given project. This section describes the kinds of information that are useful in an environmental health impact assessment and necessary to identifying remedial measures based on intersectoral linkages. Given the practical realities of acquiring accurate data, adapting information from alternative sources can be a useful option.

Part 2

Intended for Bank Task Managers and practitioners in the field, part 2 of this volume provides basic tools to identify, prioritize, and propose remedial measures for many multisectoral health problems, many of which could and do otherwise fall between the cracks in single sector projects. Chapter 7 provides basic environmental health background pertinent to all sectors covered in part 2. Chapters 8–14 provide guidance on environmental health linkages within and among sectors, which are summarized in a checklist at the end of each chapter. This edition of Environmental Health: Bridging the Gaps focuses particular attention on cross-sectoral linkages with infrastructure interventions between the agriculture and rural development sector (chapter 8) and the infrastructure sector (chapter 13). The other chapters briefly review linkages in the environment (chapter 10), health (chapter 11), and industry (chapter 12) sectors and with global issues, that is, those that affect the planet as a whole (chapter 14), because many of the issues have already been addressed in chapters 7, 8, and 13.

Chapter 7: Environmental Health Background Analyses
Chapter 7 provides basic environmental health background pertinent to all sectors covered in part 1, divided into sections on:

**Leading health problems:**
- Malnutrition
- Malaria and vector related diseases
- Diarrheas and gastroenteric diseases
- Respiratory diseases and diseases related to air pollution
- Injuries and accidents
- Mental health and stress

**Diseases for special consideration:**
- AIDS
- Epidemic cholera
- Guinea worm infection

**Key cross-cutting issues:**
- Malnutrition
- Malaria and vector related diseases
- Diarrheas and gastroenteric diseases
- Respiratory diseases and diseases related to air pollution
- Injuries and accidents
- Mental health and stress
- Pesticide use
- Biodiversity and traditional medicines

Each chapter contains definitions of key, confusing, and misused terms to help clarify their different meanings to different professions as well as to those without health or environmental training.

**Chapter 8: Cross-Sectoral Linkages: Agriculture and Rural Development Sector**

The first five sections of the chapter weave together many seemingly unrelated topics, emphasizing rural infrastructure in food production, for which linkages are strong with health. They are:

- *Human settlements.* What are the risks, especially in farming, of living conditions in villages and small towns?
- *Land use and natural resource management.* What human health risks are associated with farming, forestry, and other activities?
- *Water and waste management.* How is health linked with irrigation and drinking water? What risks link wastes to food and farmers?
- *Rural transportation.* What type of health risks are associated with transporting products from the fields to markets?

The sixth section, an environmental checklist, looks at these same issues in terms of Bank lending.

The most common environmental health linkages in the agriculture and rural development sector involve food production and other aspects of low-density rural life, such as poor access to water, sanitation, transportation, and electricity. These linkages can set in motion sometimes inter-linked health consequences, including malnutrition, spread of infectious diseases, deaths and injuries related to flooding, and so on. (See chapter 14 on how some of these effects are linked to climate change.) The most common linkages include:

- Pollution from excessive use of agrochemicals (especially pesticides and nitrates from fertilizers)
- Creation of nearly permanent vector breeding areas and other changes through, for example, year-round cultivation of food staples and impact of forestry projects
- Malnutrition from inadequate food supply or contamination of the food chain
- Water and soil contamination from inadequate processing of agricultural and animal wastes
- Respiratory diseases from use of biomass fuels for cooking, heating, and lighting, as well as injuries from gathering fuels.
**Chapters 9 Energy, 10 Environment, 11 Health, 12 Industry, and 14 Global Issues**

Chapters 9 through 12 provide less detailed guidance on environmental health linkages within and among the energy, environment, health, and industry sectors, because many of the same issues have been covered in chapters 7, 8, 13, and 14. Each chapter contains a literature review that concentrates on the policy determinants as they impinge on health for each sector. Policy is stressed more than technical aspects, because the latter are changing daily and it is hoped that future versions of this work on environmental health will be able to address technical issues more appropriately. Nonetheless, each chapter contains three tables: (a) the main environmental health linkages, (b) occupational and high risk groups, and (c) a checklist showing the typical projects and components, their major health-related issues, and suggestions for remedial measures. Chapter 14 focuses on those environmental issues that affect the planet as a whole, that is, with the potential of affecting everyone.

**Chapter 13: Cross-Sectoral Linkages: Infrastructure Sector**

This chapter covers environmental health linkages with the infrastructure sector, weaving together many seemingly unrelated topics with a common thread—urban and periurban human settlements—for which linkages are strong with health. Sections on cross-cutting issues and each of the four infrastructure subsectors present a broader range of environmental health issues than those traditionally associated with physical infrastructure:

- **Cross-cutting issues.** What are the key broad and cross-cutting environmental health issues, and what is special about their urban settings?
- **Housing and urban development.** What risks are presented by living conditions in big cities and surrounding areas? How, if at all, do secondary cities differ?
- **Telecommunications.** How are rapid changes in modern telecommunications technologies affecting health?
- **Transportation.** What type of health risks are associated with transporting products from rural fields to urban markets?
- **Water supply and sanitation.** How are health risks linked with drinking water, drainage, waste disposal, and sanitation services?

Discussion of each subsector concludes with an environmental health checklist. The chapter also discusses four environmental health issues—“brown” issues, vector-related diseases, food chain contamination, and AIDS—that impinge on all four subsectors.

**Part 3**

Chapters 15, 16, and 17 summarize the findings and present background material from a workshop in Ghana, “Targeted Collaboration among Line Agencies, Local Communities and the Ministry of Health,” putting into practice the ideas of parts 1 and 2. Innovations included a multisectoral environmental health needs assessment, as well as suggestions for remedial measures. The summaries can be useful for policymakers and the details, process, and recommendations can be useful for practitioners in the field.

**Chapter 15: Ghana Sample Sectoral Profiles**

This chapter presents several individual sector “profiles,” using data on Ghana that illustrates information readily available in Bank files, according to Bank sector designations. Such profiles contain considerable extra information to ensure that individual sectors are not summarized out of context. The material supported preparation of an environmental health needs assessment for Ghana and development of a workshop to determine priorities for targeted collaboration in Se-
kondi-Takoradi, one of Ghana’s five most populous cities. This chapter presents sectoral profiles on environment, health, infrastructure, energy, and industry, and multisectoral profiles on demographic, development assistance, institutional, and poverty reduction aspects.

**Chapter 16: Sample Needs Assessment from Ghana**

This chapter is based on a pilot study in Ghana, “Targeted Collaboration Among Line Agencies, Local Communities, and the Ministry of Health.” The work took place in Sekondi-Takoradi, one of the five largest cities in Ghana and also referred to as the Shama Ahanta East Metropolitan Assembly (SAEMA). The chapter presents a needs assessment for a city, beginning with its terms of reference.

**Chapter 17: Sample Workshop on Targeted Collaboration in Ghana**

The objective of the sample workshop on targeted collaboration in Ghana was to enhance health improvement outside the health care system by fostering multisectoral collaboration among line agencies and civil society to improve service delivery to the people. The workshop was based on three “entry points,” where the likelihood for interagency and stakeholder collaboration was expected to be high due to common interests in solving these common problems:

- Management of health facility waste
- Urban malaria and other vector-related diseases
- Water, sanitation, and drainage.

The workshop participants, drawn from SAEMA departments, the Ministry of Health, MLGRD, UESP, civil society, and the World Bank, were asked to:

- Identify risks and stakeholders, especially vulnerable groups, at risk.
- Determine institutional and financial strengths and weaknesses, relying on the information provided in the institutional needs assessment prepared for the workshop.*
- Suggest areas of mutual collaboration and partnership among infrastructure, environment, and health agencies and civil society at large.
- Propose recommendations that could constitute the elements of an action plan for improving service delivery.

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* See chapter 16.
Part 1: Harmonizing Sectoral Priorities: A New Approach to Environmental Health
CHAPTER 1: CHALLENGES OF ENVIRONMENTAL HEALTH IN DEVELOPING COUNTRIES

A great deal of the underlying causes of disease, injury, and death in developing countries lie beyond the purview of the health care system. They cover a range of physical factors (inadequate sanitation, water, drainage, waste removal, housing, and household energy) and behavioral factors (personal hygiene, sexual behavior, driving habits, alcoholism, and tobacco smoking). Many of these environment- and occupation-related health problems turn into public health problems when they become widespread, a factor aggravated by inadequate public health infrastructure.

Yet, policies in the sectors responsible for these negative health impacts are often not based on health criteria. The health sector itself tends to focus its interventions within the health care delivery system, not necessarily in other sectors that are the source of the problem. Similarly naturally occurring ecological factors that can exert negative impacts on all sectors (mosquito-borne diseases, arsenic in the water, floods, droughts, and so on) are seldom addressed systematically by any of the sectors at risk, even though some sectors may be exacerbating their effects (spreading mosquito habitats, consuming great quantities of water, or producing greenhouse gases that may worsen climate change). As a result, the enormity of health benefits possible through interventions outside the health sector are not being tapped.

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Part I of this discussion paper addresses these concerns by presenting a new multisectoral approach to reducing poverty, one that employs preventive environmental health measures to improve the efficiency of development projects and investments in several sectors. This chapter begins by explaining the rationale for a multisectoral approach and its challenges, laying the basis for understanding the proposed approach, introduced in chapter 2.

Inadvertent Bias in Neglecting Environmental Health

Much general information about environmental health is based on conditions in developed countries. This is not surprising, as the driving forces in research, development, and technology largely emanate from the industrialized world. About 90 percent of the $US56 billion currently invested in health research and development by the public and private health sectors goes to research concerning only 10 percent of the world’s population.²

This situation has introduced an inadvertent bias into many analyses of environmental health issues in developing countries. Literature on air pollution in industrialized countries generally emphasizes ambient air pollution from vehicular and industrial sources, while poorly addressing indoor air pollution from cooking, heating, and lighting, the more serious threat to human health in developing countries. Similarly, mosquitoes and snails are considered, at best, nuisances in industrialized countries, whereas they remain major health problems in developing countries.

The underlying reasons for this bias are clear. Public health or environment students in training in industrialized countries hear only passing reference to vector-related diseases. Physicians receive little basic training in environmental health, except for a few diseases, such as asthma, which are extremely sensitive to pollution.
Little time is spent in medical school and residency training on environmental hazards and their relationship to illness. General medical and pediatric textbooks devote scant attention to illness as a result of environmental factors. Information pertinent to pediatric environmental health is widely scattered in scientific, epidemiological, and specialty journals not regularly read by clinicians.\textsuperscript{3}

Nutritionists learn much about micronutrients, but little about malnutrition from diarrheal diseases caused by inadequate sanitation. Ecologists learn about reducing pollution to meet water quality standards, but water meeting those standards may still be pathogenic and unsuitable for drinking! (It does not generally harm, because it is diluted when released into receiving waters.)

Policies also unintentionally embed these biases, because many scientific journals tend to specialize and limit themselves to statistically significant results. They, therefore, underemphasize environmental health factors, which already tend to be underreported due to inadequate data. In addition, environmental health factors result in more disease and disability than death, and disability that does not require hospitalization or a medical consultation is difficult to capture in health statistics.

Inadvertent professional bias can also influence the effectiveness of remedies, for example, diverting attention from other important sources of lead in children’s blood (see box 1-1), and omitting possibly promising avenues of addressing critical health problems comprehensively with time.

**Box 1-1: The Case of Lead**

The case of lead is excellent for showing the power of interventions outside the health sector and the difficulty of coordinating multisectoral interventions. Only in the past few decades have measures been taken to reduce human exposure to lead. These have only been partial, typically reflecting the approaches of a single profession, such as engineering or medicine, and not coordinated explicitly among professions to improve health. Because lead risks are derived from many sources simultaneously (eaten, breathed, drunk, or absorbed by the skin, as shown in table 7-4) it may be more effective to coordinate sectoral approaches into preventive measures. Unfortunately, this seldom happens.

In Mexico City, for example, the phase-out of leaded gasoline has been quite effective in reducing general human exposure to lead. Nevertheless, many people may be exposed to higher levels of lead from traditional blue-glazed pottery than from automobile emissions; yet, the thrust of remedial measures has been toward transportation. One study of school children with high blood levels of lead attributed 40 percent of individual levels to walking to school near heavy traffic, but another 40 percent came from chewing the lead paint on their pencils.\textsuperscript{4} The perceived direct cause, vehicle emissions, should indeed be reduced, but authorities should not neglect other equally or more important, but less obvious indirect sources (see table 7-4). Finding cost-effective measures to address the various sources collectively underlies a multisectoral approach. Unfortunately, this, too, seldom happens, because benefit-cost analyses tend to focus only on one sector.

The case of lead also illustrates the positive effects that other sectors can have on human health, where some of the most important reductions in lead have come from the environment sector. In the Bank, for example, response by the environmental community to problems such as lead has evolved. Efforts to meet the needs of Bank borrowers initially focused on pollution abatement and control. Efforts now emphasize pollution management, which strives to address economic incentives and policies to reduce and avoid pollution in the first place. In public health terms, this would be equivalent to a temporary transformation emphasizing curative measures (abatement and control) until long-term preventive measures (management) could be developed and implemented.

Even though lead poisoning would not statistically constitute one of the top ten health problems in developing countries, the collective positive effects of such interventions over time can be significant.

*Source: Authors’ data.*
How the Health Picture Differs in Developing Countries

Understanding how the health picture differs in developing countries is the first step in countering this inadvertent professional bias.

Chief among the differences is the nature of disease in developing countries. Infectious and parasitic diseases, such as diarrheas, respiratory infections, and malaria—diseases traditionally associated with poverty—predominate. In contrast, “modern” diseases of affluence, such as cancer and heart disease, are associated more with developed countries.

Box 1-2: Key Confusing and Misused Terms on Diseases and Statistics

Burden of disease (BOD), also, global burden of disease. As used in health analyses, a comprehensive, internally consistent, and comparable set of estimates of current patterns of mortality and disability from disease and injury for all regions of the world.

Biological oxygen demand (BOD): As used in environmental analyses, a measure of the amount of oxygen in water needed to decompose organic matter and the propensity of water to eutrophy, that is, become unable to support aquatic flora and fauna. Can be used as an indicator of fecal contamination (organic).

Disability-adjusted life year (DALY), a recently derived measure of health providing more information than mortality rates by combining premature deaths and years lived with disability.

Vector-borne or vector-related diseases. Refers generally to diseases transmittable by an animal intermediary, such as mosquito, snail, or rodent. Also refers in a narrow, technical sense to diseases in which the disease agent undergoes a transformation in an intermediate animal host that is necessary to develop the pathogen that eventually infects humans.

Source: Authors’ data.

Table 1-1 summarizes this difference between developing and developed countries. Because death rates do not capture the full socioeconomic impact of death, disease, and injury, the table uses “disability-adjusted life years” (DALYs).* These combine the effects of premature deaths and years lived with disability, according to a weighted average of the severity of the disease. The table shows that, in 1998, five of the top ten individual diseases, that is, respiratory infections, diarrheal diseases, HIV/AIDS, malaria, and measles, fall into WHO’s broad category of infectious and parasitic diseases. This category ranked as the top source of DALYs in developing countries, compared with the tenth in the developed world, and accounted for 23 percent and 0.2 percent respectively of the global grand DALYs total.

Another major difference between developing and developed countries is the proportion of disability caused by disease. Table 1-1 also shows that developing countries exhibit nearly double the proportion of disability (i.e., included in DALYs) relative to death than developed countries. Significant to this observation, the overall share of DALYs attributable to environmental factors in developing countries is also high (see table 1-2), for example, 60 percent of respiratory and 90 percent of diarrheal diseases, respectively, and tend to affect the poor more than the rich. A large share of these environment-related diseases in developing countries are due to the absence of basic services, such as potable water, decent housing with proper ventilation, nonpolluting household fuels, and proper sanitation and waste disposal—services that, for the most part, are taken for granted in developed countries.

* See box 3-5 for a fuller discussion of this measure.
### Table 1-1: Top Ten Diseases and Conditions (1998) by Indicative DALYs

<table>
<thead>
<tr>
<th>Cause</th>
<th>World</th>
<th>Developed</th>
<th>Developing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DALYs (1,000s)</td>
<td>Deaths (1,000s)</td>
<td>Rank</td>
</tr>
<tr>
<td>1. Acute lower resp. infections</td>
<td>82,344</td>
<td>3,452</td>
<td>8</td>
</tr>
<tr>
<td>2. Perinatal conditions</td>
<td>80,564</td>
<td>2,155</td>
<td>5</td>
</tr>
<tr>
<td>3. Diarrheal diseases</td>
<td>73,100</td>
<td>2,219</td>
<td>17</td>
</tr>
<tr>
<td>4. HIV/AIDS</td>
<td>70,930</td>
<td>2,285</td>
<td>46</td>
</tr>
<tr>
<td>5. Unipolar major depression</td>
<td>58,246</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6. Ischemic heart disease</td>
<td>51,948</td>
<td>7,375</td>
<td>1</td>
</tr>
<tr>
<td>7. Cerebrovascular disease</td>
<td>41,626</td>
<td>5,106</td>
<td>2</td>
</tr>
<tr>
<td>8. Malaria</td>
<td>39,267</td>
<td>1,110</td>
<td>97</td>
</tr>
<tr>
<td>9. Road traffic accidents</td>
<td>38,849</td>
<td>1,171</td>
<td>4</td>
</tr>
<tr>
<td>10. Measles</td>
<td>30,255</td>
<td>888</td>
<td>67</td>
</tr>
</tbody>
</table>

Total of Top Ten: 567,129 (25,761), 31,249 (3,322), 535,881 (22,439)

Grand Totals: 1,382,564 (53,929), 1,274,259 (45,897)

DALYs/deaths: 26% (14%), 28%

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*a. Top ten and remainder. Totals may not add up due to rounding.

b. In this table, refers to premature deaths.


### Table 1-2: Environmental Factors and the Global Burden of Disease: Proportion of Global DALYs Associated with Environmental Exposures (1990)

<table>
<thead>
<tr>
<th>Cause</th>
<th>Global DALYs (thousands)</th>
<th>Percent Attributable to Environmental Factors</th>
<th>Environmental DALYs (thousands)</th>
<th>Percent of all DALYs (all age groups)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute respiratory infections</td>
<td>116,696</td>
<td>60</td>
<td>70,017</td>
<td>5.0</td>
</tr>
<tr>
<td>Diarrheal diseases</td>
<td>99,633</td>
<td>90</td>
<td>89,670</td>
<td>6.5</td>
</tr>
<tr>
<td>Vaccine-preventable infections</td>
<td>71,173</td>
<td>10</td>
<td>7,117</td>
<td>0.5</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>38,426</td>
<td>10</td>
<td>3,843</td>
<td>0.3</td>
</tr>
<tr>
<td>Malaria</td>
<td>31,706</td>
<td>90</td>
<td>28,535</td>
<td>2.1</td>
</tr>
<tr>
<td>Injuries</td>
<td>152,188</td>
<td>30</td>
<td>45,656</td>
<td>3.3</td>
</tr>
<tr>
<td>Unintentional</td>
<td>56,459</td>
<td>NEb</td>
<td>NEb</td>
<td>NEb</td>
</tr>
<tr>
<td>Intentional</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mental health</td>
<td>144,950</td>
<td>10</td>
<td>14,495</td>
<td>1.1</td>
</tr>
<tr>
<td>Cardiovascular disease</td>
<td>133,236</td>
<td>10</td>
<td>13,324</td>
<td>1.0</td>
</tr>
<tr>
<td>Cancer</td>
<td>70,513</td>
<td>25</td>
<td>17,628</td>
<td>1.3</td>
</tr>
<tr>
<td>Chronic respiratory disease</td>
<td>60,370</td>
<td>50</td>
<td>30,185</td>
<td>2.2</td>
</tr>
<tr>
<td>Total these diseases</td>
<td>975,350</td>
<td>33</td>
<td>320,470</td>
<td>23.0</td>
</tr>
<tr>
<td>Other diseases</td>
<td>403,888</td>
<td>NEb</td>
<td>NEb</td>
<td>NEb</td>
</tr>
<tr>
<td>Total all diseases</td>
<td>1,379,238</td>
<td>23</td>
<td>320,470</td>
<td></td>
</tr>
</tbody>
</table>

*a. Intentional injuries account for homicide, violence, and warfare.

b. Not estimated.

Because environment-related diseases can cause recurrent or long-term disability without killing, they tend to be underreported in health statistics, which are still oriented toward death rates. The burden of disease on the poor is, thus, often understated because of statistical limitations. For the total burden of disease in the world, for example, disability is more than twenty-five times the proportion for premature deaths alone (see DALYs/deaths in table 1-1). But, looking at vector-borne diseases, disability rises to more than 41 times the death rates (see table 1-3). The figures are even more skewed when analyzing data solely for developing countries, especially for diseases that are not tracked because mortality is low (e.g., intestinal worms).

These observations underscore the importance of understanding the indirect impacts of disease, such as disability, in developing countries and the need to look systematically for new solutions inside and outside the health sector. Similar arguments are appropriate for economic evaluation techniques, which need considerable interpretation of their face value.

_It is important to understand the indirect impacts of disease and to look systematically for new solutions inside and outside the health sector._

**The Changing Face of Disease and the Developing World**

Not only is the health picture in developing countries different, it is continually changing. Since 1950 astronauts have gone to the moon and surgeons have replaced human hearts; yet, scourges of the early twentieth century, that is, tuberculosis, cholera, and malaria, are returning and twenty-nine new infectious diseases have been discovered in the past 20 years. This includes acquired immunodeficiency syndrome (AIDS), which accounts for 9 percent of adult deaths from infectious disease in the developing world; by 2020, that share will quadruple to more than 37 percent. Population increase, rapid urbanization, and global-level changes, such as climate change and ozone depletion, are also influencing the health picture around the world, but the developing world is least prepared institutionally to respond to these changes. These new developments in health present challenges that intensify the need for innovative approaches within and outside the health sector.

**Vector-Related Diseases**

Nearly one-third to one-half of the world’s population is potentially at risk of exposure to vector-borne diseases. Table 1-3 shows estimates of the health consequences of the top ten of these diseases, which cause more than 1.2 million deaths annually. Malaria represents the lion’s share—more than 1.1 million deaths and 2.4 billion people at risk.

The parasite’s resistance to medications complicates the malaria situation, and no vaccines are likely for widespread use for at least 15 years. In 1976 drug-resistant malaria was confined to Southeast Asia; now it is global. The mosquito’s resistance to DDT, its potential carcinogenicity, and the unavailability of an ecologically suitable yet equally effective substitute further complicate the situation (see also “Vector Control” in chapter 7). Malaria is surging in many countries where it had once been sharply reduced or eradicated. More than a third of the world’s total population now live in malaria-endemic areas.
Table 1-3: Death and Disability of Top Ten Vector-Borne Diseases (1998)

<table>
<thead>
<tr>
<th>Disease/Condition</th>
<th>DALYs (thousands)</th>
<th>Deaths (thousands)</th>
<th>Population at Risk (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Malaria</td>
<td>39,267</td>
<td>1,110</td>
<td>2,400</td>
</tr>
<tr>
<td>2. Schistosomiasis</td>
<td>1,699</td>
<td>7</td>
<td>600</td>
</tr>
<tr>
<td>3. Dengue</td>
<td>558</td>
<td>15</td>
<td>2,500</td>
</tr>
<tr>
<td>4. Filariasis</td>
<td>4,698</td>
<td>0</td>
<td>1,000</td>
</tr>
<tr>
<td>5. Leishmaniasis</td>
<td>1,710</td>
<td>42</td>
<td>350</td>
</tr>
<tr>
<td>6. Trypanosomiasis</td>
<td>1,219</td>
<td>40</td>
<td>50–60</td>
</tr>
<tr>
<td>7. River blindness</td>
<td>1,069</td>
<td>0</td>
<td>123</td>
</tr>
<tr>
<td>8. Chagas’ disease</td>
<td>589</td>
<td>17</td>
<td>100</td>
</tr>
<tr>
<td>9. Guinea worm</td>
<td>NA</td>
<td>NA</td>
<td>100</td>
</tr>
<tr>
<td>10. Yellow fever</td>
<td>NA</td>
<td>NA</td>
<td>450</td>
</tr>
<tr>
<td>Total</td>
<td>50,809</td>
<td>1,231</td>
<td>NA</td>
</tr>
</tbody>
</table>


Land use changes are influencing the pattern of vector-borne diseases. For example, primarily rural vector-borne diseases are adapting to urban conditions. Periurban agriculture, recreation, and ecotourism also play key roles by changing land use and increasing human exposure (see “Periurban Agriculture and Livestock” in chapter 8).

The Double Burden of Disease in Developing Countries

In the next 25 years, the world’s population will grow from six to eight billion people. Ninety-eight percent of that increase will take place in developing countries and nearly entirely in urban areas. A large increase in urban poverty is expected, particularly in parts of Sub-Saharan Africa (SSA) and East and South Asia.

Population increase and urbanization places a double burden on developing nations in terms of disease and death. In addition to the infectious and parasitic diseases of poverty—diseases that are exacerbated by the absence of basic services such as sanitation, water supply, housing, and health care—developing countries can expect an increase in modern diseases, such as cancer, hypertension, and so on, as more people move to the cities. This will increase pollution and mental stress and place ever greater demands on cities, especially large ones, to provide basic services, initiating a vicious circle.

Box 1-3: Urbanization in Sub-Saharan Africa

In 1999, for the first time, more people in the world lived in urban than rural areas. SSA, however, is still predominantly rural, although expected to undergo rapid urbanization. Urban populations are expected to grow by about 6 million people per year and would constitute 50 percent of the total population in about 10 years. In western Africa, the figures are even more daunting—an increase of about 43 million people in the next 10 years.

Source: Authors’ data.

Global Change

Global change, notably climate change and ozone depletion, will also affect the health picture in the future (see chapter 14). Ecological disturbances may cause or worsen health effects, many indirectly (see table 14-1). Injury and death due to heat waves and flooding from storms are obvi-
ous impacts. Not so obvious are the insidious, slow effects of drought or increases in moisture that influence the breeding patterns of mosquitoes and help spread malaria. Increases in temperature can stimulate algal blooms that spread cholera.

**Multisectoral Approaches and the Challenges they Present**

Environmental health is intended to prevent human illness and injury. Past work on environmental health, however, has typically focused attention on individual diseases; sources of pollution responsible for many health problems, especially in their occupational settings; and positive steps to correct these problems and calculate their economic implications. The broad picture in project planning, however, has often been neglected. This is particularly the case for cross-sectoral linkages, which could considerably enhance the value of single sector projects, if correctly harnessed to avoid doing too much in a given project.

**Box 1-4: The Health Situation in Sub-Saharan Africa**

The face of disease and death in SSA is also changing, but in a different pattern. Diarrheal and respiratory diseases are no longer considered the single most important causes of disease and death, as they were in the 1970s; they are now competing with AIDS, and malaria. It is not that diarrheal and respiratory diseases have been reduced, but rather that HIV/AIDS (human immunodeficiency virus)/AIDS and malaria have been added to the burden.*

The situation in SSA largely reflects the global situation shown above in table 1-1, where respiratory and diarrheal diseases are among the top three. Five of the top ten entries are infectious and respiratory infections, which rank in first and second place respectively. The main difference comes from HIV/AIDS, which is more widespread throughout the Africa Region than other regions, and from “unintentional injuries” for males, reflecting a high level of traffic-related and occupational causes (see table 1-4).

**Table 1-4: Rank and Share of Burden of Disease in SSA (1990)**

<table>
<thead>
<tr>
<th>Female Rank</th>
<th>Percent</th>
<th>Male Rank</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Malaria</td>
<td>11</td>
<td>1. Injuries*</td>
<td>13</td>
</tr>
<tr>
<td>2. Respiratory infections</td>
<td>11</td>
<td>2. Respiratory infections</td>
<td>11</td>
</tr>
<tr>
<td>3. Diarrheal diseases</td>
<td>10</td>
<td>3. Malaria</td>
<td>11</td>
</tr>
<tr>
<td>4. Childhood cluster</td>
<td>9</td>
<td>4. Diarrheal diseases</td>
<td>10</td>
</tr>
<tr>
<td>5. HIV/AIDS and other STDs</td>
<td>9</td>
<td>5. Childhood cluster</td>
<td>10</td>
</tr>
<tr>
<td><strong>Subtotal of top five</strong></td>
<td><strong>50</strong></td>
<td><strong>Subtotal of top five</strong></td>
<td><strong>55</strong></td>
</tr>
</tbody>
</table>

a. Includes intentional injuries, which account for homicides, violence, and warfare
b. Childhood cluster consists of perinatal conditions: whooping cough, poliomyelitis, diphtheria, measles, and tetanus.


* Even plague may be re-emerging in about a dozen SSA countries. In the past 15 years, WHO has reported about 18,000 cases in twenty-four countries, more than half of them in Africa (Hawke 1999).
Box 1-4 (continued)

Table 1-5 shows changes in SSA for 1990–98, including about a sixfold increase in AIDS and a continuing increase in malaria.

Table 1-5: Rank and Share of the Burden of Disease in SSA (1990–98)

<table>
<thead>
<tr>
<th>Rank and Share of the Burden of Disease</th>
<th>Percentage 1990$^a$</th>
<th>Percentage 1998$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. AIDS</td>
<td>2.8</td>
<td>16.6</td>
</tr>
<tr>
<td>2. Malaria</td>
<td>9.2</td>
<td>10.6</td>
</tr>
<tr>
<td>3. Diarrheal diseases</td>
<td>10.9</td>
<td>7.5</td>
</tr>
<tr>
<td>4. Acute lower respiratory infections</td>
<td>10.2</td>
<td>7.0</td>
</tr>
<tr>
<td>5. Perinatal conditions</td>
<td>6.5</td>
<td>6.2</td>
</tr>
<tr>
<td><strong>Subtotal of top five</strong></td>
<td><strong>39.6</strong></td>
<td><strong>47.9</strong></td>
</tr>
</tbody>
</table>


AIDS

Nowhere is the AIDS epidemic more severe than in SSA, where it has become a health and development emergency. To date, 13.7 million African have died of AIDS. More than 23 million are currently living with HIV/AIDS, of whom 3.8 million were newly infected in 1999. A child born in Zambia or Zimbabwe tonight will, more likely than not, die of AIDS. In many other African countries, the lifetime risk of dying of AIDS is greater than one in three.

In June 1999 the Bank confronted these distressing facts in its strategy, *Intensifying Action Against HIV/AIDS in Africa*. Staff throughout the Region are being asked to incorporate AIDS prevention strategies in projects in all sectors. Accordingly, the checklists on environmental health found in Part II of this volume cite AIDS-preventive measures as appropriate. (see “Diseases for Special Consideration” in chapter 7.)

Malaria

More than 90 percent of the estimated 300–500 million cases of malaria worldwide occur in SSA. Children and pregnant women are the most vulnerable. Each year, the disease causes between 600,000 and 1 million deaths in children under five in Africa alone. When malaria does not kill, repeated bouts of fever lead to school absenteeism and impair physical and mental development in children.

Rural African communities are affected the worst, due to poverty. Rapid urbanization and government decentralization, however, is exacerbating the situation, partly because periurban settlements often provide similar breeding environments to those in rural areas and partly because expansion of water supply has allowed year-round breeding of mosquitoes. Various levels of governments may not have the institutional capabilities to cope with both urban *and* rural malaria.

Malaria may annually cost African countries more than 1 percent of their gross domestic product. Initial estimates of direct costs indicate that the disease places a major economic burden on households, which spend significantly on malaria prevention and treatment. Losses to productivity and output are substantial but not yet fully quantified.

*Source:* Authors’ data.

This tendency has been compounded by dispersal of responsibilities for environmental health among several agencies that generally do not collaborate. The result is that environmental health has become an institutional “orphan,” adopted by few multidisciplinary agencies as a priority or focal point.
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Economic analyses of environmental health have focused considerable attention on broad issues, under the rubric of “health effects,” although sometimes intensely scrutinizing individual diseases. Such analyses, however, have paid little attention to multiple health effects, even though dis-aggregating them could greatly improve the economic impacts of projects. For example, analysis of the benefits of urban drainage to reduce breeding areas of mosquitoes that spread malaria could miss or neglect other diseases, such as dengue and filariasis, which are spread by mosquitoes with slightly different breeding habits, but also reduced by the same drainage improvements (see chapter 3).

Multisectoral problems clearly require multisectoral solutions. Yet, multisectoral approaches present a number of challenges in and of themselves. Agencies outside the health sector that would incur the costs of these solutions would not necessarily reap the benefits. How can agencies be motivated to take on these increased costs if they benefit society at large without furthering the sector’s own priorities? Why, for example, should transport agencies take on added responsibilities to clean drains to reduce mosquito breeding sites for malaria control? Why should these agencies then spend time coordinating with other agencies on these efforts?

This dilemma has, in part, turned environmental health into an institutional orphan; environmental health efforts are hampered by a lack of incentive or motivation in agencies with other priorities.

**Dilemma: How can agencies be motivated to take on these increased costs if they benefit society at large without furthering the sector’s own priorities?**

Lessons from the past have repeatedly shown that projects that attempt too much, no matter how well intentioned, may become too cumbersome to achieve their original goals. This raises yet another dilemma: streamlining projects for administrative feasibility may inadvertently neglect many health risks, even in well-intentioned projects, or promote the wrong mix of investments.

**Dilemma: Streamlining projects for administrative feasibility can neglect many health risks, even in well-intentioned projects, or promote the wrong mix of investments.**

Collaboration with another agency can sometimes compensate for unintentional neglect based on administrative efficiency; yet, such coordination rarely occurs, primarily due to a lack of understanding of environmental health linkages or poor interagency communication.

Finding the right mixture of broad objectives tempered with administrative feasibility, however, faces a number of interrelated obstacles:

- Lack of attention to the whole picture
- Absence of or insufficient procedures to cope with multisectoral issues and environmental health
- Inadequate budget
- Poor availability and reliability of data, especially for monitoring and evaluation
- Technologies not adapted to developing countries
- Inadvertent professional bias (described above)
- Inadequate input of health personnel in decisionmaking outside the health sector
- Poor economic techniques to show value added from environmental health considerations
Inappropriate technical assistance from industrial countries with very different environmental health methods and solutions.

Box 1-5 presents a case illustrating nearly all these obstacles.*

**Box 1-5: A Near Miss in an Environmental Assessment**

The environmental assessment (EA) for a 15-year sanitary waste disposal site in Asia predictably centered on water pollution in identifying health issues and nearly omitted discussion of two potential epidemics. Preparation of the EA took place while local press carried headlines about rats spreading plague from an unrecognized virus. International newspapers and television news programs discussed global travel restrictions from India, where plague had already broken out in 1995.

The expatriate EA team and local office staff were well respected in their fields—engineering, ecology, environmental assessments, and economics. The team, however, did not contain a public health specialist and the expatriates considered rats and mosquitoes more as nuisances than health risks.

The EA was eventually altered to address vector-related diseases. The case is striking, however, because of the questions apparently not asked. This is not atypical in EAs, because current procedures do not systematically require health analyses, and illustrates the need to look at environmental health problems from a broader perspective.

*Source:* Authors’ data.

The last obstacle listed, absence of input from health personnel in decisionmaking, is particularly subtle, but crucial to harmonizing sectoral priorities. Many development projects with health repercussions are designed without direct input from health specialists, who, therefore, have little input into important decisions affecting human health (see table 1-6). Environmental health considerations are, at best, policy “afterthoughts” for the business, commerce, industry, and government agencies that create most environmental health problems, possibly inadvertently, and could help solve them. This includes 203 Bank SSA infrastructure projects (1984–94) designed mainly by engineers and economists. *Neither these projects nor the events and documents cited in table 1-6 necessarily produce unintended health repercussions, but, it is possible that these projects could have helped alleviate poverty better with the input of health specialists.* Lack of formal input from health personnel also stems from the current tendency in society for professionals to specialize, possibly aggravated by budget considerations, for example, precluding participation in conferences by staff of different specialties from the same organization.

Absence of health input can lead to unintended results, often described as “unforeseen consequences.” They are unforeseen, however, often simply because nobody looked. The examples of these omissions presented in table 1-6 are not meant as a criticism, merely an affirmation of the status quo and an indication that otherwise well-intentioned projects are achieving less than their potential. The situation could be turned around, if agency policies or environmental reviews compensated, for example, through environmental assessments that systematically include health.

* Examples of interpreting the same data from several perspectives, uncovering potential cross-sectoral conflicts, and increasing economic benefits are presented in “Analyzing Data” in chapter 4 and in chapters 5 and 6 and annex A.
### Table 1-6: Possible Consequences from the Absence of Health in Decisionmaking

<table>
<thead>
<tr>
<th>Event or Document</th>
<th>Sample Health Issues</th>
<th>Responsible Agencies</th>
<th>Agencies Not Consulted or with Minor Input</th>
<th>Possible Health Consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HEALTH EXCLUDED BY OTHER SECTORS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>203 World Bank infrastructure projects</td>
<td>Contaminated water, indoor air pollution, vector-related diseases, and injuries</td>
<td>Infrastructure: water, sanitation, housing, transport, waste management, urban management, and telecommunications</td>
<td>Health</td>
<td>Diarrheal diseases, respiratory diseases, vector-related diseases, injuries, and so on</td>
</tr>
<tr>
<td>World Bank “Green Top Ten,” lead by phase out of lead in gasoline in 5 years</td>
<td>Lead pollution, false sense of security in dealing with part of lead problem, and no health input into funding lead substitutes</td>
<td>Environment, urban development, and transport.</td>
<td>Health</td>
<td>Lead “replacements” can cause equal or worse health damage. Focus on gas can overshadow other more serious lead problems</td>
</tr>
<tr>
<td>Kyoto Climate Change Conference</td>
<td>Several indirect effects, e.g., respiratory and vector-related diseases</td>
<td>National governments, environment, and the private sector</td>
<td>Health was not part of the official agenda</td>
<td>Fuel price changes: (a) use of cheaper fuels could negatively affect respiratory disease and (b) economic analysis of dams could expand dam construction increasing schistosomiasis (and possibly malaria)</td>
</tr>
<tr>
<td>Insurance industry hurricane analyses</td>
<td>Injuries and deaths from storms, physical and mental stress from loss of home or job, and so on</td>
<td>Private sector, national and local government, infrastructure (water, housing, transport, and telecommunications), and emergency services</td>
<td>Health</td>
<td>Insurance industry calculates property damage, but not health factors covering a wide range of conditions, e.g., sickness to suicide</td>
</tr>
<tr>
<td><strong>OTHER SECTORS EXCLUDED BY HEALTH</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WHO Malaria Rollback Initiative</td>
<td>Help confront drug resistance, changes in breeding patterns, and spread of habitat</td>
<td>Health</td>
<td>Infrastructure (transport, housing, water, waste management), and agriculture</td>
<td>Missed opportunity to diminish malaria even more</td>
</tr>
<tr>
<td>The Pan-American Health Organization Disaster Preparedness Conference</td>
<td>Health and disaster</td>
<td>Infrastructure (transport, housing, water, and waste management)</td>
<td>Poor maintenance makes public infrastructure more vulnerable to severe weather.</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Authors’ data and Listorti (1996).

### The Role of Knowledge Management

Knowledge management could play an important role in reaching out to those sectors that could fruitfully contribute to a multisectoral effort. If knowledge management professionals had acquired a better understanding of environmental health issues, they might have applied better technologies to address the problem. Acquiring such knowledge is certainly important. The task remains, however, to communicate remaining opportunities and risks to other sectors that could also be involved. Table 7-4 indicates the breadth of issues needing coordination concerning lead.
This volume is intended to build bridges to promote multisectoral teams in the Bank and in developing countries to address multisectoral problems. This can also help improve service delivery in general. Box 1-6 summarizes the role of environmental health in meeting this challenge, and chapter 2 introduces methodologies and instruments that multisectoral teams may adopt, covered in more detail in chapters 4-6.

**This volume is intended to build bridges to promote multisectoral teams in the Bank and in developing countries to address multisectoral problems, which can also help improve service delivery.**

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**Box 1-6: The Contributions of an Environmental Health Approach**

Each sector and professional group needs to define their contribution to overall health outcomes and development objectives, their comparative advantage and areas of convergence, linkages, interactions or interface, and the common goals to which they all can contribute. As we think beyond sectors, what can we do in the interface between health and environment? That is environmental health.

Proponents of environmental health should define its comparative advantage, rather than focus on the limitations of others. What is the value added of an environmental health approach? For example, if the health sector has identified a set of priority health problems, what major risk factors should be addressed through an environmental health approach, for example, through water and sanitation and related behavior change interventions, reduction in indoor air pollution (technologies and behaviors), vector control, improved housing and reduced crowding, behavior change interventions, and health promotion. Environmental health can promote a systematic approach to define the most cost-effective, affordable, sustainable, culturally appropriate, and feasible set of interventions across sectors and achieve synergy through the multiple opportunities that policies and projects in different relevant sectors provide.

CHAPTER 2: DEVELOPING SOLUTIONS THROUGH TARGETED COLLABORATION

*Environmental Health: Bridging the Gaps* helps multisectoral teams identify opportunities for cost-effective interventions outside the health sector, building its approach on three underlying principles:

- **The whole is greater than the sum of its parts.** Coordinating interventions among environment, health, and other sectors will do more to reduce poverty than a series of single sector interventions.
- **Define half a problem, devise half a solution.** Environmental health problems tend to be multisectoral and require multisectoral solutions. Any benefits from a single sector approach come with a missed opportunity: the inability to prioritize the relative importance of various issues and their solutions within a broad context.
- **Do no harm.** Putting health in its broader environmental setting can help fulfill one of the most important rules of public health: to do no harm. Single sector projects may miss opportunities to address equally important health issues or sometimes inadvertently do harm by promulgating policies and promoting a mix of investments that fail to address health risks or give a false sense of security that the whole problem has been addressed.

Adhering to these cautionary principles should encourage a multidisciplinary approach to analyzing projects, one that ensures that investments in single sectors, especially for pollution control, also produce long-term health benefits. The principles should not be misinterpreted, however, as a recommendation to avoid investments in pollution management. The intention is simply to alert staff to low-cost, often neglected measures—sometimes only a small component within or parallel to a project—that could anchor and enhance the health benefits of such investments.

*Low-cost, often neglected measures—sometimes only a small component within or parallel to a project—could anchor and enhance the health benefits of investments in other sectors.*

Implementation of multisectoral approaches, however, as explained in chapter 1, is fraught with challenges. This chapter presents a new approach that attempts to address these challenges and bridge gaps in current efforts and among various agencies by harmonizing health with other sector priorities and targeting promising areas of collaboration on cost-effective health interventions. Box 2-1 explains some of the ways this new approach can be mainstreamed into the operations of the World Bank and other development agencies.
Box 2-1: Mainstreaming the New Approach into Bank Development Work

Untapped environmental health benefits in development work need to be better quantified, valued and integrated into Bank strategies, policies, and lending procedures at all levels. Bank staff need to be sensitized to practical ways to tap these potential benefits and convey this message to other development agencies, donors and NGOs. Several areas could be explored to help win promulgating these into lending: (a) options to mainstream environmental health; and (b) methodologies and instruments for Bank staff and borrowing countries among others. Environmental health constitutes one of the building blocks of the forthcoming Bank Environment Strategy, which is a recent positive factor that could catalyze the mainstreaming effort. Environmental health concerns are also being integrated in Poverty Reduction Strategy Papers (e.g., Madagascar), thanks to a mounting interest in improving the wellness of the poor through the poverty reduction.

Several other areas could be explored as non-lending options inside and outside the Bank. For example, the Development Committee of the World Bank and the International Monetary Fund need to be sensitized on environmental health issues during IDA replenishment, mainly through the Bank’s Environmentally and Socially Sustainable Development and Human Development networks. Bank, borrower countries, NGOs and CBOs can be sensitized on environmental health concerns which should also be included in Bank research programs and the World Bank Institute’s curriculum; dissemination through publication, web sites, and distance learning. Several of Environmental Health: Bridging the Gaps chapters deal with developing, enhancing or suggesting a panoply of options and tools to mainstream environmental health concerns at the macro, sector and project levels (as shown below).

<table>
<thead>
<tr>
<th>Options to Mainstream Environmental Health</th>
<th>Tools to Mainstream Environmental Health</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Country/Macro Strategies and Programmatic Instruments.</strong> Structural adjustment lending, country assistance strategies, comprehensive development frameworks, poverty reduction strategy credits, national environmental action plans (WHO-funded national environmental health action plans), and environmental action plans.</td>
<td><strong>Analytical Tools</strong> to quantify and value environmental health burden of disease (disability-adjusted life years to measure health outcomes besides mortality, and cost-effectiveness) and help mainstream its concerns at the macro, sector and project levels (chapters 3 and 6). Demographic and Health Surveys (DHS), Living Standards Measurement Study (LSMS) household surveys, World Development Indicators (WDI), and so on need to be adapted to provide data on environmental health.</td>
</tr>
<tr>
<td><strong>Economic and sector work (ESW).</strong> Integration into (a) poverty reduction strategy papers, country economic memoranda, public expenditures reviews, sector reviews, sector strategy papers, poverty assessments, and social assessments, and (b) Bank sector strategies, for example, environment, health, social, poverty, energy, and water and sanitation.</td>
<td><strong>Sectoral Tools</strong> to bring about sectoral priorities to help harmonize environmental health with other sectoral priorities, e.g., “shortcut tools,” such as “environmental health profiles,” which provide a short list of issues through a desk review or “entry points,” which focus on issues for which a critical mass of the stakeholders are ready to take action (chapters 3-5 and 15-17).</td>
</tr>
<tr>
<td><strong>Global/Regional/Local Strategies and Instruments.</strong> Including (a) intermediation mechanisms, e.g., community driven development, community action plan, and social funds and (b) other initiatives, programs, funds, and facilities, e.g., Carbon Fund, Cities without Slums, City Development Strategy, Clean Air Initiative, Disaster Management Facility, Global Environment Facility (GEF), Local Environmental Action Plans (LEAP), Multi-Country HIV/AIDS Program, Post-Conflict Reconstruction Program, and Rollback Malaria Initiative.</td>
<td><strong>Institutional Tools</strong> to help determine institutional compatibility through institutional needs assessments and foster multisectoral collaboration and forge partnerships through entry points, incentives and mutual benefits (chapters 2, 3, and 15-17).</td>
</tr>
<tr>
<td><strong>Multisector/Single Sector Project and Monitoring.</strong> Including (a) integration of environmental health into environmental assessment procedures and into project documentation, design summary, management, and monitoring and (b) preparation of environmental health projects (e.g., as the one under preparation in South Asia).</td>
<td><strong>Monitoring Tools</strong> to develop cross-sectoral outcome-based monitoring systems, e.g., application of quality adjusted life years to measure years life gained from an intervention (chapter 3), early warning monitoring indicators, and multilayered geographic information system, which can combine information ecology, topography, socioeconomic groups, and associated environmental health risks (chapters 2, 5, and 17). DHS, LSMS and WDI need to be adapted.</td>
</tr>
<tr>
<td><strong>Operational Procedures, Quality at Entry, and Safeguard Policies.</strong> Need to be adapted accordingly.</td>
<td><strong>Procedural and Operational Mechanisms</strong> to deal systematically with environmental health concerns at all levels and possibly: enhance exiting procedures, e.g., poverty, environmental and social assessments (chapters 4-6); and improve control mechanisms such as quality at entry and safeguard policies (chapters 7-14).</td>
</tr>
</tbody>
</table>

*Source: Authors’ data.*
The overall framework for implementing methodologies to tap missed health benefits through multisectoral collaboration is described below. Chapter 3 describes economic valuation. Chapters 4, 5, and 6 consider the gathering and analyzing of information to aid inclusion of environmental health in decisionmaking and chapters 8 through 15 present environmental health assessment guidelines.

**Objectives of Harmonizing Sectoral Priorities**

The main objective of the 1996 volumes of *Bridging Environmental Health Gaps* was to improve the well-being of the population at large. To this end, the Environmental Health: Bridging the Gaps program has worked to mainstream environmental health into World Bank operations. Current Bank attempts to bridge sectoral gaps through its “networks” help link two sectors, but difficult problems in Bank projects could benefit from solutions in several sectors simultaneously. The approach introduced here facilitates multisectoral efforts to the Bank’s chief goal of poverty reduction and sustainable development and expands health benefits beyond those of single sectors—health care, basic infrastructure services, and pollution management, fulfilling the first of the principles cited above.

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**Box 2-2: Environmental Health Defined**

Environmental health is as much a way of thinking as a set of facts or professional discipline. Preventing disease, death, and disability should ideally form its core and entail looking at a problem in both its broad and narrow contexts. Broadly speaking, environmental health is intended to reduce exposure to adverse environmental conditions as well as promote behavioral change. More narrowly, it addresses the underlying causes of individual groups of diseases and injuries by looking at the direct and indirect causes and effecting relationships in the short and long term. Table 2-1 shows typical examples and their adverse health consequences.

**Table 2-1: Sample Environmental Health Determinants and Consequences**

<table>
<thead>
<tr>
<th>Underlying Determinants</th>
<th>Possible Adverse Health and Safety Consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequate water (quantity and quality), sanitation,* and solid waste disposal</td>
<td>Diarrheas and vector-related diseases, <em>e.g.</em> malaria, schistosomiasis, and dengue fever</td>
</tr>
<tr>
<td>Improper water resource management (urban and rural), including poor drainage</td>
<td>Vector-related diseases, <em>e.g.</em> malaria and schistosomiasis</td>
</tr>
<tr>
<td>Crowded housing and poor ventilation of smoke</td>
<td>Acute and chronic respiratory diseases, including lung cancer</td>
</tr>
<tr>
<td>Exposures to vehicular and industrial air pollution</td>
<td>Respiratory diseases, some cancers, and loss of IQ in children</td>
</tr>
<tr>
<td>Changes in feeding and breeding grounds of vectors, such as mosquitoes, from construction and population movement</td>
<td>Vector-related diseases, <em>e.g.</em> malaria, schistosomiasis, and dengue fever</td>
</tr>
<tr>
<td>Exposures to naturally occurring toxic substances</td>
<td>Poisonings from, <em>e.g.</em> arsenic, manganese, and fluorides</td>
</tr>
</tbody>
</table>

* “Sanitation” in this document refers to the various forms of excreta and wastewater removal.
### Underlying Determinants and Possible Adverse Health and Safety Consequences

<table>
<thead>
<tr>
<th>Determinants</th>
<th>Consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural resource degradation, e.g., mudslides, poor drainage, and erosion,</td>
<td>Injury and death from mudslides and flooding</td>
</tr>
<tr>
<td>which create health and safety problems</td>
<td></td>
</tr>
<tr>
<td>Climate change, partly from combustion of greenhouse gases in transportation</td>
<td>Injury and death related to extreme heat and cold, storms, floods, and fires.</td>
</tr>
<tr>
<td>and industry and poor energy conservation in housing, fuel, commerce, and</td>
<td>Also indirect effects, e.g., spread of vector-borne diseases,</td>
</tr>
<tr>
<td>industry</td>
<td>aggravation of respiratory diseases, population dislocations, water</td>
</tr>
<tr>
<td></td>
<td>pollution from sea level rise, and so on.</td>
</tr>
<tr>
<td>Ozone depletion from industrial and commercial activity</td>
<td>Skin cancer, cataracts, and indirect effects, e.g., compromised food</td>
</tr>
<tr>
<td></td>
<td>production, and so on.</td>
</tr>
</tbody>
</table>

Environmental health is intended to prevent human illness and injury by systematically tapping resources outside the health care system to enhance those of the health sector. In this sense, “environmental health” differs from “medicine,” “public health,” and “occupational health” in emphasis and points of intervention (see box 2-3). The World Bank has no specific definition for environmental health. In practice, however, the use of the term is most frequently used in the context of pollution management projects.

*Source: Authors’ data.*

The three underlying principles, stated above, however, call for multisectoral work among government agencies and community groups from health, environment, and other sectors that are not used to working together. A secondary objective, implemented through this discussion paper, has, thus, been to achieve multisectoral collaboration by harmonizing health and other sectoral priorities, that is, identifying and prioritizing remedial measures that are practicable, as defined by national and local institutional capabilities. To this end, health-related measures that may otherwise seem too far removed from or too expensive given overall project objectives are undertaken for their residual health benefits.

### Box 2-3: Key, Confusing, and Misused Terms on “Medicine” and “Health”

* **Medicine.** Emphasizes curative and preventive services oriented to individual diseases and injuries and operates mainly through the public and private health care system.*

* **Public health.** Emphasizes preventive and curative services oriented to promoting health and safety in society and operates through the public and private health care system as well as other institutions in society at large.*

* **Environmental health.** Emphasizes preventive services oriented to reducing exposures in society (current tendency toward pollution control) and operates through various public and private sector institutions.*

* **Occupational health.** Emphasizes curative and preventive health and safety oriented mainly to the workplace. Sometimes referred to as “occupational health and safety” or “occupational and environmental health.”*  

*Source: Authors’ data.*

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*The main objectives of the program are to enhance the Bank’s chief goal of poverty reduction by mainstreaming environmental health into World Bank operations and achieve multisec-

*Chapter 4 and the glossary define terms for environmental health assessments.*

18
toral collaboration by harmonizing health and other sectoral priorities. This discussion paper is a means to achieve these objectives.

Methodologies of Targeted Multisectoral Collaboration

Harmonizing sectoral priorities depends on a process that targets collaboration among those sectors and on those measures that, tempered by administrative considerations, have the best chance of generating health and other benefits, generally at a lower cost for all. The process involves four new tactics:

- Identifying and prioritizing measures outside the health care system that will enhance efforts of the health care system
- Quantifying missed or untapped health benefits
- Devising entry points based on institutional capability to collaborate
- Enhancing mutual benefits for the sectors that agree to collaborate.

Identifying and Prioritizing Measures Outside the Health Care System

Instead of focusing analysis on the statistical levels of death, disease, and disability, this volume shifts the focus to remedial measures outside the health care system to solve health problems that are based on the types of interventions used to help solve problems: leading health problems, diseases for special consideration, and key cross-cutting issues that are pertinent to all sectors. This innovative system of classification, new in this discussion paper, maintains the focus on tapping health benefits outside the health care system, complementing and not replacing traditional health data.

Table 2-2 shows the range of possible remedial measures for the infrastructure sector, based on the top five burdens of disease in SSA (see also table 1-5.) This list would lengthen if other sectors were reviewed as part of a coordinated effort to deal with health systematically outside the health care system.

Table 2-2: Infrastructure Measures for Top Five Burdens of Disease in SSA

<table>
<thead>
<tr>
<th>Disease/Condition</th>
<th>Type of Infrastructure Remedial Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. AIDS</td>
<td>Outreach to high-risk groups, such as truckers, work crews, and market-related groups</td>
</tr>
<tr>
<td>2. Malaria</td>
<td>Vector control, and sanitation and drainage</td>
</tr>
<tr>
<td>3. Diarrheal diseases</td>
<td>Improved drinking water supply and waste management</td>
</tr>
<tr>
<td>4. Respiratory disease</td>
<td>Improved housing and air pollution abatement</td>
</tr>
<tr>
<td>5. Perinatal conditions</td>
<td>(Remedial measures handled primarily through the health ministry. Some hygiene education possible through outreach to infrastructure groups.)</td>
</tr>
</tbody>
</table>

Source: Authors’ data.

As one example, table 2-3 shows that seven of the top ten health problems in Ghana are amenable to infrastructure improvements (see also table 17-2). Chapter 3, which discusses socioeconomic aspects of health interventions outside the health sector, estimates that infrastructure projects could conceivably relieve a greater level of the burden of disease than health investments, about 20 percent, for a fraction of the cost. This is because infrastructure projects have already been justified on other grounds. These links to other sectors also open the door to identifying untapped and missed benefits.
Table 2-3: Top Ten Diseases in Ghana by Infrastructure Intervention (1994)

<table>
<thead>
<tr>
<th>Disease</th>
<th>1994</th>
<th>Major Infrastructure Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>1</td>
<td>v</td>
</tr>
<tr>
<td>Upper respiratory infection</td>
<td>2</td>
<td>v</td>
</tr>
<tr>
<td>Skin diseases</td>
<td>3</td>
<td>v</td>
</tr>
<tr>
<td>Diarrheal diseases</td>
<td>4</td>
<td>v</td>
</tr>
<tr>
<td>Accidents</td>
<td>5</td>
<td>v</td>
</tr>
<tr>
<td>Intestinal worms</td>
<td>6</td>
<td>v</td>
</tr>
<tr>
<td>Pregnancy related complications</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Acute eye infection</td>
<td>8</td>
<td>v</td>
</tr>
<tr>
<td>Gynecological disorders</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

Source: Country assistance strategy for Ghana.

Devising “Entry Points”

Entry points are determined by institutional capability and complementarity, that is, the likelihood of successful interagency and stakeholder collaboration due to their common interest in solving common problems. Promising entry points demonstrate the following characteristics:

- Widespread knowledge of the problem
- Clearly identifiable stakeholders and players
- Ability by the majority of actors in the situation to get to work.

These factors could create a framework for working on a range of environmental health problems, as the individuals and groups involved build up experience and practice working together. A trial case in Ghana Sekondi-Takoradi, one of Ghana’s five largest cities, for example, focused on the following entry points:

- Management of health facility waste
- Urban malaria and other vector-related diseases
- Diseases related to water, sanitation, and drainage.

Even though respiratory disease in Ghana ranks second out of the top ten diseases (see table 2-3), it was not selected for the case study, because the range of relevant players and stakeholders was so diverse. This increased the difficulty of those involved starting immediately to work toward a common goal without a delay involved in creating awareness among stakeholders from several sectors—health, energy, housing, transport, industry, environment—that they had a constructive role to play. With time, building on experiences with various successful entry points, other diseases and areas for collaboration may be identified in Ghana. Table 2-4 presents possibilities any country might consider.
Table 2-4: Sample Linkages and Synergies to Harmonize Sectoral Priorities

<table>
<thead>
<tr>
<th>Sector</th>
<th>Environmental Priority</th>
<th>Health Priority</th>
<th>Health Linkages</th>
<th>Possible Entry Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>Land degradation, pesticide use, and stagnant water (rural and periurban agriculture)</td>
<td>Food security, nutrition, and malaria</td>
<td>Contamination of the food chain, pesticide use, exposure to grain dust, vector-related diseases</td>
<td>Malaria and pesticide management</td>
</tr>
<tr>
<td>Energy</td>
<td>Air pollution and greenhouse gases</td>
<td>Acute respiratory diseases and indoor air pollution</td>
<td>Indoor and outdoor air pollution, and cooking fuels</td>
<td>Household ventilation and improved cookstoves</td>
</tr>
<tr>
<td>Environment</td>
<td>Natural resource management, climate change, global warming, and pollution control</td>
<td>Pollution control</td>
<td>Reduction of lead from multiple sources</td>
<td>Lead reduction for nontransport sources</td>
</tr>
<tr>
<td>Health</td>
<td>Medical waste disposal and greenhouse gas generation</td>
<td>Infant and child health, AIDS, malaria, tobacco smoking, and TB</td>
<td></td>
<td>Medical waste disposal</td>
</tr>
<tr>
<td>Industry and mining</td>
<td>Air, water, and coastal zone pollution</td>
<td>Occupational health and exposure to heavy metals and malaria</td>
<td>Mosquito breeding, respiratory diseases, and contamination of food chain</td>
<td>Malaria reduction and AIDS education</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Providing access to water, sanitation, and waste management facilities; pollution control; and drainage</td>
<td>Diarrheal diseases, traffic injuries, and malaria</td>
<td>Water, air, and land pollution; traffic safety; and mosquito breeding</td>
<td>Diarrheal diseases, traffic injuries, medical waste disposal, urban malaria, traffic-related air pollution, and AIDS in transport, construction work crews, and markets</td>
</tr>
</tbody>
</table>

Source: Authors’ data.

Health agencies may have a number of potential partners at any one entry point. For example, they might join with transport, water and waste management, and community groups, and schools to reduce urban malaria from mosquito breeding sites.

**Establishing Mutual Benefits for Sustainability**

Collaboration is more likely to be sustainable if it is based on sharing benefits, rather than merely increasing the budget for activities added. Establishing the mutual benefits that involved sectors may gain is, therefore, important to the process of harmonizing sectoral priorities. Methodologies for targeted collaboration try to reduce reliance on additional budget by identifying areas of mutual compatibility.

Table 2-5 below shows the stakeholders at risk for each of two entry points in the Ghana trial and possible partnerships. Table 2-6 lists recommendations for the potential partnerships associated with the stakeholders at risk identified in table 2-5 (see chapters 16 and 17 for more details).

* Details of the pilot study appear in chapters 15 to 17 in this volume.
### Table 2-5: Stakeholders at Risk and Potential Partnerships for Entry Points in Ghana

<table>
<thead>
<tr>
<th>Entry Point</th>
<th>Populations at Risk</th>
<th>Potential Partnerships for Solutions</th>
</tr>
</thead>
</table>
| Urban malaria and other vector-related diseases | - Children under 5 years and other vulnerable groups (women, elderly, sick, and so on)  
- Communities around bushy and marshy areas  
- Densely populated areas  
- Low income groups that cannot afford any preventive or curative treatments (bed nets or drugs). | - Hydro Division, Ministry of Works and Housing  
- Ministry of Roads and Transport  
- Ministry of Environment  
- Environmental Protection Agency  
- Ministry of Health  
- Ministry of Industry  
- Media (press and radio)  
- Ministry of Planning (Census Statistics), Education, Town, and Country Planning  
- Assemblymen, unit committees  
- Community, religious groups  
- Fishing industry  
- NGOs, community-based organizations, and private sector  
- Shama Ahanta East Municipal Area’s (SAEMA’s) Assembly, Environmental Health Unit, Public Relations Unit, Urban Roads Department, and Waste Management Department |

| Management of health facility waste | - Children  
- Community  
- Health workers  
- Patients  
- Scavengers  
- Waste management operators | - Environmental Protection Agency  
- Environmental Health Department  
- Ghana Medical Association  
- Medical drug vendors and pharmaceutical manufacturers  
- Pharmacy board  
- Waste management department |

*Source: Authors’ data.*

### Identifying the Stakeholders

Transport agencies, for example, are typically responsible for monitoring and cleaning storm drains to prevent highways and other roads from flooding. Clogged drains provide breeding grounds for malaria. Health agencies could collaborate with transport agencies by monitoring and reporting clogged drains at the neighborhood level. Transport agencies, saving monitoring time and money, could then devote more resources to cleaning. Health agencies could help reduce the spread of urban malaria and could use the monitoring for community outreach on urban malaria. As mentioned before, this collaboration could also address other mosquito-borne diseases, such as dengue (clean water) and filariasis (polluted water), often overlooked in malaria programs and economic analyses. Collaboration must also allow for changes in programs based on technical, social, or economic objectives of nonparticipants. The land reclamation recommended by the community stakeholders, for example, may not be ecologically sound and alternate means would need to be developed.
Table 2-6: Ghanaian Recommendations for Entry Points Based on Multisectoral Collaboration

<table>
<thead>
<tr>
<th>Entry Point</th>
<th>Recommendation</th>
</tr>
</thead>
</table>
| Urban malaria and other vector-related diseases | • *Land use management:*  
  (a) *Land reclamation.* Reconsider reclamation of marshy areas to destroy major mosquito-breeding grounds. Reclaimed lands could be used for agriculture, resettlement, or compatible uses.  
  (b) *Burrow pits in construction and mining sites.* Involve construction, mining, and industry in malaria prevention efforts. For example, work out the social, economic, and technical details of introducing tilapia and/or other appropriate fish species into unfilled areas and determine fishing rights.  
  • *Proper drainage.* Clarify roles and responsibilities for drain management and monitoring:  
  (a) Develop clear maps of primary, secondary, and tertiary drains  
  (b) Link maps (geographic information system) to existing roles and responsibilities  
  (c) Assure an earmarked, nonfungible budget for desilting  
  (d) Involve communities in drain clearing, drawing lessons from the Bank’s Urban Environmental Sanitation Project (UESP).  
  • *Awareness creation.* Build awareness on many alternatives to spraying to prevent mosquito breeding in households—for example, use of tilapia and sealed water tanks, storage, and containers—at all levels of government and society. |
| Management of health facility waste | • *Develop medical waste management bylaws.* Medical waste management was recently delegated to the local assemblies, which have no bylaws to implement this policy. Such bylaws would need to be based on a multisectoral approach.  
  • *Build capacity to monitor.* Improve the capacity of assemblies to monitor proper disposal of medical waste.  
  • *Add value to waste.* Examine the medical waste stream to determine those items with any economic value, removing hazardous materials from inexperienced waste pickers and disposing of them safely. Help scavengers to improve waste recycling in the medical waste. Items that are now being reused or sold with risk should be removed from the “informal market.”  
  • *Increase awareness of proper disposal of medical waste* at all levels of government and society, especially target communities and medical staff. |

Source: Authors’ data.

Establishing Mutual Benefits through Mapping

The aim of the environmental health map is to devise a model that will help identify the geographic incidence of environmental health effects at the national, regional, and communal levels. The map, which could evolve to become a decision support system to prevent environment health risks and formulate policy response, should combine environmental health risk factors and national, regional, or urban social maps (to derive vulnerable groups incurring an environmental risk) with a GIS technology to perform an environmental health survey of patterns that could be integrated in an environmental or environmental health assessment:

- Environmental health risk factors can include comparative risk assessment, risk communication, and risk management (see glossary).
- Data from social maps offer a means of exploring national or intra-urban environmental health differentials. Social maps can help identify data sources and contacts, relevant “hotspots,” both topically and geographically, and the perceived social causes that underlie and perpetuate observed patterns. They are an excellent way to begin any data search and, perhaps, frame the policy implications of later findings.
- Geographic information systems (GISs) mapping can help establish benefits by adapting existing GIS maps for environmental health purposes. GISs permit a view of a true spatial relationship of geology, hydrology, and ecology, in conjunction with land use (urban and rural settlements, industry and mining, agricultural land, and so on), social factors (income group concentration, among others), and environmental health patterns.

An environmental health map can effectively be done on a paper map, and a simple discussion note can describe how issues relate to geographic boundaries, as was demonstrated during the
Ghana pilot (see map 5-1 and chapter 17). A multidisciplinary group representing the public sector and stakeholders drew this “low-tech” map to depict the incidence of vector-related diseases in Sekondi-Takoradi.

A more advanced environmental health map could, however, be done by using a GIS or digitizing an approved map that could be used by all the sectors and tiers of the government. After producing the map, participatory discussions involving a multidisciplinary group will help (a) identify the patterns, (b) question the patterns evidenced by the data, (c) recommend further types of prioritized data and queries, believed to be necessary to ascertain the environmental health concerns, (d) formulate a plan of action in conjunction with other sectors’ goals and strategies, and (e) monitor the outcomes on a regular basis, allowing re-evaluation of policy response implementation.

Environmental health applications targeting specific health risks have been performed in several countries, but no comprehensive environmental health map has, as yet, been developed. The degree of sophistication of this decision support system will depend on time and resource constraints, availability, reliability of collected data, and sustainability of the process (designation of a lead agency, update, maintenance, and information sharing), which will help formulate environmental health policy responses at the national, regional, and communal levels.

Quantifying Untapped or Missed Health Benefits

Potential health benefits outside the health care system remain untapped or underestimated and, therefore, unrecognized. Four crucial reasons for this, compounded by problems in data availability and reliability, concern economic and health valuation techniques.

- First, health benefits, especially when calculated within the health sector, tend to focus on measures implemented through the health care system, on a single disease or condition or on a single causal factor. Only occasionally are measures multisectoral. Such analyses of malaria control, for example, tend not to look at other mosquito-borne diseases and concentrate on measures promoted by the health care system, such as bed nets, medications, and other medical treatment. In comparison, positive infrastructure interventions such as proper drainage tend to be excluded. Because drainage networks can support a variety of mosquitoes, drain cleaning and maintenance that reduces breeding sites for mosquitoes that spread malaria can also reduce breeding sites for mosquitoes spreading dengue and filariasis.

- Second, health benefits, especially when calculated outside the health sector, tend to be aggregated under “health,” without recognizing individual contributions of multisectoral causes or remedial actions. Reducing air pollution, for example, has impacts beyond respiratory diseases, addressing impacts on the circulatory system, skin, and eyes.

- Third, the tendency to focus on single diseases may also miss diseases that may be medically different, but would respond to the same type of remedial measures. Under the broad category of respiratory diseases, for example, focusing on acute respiratory infections—the number one cause of DALYs in developing countries (see table 1-1)—would miss diseases such as tuberculosis, asthma, and lung cancer.

- Fourth, it is also possible to miss diseases and conditions that are indirectly related to the single disease being evaluated. For example, in an energy project evaluating the benefits of improved household fuel. Concentrating on indoor air pollution and respiratory disease could miss a range of factors that may be equally important. The consequences of fetching firewood entail injuries (head, neck, and back) to women from carrying heavy loads, and perinatal problems if they are pregnant (low birth weight and miscarriages). Other
missed benefits could include better child nutrition, if mothers are able to improve cooking (boiling water to prevent diarrheas and more hot meals).

These four factors will depend on local conditions, but, collectively, their effects can be considerable.

Analysis of the possible impacts of multisectoral approaches to environmental health, however, can be revealing. The *World Development Report: Investing in Health 1993* estimated that the public sector health care system could relieve about 33 percent of the burden of disease. In comparison, the 1996 *Bridging Environmental Health Gaps* volumes estimated that the infrastructure sector could target up to 44 percent of the burden of disease in SSA (see table 2-7). This points to the great potential of interventions outside the health care system.

*The infrastructure sector could target up to 44 percent of the burden of disease in SSA, indicating the great potential of interventions outside the health care system.*

Table 2-7: Burden of Disease in SSA by Main Remedial Measures (1990)

<table>
<thead>
<tr>
<th>Remedial Measures</th>
<th>Disease or Condition</th>
<th>Years with Disability</th>
<th>Annual Deaths</th>
<th>DALY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved housing and air pollution abatement</td>
<td>Respiratory disease</td>
<td>3,017,000</td>
<td>1,565,000</td>
<td>45,312,000</td>
</tr>
<tr>
<td>Vector control, sanitation, and drainage</td>
<td>Tropical cluster or vector related</td>
<td>8,064,104</td>
<td>1,123,300</td>
<td>35,922,104</td>
</tr>
<tr>
<td>Improved water and waste management</td>
<td>Water and sanitation related</td>
<td>1,468,000</td>
<td>888,539</td>
<td>31,208,000</td>
</tr>
<tr>
<td>Household and traffic injury reduction</td>
<td>Unintentional injuries</td>
<td>5,322,009</td>
<td>335,300</td>
<td>15,067,000</td>
</tr>
</tbody>
</table>

*Subtotal infrastructure related* 17,871,113 3,912,139 127,509,104

*Subtotal childhood cluster* 1,501,000 788,000 28,093,000

*Subtotal remaining burden of disease* 48,158,000 3,326,861 137,236,104

**Grand total burden of disease** 67,530,113 8,027,999 292,838,208

Percent potential for infrastructure interventions 26.5 48.7 43.5

a. Childhood cluster includes pertussis (whooping cough), poliomyelitis, diphtheria, measles, and tetanus.

*Source:* Adapted from World Bank (1994) and WHO (<http://www.who.int/peh-super/lectures5.12/15.htm.>.

Table 2-8 takes the potential target of 44 percent a step further by estimating the possible range of health benefits available outside the health sector in SSA. Measures inside and outside the health care system could achieve the same order of magnitude, each averaging about 20 percent. In theory, therefore, it is possible to produce the same order of magnitude of health benefits at only a fraction of the cost, because investments have already been justified for reasons other than health (see chapter 3). Although the figures are still estimates and require rigorous statistical analyses, in the absence of statistically significant data, common sense and professional judgment argue for systematic examination of these possibilities.
Table 2-8: Burden of Disease Relieved by Remedial Measures (1998)

<table>
<thead>
<tr>
<th>Remedial Measures</th>
<th>Percent of the Range of DALYs Potentially Reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td><strong>Environmental health remedial measures for infrastructure and other sectors:</strong></td>
<td></td>
</tr>
<tr>
<td>Improved housing and air pollution abatement</td>
<td>6</td>
</tr>
<tr>
<td>Improved water and waste management</td>
<td>8</td>
</tr>
<tr>
<td>Vector control, sanitation, and drainage</td>
<td>3</td>
</tr>
<tr>
<td>Road, workplace, and housing design</td>
<td>1</td>
</tr>
<tr>
<td><strong>Subtotal of environmental health types</strong></td>
<td>17</td>
</tr>
<tr>
<td><strong>Health care/education remedial measures:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal of health care types</strong></td>
<td>15</td>
</tr>
<tr>
<td><strong>Other remedial measures:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal other</strong></td>
<td>68</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations.

Table 2-9 estimates that, for respiratory disease alone, 47 percent of the DALYs are often not analyzed for potential benefits available outside the health sector. For instance, the same factors responsible for acute respiratory infections, such as indoor air pollution from poor quality cooking, lighting, and heating fuels, can also cause or aggravate the remainder of respiratory diseases, which are analyzed separately in statistics.

Table 2-9: Possible Health Benefits Missed by Focusing on a Single Disease

<table>
<thead>
<tr>
<th>Respiratory Disease/Condition</th>
<th>World DALYs (1,000s)</th>
<th>Developed DALYs (1,000s)</th>
<th>Developing DALYs (1,000s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counted in top ten or alone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute respiratory infections (lower)</td>
<td>82,344</td>
<td>1,355</td>
<td>80,990</td>
</tr>
<tr>
<td><strong>Subtotal “counted in top ten”</strong></td>
<td>82,344</td>
<td>1,355</td>
<td>80,990</td>
</tr>
<tr>
<td>Diseases counted separately</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute respiratory infections (upper)</td>
<td>975</td>
<td>50</td>
<td>924</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>28,189</td>
<td>142</td>
<td>28,047</td>
</tr>
<tr>
<td>Chronic obstructive</td>
<td>28,654</td>
<td>2,449</td>
<td>26,205</td>
</tr>
<tr>
<td>Asthma</td>
<td>10,986</td>
<td>1,208</td>
<td>9,706</td>
</tr>
<tr>
<td>Other</td>
<td>18,932</td>
<td>1,303</td>
<td>17,089</td>
</tr>
<tr>
<td>Cancer (lung, trachea, bronchus)</td>
<td>11,176</td>
<td>3,122</td>
<td>8,054</td>
</tr>
<tr>
<td><strong>Subtotal “counted separately”</strong></td>
<td>87,736</td>
<td>5,152</td>
<td>81,971</td>
</tr>
<tr>
<td><strong>Combined total</strong></td>
<td><strong>181,256</strong></td>
<td><strong>9,629</strong></td>
<td><strong>171,015</strong></td>
</tr>
<tr>
<td>Possibly omitted in calculation of benefits</td>
<td>45%</td>
<td>14%</td>
<td>47%</td>
</tr>
</tbody>
</table>


Improved Service Delivery

The single sector approach may underestimate the environmental health benefits possible through a broader approach to improving overall service delivery. In the case of transport and health agency collaboration on reducing mosquito-borne diseases, transport agencies could improve drainage and, to a lesser extent, traffic flow in the rainy season by transferring some of the drain monitoring to health or neighborhood groups. This concept is further explored in chapter 3’s section on environmental health attributes, which dis-aggregates benefits that are typically listed under the “health” rubric. Table 2-6 above listed expanded health benefits that imply better service delivery, because they add to the types of beneficiaries otherwise excluded from a project.
Estimating Beneficiaries

Single sector approaches traditionally calculate economic rates of returns on a development project by closely examining those directly affected by a project. An environmental health approach needs to examine if benefits can be appropriately applied to a wider audience. Better estimates of beneficiaries can help justify projects or components that are considered too costly.

In the Long-Term Water Sector Project in Senegal, for example, initial economic calculations focused on water as the way to reduce diarrheal disease and on those who would benefit economically by having water conveniently and consistently accessible. An environmental health analysis, however, increased the number of beneficiaries by including (a) 70,000 people who live near a dam in the project zone that are exposed to schistosomiasis and (b) Dakar residents who might benefit from better management of market gardening to help curtail the current spread of urban malaria (see table 2-10).

Table 2-10: Sample of Increased Health Benefits in Long-Term Water Sector Project in Senegal

<table>
<thead>
<tr>
<th>HEALTH BENEFIT</th>
<th>STAGE OF DELIVERY</th>
<th>HEALTH COST/RISK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Production of Water at Ultimate Source: Senegal River</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Added income to promote better nutrition, especially protein.</td>
<td>• Local populations are moving around the Lac de Guiers because of economic activity spurred by a link to the Senegal River.</td>
<td>• Spread of malaria and bilharzia.</td>
</tr>
<tr>
<td>• Construction of plant will require sand, soil, and vehicles.</td>
<td>• Areas used for sand and soil can become vector breeding grounds, if not filled in.</td>
<td></td>
</tr>
<tr>
<td>• Health services available at the water production plant.</td>
<td>• Operation of plant.</td>
<td>• Poor sanitation and drainage by workers can spread diarrheal vector-related disease.</td>
</tr>
<tr>
<td>• Construction of plant will require sand, soil, and vehicles.</td>
<td></td>
<td>• Increased risk of bilharzia for locals who need to find a new watering site because the area now has no vegetation (breeding sites) at its shore, although other nearby suitable sites do.</td>
</tr>
<tr>
<td>HEALTH BENEFIT</td>
<td>STAGE OF DELIVERY</td>
<td>HEALTH COST/RISK</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td><strong>C. Housing for Water Treatment Workers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Improved housing, in addition to water sanitation for about 75 families.</td>
<td>• Vehicle traffic during operations.</td>
<td>• Risk of noise pollution, traffic injuries, and respiratory disease from frequent vehicle traffic passing near homes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Risk of spreading vector-related diseases due to poor sanitation and drainage.</td>
</tr>
</tbody>
</table>

| **3. Water transportation: Keur Momar Sarr–Thies main** | | |
| • Clean water. | • Villages along water main. | • Spread of malaria through improper agricultural practices. |
| • Market gardening. | | • Small dams can lead to water contamination and breeding sites for disease vectors, if not correctly maintained. |
| • Additional sources of nutrition, especially protein from additional crops possible. | | |
| • Possible added income from lower water costs. | • Legal connections for drinking water. | • Spread of malaria through improper drainage of water. |
| (None readily apparent) | • Construction work crews and worker camps during pipe laying. | • Spread of AIDS |
| (None readily apparent) | | |

| **4. Use: Greater Dakar (Agglomeration de Dakar)** | | |
| • Possible reduction in malaria by changing from sprinkle-saturation watering to drip. | • Market gardening in periurban Dakar and five secondary cities. | • Increase in urban malaria from added water without proper drainage. |
| • Reduction in diarrheas and intestinal parasites through improved water, sanitation, and drainage. | • Improved sanitation and drainage. | • Spread of urban malaria from improper disposal and drainage. |

| **5. Use: Dakar City (Ville de Dakar)** | | |
| • Reduction in diarrheas and intestinal parasites through improved water, sanitation, and drainage. | • Improved sanitation and drainage. | • Spread of urban malaria from improper disposal and drainage. |
| • Reduction in diarrheal diseases and intestinal parasites through improved hygiene. | • House connections. | • Spread urban malaria through improper drainage of water. |
| • Reduction in diarrheal diseases and intestinal parasites through improved hygiene. | • Standpipes. | • Spread malaria through improper drainage of water. |
| (None readily apparent) | • Illegal connections. | • Increase diarrhea from improper water management. |

Human beings are at the center of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.*

Relative to the other chapters, Chapter 3 is written with a greater emphasis on technical issues. Many ideas being presented are new, particularly those of health benefit valuations that have often been missed. These new ideas have not been subjected to analyses from several sectors. As a result, greater attention has been placed on explaining methodology than on its application.

This chapter deals with the economic underpinnings of the new ideas being proposed in this discussion paper: that considerable health benefits outside the health care sector remain untapped and require further research and analysis, for example, infrastructure interventions. The chapter builds on the tremendous environmental work that has been done to quantify these health effects and attempts to complement and expand the environmental scope, work, and analysis to look comprehensively and multisectorally at environmental health effects outside the health care system, especially those affecting the poor. More specifically, the chapter covers the following topics:

- First, the chapter introduces the notion of environmental health and attempts to justify the need to mainstream environmental health concerns in development work, while emphasizing that environmental health interventions are not competing with, but complementing health care delivery system interventions in a cost-effective manner.
- Second, the chapter clarifies environmental health attributes, such as ecological factors, man-made factors (or environmental health externalities that tend to be treated under a general rubric of "health"), and human behavior.
- Third, the chapter stresses the need to harmonize the enabling environment to formulate adequate environmental health policy responses (identifying environmental health externalities and associated policy, institutional, and market failures) and devise monitoring systems to achieve outcome-based results. To this end, macro and sectoral World Bank instruments are reviewed to integrate environmental health concerns.
- Fourth, the chapter quantifies and values in terms of social costs the environmental health burden of disease (BOD) in Sub-Saharan Africa and apportion the environmental health BOD borne by the poor. More specifically, the BOD is dis-aggregated and re-aggregated, which allows for "back-of-the-envelope" calculations on the SSA burden of disease that is targetable through environmental health and health care interventions. These are quantified in terms of lower-bound social cost to SSA economies.
- Fifth, the chapter prioritizes a cluster of interventions based on environmental health BOD to relieve the burden on the entire population as well as on the poor. A cost-effectiveness analysis is performed and possible intervention efficiency ratios are derived by intervention. Also, policy response and implications are drawn.

Why Do Mainstream Environmental Health in Development Work?

Economic thinking relies on the concept of utilitarianism, by which people strive for well-being and avoid pain. Sustainable development* promotes non-declining well-being for present and future generations through a well-managed physical, natural, human, social, and financial capital. Growing sustainable development challenges in the 1980s and 1990s led to the development of institutional frameworks and application of conventional economic thinking to come up with optimal economic solutions for addressing environmental problems. In contrast, environmental health (see box 3-1 for a working definition) problems (human health problems falling outside the purview of the health care sector, such as health effects resulting from economic activity affecting the environment) are still only partially identified and addressed through a fragmented sectoral approach.

Box 3-1: Working Definition of Environmental Health

Environmental health† relates to ecological factors, human activity (production or consumption), and human behavior that impact socioeconomic conditions and environmental life support systems and potentially affect the well-being of present and future generations by increasing human disease, injury, conditions, and premature death.‡

Source: Authors’ data.

At the end of the 1990s, major efforts were made essentially to recognize environment health problems, and numerous surveys and prospective studies were conducted to bring this important issue to the forefront. A worldwide public opinion survey conducted in thirty countries singled out children’s health affected by environmental problems as one of the most important concerns. Over the 1990-99 period, the burden of disease (BOD) growth outpaced the population growth in SSA (26 against 21 percent respectively over the period). This increase is a stern reminder that communicable diseases (+41 percent), mainly HIV/AIDS, malaria, respiratory diseases and water-related diseases, which have different growth rates over the period, represent a growing portion of SSA’s BOD in relative terms (73 percent in 1999 against 66 percent in 1990). A recent World Bank study suggests that the concentration of death and disability-adjusted life years (DALYs) lost to communicable diseases, of which almost a third can be attributed to environment-related problems in SSA, affects the poor—about 60 percent of ill health for the poor compared with 8–10 percent among the richest quintile. In terms of environmental health, communicable diseases (excluding HIV/AIDS) represent the majority of the diseases affecting both, the entire population (86 percent) and the poorest of the poor (87 percent) (see table 3-1).

Environmental health problems are rarely aggregated per se, but, collectively, they amplify the burden of disease, which impinges on Sub-Saharan Africa’s (SSA) in the following ways:

---

* Definition: development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland Report: World Commission on Environment and Development, 1987, p. 43).
† See glossary for various definitions on environmental health.
‡ Future generation preferences and possible environment-related human genetic defects cannot be determined or documented ex ante and, therefore, constitute an unresolved issue that will not be addressed in this chapter (See also institutional failures).
Table 3-1: Back-of-the-Envelope Burden of Disease (BOD) Breakdown in SSA, 1998

<table>
<thead>
<tr>
<th>Attributable BOD</th>
<th>SSA Burden of Disease by Attributable Risk</th>
<th>Social Benefits</th>
<th>Share of GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Commmunicable Diseases (%)</td>
<td>Non-Communicable Diseases (%)</td>
<td>Injuries (%)</td>
</tr>
<tr>
<td>Environmental Health BOD affecting the entire population</td>
<td>86</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Environmental Health BOD affecting the poorest quintile</td>
<td>87</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>AIDS/HIV affecting the entire population</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>AIDS/HIV affecting the poorest quintile</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>From SSA Burden of Disease</td>
<td>68</td>
<td>17</td>
<td>15</td>
</tr>
</tbody>
</table>

Note: See tables 3-9 and 3-10 for details.

• **Population well-being.** Environmental health effects account for at least 20 percent of the burden of disease (BOD); 10 percent affect the poorest of the poor (see table 3-1). In comparison, AIDS represents 17 percent of the BOD for the entire population and 7.7 percent for the poorest of the poor. Also, demographic growth and growing urbanization (one third of SSA population in 1998) could exacerbate and complicate environmental health problems, for example, a possible migration and adaptation of rural diseases, such as vector-borne, to urban settings (see box 1-3).

• **Overall economic performance.** Environmental health BOD for the entire population is equivalent to approximately 6 percent of the 1998 nominal GDP in SSA. A recent study suggests that malaria and poverty are intimately correlated: in 1995 SSA countries with intensive malaria had income levels only 33 percent of countries without malaria and grew 1.3 percent less per person per year with a loss in GDP of more than $100 billion in 25 years (1965–1990), equivalent on average to one-fourth the net official development assistance per year for SSA. A 10 percent reduction in malaria translated to 0.3 percent higher growth, and a suggested $1 billion spending on malaria control and management could generate short term benefits accruing to SSA economies ranging between $3 and 12 billion per year. These results are staggering, especially because targetable malaria through environmental health interventions (land use/shore management, infrastructure improvement, and behavioral change) could represent up to 40 to 50 percent of the total burden of malaria. Without reverting to simple extrapolations, especially regarding AIDS, it is interesting to note that malaria represents 22 percent of the environmental health BOD in SSA.
Box 3-2: Key, Confusing, and Misused Economic Terms on Environmental Health

Cost-benefit analysis (CBA). A normative technique that optimizes both the target and the means of a policy (macro and sectoral) choice, project, or intervention and is, therefore, more economically efficient than the cost-effectiveness technique. The general premise is well accepted, but becomes controversial when specific numbers are attached, for example, value of life, and so on.

Cost-effectiveness. A normative technique that, in the absence of proper valuation of the benefits (unreliable or controversial data, and so on), sets the target (for example, standard for a pollutant or number of DALYs, HeaLYs, or quality-adjusted life year) and determines the means of a policy choice, project, or intervention.

Disability-adjusted life year (DALY). A numéraire or a metric that measures the burden of disease and expresses years life lost to premature death and years lived with a disability of specified severity and duration. One DALY is one lost year of healthy life (see box 3-5).

Efficacy. Refers to the impact of a successful intervention when implemented in ideal circumstances, such as a scientific trial. Effectiveness, in contrast, refers to the impact under routine conditions, when implementation is imperfect.

Environmental health externalities. See Man-made environmental health problems.

Healthy life years (HeaLY). HeaLYs account for almost the same as DALYs, although within a slightly different theoretical framework. HeaLY could be applied to individuals or populations to determine the impact of a particular disease, determine the effects of interventions on populations and socioeconomic groups, or compare areas (see box 3-5).

Incidence. The fraction or proportion of a group initially free of the disease, who develop the disease within a given period of time (usually one year).

Intervention. A specific activity meant to reduce morbidity and/or mortality risks, treat illness, or palliate the consequences of disease and disability.

Man-made environmental health problems or environmental health externalities. The positive or negative effects of the action of a human agent (generator) on other human agents (affected parties), for which no organized market for this effect exists, for example, emission of pollutants or spread of disease that affects other individuals.

Prevalence. A fraction or proportion of a group possessing a disease at a given point in time, measured by a single examination or survey of a group (usually two weeks).

Quality adjusted life year (QALY). An outcome measure that expresses years life gained (opposite of DALYs) from an intervention, that is, the quantity and quality of the extra life in years provided by an intervention. It is the arithmetic product of the life expectancy and the quality of the remaining years. One QALY is one gained year of healthy life (see box 3-5).

Risk assessment. Provides a framework for quantifying the adverse environment-related health effects of a pollutant. Once a hazard has been identified, the researcher attempts to measure the extent to which people in a population are exposed to the hazard, and the impact of the exposure on health, which is measured in a dose-response function.

Value of life, value of statistical life, value of lives saved, and value of lives extended. All basically synonymous terms for measures that permit reductions in mortality risks to be monetized. It is, thus, not life itself that is valued, but a reduction in the probability of avoiding a given risk. Values for these terms are derived by dividing an estimate of the value (see WTP) for avoiding (or obtaining) a given change in the risk of death by the risk change.

Willingness to accept (WTA). In terms of health, WTA is the monetary value of compensation an individual is willing to accept, given a proven risk of illness, accident, or premature death. WTA is considered a benefit in a CBA. If an individual is not compensated, the WTA is considered a cost in a CBA.

Willingness to pay (WTP). In terms of health, WTP is the monetary value an individual is willing to pay or forgo to reduce the risk of illness, accident, and/or premature death. WTP is considered a cost in a CBA. In case of an intervention, the WTP is considered a benefit measure in a CBA.

Source: Authors’ data and, Harou and Doumani (1998).
• Health care delivery systems. Environmental health problems are preventive in nature through mainly targeted infrastructure interventions¹ and need to complement public health interventions (public health expenditures¹⁸ averaged $33 per capita in 1990–98; lows reached $3 in certain countries, such as Kenya). Yet, in the absence of adequate environmental health interventions (land use/shore management, infrastructure provision, and associated behavior change), environmental health-related problems (20-25 percent of health care spending) turn into public health problems by default and burden the health care delivery system. The possible average environmental health intervention efficiency ratio amounts to 2.3; in other words, each dollar spent toward an infrastructure intervention (water and sanitation, drainage, and so on), including education where environmental health considerations are taken into account, could also relieve the environmental health BOD and generate an average of $2.30 in social benefits for both the entire population, as well as the poorest of the poor (see tables 3-1 and 3-9). These infrastructure interventions can relieve environmental health risks in a cost-effective manner. The estimated associated costs of adding an environmental health component to projects could be derived as a proxy and range from 0.1¹⁹ to more than 10²⁰ percent, depending on the sector, geographic location, topography, ecological zone, and/or project.

The environmental health burden on the poor is a salient problem, and environmental health constitutes a potential entry point worth exploring to relieve the burden on the poor; this is in line with the Bank’s objective to reduce poverty. It calls, however, for mainstreaming environmental health concerns in Bank work or other developing institutions at all levels, that is, macro, sectoral, and, mainly, project, by improving the environmental impact assessment process, in which environmental health problems need to be duly considered (see chapter 6 on mainstreaming health concerns in the EA process). Environmental health is multisectoral in nature and needs to be harmonized with environment, health, and other sector’s interventions to identify problems, prioritize interventions, formulate policies, determine a cluster of interventions, and devise outcome-based monitoring systems across sectors. Comprehensive environmental health interventions, which call for cross-sectoral collaboration and partnerships, would not only prove cost-effective, have synergistic effects, and improve development outcomes, but, most important, would improve the well-being of the poor and increase IDA† efficiency.

Understanding Environmental Health Attributes

Understanding environmental health attributes can help establish the relationship between health effects on the one hand and ecological factors, man-made environmental problems, and human behavior-prone health problems on the other. Environmental health problems could also be attributed to civil strife and wars, but will not be covered in this section.¹ It is important to note that these attributes could vary according to ecological and geographic zones, as well as to urban compared with rural settings. Identifying environmental health attributes will help achieve outcome-based results through better (a) identification and quantification of problems and (b) prioritization and formulation of multisectoral cost-effective interventions and monitoring systems (see “Prioritizing” and “Monitoring” below).

¹ Infrastructure interventions include improved stove and associated behavior change in this chapter.
² IDA, the International Development Agency, is one of the five agencies that make up the World Bank Group, which consists of IDA, the International Bank for Reconstruction and Development (IBRD), the International Finance Corporation (IFC), the Multilateral Investment Guarantees Agency (MIGA), and the International Center for Settlement of Disputes. IDA lends to the poorest countries, i.e., per capita GNP less than $800. The credits are, in effect, interest free. All SSA countries except South Africa fall into the IDA lending category.
³ There is, however, a need to consider early on environmental assessment underscoring environmental health issues in Bank Post-Conflict Reconstruction programs whose aim are to easing the transition to sustainable peace and supporting socioeconomic development in conflict-affected countries. World Bank web site: Post-Conflict/Reconstruction, <wbln0018.worldbank.org/essd/essd.nsf/96144278b17f6ab1852567cf006967ef/c85899e7b0aa28418525682c0056f6bf?OpenDocument>.
In addition to civil strife and wars, environmental health problems can subsequently be attributed to three main factors that may sometimes be interrelated and even self-reinforcing:

- **Ecological factors including natural disasters:**

  Ecological factors, such as specific ecosystems can impact human health (for example, groundwater contamination by naturally occurring arsenic in Bangladesh, marshes or a natural lake, in which mosquitoes can breed, can spread vector-related diseases). This can be mitigated through better environmental management, as was the case in Italy in the 1930s, where proper land use/coastal shore management eradicated malaria. These interventions should, however, be complemented with traditional preventive measures in endemic areas (indoor and outdoor spraying, screens, impregnated bed nets, and prompt treatment, as appropriate). In the case of a lake, for example, introduction of larvivorous fish (tilapia or St. Peter’s fish from the Nile river) can help control mosquito breeding sites (lake shores and shallow areas as appropriate) and form the basis for aquaculture. This intervention, for example, in Lake Tanganyika, could target the rural poor, provide them with fishing opportunities/rights, and supplement their dietary intake with protein.

  Valuation of these ecology-related health impacts, applying the same valuation techniques used to value environment health externalities, can help justify development projects on economic (increased opportunities and livelihood), as well as on social (improved health) grounds, provided proper and satisfactory environmental, environmental health, and social assessments are initially conducted.

<table>
<thead>
<tr>
<th>Natural Disaster</th>
<th>People affected (millions)</th>
<th>People at Risk and Disaster Occurrence</th>
<th>Natural Disaster</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Drought</td>
<td>Famine</td>
</tr>
<tr>
<td>Death</td>
<td>239</td>
<td>6,087</td>
<td>6,423</td>
</tr>
<tr>
<td>Risk of communicable diseases</td>
<td>Potential risk following all major disasters, especially with lack of access to water and sanitation. During the period, 223 outbreak of epidemics (not necessarily associated with the above-mentioned natural disasters) occurred, 8.4 million people affected, and 59,736 people reported dead.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Natural disaster figures, especially for severe injuries, are extremely underreported in SSA; these figures are only meant to give an order of magnitude on reported natural disasters. “Other” includes earthquakes, extreme temperatures, insect infestations, landslides, volcanoes, and wildfires. “Epidemic” includes anthrax, arbovirus (e.g., ebola and west Nile), diarrhea (e.g., cholera), malaria, measles, meningitis, plague, rabies, rickettsia, and outbreak of unknown origin.

Year 2000 data until October.

**Source:** Catholic University of Louvain, Louvain, Belgium, EM-DAT: The OFDA/CRED International Disaster Database, web site: <www.cred.be/>.

Natural disasters, such as droughts, famines due to natural causes, flooding, torrential rains, and so on could be caused or accentuated, in some cases, by global externalities. Climate change, for example, accentuated the effects of El Niño and La Niña. Natural disasters are placing increasing economic and social costs on developed and developing countries. In SSA, almost 1 out 6 Africans was affected by reported natural disasters over the 1990-2000 period (see tables 3-2 and 8-2). WHO, for example, estimates that up to a third of the people who die of malaria every year in SSA are from countries affected not only by serious natural disasters, but also by wars and civil strife. Prevention and mitigation measures and improved emergency responses to reduce the vulnerability of the population at risk, especially SSA’s population, are being pursued at the Bank’s Disaster Management Facility (DMF). The DMF tries to prevent and mitigate the damage to physical assets. Anticipating environmental health
risks emerging after a disaster, especially because vulnerable groups are generally the most affected by natural disaster, could enhance the DMF emergency response by adapting the Rapid Environmental Health Assessment Checklists (see annex A). A checklist could be integrated into the DMF Rapid Response for Recovery Planning, especially regarding knowledge of vulnerability to risk aspects that is included in the DMF guidance on damage and needs assessments.

- **Man-made environment-related health problems or environmental health externalities.** The latter, which are not explicitly recognized per se in development work, are defined as a spill-over of benefits or losses from one or several individual(s) to another, for example, water pollution causing water-related diseases, stagnant water due to clogged drains that spread vector-related diseases, and so on. Environmental externalities are usually dis-aggregated cross-sectorally by resource degradation and environmental problems. In contrast and excepting diarrheal (water-related) diseases, respiratory-related diseases (from air pollution), and another few diseases, environment health externalities, when identified, are generally ascribed to “public health,” “health,” or even occupational issues and are rarely dis-aggregated in terms of specific diseases and injuries (environmental and natural resource problems are integrated in each sector in table 3-3 below).

- **Human behavior-prone diseases and injuries,** such as women who are cooking and inhaling fumes from indoor sources of pollution (from use of stoves, cooking oils, and heating fuels), driver habits (self-inflicted injuries due to car accidents), improper hygiene practices or sexual mores, among others, need to be identified through household surveys, social assessments, or other studies, and addressed through appropriate awareness and education campaigns and better regulation and enforcement measures.

### Table 3-3: Environmental Health Externalities Usually Neglected in Valuation

<table>
<thead>
<tr>
<th>Sector or Subsector</th>
<th>Selected Negative Externalities</th>
<th>Environmental Health: Typically Aggregated as “Public Health” or “Health”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agriculture, Rural Development and Natural Resource Management</strong></td>
<td>Slash and burn; salinization; land degradation; land erosion; productivity loss; resource depletion; deforestation; runoff; depletion of carbon sink; biodiversity loss; watershed pollution; aquifer pollution; waste water reuse; coastal and marine pollution; and, resettlement and migration</td>
<td>Respiratory, eye, and circulatory system diseases (slash and burn and food-smoking); food chain contamination and food poisoning, including from lead (flour from traditional millstones reinforced with lead joints); vector-related diseases (VRD); arsenic and nitrate poisoning; possible cases of cancer from pesticides, and reproduction disorders; and spread of AIDS (seasonal, construction and O&amp;M workers and so on)</td>
</tr>
<tr>
<td><strong>Transportation (All modes)</strong></td>
<td>Air pollution from various pollutants; ozone layer damage; noise and odor pollution; deforestation; coastal and marine and river pollution; and resettlement</td>
<td>Respiratory, eye, and circulatory system diseases; VRD; transport injuries; physical and mental stress; lower IQ in children (from lead in fuel); food chain contamination (for example, fish from coastal pollution), including food poisoning; possible cases of cancer due to chemical interactions in air; spread of infectious diseases (globalization and trade); and AIDS (truckers and workers)</td>
</tr>
<tr>
<td><strong>Water Supply</strong></td>
<td>Refuse; salinization; resource depletion; land and water pollution; and, coastal and marine pollution</td>
<td>VRD; diarrheal, and other infectious diseases, including cholera and typhoid; physical stress (water carrying); food chain contamination, including food poisoning; arsenic and nitrate poisoning; lower IQ in children (from lead); and spread of AIDS (construction and O&amp;M workers)</td>
</tr>
<tr>
<td>Sector or Subsector</td>
<td>Selected Negative Externalities</td>
<td>Environmental Health: Typically Aggregated as “Public Health” or “Health”</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Sanitation</strong></td>
<td>Refuse; aquifer pollution; land and water pollution; and, coastal and marine pollution</td>
<td>VRD; diarrheal, and other infectious diseases, including cholera, typhoid and plague; food chain contamination, including food poisoning; and spread of AIDS (same as above)</td>
</tr>
<tr>
<td><strong>Drainage</strong></td>
<td>Refuse; aquifer pollution; watershed and surface water pollution; land and water pollution; and, coastal and marine pollution</td>
<td>VRD; diarrheal, and other infectious diseases including cholera and plague; food chain contamination, including food poisoning; and spread of AIDS (same as above)</td>
</tr>
<tr>
<td><strong>Solid, Hazardous and Medical Waste</strong></td>
<td>Air pollution; watershed and surface water pollution; aquifer pollution; land pollution; coastal and marine pollution; noise and odor pollution; and resettlement</td>
<td>VRD; AIDS, and other infectious diseases (infected syringes), including plague and so on; respiratory, eye, and circulatory system diseases; food chain contamination, including food poisoning; and mental stress</td>
</tr>
<tr>
<td><strong>Housing</strong></td>
<td>Air pollution (could include second-hand smoke, which is not considered as environmental externalities)</td>
<td>Respiratory, eye, and circulatory system diseases, including TB; VRD (water tanks, containers, indoor plants, and so on); diarrheal and other infectious diseases, including cholera and typhoid; lower IQ in children (from lead-based paints); and spread of AIDS (construction and O&amp;M workers)</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td>Air pollution from various pollutants, including greenhouse gases; ozone layer damage; watershed pollution; coastal and marine pollution; deforestation; biodiversity loss; resettlement; resource depletion; depletion of carbon sink; and, noise and odor pollution</td>
<td>Respiratory, eye, and circulatory system diseases; VRD (dams); diarrheal, and other infectious diseases; lower IQ for children (lead); physical (fuel-wood) and mental stress; food chain contamination including food and arsenic poisoning; possible cases of leukemia in children (transformers and transmission lines); possible cases of skin cancer and cancer due to chemical interaction in air; and spread of AIDS (same as above)</td>
</tr>
<tr>
<td><strong>Industry</strong></td>
<td>Air pollution from various pollutants, including greenhouse gases; ozone layer damage; watershed pollution; land pollution; aquifer pollution; coastal and marine pollution; and, noise and odor pollution</td>
<td>Respiratory, eye, and circulatory system diseases; VRD; diarrheal, and other infectious diseases; lower IQ for children (from lead); physical and mental stress; food chain contamination, including food and arsenic poisoning; mental stress; possible cases of skin cancer and cancer due to chemical interactions in air; and spread of AIDS (workers)</td>
</tr>
<tr>
<td><strong>Mining</strong></td>
<td>Land pollution and erosion; air pollution from various pollutants; ozone layer damage; watershed pollution; aquifer pollution; coastal and marine pollution; resource depletion; noise and odor pollution; and resettlement</td>
<td>Respiratory, eye, and circulatory system diseases; food chain contamination, including food poisoning; infectious diseases; VRD; mental stress; possible cases of skin cancer and cancer due to chemical interactions in air; and spread of AIDS (workers)</td>
</tr>
</tbody>
</table>

*Note:* Environment and natural resources are integrated in each sector. VRD are transmitted through mosquitoes (i.e., anopheles [malaria and filariasis], aedes [yellow fever, filariasis, dengue, and Rift Valley Fever]; and culex [filariasis]), and other vectors (i.e., snails [schistosomiasis], rodents [leptospirosis], water flea [guinea worm], and blackfly [onchocerciasis]. For more details on exposures and effects, see tables 7-2 through 7-9.

*Source:* Authors’ data.

### Harmonizing Environmental Health with Environment Policies, Law, Institutions, and Monitoring Systems

Generally, policy, institutional, and market failures are attributed to, respectively, government’s distortionary interventions, unclear “sets of rules,” and lack of interventions, which cause or ex-
acerbate environment and environmental health problems. Regarding environmental health externalities, these failures result in the conjunction of inappropriate prices needing correction and inadequate institutional setup needing adjustment, if resources to be allocated optimally throughout the economy. Prices corrected for various types of failures and appropriate institutional reforms targeting the environment and environmental health constitute, in certain cases, a “win-win” situation, because price adjustments and subsidy removal (although not in all cases, as shown in table 3-3) and/or institutional reforms benefit both the environment and environmental health. Some environmental interventions alone, however, can lead to partial environmental health solutions. A World Bank initiative, for example, in conjunction with other partners and consisting of elimination of lead from fuel worldwide, proved a success. It overshadowed, however, the need to look comprehensively at the lead problem, identify the most important sources of lead, and prioritize cost-effective interventions (see table 7-4). Lead concentration in blood usually negatively affect children by lowering IQ and the elderly by causing pulmonary problems. Interventions targeting other sources of lead, such as water pipes made of lead, eye cosmetics (kohl in the Middle East or surma in Latin America), glazed pottery, lead-based paint, food chain contamination (in India, in wheat ground by millstones reinforced with lead joints), and so on could be as or even more cost-effective than eliminating leaded fuel, especially in most SSA countries where the number of automobiles per capita is low (two vehicles for every 100 persons in 1996 and no recent statistics available for two-stroke engines in SSA). Some vehicular emission “hot spots,” however, exist and need to be addressed along with other lead sources, especially in Lagos in Nigeria and Cape Town and Johannesburg in South Africa, where the population density per vehicle is higher than the SSA average.

**Policy Failures**

Policy failures are due to poorly designed macroeconomic and sectoral policies that do not properly gauge the economic benefits and costs of these policies and compare them to their economic and social benefits and costs. Imperfect government interventions may exacerbate market distortions and lead to further environmental and environmental health problems. For instance, a devaluation of the local currency could lead to increased logging, deforestation, and use of cheap fuel wood in the absence of clear property rights and socially optimal stumpage fees (fees charged to logging companies); hence, the social cost is not internalized in the private cost. The resulting effects stemming from poor environment management can lead, among others, to an increased incidence of VRDs (vector breeding increases due to stagnant water), respiratory diseases from indoor pollution (from use of fuel wood), and land erosion leading to landslides causing injuries, death, and/or homelessness.

Thirty-four African countries prepared national environmental action plans (NEAPs) between the late 1980s and 2000, which were intended as a tool for integrating environmental concerns into national development, namely, at the macro and sectoral levels. Although, several NEAPs acknowledged health concerns (see table 6-6), environmental health concerns were rarely internalized in the development strategies in most countries. Furthermore, regarding the NEAP experience, the Bank introduced a new optional procedure, the environmental action plan (EAP), which is a comprehensive and participatory national environmental policy backed by programs to

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**In this specific case, policies are not confined to policy failures and could, for example, include: land use/shore management policies to mitigate ecological problems with environmental health effects; and behavior change policies.**

**Along with all other IDA countries, in response to a requirement set out for IDA 10 financing. Four additional NEAPs are under preparation in 2000.**

World Bank Operational Policy and Bank Procedures 4.02, February 2000. The EAP, which is not compulsory, describes a country’s major environmental concerns, identifies the principal causes of problems, and formulates policies and actions to deal with the problems.
implement the policy. Countries are encouraged to prepare and implement an appropriate EAP and revise it periodically, as needed. A CAS and structural lending program could include part or all of an EAP (see below).

A number of methods or tools, developed to establish the linkages between macro and sectoral policies and the environment, are adapted or enhanced below to include the environmental health dimension. Numerous tools exist; however, the main avenue by which EAPs are intended to integrate environment into national development (and possibly identify environmental health problems) is through the CAS, which is adapted below to include the environmental health dimension. In addition to the CAS, selected conventional and emerging avenues to link environment and environmental health to macroeconomics and other building blocks of sustainable development targeting the poor, are being considered:

- Structural and sectoral adjustment lending: macroeconomic matrix
- Structural and sectoral adjustment lending and strategic environmental assessment: action impact matrix
- Public expenditures review
- Country assistance strategy environmental analysis matrix
- Comprehensive development framework matrix
- Poverty reduction strategy paper
- Intermediation mechanisms, for example, community-driven development.

These tools could be self-standing or complementary, which could, therefore, constitute an integrated process to help mainstream environmental health, not only in EAPs, but also at the macro and sectoral levels. Environmental health could also be canvassed onto many initiatives, programs, funds and facilities which is covered in chapter 2 (see Box 1-2 for options to mainstream environmental health concerns in Bank work and development or enhancement of tools). Some conceptual and practical concerns could, however, emerge on how all these tools could fit together (see below). At the project level, mainstreaming environmental health in the environmental assessment process, which needs to be revisited to increase environmental health outcomes, is covered in chapters 4–7.

**Structural and Sectoral Adjustment Lending: Macroeconomic Matrix**

Macroeconomic policies, which include stabilization or structural adjustment programs, tend to reduce the composition and level of aggregate demand through a combination of monetary, fiscal, and exchange rate policies that could affect the environment and environmental health. Sectoral policies complement macroeconomic work and determine the effects of general policy variables at the sectoral and project levels. Table 3-3 lists several policy variables, which are not covered in depth and could negatively impact environmental health.

The World Bank did not require identification of linkages between the various reforms in adjustment lending and the environment until March 1999. Although the macroeconomic matrix is not compulsory in Bank work, it helps establish linkages among macroeconomics, the environment, and environment-related health problems (see table 3-4), where policy variables and their environmental and environmental health impacts are linked together. The macroeconomic matrix could prove essential when structural or sectoral adjustment loans are being considered (see table 3-4, which shows the impact of macro policies on the environment and environmental health).

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* Since 1995, a new structural lending, Higher Impact Adjustment Lending (HIAL), was introduced in the Africa Region. HIAL include more poverty-focussed operations.
† The effects of globalization on environmental health are not covered in this section and require new research and analytical work.
‡ Environmental provisions are set out in the World Bank’s Adjustment Lending Policy, OP/BP 8.60.
### Table 3-4: Macro Policies Impact on Environment and Environmental Health

<table>
<thead>
<tr>
<th>Macro Policies</th>
<th>Intervention Instrument</th>
<th>Short- and Long-Term Selected Environmental Impact</th>
<th>Short- and Long-Term Selected Environmental Health Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fiscal</strong></td>
<td>Govt. Exp.</td>
<td><em>Sectors:</em> public infrastructure (e.g., roads and drainage), environmental management, and so on&lt;br&gt;<em>Programs:</em> drought relief, food aid, agricultural extension, and so on</td>
<td>Malnutrition could accentuate other health risks, especially for children under 5 (mainly diarrhea, measles, acute lower respiratory infections, and malaria), increased VRDs, diarrhea, physical and mental stress, and so on</td>
</tr>
<tr>
<td><strong>Taxes</strong></td>
<td></td>
<td>Reduction of demand for resources and environmental charges</td>
<td>Optimized use of resources could have positive (less industrial pollution) or negative (substitution to fuel woods) impacts on respiratory diseases, depending on income groups</td>
</tr>
<tr>
<td><strong>Subsidies</strong></td>
<td></td>
<td><em>Input:</em> machinery, fertilizers, pesticides, irrigation water, energy, and credit&lt;br&gt;<em>Output:</em> depends on crop characteristics, mining, and industrial park</td>
<td>Reduced contamination of the food chain; respiratory diseases for low-income groups, due to substitution to more polluting heating and cooking fuels; improved nutrition or nutrition deficiency, depending on income groups; increase in VRDs (burrow pits from mining) and respiratory diseases (higher cost of production and possibly less maintenance).</td>
</tr>
<tr>
<td><strong>Monetary</strong></td>
<td>Credit</td>
<td>Reduced credit for inputs, for example, fertilizers and pesticides, and investments, for example, leveling, irrigation, machinery, and so on</td>
<td>Contamination of the food chain and reduced industrial maintenance resulting in increased respiratory diseases</td>
</tr>
<tr>
<td><strong>Interest Rate</strong></td>
<td></td>
<td>Reduced investment, and resource and energy demand.</td>
<td>Contamination of the food chain and increased (due to reduced industrial maintenance) or decreased (due to reduced fuel consumption) respiratory diseases.</td>
</tr>
<tr>
<td><strong>Price Control</strong></td>
<td></td>
<td><em>Rise in official prices:</em> impact on output responses depends on crop and farming practices.&lt;br&gt;<em>Fall in official prices:</em> reverses the effect</td>
<td>Malnutrition</td>
</tr>
<tr>
<td><strong>Exchange Rate</strong></td>
<td>Devaluation or Depreciation</td>
<td><em>Import effect:</em> increases price of imported inputs, for example, fertilizers, pesticides, raw materials, and energy.&lt;br&gt;<em>Export effect:</em> increased export crops depends on crop characteristics and farming practices; increased export of minerals, wood, and goods; and increased foreign direct investment, polluting industries, second-hand vehicles, ecotourism, and so on</td>
<td>Food chain contamination and respiratory diseases and VRDs due to deforestation; respiratory diseases due to relocation of polluting industries and import of second-hand vehicles from countries with more stringent emission standards; and sexually transmitted diseases, including AIDS by tourists and infectious diseases</td>
</tr>
<tr>
<td><strong>Trade</strong></td>
<td>Import/Export Taxes</td>
<td><em>Removal of protectionist taxes:</em> same effects as devaluation, but on selected commodities</td>
<td>Same effects as devaluation</td>
</tr>
<tr>
<td><strong>Trade Controls</strong></td>
<td></td>
<td>Same effects as trade taxes; technological lock in.</td>
<td>Respiratory and infectious diseases</td>
</tr>
<tr>
<td><strong>Institut. Reform</strong></td>
<td>Land</td>
<td>Encourage farm investments and long-term sustainable resource management</td>
<td>Malnutrition, VRDs, and contamination of the food chain (pesticides)</td>
</tr>
<tr>
<td>Macro Policies</td>
<td>Intervention Instrument</td>
<td>Short- and Long-Term Selected Environmental Impact</td>
<td>Short- and Long-Term Selected Environmental Health Impact</td>
</tr>
<tr>
<td>---------------</td>
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</tr>
<tr>
<td>Financial</td>
<td>Improved credit mobilization may benefit rural farmers</td>
<td>Malnutrition, VRDs, and contamination of the food chain (pesticides)</td>
<td></td>
</tr>
<tr>
<td>Privatization</td>
<td>Increased efficiency depends on regulation, monitoring, and enforcement</td>
<td>Privatized provision usually misses the poorest of the poor: VRDs (stagnant water), diarrhea (water quality), respiratory diseases, and spread of AIDS through work crews</td>
<td></td>
</tr>
<tr>
<td>Research and Extension</td>
<td>Improved extension services promoting sustainable resource management</td>
<td>Malnutrition, VRDs, and contamination of the food chain (pesticides)</td>
<td></td>
</tr>
<tr>
<td>Invest. Policy</td>
<td>Training</td>
<td>Investment in human capital: agricultural extension, wildlife, resource management, and vocational training</td>
<td>Occupational hazards</td>
</tr>
<tr>
<td></td>
<td>Valuation</td>
<td>Project evaluation to include environmental cost and benefits</td>
<td>Project evaluation to include environmental health cost and benefits</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>Industrial abatement technologies, adapted agricultural technologies, and mining practices</td>
<td>Respiratory diseases, nutrition, and VRDs</td>
</tr>
<tr>
<td></td>
<td>Public Infrastructure</td>
<td>increased access to natural resources, and encouraged exploitation; supporting infrastructure for producers enabling greater price responsiveness</td>
<td>Malnutrition, VRDs (deforestation and roads), and spread of AIDS through work crews, truckers, and so on</td>
</tr>
</tbody>
</table>

Source: Adapted from Reed (1996) and Harou and Doumani (1998).

Structural and Sectoral Adjustment Lending and Strategic Environmental Assessment: Action Impact Matrix

The Action Impact Matrix (AIM) is not required by Bank rules and procedures, but it helps establish the links among macroeconomic policies, poverty, the environment, and environment-related health problems that were added to the matrix. The AIM, which also can be used in the context of structural or sectoral adjustment loans, is a tool for policy analysis and coordination of sectoral interventions. It helps identify important problems and links among sectors and policy decisions and environmental outcomes. Introducing the environmental health dimension by establishing the linkages with macroeconomic, sectoral, and environmental policies may help achieve sustainable development goals in an integrated manner, with a special focus on the poor (for example, table 3-5 links and articulates various activities). A strategic environmental assessment, which is an environmental assessment performed at the macro, sectoral, and regional levels, is suggested to assess environmental and environmental health implications of a policy change on the poor, where its results can be integrated into the AIM.
### Table 3-5: Example of an Action Impact Matrix (AIM)

<table>
<thead>
<tr>
<th>Concern/ Policy</th>
<th>Main Objective</th>
<th>Selected Impacts On Key Sustainable Development Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Macroeconomic and sectoral policies</td>
<td>Macroeconomic and sectoral improvements</td>
<td>Land Degradation</td>
</tr>
<tr>
<td>a. Exchange rate</td>
<td>Improve trade balance and economic growth</td>
<td>Positive impacts due to removal of distortions</td>
</tr>
<tr>
<td>b. Energy pricing</td>
<td>Improve economic and energy use efficiency</td>
<td>Negative impacts mainly due to remaining constraints</td>
</tr>
<tr>
<td>2. Complementary measures</td>
<td>Specific and local social and environmental gains</td>
<td>Enhance positive impacts and mitigate negative impacts (above) of broader macroeconomic and sectoral policies</td>
</tr>
<tr>
<td>a. Market based</td>
<td>Reverse negative impacts of market failures, policy distortions, and institutional constraints</td>
<td>(+M) (Pollution tax)</td>
</tr>
<tr>
<td>b. Nonmarket based</td>
<td></td>
<td>(+H) (Property rights)</td>
</tr>
<tr>
<td>3. Investment projects</td>
<td>Improve efficiency of Investments</td>
<td>Investment decision made more consistent with broader policy and institutional framework</td>
</tr>
<tr>
<td>a. Project 1 (hydro dam)</td>
<td>Use of project evaluation (cost benefit analysis, environmental assessment, multicriteria analysis, and so on)</td>
<td>(-H) (Inundate forests)</td>
</tr>
<tr>
<td>b. Project 2 (reafforest and relocate)</td>
<td></td>
<td>(+H) (Reforestation)</td>
</tr>
<tr>
<td>c. Project N</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: A few examples of typical policies and projects as well as key environmental and social issues are shown. Some illustrative, but qualitative impact assessments are also indicated: thus, “+” and “-” signify beneficial and harmful impacts, whereas “H” and “M” indicate high and moderate intensity. These qualitative scores are, however, site specific and could differ from region to region. The improved AIM process helps to focus on the highest priority environmental and environmental health issues and related social concerns. Source: Adapted from Munasinghe (1993), pp. 16–19.*

Such a strategic environmental assessment could be envisaged by using the AIM to target new sectoral tools that are gaining momentum at the Bank and could become full-fledged instruments, for which environmental health need to be considered. Given the global trend of city growth, two initiatives that emanate from the Bank urban strategy could be considered complementary and would require identification of environment and environmental health concerns and their impact on poverty at their onset; these are: *City Development Strategy* and the *Cities without Slums* initiative, whose objective is to address the challenge of urban poverty by upgrading slums.

**Public Expenditures Review**

Budgetary processes may vary across countries and a public expenditures review (PER), which is not a compulsory Bank tool, is perhaps the only mechanism for a systematic (and often compre-
hensive) analysis of public sector issues. Macroeconomic imbalances underscore the need to cut spending and deficits. Governments, which strive for balanced budgets through deficit reduction packages, are required to adopt stringent fiscal and monetary policies. These policies entailed difficult choices in terms of both spending and allocating scarce resources. To bring about the linkages existing between investments, the macroeconomic and institutional constraints, and the available resources, a framework for evaluating the level and composition of public expenditures can be applied to analyzing broad allocations within and across sectors. Mainstreaming environment and environment health at the macro level could target PERs, for which (a) direct government expenditures are allocated for environmental protection and environmental health prevention, (b) extra budgetary revenues and expenditures channeled through environment or social funds could be earmarked to mitigate environmental health externalities, (c) a recalibration of subsidies, tax relief, and taxes could correct or aggravate environmental and environmental health externalities, (d) the introduction of green taxes could mitigate both environment and environmental health concerns, and (e) multisectoral collaboration and partnerships could be fostered to create adequate opportunities to raise issues and influence allocations.

Country Assistance Strategy Environmental Analysis Matrix

The CAS is the central vehicle for the Bank’s assistance strategy for all its IDA and IBRD borrowers. The CAS document, which is prepared with the government in a participatory way: (a) describes the Bank strategy based on an assessment of priorities in the country and (b) indicates the level and composition of assistance to be provided based on the strategy and the country’s portfolio performance. The Country Assistance Strategy Environmental Analysis Matrix (CASE), which was developed to integrate environmental concerns primarily in EAPs that feed into the CAS, could be adapted to integrate the environmental health dimensions as well. This modified tool could build on the Macroeconomic Matrix, the adapted AIM, and PER to relate environmental impacts with environmental health impacts (see tables 3-6 and 3-7, which link the general context of a country, including the driving force, policy response, and projects, with environment, natural resources, and environmental health).

The purpose of this framework is to provide a more structured and organized approach to environment and environmental health in CASs, in the belief that mainstreaming environmental and environmental health issues can lead to improved development outcomes. Environment and environmental health, for example, appear as a cross-sectoral theme, including integration into CAS sections on the economy, poverty, urban and rural issues, and so on. Environment and environmental health, featured in the CAS process, include the participatory processes and targeted collaboration among line agencies, NGOs, CBOs, the private sector, and the community. Lending or nonlending programs related to the environment and environmental health to be included in the CAS include specific projects, economic and sector work, technical assistance, various components distributed among several projects or other programs, such as energy, infrastructure, and macroeconomic reforms. Performance indicators for projects, programs, and components can be specified and tracked.
Table 3-6: CAS Environmental and Environmental Health Analysis Matrix

<table>
<thead>
<tr>
<th>Context, Driving Force, Policy Response, and Projects</th>
<th>Environment and Environmental Health Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Natural resources and land use management(^a)</td>
</tr>
<tr>
<td></td>
<td>Water resources(^a), coastal zone and watershed management(^a)</td>
</tr>
<tr>
<td></td>
<td>Airshed management (indoor and outdoor pollution)</td>
</tr>
<tr>
<td></td>
<td>Global: climate change and biodiversity</td>
</tr>
<tr>
<td></td>
<td>Other, for example, cultural, other sectoral EH (injuries, and so on)</td>
</tr>
<tr>
<td>Current issues: local, regional, and global</td>
<td>(E^b) (EH^b) (E^b) (EH^b) (E^b) (EH^b) (E^b) (EH^b)</td>
</tr>
<tr>
<td>Driving force, e.g., population growth, migration, and concentration; and poverty and inequality</td>
<td>(E^b) (EH^b) (E^b) (EH^b) (E^b) (EH^b) (E^b) (EH^b)</td>
</tr>
<tr>
<td>Macro policies: impacts</td>
<td>(E^b) (EH^b) (E^b) (EH^b) (E^b) (EH^b) (E^b) (EH^b)</td>
</tr>
<tr>
<td>Sector policies: impacts</td>
<td>(E^b) (EH^b) (E^b) (EH^b) (E^b) (EH^b) (E^b) (EH^b)</td>
</tr>
<tr>
<td>Projects, programs, components: impacts</td>
<td>(E^b) (EH^b) (E^b) (EH^b) (E^b) (EH^b) (E^b) (EH^b)</td>
</tr>
<tr>
<td>Environment, resource, institutional, and budgeting issues</td>
<td>(E^b) (EH^b) (E^b) (EH^b) (E^b) (EH^b) (E^b) (EH^b)</td>
</tr>
<tr>
<td>Environment health, institutional, and budgeting issues</td>
<td>(E^b) (EH^b) (E^b) (EH^b) (E^b) (EH^b) (E^b) (EH^b)</td>
</tr>
</tbody>
</table>

\(^a\) From extraction/withdrawal to disposal as appropriate.
\(^b\) Representative environmental (E) and environmental health (EH) issues.

Source: Adapted from World Bank (2000c).

Table 3-7: CAS Country Program Matrix

<table>
<thead>
<tr>
<th>Development Objectives/Diagnosis of Problems</th>
<th>Bank Group Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategy/Actions</td>
<td>NLS</td>
</tr>
<tr>
<td>Lending/Financing</td>
<td>Other Donor Instruments</td>
</tr>
<tr>
<td>Progress Indicators</td>
<td></td>
</tr>
</tbody>
</table>

Other sectors

Environment and natural resources

Environmental health

Source: Adapted from World Bank (2000c).

Comprehensive Development Framework Matrix

Structural adjustment or stabilization programs usually focus on reducing aggregate demand while relaxing supply-side constraints. These programs are intended to increase output from existing capacity by prescribing a greater role for prices, markets, and the private sector in the development process. In recent years, such policies have been criticized on the grounds that the burden of adjustment has often fallen on vulnerable groups and on the environment. The World Bank Comprehensive Development Framework (CDF), which is being piloted in twelve countries, is intended to address these policy failures and reach a better balance in policymaking by underscoring the interdependence and inclusion of all elements of sustainable development and poverty reduction, that is, social, structural, human, governance, environmental, economic, and financial. The CDF seeks to address the fundamental long-term issues of the structure, scope, and substance of societal development through close collaboration and participation of donors, the public sector, civil society, and the private sector. Poverty reduction is the main objective of the CDF, and it cuts across the CDF matrix, which includes structural elements where specific strategies relate to a sector or cross-sectoral issues, that is, vertically in the matrix. The development outcome of environmental concerns and their links to poverty, which are already addressed in ongoing CDF pilots, could be enhanced by introducing the environmental health dimension.
which should possibly cut across sectors together with environmental concerns, and be reflected “horizontally” in the CDF matrix.

Poverty Reduction Strategy, Environmental Health, and Poverty Linkages

Unlike extensive literature on the effects of macroeconomic policies on the poor, the exact impact of these policies on the environment and environment-related health problems remains difficult to generalize and depends on specific factors concerning each country’s institutions, existing policies (environmental policies, regulatory agencies, judicial system, and law enforcement), health standards, market organizations, and factor endowments. Still, clarifying the linkages among environmental degradation, other externalities, environmental health, and the poor could be challenging. The literature on poverty and the environment, however, offers several theories about different linkages without considering the environmental health variable as an important actual and causal factor. A new effort could help shed some light on all these linkages thanks to a new instrument in line with the Bank mission, poverty reduction strategies, as well known as poverty reduction strategy papers (PRSPs). PRSPs link poverty reduction to the Heavily Indebted Poor Countries (HIPC) Initiative and are the basis for World Bank and International Monetary Fund (IMF) debt relief (HIPC) and concessional assistance (IDA and Poverty Reduction Growth Facility, formerly IMF's Extended Structural Adjustment Facility).

PRSPs, which heavily indebted countries with good track records are preparing, will eventually be prepared by all IDA countries with the participation of local stakeholders, including the poor. In brief, PRSPs are prepared by national governments and result from a participatory process, lead to better and integrated country strategies, allow sector strategies to be seen through the lens of poverty reduction, and have a long-term perspective. PRSPs are meant to transform the principles underlying the CDF into a plan of action for poor countries. Although certain conceptual and practical links between the “over-elaborated” CDF and the PRSP remain to be clarified, PRSPs embody the key principles of (a) the CDF, including comprehensive and long-term country ownership, coordinated with partners and addressing the burden on the poor through outcome-based interventions across sectors and (b) the 2001 World Development Report on poverty’s building blocks, that is, empowerment, vulnerability, security, and opportunity. Although no blueprint exists for a PRSP, a simple approach has been recommended based on core elements that are likely to be common to all strategies (diagnosing obstacles to poverty reduction and growth, setting objectives and formulating policies, monitoring, managing external assistance, and accounting for the participatory process). A PRSP “toolkit” was prepared including contributions from all Bank sectors and cross-cutting themes to guide World Bank staff and their country counterparts in the development of PRSPs. Also, Poverty Reduction Strategy Credits are being developed and will become a fast disbursing lending instrument to implement PRSPs. Although the track record of the PRSP process is too short to really lend itself to serious analysis, it constitutes an entry point to target environmental health multisectorally at its onset. Those to date have tended to emphasize social sectors, such as health and education, but an effort is being made to adopt an environmental health approach for the PRSP in Madagascar and other countries.

Intermediation Mechanisms: Community-Driven Development

Community-Driven Development (CDD), which has an SSA-enhanced version emphasizing decentralization and local capacity building called community action plans (CAPs), is not a Bank-compulsory instrument, but is an increasingly important intermediation mechanism or an enhanced social fund for channeling funds directly to community groups. The objective of CDD is

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* Seven out of the 12 CDF pilot countries are implementing both, the CDF and the PRSP and it would interesting to analyze, compare and contrast the processes to see how they fit together: Bolivia, Côte d’Ivoire, Ethiopia, Ghana, Kyrgyz Republic, Uganda and Vietnam. It is also worth mentioning that some countries have embarked upon developing their own CDF, e.g., Tanzania, and so on.
to empower and assist people on the ground to steer their own course of development by defining their own priorities, managing their own resources in collaboration with central and local governments. This creates new challenges and opportunities for mainstreaming environment and environmental health issues. Awareness raising and education are essential for people to understand fully the significance, impacts, and linkages of environmental and environmental health issues on their well-being, livelihoods, and development options; however, CDD offers a unique opportunity to provide targeted funds and incentives to encourage a cluster of efforts to upscale infrastructure (see “Prioritization” below) to maximize environmental health benefits.  

**Institutional Failures**

Institutional failures occur when formal and informal rules and practices that govern the behavior and actions of individuals are not obeyed. Unclear sets of rules, transaction costs (see ”Market Failures” below), overregulation or underregulation could often exacerbate policy and market failures. Environmental institutions set the rules of natural resource management, especially in terms of defining property rights to mitigate open-access externalities and insure law enforcement. They also have a regulatory role regarding environmental impacts, including pollution control, emission standards, permits, and so on. Environmental institutions, however, tend to address specific environment-related health problems without looking comprehensively at these problems or even collaborating with the health sector.

Unclaimed by practically any sector, environmental health is practically “institutionless” and fragmented across sectors and needs to be provided with a legitimate institutional setup to clarify the sets of rules that govern the behavior and actions of individuals. This institutional mandate could be jointly shared by environmental and health agencies with possibly one of them becoming the lead and coordinating agency. This requires a redefined and proper legislative and institutional framework to harmonize, coordinate, and implement environment and environmental health policies for better environmental health management.

**Legislative Framework**

Environmental law frameworks, which usually have a provision for a health code under pollution control, tend to contribute to the fragmentation of health issues outside the health care system. Environment-related health problems that are attributable to land use management (for example, contamination of the food chain), that are resource specific, such as deforestation or (man-made breeding sites for mosquitoes), or that involve, for example, traffic accidents or truckers and work crews (spread of AIDS) are usually not included in the health regulations that include emission standards and under the jurisdiction of the environment sector. A new or amended framework legislation (See box 3-3) should be conceived through a participatory process intended to implement clear environmental health policy goals and strategies. These goals and strategies need to be established in conjunction with existing environmental and health strategies and be in tune with the government’s overall strategy and policy goals.

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* Institution failure is not discussed in terms of institution deficiency that fails to act on behalf of future generations in order to insure the same intergenerational well-being. To address this failure, the implementation of a fund for future generations is usually envisaged.
Box 3-3: Example of Legislation Adapted for Environmental Health

The document could be designed as a model for revising existing legislation or adopting new legislation. The document includes general provisions including (a) designation of a lead agency responsible for overall policy formulation and harmonization, (b) the organizational system of environmental and environmental health safeguards, (c) right to information and public participation and consumer advocacy in protecting the environment and preventing environmental health problems, (d) distribution of responsibilities and coordination among different tiers of government and the civil society at large, and (e) enforcement including the development of and access to the judicial system and legal expertise.

Source: Authors’ data.

Institutional Framework

Institutions refer to the sets of rules by which an entity (agency, association, and so on) functions in order to coordinate activities within (vertically) and between (horizontally) organizations. Institutions have three layers: (a) operational (laws and regulations), (b) governance (who makes and applies the rules and how this is done), and (c) constitutional (rules that constrain rule making). The coordination mechanism, which is determined by the nature of the good (see market failures) and service, allows for provision of goods and services by the public sector (hierarchy) and/or the private sector (market) and/or stakeholders (collective action).

Institutional reforms are challenging, due to recognition of the problem, existing institutional arrangements and the need to create incentives for agents making decisions, rent/profit-seeking situations, the nature of the goods and services (see box 3-4) that generate environmental health externalities, and the need for a harmonized environment and environmental health strategies.

Box 3-4: Key, Confusing, and Misused Terms on Goods and Services

Public goods and services, such as clean air, are characterized by a lack of rivalry in consumption (does not affect the quantity to individuals) and nonexcludability (nobody is excluded from bad or good effects or quality) features.

Private goods and services, such as fertilizers, are highly rival and highly excludable.

Toll goods and services, such as electricity, could be used jointly, but could exclude nonpayers.

Common pool goods and services, such as ground water, are finite; therefore, it is difficult to exclude nonpayers from their consumption. Common pool goods can be coproduced, for example, rural water supply.


Harmonized environment and environmental health strategies: Harmonizing environment, environmental health, and other sectors’ strategies is not an easy task, but some general guiding principles exist that can help harmonization of the process. A strategy refers to a plan for change and should be based on some guiding principles. A first principle for a harmonized strategy would be to recognize that sustainable development is not a unidimensional concept and requires a multidisciplinary effort and commitment to reach a balance between economic development, environmental and environmental health concerns, and social issues. A second principle is to involve the public sector, the private sector, and stakeholders in determining and implementing the strategy. A third principle, prevention is better than cure, means that environmental health issues need to be quantified to set priorities and be integrated at the macro, sectoral, and project levels. These principles require an overall institutional assessment that will guide the development of the strategy. The institutional assessment can help determine a new multisectoral institutional setup and mandate. This will entail a workable collaborative framework among the public...
sector, private sector, and stakeholders at the national, regional, and community levels that could translate into better service delivery benefiting notably vulnerable groups. An institution (environment and/or health) needs to be designated (constitutional) for: (a) determining the institutional responsibilities for addressing the various causes of environmental health risks (ecological, man-made, human behavior prone risks); (b) valuing the effects and setting priorities; (c) coordinating activities across line agencies and forging partnerships; (d) resolving conflicts; (e) and designating an entity for law enforcement and regulation. Also, the newly designated institution(s) that will take the lead need(s) to (a) develop legislation and administrative structures providing needed skills, information flow, and coordination among centralized and decentralized organizations and services, (b) ensure appropriate budget procedures, and (c) ensure desirable outcomes in terms of efficiency, equity, sustainability, and accountability (governance).

A recent study suggests that, until 2000, at least twenty-four countries in SSA have come up with their own environmental rules and requirements regarding EAs and that participation and consultation in the EA process are being emphasized to insure better results and outcomes. Also, a process of harmonizing EAs across SSA is under way. The three ingredients (multidisciplinary commitment, participation and prevention) of a sound environmental strategy have, essentially, been successfully applied in half the countries of SSA and are well under way in the second half, which suggests that a strong commitment to enhance and adapt the environmental legislative framework could help internalize environmental health concerns in the existing framework, especially through a harmonized EA process across SSA.

**Market Failures**

In conventional economics, market failures are an afterthought. They are, however, necessary for environmental health economics, because market failures are the norm for pollution problems in terms of emission sources and exposure, that is, spatial and temporal issues play a pivotal role. Market failures occur when a market is not able to set an equilibrium price of a good or service that equals the social marginal value. The social marginal value is the value that internalizes all the recognized and quantified externalities, including those pertaining to environmental health; hence, to adjust market failures, governments need to formulate policies to compensate for distorted market price and external social values. Public goods, open access (property rights and unpriced assets), and intertemporal externalities that affect future generations are the most important externalities that generate market failures in terms of the environment. In the case of environmental health, externalities, transaction costs, and short-sightedness could constitute the three main aspects of market failures.

The consumption or production of any types of goods and services could generate environmental health externalities, because no organized market exists for these external effects. It is important to note that a public good, for example, is not defined by the nature of the supplier of the good (public sector, private firm, or NGO), but by the technical nature of the good. The number of watchers or listeners of an AIDS media campaign aired by a private television/radio network will neither affect the quality nor the quantity of the message. In other words, public goods and services could be provided by the private sector, for example, and vice versa, a private good could be provided by the public sector (sales of fertilizers). Depending on the nature of goods and services, an appropriate coordination mechanism needs to be determined to mitigate environmental health externalities (see *Institution Failures*). Three basic mechanisms exist to coordinate economic activities, and one or a combination of mechanisms could be used to mitigate environmental health externalities, that is, markets and creation of markets (market-based instruments, such the introduction of pollution charges or tradable pollution permits), hierarchy and hierarchical collaboration (multisectoral collaboration and regulation, such as the introduction of standards), and collective action (engaging the public, such as public participation in monitoring, pub-
lic-private-community partnerships, disclosing information, consultation, collaboration, and empowerment).

Environmental health externalities occur when a consumer or a producer affects other parties for which no organized market exists for these effects. All sorts of produced or consumed goods could entail environmental health externalities that generate market failures, for instance, (a) toll goods (a main sewerage system, if not properly operated and maintained, could spread vector-related and cause water-borne diseases), (b) public goods (ambient air, if polluted, could produce respiratory diseases and possibly cancer), (c) private goods (pesticides and fertilizers could be overused and contaminate the food chain and spread water-borne diseases through polluted aquifer and watershed), and (d) common pool goods (tertiary urban roads [slums], if poorly designed and maintained, could generate accident injuries or fatalities and spread vector-related diseases due to bad drainage especially in rainy seasons). A quantitative analysis of environmental health externalities would usually require that both parties, the generators and affected agents, be precisely identified and that these externalities be valued in monetary terms. These externalities could, however, be difficult to internalize if both parties are not properly identified and if the short- and long-term external health effects are not properly defined. This is due mainly to a lack of information that prevents a proper valuation of the short- and long-run effects in monetary terms.61

Transaction costs, which are costs incurred gathering information, may be high, in formal and informal negotiations and monitoring, regarding environmental health and prevent both generators and affected parties from beneficial environmental health exchanges, because the transaction costs exceed the trade of gain. Transaction costs could be reduced through a combined effort that should promote, encourage, and disseminate the results of epidemiological studies targeting environmental health externalities.62

Short-sightedness occurs when individuals and decisionmakers are not held accountable for the long-term impacts of their policies and actions. Policies and actions that have a short-term impact are complemented by high discount rates that outweigh the benefits that may be realized in the long run. Society, however, has a much longer time horizon and cannot discount future benefits in the same way as an individual might discount them. The prevalence of environmental health effects that could sometimes occur fifty years later and need to be identified and discounted to reflect social rates of time preference. The latter are generally below the private market rate and need to be adjusted to better gauge the benefit/cost of an environmental health policy addressing market failures.63

**Monitoring**

Proper policy response (see “Prioritization” below) needs to be monitored by selected indicators that need to be devised. Monitoring for sustainability at the macro, sectoral, and project levels is used to determine if progress is being made toward the goal of sustainability. It is different from traditional methods of monitoring policy and project process performance, progress, or impact. Sustainability monitoring is usually based on five interconnected core sustainability themes (financial, technical, institutional, social, and environmental) to which environmental health needs to be added either as a full-blown sixth theme or as a subset of the social and environmental themes. To monitor environmental health, simple and cost-effective indicators need to be devised based on key factors such as what (devising baseline data on health and environment and determining a good indicator varies with the institutional setup and the country capacity and should attempt to involve stakeholders), how (collecting data on indicators and feeding the data in an information system/GIS (see chapter 2 and Map 5-1) that will allow analysis and readjustment of the policy, project, or component calls for an appropriate institutional setup to achieve sustainability), and when (monitoring indicators, early warning monitoring indicators [e.g., plague], and
their frequency need to be devised at all stages of a policy or project component, that is, planning, implementation, and operation and maintenance). Given the country’s capacity, a national burden of disease (DALY) could be set up, but would be difficult to maintain. An easier tool would be to introduce health utilities based on QALYs (see box 3-2) as a tool to prioritize interventions based on cost-effectiveness and simpler outcome-based monitoring grounds.

Based on the country monitoring capacity, selection of key indicators could be prioritized to monitor the highest disease risks. To measure environmental health outcomes, a number of indicators, which must satisfy a number of criteria, are needed. No single set of environmental health issues exists, nor do issues exist in isolation; instead, they connect, overlap, and intersect. To avoid complications, the widely used DPSEEA (driving force, pressure, state, exposure, effects and action) could serve as a base to determine the needed outcome-based indicators. In SSA, the outcome-based monitoring system could be based on the following health problems: indoor/outdoor air pollution and housing and settlements; water, sanitation, and waste management; vector-borne disease; traffic and possibly all modes of transport injuries and death; pesticides; other toxins and radiation; and natural disasters (see table 3-8). STD/AIDS, which is not a driving force, but rather an effect, is not included, because it is generally monitored by the health care system. A complementary tool would be to develop a QALY monitoring system (see above) that will allow measuring gains from interventions by calculating the years remaining to an individual of a specified age.

Table 3-8: Example of Environmental Health Monitoring System Targeting Poverty

<table>
<thead>
<tr>
<th>Source of Cause Damage</th>
<th>Associated Public Action</th>
<th>Health Outcome Affected</th>
<th>Monitorable Health Indicators</th>
<th>Proxy Sector Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoor Air Pollution</td>
<td>Energy (cleaner fuels, improved stoves), and rural development</td>
<td>Mortality, chronic lung diseases (COPD), and acute respiratory infections (ARI)</td>
<td>Death (including for children under 5), symptom days, COPD, cases of ARI, and QALYs gained by intervention ($/QALY)</td>
<td>Number/share of households using clean fuels/improved stoves/type of housing</td>
</tr>
<tr>
<td>Outdoor Air Pollution</td>
<td>Energy/heat; transport</td>
<td>Mortality; COPD, ARI, Respiratory Hospital admissions (RHA); IQ impairment (lead)</td>
<td>Death (adult), Symptom days, COPD, cases of ARI, RHA, QALYs gained by intervention ($/QALY)</td>
<td>Annual mean level of PM$_{10}$; lead level in blood</td>
</tr>
<tr>
<td>Vector-borne Diseases</td>
<td>Irrigation; reforestation; infrastructure (drainage); health (vector control)</td>
<td>Malaria Mortality; Malaria morbidity</td>
<td>Death due to malaria; malaria cases; QALY gained by intervention ($/QALY)</td>
<td>Access to sanitation (percent of households, urban/rural); community coverage (percent of HHs on a community); Access to water (percent of households, percent of households with in-house connections, local, urban/rural); Distribution rate (days per month or quarter of provision of water); Cleaning</td>
</tr>
<tr>
<td>Lack of water, sanitation and hygiene education</td>
<td>WSS Infrastructure: provision and maintenance</td>
<td>Diarrhea mortality; diarrhea morbidity</td>
<td>Death due to diarrhea (including children); Diarrhea cases (including children); QALY gained by intervention ($/QALY)</td>
<td></td>
</tr>
<tr>
<td>Source of Cause Damage</td>
<td>Associated Public Action</td>
<td>Health Outcome Affected</td>
<td>Monitorable Health Indicators</td>
<td>Proxy Sector Indicators</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------</td>
<td>-------------------------</td>
<td>------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Death and injuries due to various modes of transport</td>
<td>Improved transport management: education, enforcement and insurance</td>
<td>Various injuries and death</td>
<td>Number of accidents, injuries and death; QALY gained by intervention ($/QALY)</td>
<td>rate of on-site sanitation (sample)</td>
</tr>
<tr>
<td>Pesticides Residues</td>
<td>Agriculture</td>
<td>Acute poisoning; cancers; Fetal defects</td>
<td>Cases of acute poisoning; Cases of cancer; Spontaneous abortions; QALY gained by intervention ($/QALY)</td>
<td>Application norms; storage and handling practices</td>
</tr>
<tr>
<td>Other Toxic Substances</td>
<td>Industrial pollution control</td>
<td>Cancers; IQ impairment (lead)</td>
<td>Cases of cancer; QALY gained by intervention ($/QALY)</td>
<td>Environmental performance; waste management codes; land zoning regulations</td>
</tr>
<tr>
<td>Natural Disasters</td>
<td>Improve prediction, mitigation and emergency preparedness</td>
<td>Various cases of malnutrition, diseases, injuries and death to population directly and indirectly affected</td>
<td>Cases of cases of malnutrition, diseases, injuries and death; QALY gained by intervention ($/QALY)</td>
<td>Depending on the disaster, availability of early warning systems</td>
</tr>
</tbody>
</table>


Quantifying and Valuing the Environmental Health Burden of Disease

Environmental health should be considered a priority area that could help achieve the Bank’s primary goal of reducing poverty. Because resources are limited, choices must be made; therefore, environmental health effects need to be quantified and valued at the macro and sectoral levels to prioritize cost-effective interventions and formulate appropriate policy responses.

Hypothesis for Back-of-the-Envelope Calculations

In the absence of quantitative analysis and the difficulty of performing benefit transfers in SSA for willingness-to-pay (WTP) studies (although some have been done for the cost-effectiveness interventions), the reader should look to these back-of-the-envelope calculations as a way to give an order of magnitude to environmental health problem, which, therefore, need to be interpreted with extreme caution. These preliminary calculations should be seen as new areas or a “road map” to guide environmental health analytical work. Several hypotheses were made to be able to perform these calculations; for example, some of the re-aggregation of the environmental health BOD required some professional judgment in the absence of usable analytical work; cost-effectiveness interventions, which vary across countries, ecological zones, and urban compared with rural settings, required application of benefit transfers to reflect SSA’s environment better; in the absence of WTP studies (which is by far the most accurate approach) for the cluster of environmental health interventions, a cost-of-illness (COI) approach was retained for the calculations. Although controversial, the COI approach remains the most appropriate one in these circumstances, given the lack of environmental health quantitative work on SSA.

50
Hypothesis for Quantification

Several analytical tools exist to quantify mortality and morbidity; however, the DALY\textsuperscript{65} (see boxes 3-2 and 3-5 for other metrics) was used to determine the environmental health BOD and apportion the environmental health BOD borne by the poor. The DALY was developed for the 1993 World Development Report, \textit{Investing in Health},\textsuperscript{66} and used to measure the state of health of a population by region and prioritize selected cost-effective health interventions. Two inherent problems in the Murray and Lopez\textsuperscript{67} BOD could characterize all the quantification calculations made below. The BOD is \textit{(a)} mostly taken from urban centers and, hence, underrepresent diseases prevalent among rural populations in particular and \textit{(b)} based on developing country records that tend to underreport diseases in general. Another important analytical tool is the comparative risk assessment, which is an interrelated, phased (hazard identification, dose-response assessment, exposure assessment, and risk characterization) process to identify the impacts that a substance can have on human health.

\begin{box}
\textbf{Box 3-5: Measuring the Burden of Disease: The DALY Concept}

What distinguishes DALYs from QALYs and Heal.Ys (see box 3-2)? What is their order of magnitude? These are important questions, because the justification for use of a single indicator is that such indicators enable decisionmakers—who are not necessarily health experts—to avoid having to choose among conflicting indications. These indicators present three common characteristics: \textit{(a)} they are all expressed in years (quantity of time) adjusted for the quality of time lived, \textit{(b)} they all generated much controversy, \textit{(c)} and they are all complex. These indicators simultaneously raise issues of demography, epidemiology, health measures, economics, philosophy, and psychology. An understanding of these issues is needed to resolve difficulties with, for example, nonhomogeneous data on prevalence and incidence, the notion of expected gains, the definition of disability, time preference (why a year lived today is valued higher than a year lived in the future), or preference revelation (what makes people reveal their relative preference between different states of health). Only the DALY concept will be considered to address some of these issues.

The World Bank, WHO, and Harvard School of Public Health initiated the Global Burden of Disease study in 1992, which served as a background paper for the Bank’s World Development Report of 1993. The study, which helped develop comparable regional and global assessments, provided detailed estimates of death and disability for eight regions, by sex and age, for more than 100 conditions and ten risk factors. A weighting function that incorporates a 3 percent discount rate was used to reflect the different social weights usually given to illness and associated with premature mortality at different ages. A worldwide life expectancy age was set at 80 and 82.5, respectively, for men and women. The disability adjusted life year (DALY) was developed as a common metric for measuring years of life lost due to premature mortality (YLLs) and years of life lived with a disability, adjusted for severity (YLDs). Causes of death were first estimated for 1990 using a variety of data sources and adjusted procedures. Incidence, prevalence, and duration of diseases and injuries were estimated in collaboration with more than 100 scientists, and internal consistency with mortality estimates was obtained through modeling.

The DALY is a practical tool for prioritizing interventions at the regional and national levels. Several disadvantages are, however, associated with the DALY concept: \textit{(a)} consideration of differences among morbidity states is limited, for example, calculations for conditions with states of remission and relapse dynamics (cancer, malaria, hypertension, and so on) have not yet been resolved, \textit{(b)} alternative valuations for the age weighting, such as an expenditure-sensitive age weighting or a differential gender or urban-rural functions, \textit{(c)} DALYs do not take into account predisposing features that are biological (genetics), behavioral (smoking and drinking), cultural (ethnicity, care taking of elderly), or economic (income group, access, and so on), and \textit{(d)} DALYs do not consider the compounding disability status of comorbidity or the synergistic relationships among diseases.

The re-aggregation of the DALYs below are partly based on risk assessment studies on different pollutants. The breakdown of the BOD, however, remains an estimate due to the paucity of information regarding disease etiology. Also, it is important to note that DALYs are bias-oriented toward urban areas, due to the quasi-exclusive availability of urban health data in SSA. Nevertheless, both laboratory and epidemiological researches have attempted to identify risk factors in disease causation, which could be explored for this purpose. Table 3-9 estimates are largely guided by such studies and primarily based on Smith (1999) calculations of environmental attributable fractions.

The method of calculation involves the listing of the different environment-related diseases and the risks and percentages that may be attributable to environmental factors. The Global Burden of Disease study by Murray and Lopez is the basis for the calculations, primarily because it reflects both morbidity and mortality. The list of diseases was also taken from this source. Estimates for the region are also guided by the prevalence of the risk factors, such as traditional cooking fuels in SSA and smoking rates. Air pollution and housing-related diseases are an example for the methodology. This methodology of estimation is used to “guessimate” the remaining environment-related diseases in the absence of reliable data. A range is shown for each disease/remedial measure category to show conservative and liberal estimates.

The re-aggregation of BOD attributable to environmental health is innovative, because it includes the compounding of several diseases by remedial measures that were not taken into consideration in previous studies, for example, diseases attributable to circulatory system, eye, and noninfectious diseases are compounded with respiratory diseases (see “improved housing and air pollution abatement” in table 3-9. For instance, compounded DALYs attributable to infrastructure and other sectors and categorized under environmental health remedial measures is on average 4 percent larger than single disease estimates and range between a 17 percent low and a 22 percent high with a 20 percent midpoint.

To apportion the relative share of the environmental health BOD on the poor, the figures obtained in a recent Bank publication (56 percent of the SSA population was considered to be under the poverty line in 1990 and 48 percent in 1998 according to a more recent publication) were extrapolated for the 1998 BOD and applied for each disease of the environmental health BOD.

**Hypothesis for Valuation**

Cost-effectiveness interventions per environmental health DALY saved (see box 3-2) have been compiled from different studies and the $/DALY saved numbers rely on global averages or a small sample of studies, so the rough meta-analysis performed should be used with care; for example, in the case of water and sanitation, only the Hughes and others study, cited above, is being used to derive cost-effectiveness, whereas, in the case of indoor air pollution, several studies have been distilled to come up with the cost-effectiveness intervention. Also, although calculated for different time periods, costs per DALY saved were not adjusted for inflation (see table 3-10 for additional notes and sources). Additional research is, however, needed to determine the BOD on the poor in an urban compared with rural settings.

Most environmental health problems listed in tables 3-9 and 3-10, except traffic injuries, can be substantially controlled with cost-effective interventions at less than $350 per DALY saved. When adjusted efficacy could not be determined through existing analytical work, a professional judgment (which does not always produce the most accurate forecast) was applied to determine the adjusted efficacy of DALY (see box 3-2) saved through environmental health interventions.

Disabilities are “adjusted” for their severity using a “quality-of-life scale,” based on individual rankings of severity of disease and disability for the DALY. For the calculations, we assume that one DALY is one lost year of healthy life (see box 3-5) to apply the cost-of-illness (COI) ap-
proach for the entire environmental health BOD in one year. A cost per DALY intervention is translated, from a societal point of view, into averted COI or a lower-bound benefit to society at large. The COI approach, because it captures only the first two components of WTP (see box 3-2) should, in general, serve as a lower bound to WTP to avoid the risk associated with illness, accident, and/or premature death, that is, the lost time associated with the illness (GDP per capita for a year, that is, DALYs are estimated at the regional average nominal GDP per capita, that is, a GDP per capita of $545 for people five years and older—62 percent of the environmental health DALYs—and for children under five—38 percent of the DALYs. A third of the GDP per capita, $182, has been applied for each DALY lost.) and the private and public health expenditures associated with medical costs incurred in a year (health expenditures in SSA per DALY in 1998, which amounts to $32.9/DALY). In addition to lost income and medical costs, the WTP usually reflects any expenditures made to try to avoid the illness or ameliorate its effects and the value of the discomfort associated with the illness that are not captured in this analysis. Possible intervention efficiency ratios are the COI over the cost of DALYs averted (see table 3-9 and 3-10). Also, it is assumed that any cost-effectiveness intervention to relieve the burden of environmental health on a targeted group of individuals will generate health benefits that will start accruing on the group of individuals over the first two years of the intervention.

Quantifying the Environmental Health Burden of Disease

Quantifying the environmental health burden of disease, including the burden borne by the poor, cannot be determined without assessing quantitatively the relative importance of different disease problems on the health of the population. An additional step would be to map the BOD, which could be a useful first step in determining the health risks and people at risk at the national, regional, and local levels. An environmental health map (geographic information system) that could be superimposed on a multilayered topological, ecological, and socioeconomic map could be an extremely helpful tool in identifying health risks and vulnerable groups and setting up geographic priorities and designing appropriate policy responses (see chapters 2 and 5).

The DALY, despite its limitations (see box 3-5), is used to dis-aggregate the Listorti (1996) guesstimated 44 percent SSA BOD for 1990, amenable to reduction through infrastructure interventions and re-aggregate (see “Valuation of the Environmental…” below to understand the specifics of each quantification entry) the same targeted diseases, which do not include AIDS, other STDs, and agrochemical-related diseases (agrochemical exposure). The re-aggregation allows derivation of the remedial measure estimates in 1998 DALYs and percentage terms attributable to environmental health on the one hand and health care delivery system on the other. Except for AIDS and other STDs, the entries under “Remainder Including Other Remedial Measures Not Included Above” (row 3 in table 3-9), including agrochemical exposure, are not broken down by disease or injury. The preliminary guesstimates of Listorti (1996) showed that infrastructure sector interventions are amenable to relieving up to 44 percent of the 1990 BOD against 38 percent of the BOD in 1998 (the BOD reduction is due to the sharp increase in AIDS in relative terms during the period). This work takes the targets a step further by performing back-of-the-envelope calculations with 1998 figures (38 percent) and gives a possible range of health interventions outside and inside the health sector. Environmental health–targetable remedial measures (20 percent of the BOD) can achieve more than the health care delivery system (18 percent of the BOD) for the same targeted diseases, that is, respiratory, circulatory system, gastrointestinal, tropical, and eye diseases, as well as traffic accidents and falls. These diseases do not, however, include AIDS, other STDs, and agrochemical exposure.

* No breakdown of data by year for children under five BOD exist to be able to apply a gradual increase in the GDP/capita. GDP was applied for children under and over five to account for in kind contribution and missed opportunities, e.g., in-kind contribution to household and family livelihood, kindergarten, school, and so on.
Table 3-9: Back-of-the-Envelope SSA Environmental Health Quantification, 1998 (DALY and $Billion)

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
<td>Midpoint Entire population</td>
<td>Cost Children &lt; 5</td>
</tr>
<tr>
<td></td>
<td>($000’ DALYs)</td>
<td>($000’ DALYs)</td>
<td>($000’ DALYs)</td>
<td>($ Bn)</td>
</tr>
<tr>
<td>I. ENVIRONMENTAL HEALTH REMEDIAL MEASURES</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1A. Air Pollution Abatement, Improved Housing and Education</td>
<td>18,648</td>
<td>27,052</td>
<td>22,850</td>
<td>2.7</td>
</tr>
<tr>
<td>1. Respiratory diseases a</td>
<td>16,753</td>
<td>24,688</td>
<td>20,721</td>
<td>2.6</td>
</tr>
<tr>
<td>2. TB</td>
<td>1,085</td>
<td>1,361</td>
<td>1,224</td>
<td>0.0</td>
</tr>
<tr>
<td>3. Circulatory system diseases b</td>
<td>608</td>
<td>766</td>
<td>687</td>
<td>0.0</td>
</tr>
<tr>
<td>4. Eye diseases c</td>
<td>199</td>
<td>237</td>
<td>218</td>
<td>0.0</td>
</tr>
<tr>
<td>5. Non-infectious diseases, e.g., cancer not included above</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>6. Malaria, Tropical diseases cluster and Dengue</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>1B. Improved Water, Sanitation, Waste management and Hygiene Education</td>
<td>25,478</td>
<td>29,561</td>
<td>27,519</td>
<td>4.1</td>
</tr>
<tr>
<td>1. Diarrheal diseases</td>
<td>19,400</td>
<td>21,815</td>
<td>20,608</td>
<td>3.2</td>
</tr>
<tr>
<td>2. Intestinal worm infections</td>
<td>396</td>
<td>446</td>
<td>427</td>
<td>0.0</td>
</tr>
<tr>
<td>3. Eye diseases d</td>
<td>274</td>
<td>312</td>
<td>293</td>
<td>0.0</td>
</tr>
<tr>
<td>4. Tropical diseases cluster</td>
<td>213</td>
<td>275</td>
<td>244</td>
<td>0.0</td>
</tr>
<tr>
<td>5. Malaria</td>
<td>5,191</td>
<td>6,708</td>
<td>5,950</td>
<td>0.9</td>
</tr>
<tr>
<td>6. Dengue</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>0.0</td>
</tr>
<tr>
<td>7. Non-infectious diseases, e.g., cancer not included above</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>1C. Vector Control, Drainage and Irrigation (plus Sanitation and Waste Mgt.)</td>
<td>9,096</td>
<td>12,632</td>
<td>10,864</td>
<td>1.2</td>
</tr>
<tr>
<td>1. Tropical disease cluster e</td>
<td>2,697</td>
<td>3,485</td>
<td>3,091</td>
<td>0.0</td>
</tr>
<tr>
<td>2. Malaria</td>
<td>6,395</td>
<td>9,142</td>
<td>7,768</td>
<td>1.1</td>
</tr>
<tr>
<td>3. Dengue</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>0.0</td>
</tr>
<tr>
<td>1D. Transport, Workplace, Housing Design and AIDS Education</td>
<td>2,179</td>
<td>2,602</td>
<td>2,391</td>
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</tr>
<tr>
<td>1. Road Traffic Accidents</td>
<td>1,589</td>
<td>1,898</td>
<td>1,744</td>
<td>0.0</td>
</tr>
<tr>
<td>2. Falls</td>
<td>590</td>
<td>704</td>
<td>647</td>
<td>0.0</td>
</tr>
<tr>
<td>3. Drowning and Fires (no breakdown available)</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
<td>Midpoint Entire population</td>
<td>Cost Children &lt; 5</td>
</tr>
<tr>
<td>(000' DALYs)</td>
<td>(000' DALYs)</td>
<td>(000' DALYs)</td>
<td>($ Bn)</td>
<td>($ Bn)</td>
</tr>
<tr>
<td>4. AIDS and other STDs (no breakdown available)</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Subtotal SSA DALYs from Environmental Health (IA-ID)</td>
<td>55,402</td>
<td>71,847</td>
<td>63,624</td>
<td>18.0</td>
</tr>
<tr>
<td>% of Total SSA DALYs from Environmental Health (IA-ID)</td>
<td>17%</td>
<td>22%</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>II. HEALTH CARE SYSTEM/EDUCATION REMEDIAL MEASURES</td>
<td>Selected Diseases (same diseases as in I.)</td>
<td>49,335</td>
<td>65,780</td>
<td>57,558</td>
</tr>
<tr>
<td>1. Diarrheal diseases</td>
<td>2,416</td>
<td>4,831</td>
<td>3,623</td>
<td>0.6</td>
</tr>
<tr>
<td>2. Intestinal worm infections</td>
<td>2.974</td>
<td>10,909</td>
<td>6,942</td>
<td>0.9</td>
</tr>
<tr>
<td>3. Respiratory diseases a</td>
<td>11,978</td>
<td>12,136</td>
<td>12,057</td>
<td>0.2</td>
</tr>
<tr>
<td>4. Circulatory system diseases b</td>
<td>1,798</td>
<td>2,648</td>
<td>2,223</td>
<td>0.0</td>
</tr>
<tr>
<td>5. Tropical diseases cluster</td>
<td>18,656</td>
<td>22,920</td>
<td>20,788</td>
<td>0.9</td>
</tr>
<tr>
<td>6. Malaria</td>
<td>6</td>
<td>8</td>
<td>7</td>
<td>0.0</td>
</tr>
<tr>
<td>7. Dengue</td>
<td>1,657</td>
<td>1,733</td>
<td>1,695</td>
<td>0.0</td>
</tr>
<tr>
<td>8. Eye diseases c</td>
<td>4,082</td>
<td>4,354</td>
<td>4,218</td>
<td>0.1</td>
</tr>
<tr>
<td>9. TB</td>
<td>4,219</td>
<td>4,528</td>
<td>4,574</td>
<td>0.1</td>
</tr>
<tr>
<td>10. Road Traffic Accidents</td>
<td>1,501</td>
<td>1,615</td>
<td>1,558</td>
<td>0.1</td>
</tr>
<tr>
<td>11. Falls</td>
<td>54,101</td>
<td>54,101</td>
<td>54,101</td>
<td>2.4</td>
</tr>
<tr>
<td>12. Drowning and Fires (no breakdown available)</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Subtotal SSA DALYs from Health Care/Education (II.)</td>
<td>57,558</td>
<td>57,558</td>
<td>57,558</td>
<td>25.2</td>
</tr>
<tr>
<td>% SSA DALYs from Health Care/Education (II.)</td>
<td>15%</td>
<td>20%</td>
<td>18%</td>
<td>9%</td>
</tr>
<tr>
<td>III. REMAINDER INCLUDING OTHER REMEDIAL MEASURES NOT INCLUDED ABOVE</td>
<td>220,461</td>
<td>187,571</td>
<td>204,016</td>
<td>99,252</td>
</tr>
<tr>
<td>1. AIDS</td>
<td>54,101</td>
<td>54,101</td>
<td>54,101</td>
<td>2.4</td>
</tr>
<tr>
<td>2. Other STDs</td>
<td>5,249</td>
<td>5,249</td>
<td>5,249</td>
<td>0.4</td>
</tr>
<tr>
<td>3. Drowning and Fires</td>
<td>5,705</td>
<td>5,705</td>
<td>5,705</td>
<td>0.3</td>
</tr>
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</table>
### Re-aggregation of the same remediable diseases and injuries through environmental health and health care system targetable interventions

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>High</td>
<td>Midpoint Entire population ((3=(1+2)/2))</td>
<td>Cost Children &lt; 5 ((4))</td>
</tr>
<tr>
<td>(000' DALYs)</td>
<td>(000' DALYs)</td>
<td>(000' DALYs)</td>
<td>($ Bn)</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>4. Childhood diseases cluster f</td>
<td>25,375</td>
<td>25,375</td>
<td>25,375</td>
</tr>
<tr>
<td>5. Agrochemical Exposure g</td>
<td>650</td>
<td>2,927</td>
<td>1,789</td>
</tr>
<tr>
<td>6. All Others</td>
<td>129,381</td>
<td>94,214</td>
<td>112,936</td>
</tr>
<tr>
<td>% SSA DALYs from STDs including AIDS</td>
<td>18%</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>% of SSA DALYs from other diseases</td>
<td>68%</td>
<td>58%</td>
<td>63%</td>
</tr>
<tr>
<td>Grand total of SSA DALYs</td>
<td>325,198</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations and see table 3-10 for additional notes and source.

Note:
- a acute respiratory infections, chronic obstructive pulmonary disease, asthma, trachea, bronchitis and lung cancers.
- b heart disease and stroke.
- c cataracts and trachoma.
- d trachoma.
- e trypansomiasis, Chagas disease, schistosomiasis, leishmaniasis, lymphatic filariasis and onchocerciasis.
- f pertussis, poliomyelitis, diphtheria, measles and tetanus.
- g liver and pancreas cancer, melanomas and other skin cancers, lymphomas and multiple myeloma, endocrine disorders, unipolar major depression, cataracts, nephritis and nephrosis, rheumatoid arthritis, congenital anomalies (excluding spina bifida and congenital heart anomalies), and poisonings.
- This entry does not include possible health risks associated with biotech/genetically altered food.
The relative share of the environmental health BOD in SSA, which is estimated to be at least 20 percent for the entire population, represents 10 percent for the poorest of the poor. The health care delivery system share for the same diseases represents 18 percent for the entire population and only 9 percent for the poorest of the poor.

**Valuation of Environmental Health Burden of Disease**

Environmental health BOD estimates, which constitute about 70 million DALYs (20 percent for the entire population and 10 percent for the poorest of the poor) of the BOD in SSA, is equivalent to approximately 6 percent of the 1998 nominal GDP\(^7\)\(^4\) in SSA ($343.6 billion) or $35.8 billion. The environmental health BOD will be used to derive environmental health cost-effectiveness interventions for the entire population and the poorest of the poor and possible intervention efficiency ratios.

An analysis based on the environmental health BOD borne by the entire population will be developed below and concentrate on five main topics: (a) improved indoor air quality and improved housing and education (for example, respiratory diseases and so on), (b) improved outdoor air quality for transport, energy, and industry (for example, respiratory diseases and so on), (c) improved transport management: education, enforcement, and insurance (for example, traffic deaths and injuries), (d) improved water, sanitation, waste management, and hygiene education (for example, water-related, vector-borne diseases, plague, and so on), and (e) vector control through land use management and improved drainage and irrigation (plus partial sanitation and waste management, for example, vector- and water-related diseases). It is important to note, however, that the prevalence of malaria is increasing in urban areas in SSA, but no analytical work exists that allows determination of a conclusive breakdown of malaria between urban and rural areas. The malaria attributed to environmental factors amounts to 90 percent according to WHO\(^7\)\(^5\) and a professional judgment\(^7\)\(^6\) has been used to determine targetable malaria through environmental health interventions. Drugs are used to treat malaria victims but climate change, social instability, and increased resistance to pesticides and treatments have hampered the battle against the illness in SSA. Also, due to unavailable analytical work that allows for a breakdown of infrastructure outreach for high-risk groups (for example, AIDS and other STDs education campaign), living environment improvement (for example, avoided falls), and agrochemical exposure between environmental health outreach and health care system remedial measures/outreach, these topics are addressed below, but no cost-effectiveness have been associated with these interventions.

**Improved indoor air quality, improved housing and education** (for example, respiratory diseases, and so on). Based on Smith,\(^7\)\(^7\) indoor exposure to particulate matter accounts for at least 75 percent of the total indoor and outdoor exposure in developing countries. A midpoint $75 cost-effectiveness intervention to relieve this BOD was applied in tables 3-9 and 3-10. DALYs saved through indoor air interventions, that is, 19.2 million DALYs or almost 6 percent of the SSA BOD, are, by far, the most cost-effective among the five interventions.

**Improved outdoor air quality for transport, energy and industry** (for example, respiratory diseases, and so on) accounts for only 3.7 million DALYs, a fifth of the indoor pollution BOD. The social benefits of this intervention are negative, that is, for a dollar spent, $0.90 is socially recouped, due to the aging car fleet and obsolete industrial processes in SSA. These figures, however, need to be refined to allow for better (a) differentiated cost-effectiveness for indoor (improved stove and ventilation) and outdoor (energy and industry specific to SSA) capital cost and recurrent cost and (b) marginal health benefits in terms of respiratory and associated diseases.
Table 3-10: Back-of-the-Envelope SSA Environmental Health Valuation, 1998 (DALY and $Billion)

<table>
<thead>
<tr>
<th>INTERVENTIONS TO RELIEVE THE BURDEN OF DISEASE</th>
<th>SOCIAL COST AND BENEFIT OF INTERVENTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cost of Intervention for the Entire Population</td>
</tr>
<tr>
<td></td>
<td>Targetable SSA Burden of Disease: Midpoint</td>
</tr>
<tr>
<td></td>
<td>(DAILY Mn)</td>
</tr>
<tr>
<td>I. REMEDIAL MEASURES THROUGH INFRASTRUCTURE and ENERGY INTERVENTIONS</td>
<td>63.6</td>
</tr>
<tr>
<td>Improved Indoor Air Quality, Improved Housing and Education (e.g., respiratory diseases, etc.)</td>
<td>19.2</td>
</tr>
<tr>
<td>Improved Outdoor Air Quality for Transport, Energy and Industry (e.g., respiratory diseases, etc.)</td>
<td>3.7</td>
</tr>
<tr>
<td>Improved Transport Management: Education, Enforcement and Insurance (e.g., traffic death and injuries)</td>
<td>1.7</td>
</tr>
<tr>
<td>Improved Water, Sanitation, Waste Mgt. and Hygiene Education (e.g., water-related and vector borne diseases)</td>
<td>27.5</td>
</tr>
<tr>
<td>Vector Control Through Land Use Mgt, Improved Drainage and Irrigation (plus partial Sanitation and Waste Mgt., e.g., vector-/water-related diseases)</td>
<td>10.9</td>
</tr>
<tr>
<td>Infrastructure Outreach for High Risk Groups (e.g., AIDS and other STDs Education; no breakdown available)</td>
<td>NA</td>
</tr>
<tr>
<td>Living Environment Improvement (e.g., Avoided Falls; no breakdown available for Drowning and Fires)</td>
<td>0.6</td>
</tr>
</tbody>
</table>
## SOCIAL COST AND BENEFIT OF INTERVENTION

<table>
<thead>
<tr>
<th>INTERVENTIONS TO RELIEVE THE BURDEN OF DISEASE</th>
<th>Cost of Intervention for the Entire Population</th>
<th>Lower Bound Social Benefits for the Entire Population</th>
<th>Cost of Intervention for the Poorest Quintile</th>
<th>Lower Bound Social Benefits for the Poorest Quintile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Targetable SSA Burden of Disease: Midpoint</td>
<td>Cost/DALY Saved</td>
<td>Cost of Averted DALYs</td>
<td>Lost Income</td>
<td>Medical Cost</td>
</tr>
<tr>
<td>(DALY Mn)</td>
<td>(%)</td>
<td>($/DALY)</td>
<td>($ Bn)</td>
<td>($ Bn)</td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3=1 x 2)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
</tbody>
</table>

### II. REMAINDER (A + B + C) 261.6 80%  
A. HEALTH CARE SYSTEM REMEDIAL MEASURES FOR THE SAME DISEASES and INJURIES (except for AIDS, other STDs, Drowning and Fires)  
57.6 18% VARIES NA 25.2 1.9 27.1 VARIES NA NA 10.3 VARIES NA  
B. OTHER ENVIRONMENTAL HEALTH PARTIALLY TARGETABLE DISEASES and INJURIES NOT INCLUDED ABOVE  
66.8 21% VARIES NA NA 2.2 NA VARIES NA NA NA VARIES NA  
AIDS 54.1 16.6% 20 - 20,000 NA 23.9 1.8 25.7 VARIES NA NA 11.9 VARIES NA  
Other STDs 5.2 1.6% 100 0.5 1.9 0.2 2.1 1.6 4.0 0.2 1.0 0.8 4.0  
Drowning and Fires 5.7 1.8% NA NA 0.2 NA NA NA NA NA NA NA  
Agrochemical Exposure (insecticides and pesticides excluding biotech) 1.8 0.6% NA NA 0.9 0.1 0.9 NA NA NA 0.4 NA NA  
C. All Others (with a breakdown of high percentages) of which:  
137.2 42% VARIES NA NA 4.5 NA VARIES NA NA NA VARIES NA  
Childhood diseases cluster 25.4 7.8% 100 2.5 5.8 0.8 6.6 4.1 2.6 1.4 3.5 2.5 2.6  
GRAND TOTAL (I. + II.) 325.2 100% 10.7  

**Note:**  
NA Breakdown Not Available. For interventions, DALYs are bias-oriented towards urban areas due to the availability of mainly urban data in SSA. Cost-effectiveness interventions per environmental health DALY saved have been compiled from different studies and should be used with care. Health improvements from an intervention are assumed to start accruing on the well-being of the targeted population as of the first or second year of the intervention. When data were not available, a professional judgement was used to derive “Adjusted efficacy.” Numbers may not add up due to rounding. Lower Bound Social Benefits cannot be fully quantified. Apportioning of environmental health affecting the poorest of the poor (48 percent in 1998 compared to 56 percent in 1990) derived from the application ratios available in Gwatkin and Guillot (1999). Average 1993-98 SSA Public and Private Health Expenditures were divided by the SSA total number of DALYs to get $/DALY spent and determine “Medical Cost.” In the 1993 WDR, it is mentioned that SSA public sector's health care delivery system could relieve up to 32 percent of the burden of disease. However, a distribution of targeted diseases is unavailable to adapt it to this context. Therefore, it is assumed that 1998 SSA Public and Private Health Expenditures are equally distributed among 1998 SSA’s burden of disease, that is, all the DALYs.
Source: Authors’ calculations.
For Cost-Effectiveness, figures have been gathered from different sources and regions and should be applied with caution: Benefit transfers have been applied to certain data. Although calculated for different time periods, costs per DALY saved were not adjusted for inflation.
Improved stoves (indoor air)-- $50-100 per DALY [Smith (1999)]. For Proportion of Outdoor/Indoor, 16 percent vs. 84 percent [Bridging... Guesstimate based on Ronald Subita, MD calculations].
Improved ambient air --large variations, from negative costs (fuel savings) to $20,000 per DALY [Environment and Health, Background paper for the Bank Environment Strategy, Draft, April, 2000]—was set at $ 350.
Water and Sanitation: cost per DALY is $ 235 (rural) and $ 385 (urban) for improved water supply and $120 for improved sanitation. A benefit transfer has been performed and a price differential and different rural (2) vs. urban (1) weights were assigned to data. [Hughes and Dunleavy (2000)].
Hygiene behavior change for water supply and sanitation interventions, $ 20 per DALY [Environmental Health Program, USAID, 1998].
Malaria control: cost per DALY ranges from $ 35 to 75 [Environment and Health, Background paper for the Bank Environment Strategy, Draft, April, 2000].
Vector Control through improved Land use management, Drainage and Irrigation including partial sanitation is estimated at $ 158 per DALY [Bridging... guesstimate based on the case of Hardwar, India].
Traffic Injuries varies from $ 250 to $ 999 per DALY. $ 325 per DALY was applied for traffic management that includes seat belts, enforcement and insurance. [1993 WDR, the World Bank].
STD including HIV/AIDS, and TB remedial measures: cost per DALY is $20 for media AIDS campaign, $250 for condom distribution to combat AIDS and $1,500 to >=20,000 AIDS; >$100 for other STDs and >$50 for TBs. [Prabhat, Ranson and Bobadilla (1996)].
1998 SSA: total population ( 627.1 million), urban population (208.8 million), rural population (418.3), GDP ($ 333.9 billion), GDP per capita ($ 532.4), GDP/Capita used for Children >= 5 per DALY Lost ($ 532.4), 1998 GDP/Capita divided by 3 used for Children < 5 per DALY Lost ($ 177.5), 1990-98 Public and Private Health Expenditures (PPHE) (3.2 percent of GDP and $ 10.7 billion on average over the period) and 1998 SSA PPHE/DALY ($ 32.9) [WDI 2000].
1998 SSA breakdown of DALYs by disease (total: 325.2 million) [WHO 1999 Annual Report].
Improved transport management: education, enforcement and insurance (for example, traffic death and injuries). Cost of averted DALY data is provided by the 1993 World Development Report and the wide range of cost-effectiveness, $100–$999, is attributable to the variety of costs of interventions: these stretch from enforcing stringent measures to fight drunk and careless driving (progressive penalties, introduction of differentiated accident insurance premiums, and compulsory seat belts) to improving road design. An adjusted efficacy of 30 percent was derived, thanks to a professional judgment and an adjusted midpoint cost-effectiveness of $325 was used for the least expensive interventions, that is, fighting drunk and careless driving. Cost of averted DALYs amounts to $0.6 billion and represents 1.7 percent of the SSA BOD.

Improved water, sanitation, waste management and hygiene education (for example, water-related, vector borne diseases, plague, and so on). Improving the quantity and quality of water available for domestic use, as well as facilities for disposing of human waste, can significantly reduce illness and death from diarrheal diseases and waterborne illness. A recent review of the literature suggests that for diarrheal disease, ascariasis, hookworm, schistosomiasis, and trachoma, the quantity of water and availability of excreta disposal facilities are more important in preventing disease than improving drinking water quality. This underscores the point that improved water and sanitation reduce illness by breaking the oral-fecal contamination route.

A $285 and $467 per DALY for, respectively, rural and urban improvement in water supply by Hughes and Dunleavy (2000) was calculated for Andhra Pradesh in India without accounting for a differentiated water provision (in-house tap, communal hand pumps, vendors, and so on) by income group, which skew the results (Cost-effectiveness interventions, which are function of the level of provision, for example, piped water vs. well, were weighted by the breakdown of the urban vs. rural population in table 3-10. See notes for weights and price differentials). This methodology is, however, cutting edge and needs to be refined to allow for: (a) differentiated water provision by income group; (b) differentiated cost-effectiveness for water supply and waste management capital cost and recurrent cost; and (c) marginal health benefits in terms of vector control, diarrheal and associated diseases, as well as tropical cluster. The cost-effectiveness figures in table 3-10, $158 for rural and urban areas, were adjusted with a crude India/SSA GDP differential and weighting was applied to the cost-effectiveness figure used for rural and urban areas (see notes to table 3-10). Bearing in mind that cost-effectiveness figures include capital cost, this intervention remains the least cost-effective among the four interventions and relieves almost 27.5 million DALYs or almost 9 percent of the SSA BOD for a cost ($4.3 billion), which is almost three times ($1.3 billion) that of improved indoor air quality and improved housing and education.

Vector control through land use management and improved drainage and irrigation (plus partial sanitation and waste management, for example, vector- and water-related diseases). Based on USAID’s Environmental Health Program, in 1998, a $20 per DALY could be achieved through hygiene behavior change for water supply and sanitation interventions. Concomitantly, based on Hughes and Dunleavy (2000), a $120 per DALY for improved sanitation was determined in India. An investment threshold beyond a 60 percent sanitation coverage level was also established and could not procure any additional health benefits to the community. These remarkable preliminary findings call for further analysis along the issues identified for improved water and waste management: (a) differentiated sanitation provision by income group, (b) differentiated irrigation cost-effectiveness for capital cost and recurrent cost, and (c) marginal health benefits in terms of vector control, diarrheal, and associated diseases, as well as tropical cluster. It is important to note, however, that the prevalence of malaria is increasing in urban areas in SSA and a cost/DALY (derived by combining the Environmental Health Program, Hughes and Dunleavy (2000), and a guesstimate from an example of a successful partnership in an urban setting to managing vector-related diseases in Uttar Pradesh in India [see box 3-6]), amounts to $158/DALYs saved. Cost of averted DALYs ($1.0 billion for 3.3 percent of the SSA BOD) are the second-most cost-effective among the five interventions.
Box 3-6: Partnerships to Manage Vector-Related Diseases in an Urban Setting

A collaborative and multipronged environmental health approach to controlling vector-related diseases was developed by a private manufacturer of heavy electrical equipment, Bharat Heavy Electricals Ltd. (BHEL), in 1987. BHEL is located in Hardwar, an industrial city in the State of Uttar Pradesh in India. BHEL took action due to an increasing rate of malaria-related absenteeism of the workforce, which affected productivity. BHEL’s approach was characterized by a private-public-community collaboration that included (a) the use of BHEL’s own resources, intersectoral technical expertise, and maintenance crews, (b) in-kind contribution from the state (for example, borrowing heavy equipment, such as bulldozers), and (c) community awareness and involvement in monitoring mosquito breeding sites.

The innovative multipronged approach consisted of (a) infrastructure interventions targeting water, sanitation, and drainage, (b) bioenvironmental control, and (c) proper monitoring. Selected tasks consisted of (a) construction of stand posts and proper drainage and mosquito proofing of overhead tanks, (b) preventive maintenance of the water supply and sewage system, including the introduction of biolarvicides to blocked drains and larvivorous fish to stormwater drains and effluent ponds, and (c) filling pits and ditches with fly ash from coal-fired power stations. Prior to using fly ash (with the possibility of leaching into the groundwater), however, its content should have been analyzed to ensure that neither environmental nor environmental health short- or long-term concerns were associated with its application.

Improved surveillance and treatment coupled with a comprehensive control approach led to a stunning reduction of the malaria incidence rate: from 6.7 percent of the total population in 1986 (3,733 cases and 1 out of 15 inhabitants for a population of 56,132) to a mere 0.2 percent in 1995 (190 cases and 1 out of 440 inhabitants for an estimated population of 83,500) or a reduction factor of 20.

The outcome in terms of reduction of other vector-related diseases is not reported in the study, but sixteen different species of aedes, anopheles and culex were identified and ultimately targeted.

Although a cost/benefit analysis was not performed, preliminary costs were estimated at less than $400,000 for the multipronged intervention compared with $2.2 million without intervention (cost of malaria treatment and BHEL’s production loss only) for the 1986–95 period, that is, a ratio of 1/5.5. These figures do not include benefits such as (a) reduction of other vector-related health risks, such as filariasis, yellow fever, and dengue, (b) the averted cost of disposal of most of the fly ash ($40,000 per year), which was utilized to fill large ditches, burrow pits, and low-lying areas, or (c) reduction of cancer-causing DDT and HCH residues in blood that were sampled in Hardwar (4.71 µg/l and 1.2 µg/l respectively) in 1995 and compared with samples from neighboring towns (38.13 µg/l and 24.3 µg/l) where DDT and HCH spraying was still used for malaria control.

Source: Authors’ data and “Bioenvironmental Control of Industrial Malaria” (1997).

Infrastructure outreach for high risk groups (for example, AIDS and other STDs education). AIDS and other STDs are listed in table 3-9 without being included under either environmental health or health care remedial measures due to the lack of analytical work that helps estimate a breakdown between both remedial measures. Growing AIDS challenges in SSA, however, led the World Bank to provide extensive assistance for efforts to collect information on surveillance and behavioral studies. A major effort is currently being made to mainstream AIDS concerns in Bank operations by (a) focusing its support for HIV prevention interventions on reaching groups at the highest risk of contracting and spreading HIV and (b) improving the economic analysis used in preparing Bank HIV-related projects and evaluating their effectiveness. It is, however, important to note that AIDS and other STDs represent 18 percent (16.6 percent for AIDS alone) of the SSA BOD. These lower-bound estimates (health expenditures associated with the disease could vary from $20 to more than $20,000) of cost of inaction per year will also need further investigations.
AIDS prevention is far more cost-effective than its cure: media campaigns and behavioral change could cost from $20 (media campaign) to $100–250 (distribution of condoms) per DALY saved (see table 3-9); whereas, cost-effectiveness for AIDS medical care can range between $1,500 and more than $20,000, depending on the quality of care. In Senegal, AIDS retro-viral therapy per patient dropped to about $950-1,800 per year in 2000, thanks partly to the establishment of a partnership with private companies, which are manufacturing generic drugs. The conjunction of a strong governmental commitment, a well-orchestrated media and awareness campaign that led to behavioral change, paid off in Senegal where the spread of disease was contained (adult prevalence rate is less than 2 percent). In contrast, in Ghana (prevalence between 2–8 percent), where AIDS is becoming a serious problem, a study has found the prevalence of HIV infection due to construction workers to be 5 to 10 percent higher in the population of a rural district, where the Akomoso hydroelectric dam was under construction than in neighboring districts. In Zimbabwe (prevalence between 16–32 percent), where the disease is endemic, the example of a trucking company is quite revealing: More than one-fourth of the cohort of employees had AIDS, which had cost the company more than $1 million in losses (direct and indirect, for example, increased medical and life insurance premiums), in 1997, or 20 percent of the company’s profits. Some studies suggest that the spread of AIDS is partly due to truckers and force account/private contractor crews, but a breakdown between infrastructure-related AIDS and other means of spreading AIDS needs further analysis to target infrastructure-related AIDS spreading agents better through professional associations (truckers), labor union (workers), cart/street vendor groups, and so on.

Living environment improvement (for example, avoided falls; no breakdown available for drowning and fires). Cost-effectiveness for falls, fire, and drowning could not be calculated.

Agrochemical exposure. The burden of insecticides and pesticides could be reduced through awareness, safety programs, and proper application of pesticides, that is, in integrated pesticide management programs, however, no cost-effectiveness estimates are associated with agrochemical exposures. Estimates of the burden of disease potentially associated with acute and chronic exposure to pesticides and insecticides, which are known in the literature to be associated with the use of pesticides and insecticides, are based on conservative (0.2 percent of the total BOD in SSA) and liberal (0.9 percent) boundaries, related to the summation of more than fifteen disease sequelae. The disease groups summed include liver and pancreas cancer, melanomas and other skin cancers, lymphomas and multiple myeloma, endocrine disorders, unipolar major depression, cataracts, nephritis and nephrosis, rheumatoid arthritis, congenital anomalies (excluding spina bifida and congenital heart anomalies), and poisonings across all age groups. These diseases span the range of exposure duration from acute (accident where substance is poured on skin directly) to long-term (inhaling for 20 years, while working in field). As all of these diseases are multifactoral (have many causal factors) and genetically influenced (i.e., endogenous as well as exogenous factors), it was not reasonable to assume that pesticide and insecticide exposure caused all of the disease events; thus, we used a low-end, high-end bracket of 0.2 percent and 0.9 percent, which could be interpreted as (a) 0.2 percent (likely proportion of DALYs attributable to recognized disease groups most strongly associated with morbidity and mortality due to short and long term exposure to pesticides/insecticides) and (b) 0.9 percent (potential proportion of DALYs attributable to recognized disease groups most strongly associated with high exposure to pesticide/insecticide use could summarize a small pocket of population who use canal water for drinking purposes and [both genders] work in the fields applying these chemicals).
Prioritizing a Cluster of Environmental Health Interventions and Policy Responses

Prioritization

Prioritizing the five interventions based solely on optimum economic solutions by using the cost-effectiveness figures and especially the Possible Intervention Efficiency Ratio (the same for the entire population and the poorest of the poor [see table 3-10, column 8, which is the ratio of social benefits over social costs]) requires the sequencing of resources to avert the adjusted remedial DALYs. This is done as follows: applying the cheaper intervention option per unit of effectiveness first, (a) indoor air pollution with an efficiency ratio of 4.4 for each dollar spent, (b) vector control and sanitation with 3.7, (c) water and vector control with 1.7, (d) traffic accidents with 1.8, and outdoor air pollution with a ratio of less than one, 0.9. The reality is, however, more complex than a simple ranking of interventions on economic grounds, because most policies or interventions, which are based on political and socioeconomic grounds, try to achieve more than one objective at a time, for example, provision of safe drinking water or clean energy fuels are essential to sustain life, improve living conditions (hygiene, indoor air, and so on), reduce cost, time, and physical load borne by consumers, and so on.

From an environmental health perspective, targeting the poor to improve their well-being would require a cluster of infrastructure interventions (see “Intermediation Mechanisms: Community-Driven Development”) to complement necessary health care interventions such as nutrition and AIDS prevention, that is, to improve and/or maintain all at once indoor air (improved or clean-fueled stoves* associated with appropriate education), water and sanitation (better provision and hygiene education to reduce diarrhea), drainage, potholes and other standing water (vector control), etc., as appropriate. From an environmental health standpoint—given the lack of infrastructure provision specific to each circumstance—, it is more effective to promote a cluster of infrastructure interventions that should target one specific geographic area/community/village than spreading uncoordinated single-sector interventions across several geographic areas/communities/villages. Only then, compounded health benefits could accrue to the population at risk and outcome-based results could be monitored and achieved. The need exists, therefore, to look at confounding factors that would help achieve synergetic gains and increased health outcome. For example, malnutrition could accentuate mortality in children under 5 for the following main diseases: diarrhea in 70 percent of cases, tuberculosis in 60 percent, acute lower respiratory infections in 44 percent, and malaria in 40 percent, among other diseases, not to mention HIV/AIDS. In other words, targeting health outcomes through a sector specific approach could slightly reduce the probability of mortality or morbidity for children under 5 for a given risk without really resolving the problem, because children or adults are usually exposed to a multitude of health and environmental health risks. Therefore, there is a critical need to bring awareness and educate the people to fully understand the significance, impacts and linkages of environmental, environmental health and health issues on their well-being and livelihoods. Also, a better understanding of the linkages between urban and rural areas in spreading new diseases, including vector-related diseases (especially because HIV-infected individuals are harboring a large reservoir of malaria parasites) and their effects on the poor, needs to be thoroughly researched.

* In recent literature, it is suggested that clean-fueled stoves for the poor need to be considered an infrastructure investment with a 5 to 10 year lifespan in Smith and Mehta (2000).
Policy Response and Implications

Policy response will be briefly described due to lack of environmental health policy examples that allow some lessons to be drawn. It is, however, important to note that a great deal of environmental policy responses targeted environmental health problems, but some environmental interventions alone can, however, lead to partial environmental health solutions (see case of lead above). A policy response needs to be subjected to a social cost-benefit analysis before being implemented, monitored, and evaluated. A prerequisite to formulating a policy is to assess the enabling environment, that is, policy instruments, budgetary processes, institutions, and laws.

Policy instruments. The Environmental Policy Matrix, which could be used to select environmental health instruments, organizes the different policy instruments approaches into four categories depending on the principal emphasis of each policy instrument: the market, the creation of a market, environmental regulations, and engaging the public (all the instruments can be beneficial to both the environment and human health [see table 3-11]). Policy instruments need to be gauged to ensure the effectiveness of environmental health policy goals. Although market instruments are more flexible and allow for improved efficiency over time, regulatory instruments are often a necessary complement.

Table 3-11: Policies and Instruments for Sustainable Development

<table>
<thead>
<tr>
<th>Theme</th>
<th>Policy Instruments (all instruments can be beneficial to both the environment and human health)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Using Market</td>
</tr>
<tr>
<td>Resource Management and Pollution Control</td>
<td>Subsidy reduction</td>
</tr>
<tr>
<td></td>
<td>Targeted subsidies</td>
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<tr>
<td></td>
<td>Environmental taxes</td>
</tr>
<tr>
<td></td>
<td>User fees</td>
</tr>
<tr>
<td></td>
<td>Deposit-refund system</td>
</tr>
</tbody>
</table>


Budgetary processes. In addition to PER, which could be instrumental in allocating targeted resources toward environmental health mitigation (see “Public Expenditures Review” above), environmental health could be canvassed onto existing intermediation instruments, such as environment, road, or water funds that could be used to generate extra revenues to internalize the social cost of environmental health concerns. These extra revenues could be channeled through intermediation mechanisms, such as the CDD or social funds and target specific clusters of interventions to mitigate the health risk of especially vulnerable groups.

Institutions and law. The cluster of intervention raises an intractable multisectoral institutional issue within the Bank as well as at the country level (see chapter 1 and “Institutional Failures” above).

Policy implications (see chapters 1 and 2) of a cluster of environmental health interventions should be gauged with care. In most cases, environmental health benefits are maximized and sustained only if infrastructure is properly used and maintained. Human behavior, at the household (for example, hygiene, vector, and smoke prevention) and societal (institutions, governance, partnerships, social capital) levels play a major role. This raises the fundamental issue of linking infrastructure and environmental health. An environmental health policy needs to favor an environment conducive to the proper use and upkeep of infrastructure assets that should lead to environmental health improvements. Also, each cluster of interventions requires careful assessment based on a number of factors (environmental health attributes, socioeconomic group, and so on), which calls for careful valuation of environmental health issues at the local level for a particular intervention that should ideally be part of the EA process. In the short run, this could entail a cost-
effective intervention in favor of the health care sector, because the up-front infrastructure capital costs largely exceed health sector intervention costs for a given illness and time preferences for immediate life-saving programs (health care sector interventions) could be much higher than differed health benefits associated with infrastructure interventions.\footnote{86}

The cost-effectiveness of interventions between health care sector intervention and infrastructure interventions, which could sequence interventions (short and long term), poses another fundamental question. That infrastructure interventions try to achieve more than one objective at the time (see “Prioritization” above), which means that the cost-effectiveness per DALY saved includes the capital investment (for example, provision of clean water) that generates health benefits. Further analytical work is needed, therefore, to extract the health benefits associated with an infrastructure intervention and compare it with a health care sector intervention over the duration of the investment, for example, the difference in costs between an inefficient stove (wood or charcoal fueled) and an efficient one (gel-fueled stove) could help derive the net health benefits from an intervention and possibly the marginal effects on global warming associated with wood and charcoal fueled stoves.

**Concluding Remarks**

This first attempt at identifying environmental health externalities and formulating policy responses at the macro, sectoral, and project levels underscores the need to perform additional analytical and applied work to expand the understanding of the linkages between economic development, environmental, and environmental health concerns and social issues in an urban compared with rural setting. Mainstreaming environment health in sustainable development work is still a challenge due to the difficulties of fostering collaboration across sectors and forging partnerships with the private sector and stakeholders (see chapter on Ghana pilot) in this nascent field: additional efforts and commitments are required to address policy, institutional (need to designate a coordinating entity responsible for environmental health issues: environment and/or health), and market failures associated with environmental health effects. It is important to internalize the additional health benefits in economic analysis resulting from a preventive cluster of infrastructure intervention approach, which could have long-lasting outcomes on the burden of the poor and outweighs a recurrent curative health care system intervention approach. These clusters or bundling of infrastructure interventions would obviously need to complement necessary health care interventions, such as nutrition, immunization and AIDS. Environmental health interventions need to be closely monitored and possibly evaluated to establish a badly needed track record in this nascent field. This will allow sharpening and development of new instruments that will positively improve the well-being of the population, especially the poor.
Chapter 2 summarized the new approach to environmental health, harmonizing sectoral priorities, proposed in this discussion paper. Chapter 3 explored options for mainstreaming environmental health concerns at macro and sector levels by quantifying and valuing the environmental health burden of disease in SSA and prioritizing interventions. This chapter describes the environmental health assessment (EHA) process—a planning tool that helps prevent, mitigate, or manage health risks by evaluating environment-based risks and proposing remedial measures. The chapter then compares and contrasts two alternative approaches to completing a full EHA. Of these two, this discussion paper recommends the environmental health profile, whose preparation is detailed in chapter 5 and may also serve as a preliminary step to completing a full EHA. Chapter 6 presents two other alternatives, adapting an existing environmental assessment (EA) to serve as an EHA, as well as describes preparation of a complete EHA.

**An EHA is a planning tool that helps prevent, mitigate, or manage negative health risks by evaluating environment-based risks and proposing remedial measures.**

**An Overview of EHAs**

An EHA is not merely a health assessment within an EA, nor is it limited to pollution. It blends techniques from separate, but related fields, such as EAs, social impact assessments (SIAs), health impact assessments (HIAs), national or local environmental action plans (NEAPS/LEAPS), and comparative risk assessments of pollutants.

EHAs have no set definition or criteria, nonetheless, they may be confused with the other types of assessments and action plans (see box 4-1 and the glossary for terms used in environmental health assessments). Neither EHAs nor HIAs have gained as much acceptance as the EA process.

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**Box 4-1: Key, Confusing, and Misused Terms on Assessments and Plans**

*Environmental assessment.* Focuses broadly on the environment, not necessarily including human health, except sometimes for health analyses on pollution treatment.

*Environmental health assessment.* Blends an EA with a health impact assessment (HIA), but limited to curative or preventive measures in a sector. May cover socioeconomic groups, one or more sectors, a region, or a country.

*Health assessment (HA) or health impact assessment (HIA).* Focuses broadly on health effects. Tends to focus on measures of the health care delivery system. Does not necessarily analyze the natural environment or causes outside the health care system.

*Local environmental action plan (LEAP).* Applies an EA to the local level (see NEAP).

*National environmental action plan (NEAP).* Applies an EA to the national level (frequently in SSA countries).

*National environmental health action plans (NEHAPs).* A NEAP that takes health into consideration. Prepared by far fewer countries (mostly in Eastern and Central Europe) than NEAPs, because the overall EHA process is less widely implemented than the EA process.

*Poverty assessment (PA).* A tool developed for the World Bank, a PA provides the basis for a collaborative approach to poverty reduction by country officials and the Bank. It helps establish the agenda of
issues for the policy dialogue. The scope of the poverty assessment will necessarily vary across countries, depending on the country situation, the government’s commitment to poverty reduction, and the nature of available data.

**Risk assessment.** Assesses the risks of biological and chemical pollutants.

**Social assessment (SA) or social impact assessment (SIA).** Focuses broadly on socioeconomic issues with an emphasis on the community’s role in defining and solving problems. Does not necessarily deal with health or environmental issues.

**Comparative risk assessment** ranks actual risk from potential exposure to two or three pollutants or hazards. Does not look at the broad health context.

*Source: Authors’ data.*

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**Box 4-2: Clarifying the Objectives of Assessments and Projects**

Titles of projects, components, and assessments should clearly avoid implying that they are intended to improve environmental health conditions more than they are capable of doing. Many waste management and pollution abatement projects have been called “environmental,” for example, possibly implying that they address a broader range of problems than is feasible, practicable, or intended. If the assessment or project concentrates on pollution, the title should clearly state this. Using “environment” in the main title and “pollution” in the subtitle may help avoid misinterpretation and clarify whether the project consists of measures for pollution abatement and control or management (see box 1-1).

A project or assessment should also clearly define its pollution objectives to help identify other institutions or projects that could help secure these objectives. Transport projects, for example, can greatly contribute to reducing lead pollution, but cannot address the full range of lead sources, some of which may be more important local health problems than vehicle exhausts. An air pollution focus in the energy sector could easily neglect the health consequences of the absence of electricity, possible spread of vector-related diseases due to dams, physical stress and injuries from fetching large loads of biomass fuel, and possibly beneficial aspects of indoor air pollution in warding off mosquitoes in areas with malaria or protecting food stored in the home from insects. Projects or components that address these potentially neglected areas could easily strengthen their funding possibilities.

*Source: Authors’ data.*

The techniques used in EHAs are still evolving, and no standardized reference texts, outlines, formats, or procedures have been accepted as international norms for them. Because many EHA users will probably not have background in health or environment and possibly neither, an EHA, environmental health profile, or equivalent analysis should include background material that is easily skimmed and absorbed (i.e., avoiding technical jargon and complicated tables and calculations). The EHA should also:

- Provide the overall context
- Differentiate between direct and indirect (the latter sometimes being more important) and short- and long-term effects, as appropriate
- Illustrate the overall situation with descriptions of typical projects for the sector
- Explain linkages with other sectors
- Identify sources of information
- Clarify relevant institutional strengths and weaknesses
- Define terms
- Identify high-risk and vulnerable groups
- Describe special cases
- Identify any hot spots and key pollutants, as appropriate
• Make recommendations for remedial actions.

These points, explained in more detail in chapter 6, do not constitute an outline for an EHA, but indicate the types of information useful to decisionmakers for making informed choices on a full set of linkages. Examples of such information can be found in part II in sector-specific chapters covering agriculture and rural development (chapter 8), energy (chapter 9), environment (chapter 10), health (chapter 11), industry (chapter 12), infrastructure (chapter 13), and global issues (chapter 14).

**EHAs and Alternatives**

Five different approaches may be taken to identifying entry points or prioritizing environmental health collaboration, all based on or relating to an EHA. This discussion paper recommends conducting an *environmental health profile*, a technique developed for this discussion paper that assists the targeting process by generating a short list of important issues and directing funds for environmental health problems more precisely. Four other alternatives, however, may also be considered. The first three involve adapting existing assessments—environmental, health, or social—to serve as an EHA. The fourth involves conducting a complete EHA. The advantages and disadvantages of the five are detailed below. Disadvantages reflect difficulties in adapting an existing assessment to serve as an EHA and do not criticize the techniques themselves. It is expected that these disadvantages will diminish with time, as all the techniques are improved.

**Environmental Health Profiles**

Environmental health profiles (EHPs) can be largely compiled from existing information from several sectors and then reorganized for analysis by a multidisciplinary team through an environmental health review. Because not all projects need a full EHA or equivalent and no universally accepted standard for EHAs exists, EHPs can help interpret priorities for high-risk groups from different sectors, which can then be compiled into a short list of possible entry points. If further analysis is needed, an EHA focusing on specific issues can be undertaken later. EHPs are intended as *alternative*, not *additional* sources of information.

By avoiding having to generate new health analyses, EHPs save time and money that could be better spent on other tasks. EHPs also provide basic information that may later be used by a multidisciplinary team in an environmental health assessment should they decide one is still needed. EHPs are recommended, although not essential, preliminary step in preparing an EHA, because they:

• Increase the likelihood of including important linkages and key players omitted in single-sector analyses
• Identify priorities from other sectors that can serve as entry points for collaboration on environmental health
• Reduce the potential for inadvertent professional bias, which accentuates analysis from one discipline, while excluding equally important inputs from other disciplines.

EHPs would be one of only a few types of documents attempting to *integrate* materials from different sectors. Bank documents, in contrast, usually separate material on sectors into different chapters. Except for general economic analyses and poverty reduction work, few documents at the Bank integrate information or look for common problems among sectors.
Adapting an Existing Environmental Assessment as an EHA

The environmental assessment process has been well established in industrialized countries for at least thirty years. In that time, techniques have been perfected, regulatory measures have been developed stipulating when and how EAs should be conducted, and responsibility for protecting public health and safety has generally been vested in environmental authorities. Similarly, EA procedures have been adapted for use in developing countries for at least a decade. This collective experience is a considerable advantage and could be tapped to facilitate inclusion of health factors.

In contrast, current EA procedures do not systematically address health, whose inclusion is largely determined by the preferences of the EA team. This poses a range of disadvantages. EA techniques were originally developed to suit the needs of industrialized countries, where industrial and vehicular pollution are focal points of environmental health, a factor carried over into many training programs. Practitioners may, thus, not address infectious diseases such as respiratory or diarrheal infections appropriately as life threatening or may consider mosquito control as a nuisance rather than a source of malaria. (see box 1-5) or may assume a higher level of institutional capability than is available in developed countries.

Adapting an Existing Health Assessment as an EHA

In contrast with EAs, health assessments are tools currently under development. Adaptation would, therefore, depend on their availability. HAs would have a clear advantage by making health their focal point, identifying a wider range of health issues than would probably be available in an EA and, thus, a wider range of remedial measures and institutional interventions, for example, schools, that may be required to address health problems with multiple causes. HAs may also already contain much useful demographic information needed to determine risk groups or target interventions.

As HAs are much less common, they are at a disadvantage. HAs may concentrate on services of the health care system, rather than on other sectors, and preventative measures are likely to reflect pollution-related diseases. HAs may, consequently, miss opportunities for collaboration that would not be obvious to an EA practitioner without a health background or, conversely, find them too broad or ambitious to include as a component. An HA of a development project that would stimulate local population growth, for example, a dam, road, or new housing, may cite multiple disease risks without clarifying potential for contributions from other sectors. For example, a transport agency could address the risks of accidents for numerous reasons or of AIDS to or from truckers and implement preventative measures, but would not be able to address the potential increase in respiratory disease from population congestion.

Box 4-3 shows a sample outline of a health (or health impact) assessment. Box 4-4 shows a sequence of steps that could be followed to adapt an HA to an EHA.

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Box 4-3: Sample Outline for a Health Impact Assessment

**Introduction:** This states the purpose of the terms of reference, the type of product to be assessed, and the implementing arrangements for the health impact assessment.†

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* Examples of information available in health reports is detailed in chapter 5 “Health Profile.”
† Terms of reference will have already been prepared for the project in question.
**Background information:** This provides a project description including objectives, status and timetable, and project proponent. Related projects within the region must be identified.

**Objectives:** This states the general as well as specific objectives of the health impact assessment in relation to the project preparatory activities, such as feasibility studies (planning, design, and execution), and as part of an environmental impact assessment.

**Environmental requirements:** This section identifies regulations and guidelines that will govern the assessment, such as operational directives, national laws or regulations, regional or provincial regulations, and specific regulations of other funding organizations involved in the project. The requirement for health impact studies may be included in the EIA regulations.

**Study area:** This specifies the boundaries of the study for the assessment. It should include the human communities downstream and downwind of the project. The HIA boundaries could go beyond the EIA boundaries, which are usually the watershed or air shed.

**Scope of work:** The health hazards and communities that require particular attention are obtained from the “Initial Health Examination Summary Table.” The consultant could be asked to refine the scope of work for contracting agency review and approval. Other agencies may be invited to comment, and public meetings may be held.

**Health risk assessment:** The consultant will assess the health risk associated with each health hazard at each project stage. The assessment will include the following considerations:

- **Community vulnerability:** Identify the environmental factors that may contribute to an increase in health risk and define mitigating measures as input to project planning. Estimate the magnitude of the factors.

- **Environmental factors:** Consider the environmental factors that may contribute to an increase in health risk and define mitigating measures as input to project planning. Estimate the magnitude of the factors.

- **Capability of protection agencies:** Establish in more detail the capabilities of existing protection agencies, such as the environmental and health agencies with jurisdiction for the project site. The consultant should assess the limitations of existing data and recommend how to strengthen health information systems to meet requirements for health risk management.

- **Health risk management:** The consultant may be asked to formulate a monitoring program during the construction and operational stages, which includes a description of the work tasks; skills, tests, and interviews; frequency; institutional and financial arrangements; and justification and use of the monitoring data. The consultant should define safeguards and mitigating measures required as inputs to the feasibility study.

- **Context for health risk management:** Account should be taken of the availability of resources and funds, whether any interest groups are actively concerned about the project and its health impact, whether local environmental lobby groups exist, the attitudes of local authorities and government, and whether meetings have been held to promote changes in the project. Consideration should be given to any groups that may oppose change and any groups whose support could be obtained to increase the prospect of protective mitigating measures being applied.

- **Consultant requirements:** The consultant would ideally have previous experience assessing the health impacts of development projects. The consultant, however, must have specialist knowledge of the most significant health risks identified during the initial health examination. If diverse health risks were identified, additional consultants may be required with specialist knowledge of each.

- **Reports, duration and schedule:** This will specify the total period of the study, staff-months of experts, dates for consultation, periodic reports, and other target dates.

- **Other information:** This will provide the consultant(s) with preliminary information on data sources, background reports and studies, and other relevant publications.

**Source:** Birley (1995), pp. 31–33.
Adapting an Existing Social Assessment as an EHA

The field of social assessment (SA) has a slightly longer history than HAs, but is still new and evolving when compared with EAs. The main advantage of SAs stems from their origin within and concentration on issues pertinent to the community. As with an HA, an SA could have particularly useful demographic information about populations at risk and local institutions. This focus could be extremely helpful in defining remedial measures for which community support is essential. Social assessments, such as poverty assessments (see below), can contain key information to help health specialists prepare a response geared to local conditions. For example, a social assessment might reveal that fear of fires are a key neighborhood concern, a factor that would not necessarily be revealed in health statistics. Addressing fear of fires could have also served as an entry point for discussion of respiratory diseases due to cooking, heating, and lighting fuels, which the local population might not realize are linked to fuels and stoves (partly because they are used to smoke-filled rooms).

The disadvantages arise from a lack of attention to environmental health issues. In many instances, the community may not understand the technical dimensions of risks, except in cases of epidemics or high pollution levels. For example, at the beginning of the International Drinking Water Supply and Sanitation Decade (1970s), the link between high infant mortality and diarrheal diseases was poorly appreciated and diarrheal diseases were considered part of normal childhood. Since that time, hygiene education has become integrated into water and sanitation sector programs.

Adapting an Existing Poverty Assessment as an EHA

Poverty assessments focus on the specific determinants of poverty (OP 4.15) and the design of targeted solutions. In countries where data are not available, analysis in the poverty assessments will necessarily be more qualitative. While preparing a PA, a critical need exists to fully understand the significance, impacts, and linkages of environmental, environmental health, and health issues on the well-being, livelihoods, and development options of the poor. A first step would

Box 4-4: Sample Sequence of the EHIA Process

Step 1: Assessment of primary impacts on environmental parameters
Step 2: Assessment of secondary and tertiary impacts on environmental parameters
Step 3: Screening of impacted environmental parameters for health significance (identification of environmental health factors). Preliminary identification of environmental health impacts
Step 4: Prediction on how project will affect exposure of populations to environmental health factors
Step 5: Prediction of how project will affect size of health risk
Step 6: Computation of predicted health impacts in terms of mortality and morbidity, if possible
Step 7: Definition of significance and acceptability of adverse health impacts
Step 8: Identification of mitigation measures to prevent or reduce significant adverse health impacts
Step 9: Final decision on whether or not the project should proceed

require identifying the major (top ten) diseases and apportion the environmental health burden of disease borne by the poor. A second step would require determining institutional, financial, and partnership (public-private-stakeholder) strengths and weaknesses to devise a pro-poor cluster of infrastructure interventions (see chapter 3). These interventions would, in turn, complement necessary health care interventions, such as nutrition, immunization, and AIDS prevention. Com-pounded health benefits could accrue to the poor at risk, and outcome-based results could be monitored and achieved.

Poverty assessments can also provide a wealth of socioeconomic data that can be helpful for health specialists to interpret. For example, levels of economic development, quality of housing, access to basic services, availability of radios or televisions, number of people wearing shoes. All of these can be linked with malnutrition, diarrheal and respiratory diseases, intestinal worms, and so on.

The disadvantages would be similar to those for a social assessment in that the information provided may not deal with environmental health issues.

**Conducting a Complete EHA**

The main advantages of conducting a complete EHA are that it would analyze the problems and propose solutions in an appropriately broad context. These are addressed in the overview to this chapter and chapter 6.

Disadvantages include cost, absence of current procedures, and the need for a multidisciplinary team. Moreover, interagency collaboration is difficult, because of the full range of factors described in chapter 1. In addition, current procedures, developed in industrialized countries, tend to focus on chemical and biological pollution and need to be adapted to conditions of developing countries, where, for example, indoor air pollution and vector-related diseases are far more important than in developed countries.
CHAPTER 5: PREPARING AN “ENVIRONMENTAL HEALTH PROFILE”

An environmental health profile (EHP), as stated earlier, is a new technique proposed in this volume and presented as either an alternative or preliminary step to an EHA. The technique essentially involves a cut-and-paste desk review—not new research—that looks at priorities in other sectors. The result is a short list of significant potential health problems on which to base action.

A multidisciplinary team drafts an EHP by first compiling sectoral profiles as background information and then analyzing the data for sectoral linkages. Sectoral profiles facilitate the EHP process by (a) noting key players and stakeholders for individual sectors who may be the same for environmental health, (b) facilitating intersectoral collaboration within agencies, and (c) helping to make decisions using incomplete data.

The multidisciplinary team may confront two complementary problems in preparing these profiles: a paucity of reliable data on environmental health and staff without background in environment or health. This chapter and the next help address these difficulties by identifying existing sources of data in World Bank documents from several sectors or similar sources in bilateral or government agencies, reducing the need for basic research or data gathering. The team then “cuts and pastes” from these different reports, helping to compensate for the team’s lack of specialization in health and environment. Analysis of the information, however, does require such background. Joint discussion and analysis may help somewhat to overcome this deficiency. In this way, an environmental health profile may be prepared by sectoral specialists not used to working with information outside their own sector, or, especially in the Bank, by economists who work on poverty reduction without focusing on any one sector.

Table 5-1 lists sectoral priorities for Ghana, illustrating how existing information can help set a short list of priorities. Table 5-2 provides sample sectoral problems and strategies and actions from Ghana. Its first two columns provide a sample of material drawn from sectoral reports on Ghana. “Possible Entry Points” (column 3) is new information presented in this volume. Both tables summarize information an example of an EHP for Ghana (see table 15-1) and a sample set of sectoral profiles for that country, cut and pasted from Bank and Ghanaian materials.

This short list of issues and priorities (EHP) is the basis for developing a strategy or plan of action. This could take several forms, depending on the EHP’s findings and local circumstances, such as an institutional needs assessment, risk assessment of different pollutants, or first draft of a broader analysis, such as an EHA. Based on the Ghanaian profiles, it was decided that the most appropriate follow-up was an institutional needs assessment (see chapter 16).

Sectoral profiles can sometimes furnish as much, if not more, information than a field mission. Their analysis can, at a minimum, identify a short list of information gaps or issues to be raised during a mission. This kind of preparation is virtually standard operating procedure for a single sector. The difference is that review for an EHP is multisectoral and may require tapping different and less obvious resources. Within the Bank, the CAS provides a useful comparison of sectoral priorities, but does not necessarily weave them together, except at the macroeconomic level. It is, therefore, appropriate to prepare profiles from each of the sectors. Sources of information for these profiles include project appraisal documents (PADs), implementation completion reports (ICRs), project information documents (PIDs), country poverty strategies (CPSs), the newly initiated poverty reduction strategy papers (PRSPs), the country development framework (CDF), and various other sectoral reports accessible through the Bank’s web sites.
Table 5-1: Summary of Sectoral Problems, Strategies, and Actions for Ghana

<table>
<thead>
<tr>
<th>Main Problems</th>
<th>Strategies and Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environment</strong></td>
<td><strong>Environment</strong></td>
</tr>
<tr>
<td>- Water supply: limited access, water-related diseases, and water balance</td>
<td>- Natural resource management: sustainable supplies of fuel wood, pesticide control, and water master plans for all river basins</td>
</tr>
<tr>
<td>- Urban decay: lack of adequate roads, sanitation, and waste disposal</td>
<td>- Institutional reform: institutional structure for integrated land use planning, and sectoral and interagency coordination</td>
</tr>
<tr>
<td>- Energy needs: increased energy requirements (80 percent from wood fuels)</td>
<td>- Environmental monitoring: environment- and health-related indicators</td>
</tr>
<tr>
<td>- Land and coastal degradation, due to deforestation, mining, and waste disposal</td>
<td>- Built environment management: post-audits on industries, and standard and regulation enforcement</td>
</tr>
<tr>
<td>- Pollution: quality of air, water, soil, and life is affected by industries and agrochemicals</td>
<td></td>
</tr>
<tr>
<td><strong>Health</strong></td>
<td><strong>Health</strong></td>
</tr>
<tr>
<td>- Access to health care constrained by geographic distances and financial barriers</td>
<td>- Prioritizing health services for maximum benefits in terms of morbidity and mortality reduction</td>
</tr>
<tr>
<td>- Poor community, intersectoral, and private sector linkages</td>
<td>- Empowering households and communities to take more responsibility for their health</td>
</tr>
<tr>
<td>- Prioritizing health services for maximum benefits in terms of morbidity and mortality reduction</td>
<td>- Promoting intersectoral action for health development particularly in the area of water and sanitation</td>
</tr>
<tr>
<td><strong>Agriculture</strong></td>
<td><strong>Agriculture</strong></td>
</tr>
<tr>
<td>- Poor basic infrastructure and support services</td>
<td>- Diversification of agricultural exports and improvement of public investment in rural infrastructure</td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td><strong>Infrastructure</strong></td>
</tr>
<tr>
<td>- Inefficient and insufficient infrastructure services in telecom, power, rails, ports, urban water supply, airports, and roads</td>
<td>- (See subsectors below)</td>
</tr>
<tr>
<td><strong>Urban Development</strong></td>
<td><strong>Urban Development</strong></td>
</tr>
<tr>
<td>- Water supply, sanitation, urban roads and traffic, and others are a major constraint on urban productivity in Ghana</td>
<td>- Traffic management, storm drainage to alleviate flooding, comprehensive sanitation services by the year 2005 (prepared by metropolitan assemblies), direct septage hauling and solid waste collection turned over to operators, and properly engineered sanitary landfills built</td>
</tr>
<tr>
<td><strong>Water Supply and Sanitation</strong></td>
<td><strong>Water Supply and Sanitation</strong></td>
</tr>
<tr>
<td>- Inadequate access to safe potable water and sanitation</td>
<td>- Private concessions in cities (see rural development)</td>
</tr>
<tr>
<td><strong>Transport</strong></td>
<td><strong>Transport</strong></td>
</tr>
<tr>
<td>- Deterioration of the transport network</td>
<td>- Rehabilitation and maintenance of the road network, new institutional setup and financing mechanism (road fund), and private sector development includes small and labor-intensive contractors for upkeep</td>
</tr>
<tr>
<td><strong>Rural Development</strong></td>
<td><strong>Rural Development</strong></td>
</tr>
<tr>
<td>- Poor rural infrastructure, inadequate rural industrialization and off-farm processing</td>
<td>- Rural infrastructure facilities development in a more integrated manner, and mitigation measures in semi-urban mining towns</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td><strong>Energy</strong></td>
</tr>
<tr>
<td>- Energy (electric and fuel wood) production and distribution are inefficient</td>
<td>- Sustainable supplies of fuel wood</td>
</tr>
<tr>
<td><strong>Industry</strong></td>
<td><strong>Industry</strong></td>
</tr>
<tr>
<td>- Concentration of industries in coastal zones, and emissions and effluents unmonitored</td>
<td>- Emissions and effluents monitoring</td>
</tr>
<tr>
<td><strong>Poverty Reduction</strong></td>
<td><strong>Poverty Reduction</strong></td>
</tr>
<tr>
<td>- One-third of the population is below the poverty line (1991–92), and one-quarter of the Accra population is poor.</td>
<td>- Poverty reduction policies, monitoring and dialogue, and increased public expenditure on targeted poverty reduction schemes</td>
</tr>
</tbody>
</table>

### Table 5-2: Sample Sectoral Problems and Strategies/Actions from Ghana

<table>
<thead>
<tr>
<th>Main Problems</th>
<th>Strategies/Actions</th>
<th>Possible Entry Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Poverty Reduction</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| • One-third of the population is below the poverty line (1991–92).  
• One-quarter of the Accra population is poor. | • Poverty reduction policies, monitoring, and dialogue  
• Increased public expenditures on targeted poverty reduction schemes | • Economic analyses that explore health benefits outside health care system  
• Reexamine economic indicator analyses from health perspective. For example, could absence of shoes and radios be linked to malnutrition and intestinal worms? |
| **Agriculture and Rural Development** | | |
| • Poor basic infrastructure and support services  
• Poor rural infrastructure  
• Inadequate rural industrialization/off-farm processing | • Diversification of agricultural exports and improvement of public investment in rural infrastructure  
• Rural infrastructure facilities development in a more integrated manner  
• Mitigation measures in semi-urban mining towns. | • Links between diversified crops to health outcomes, related to erosion, pesticide use, and irrigation  
• Links between rural infrastructure and vector-borne diseases  
• Links with transport, air pollution and occupational hazards from mining |
| **Energy** | | |
| • Energy (electric and fuel wood) production and distribution are inefficient | • Sustainable supplies of fuel wood | • Links with indoor air pollution and fuel use, and erosion from denudation |
| **Environment** | | |
| • Water supply: Limited access, water-related diseases, and water balance  
• Urban decay: lack of adequate roads, sanitation, and waste disposal  
• Energy needs: increased energy requirements (80 percent from wood fuels)  
• Land and coastal degradation due to deforestation, mining, and waste disposal  
• Pollution: the quality of air, water, soil, and life is affected by industries and agrochemicals | • Natural resource management: sustainable supplies of fuel wood, pesticide control, and water master plans for all river basins  
• Institutional reform: institutional structure for integrated land use planning, and sectoral and interagency coordination  
• Environmental monitoring: environment- and health-related indicators  
• Built environment management: post-audits on industries, and standard and regulation enforcement | • Links with (a) indoor air pollution and fuel use, and erosion from denudation, (b) pesticide use, and (c) vector-related diseases  
• Economic analyses to show benefits of mutual collaboration in agencies working on the same problem  
• Develop proxy indicators for health  
• Economic analyses to create incentives for pollution reduction |
| **Health** | | |
| • Access to health care constrained by geographic distances and financial barriers  
• Poor community, intersectoral, and private sector linkages | • Prioritization of health services with maximum benefits in terms of morbidity and mortality reduction  
• Empowering households and communities to take more responsibility for their health.  
• Promoting intersectoral action for health development, par- | • Explore benefits of interventions outside health care system for urban malaria and medical waste disposal |
<table>
<thead>
<tr>
<th>Main Problems</th>
<th>Strategies/Actions</th>
<th>Possible Entry Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>particularly in the area of water and sanitation</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Industry</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Concentration of industries in coastal zones</td>
<td>• Emission and effluent monitoring</td>
<td>• Find proxies to monitor pollution, and promote home monitoring kits to help public do some monitoring</td>
</tr>
<tr>
<td>• Emissions and effluents un-monitored</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Infrastructure (General)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Inefficient and insufficient infrastructure services in telecom, power,</td>
<td>(see subsectors below)</td>
<td>(see subsectors below)</td>
</tr>
<tr>
<td>rails, ports, urban water supply, airports, and roads</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Infrastructure: Urban Development</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Water supply, sanitation, urban roads and traffic, and other factors as a</td>
<td>• Traffic management</td>
<td>• Protective gear for traffic managers</td>
</tr>
<tr>
<td>major constraint on urban productivity in Ghana.</td>
<td>• Storm drainage to alleviate flooding</td>
<td>• Calculate benefits of reducing vector-related diseases</td>
</tr>
<tr>
<td></td>
<td>• Comprehensive sanitation services by the year 2005 to be prepared by Metropolitan</td>
<td>• Link with drainage services to show benefits of combined approach</td>
</tr>
<tr>
<td></td>
<td>Assemblies</td>
<td>• Make protective gear available and create incentives for proper disposal of medical waste</td>
</tr>
<tr>
<td></td>
<td>• Direct septage hauling and solid waste collection turned over to operators and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>properly engineered sanitary landfills to be built</td>
<td></td>
</tr>
<tr>
<td><strong>Infrastructure: Water Supply and Sanitation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Access to safe potable water and sanitation is inadequate</td>
<td>• Private concessions in cities</td>
<td>• Make sure to include incentives to protect purity</td>
</tr>
<tr>
<td></td>
<td>(see above for rural areas)</td>
<td></td>
</tr>
<tr>
<td><strong>Infrastructure: Transport</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Deterioration of the transport network</td>
<td>• Rehabilitation and maintenance of the road network</td>
<td>• Link with health benefits of traffic safety</td>
</tr>
<tr>
<td></td>
<td>• New institutional set up and financing mechanism (road fund)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Private sector development that includes small and labor-intensive contractors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>for upkeep</td>
<td></td>
</tr>
</tbody>
</table>


**Preparing Sectoral Profiles**

It is important to provide the environmental health assessment team a broad picture, which is so essential for decisionmaking. This section outlines typical content for each sectoral profile, providing a representative sample of useful material on environmental health that could be drawn from sectoral reports. The cross-sectoral tables and analyses of linkages provided in chapters 8–14 also suggest important points for follow-up. In some cases, cutting and pasting from the report’s executive summary or introduction may suffice. It is possible that the first draft, which combines unedited material from a variety of sources, may reach 50–100 pages. This should then be cut down to a working reference document of about 20–25 pages or about 3–5 pages per sector.
Box 5-1: A Word of Caution

Because a team representing different disciplines will use the sectoral profiles, it is important that the material be excerpted intact and not summarized. Summary and analysis constitute the next step (see below). Following this advice avoids incorrect rendition of technical terms that carry weighted meanings, often with policy implications within their profession, but not necessarily in common usage. Examples are “privatization,” “risk,” “research,” “sewerage,” “management contracts,” “fertilizer,” “operation and maintenance,” “economic analysis,” and so on.

Source: Authors’ data.

The profile development process outlined below represents two categories of information:

- **Individual sectors.** Information on the following is generally available in sectoral reports:
  - Agriculture and rural development
  - Energy
  - Environment
  - Health
  - Industry
  - Infrastructure.

- **All sectors.** Information on the following cuts across several sectors and may need to be gathered from several reports:
  - Urban and rural (demographic)
  - Institutional
  - Development assistance
  - Poverty reduction.

Each area covered below includes a few examples of the types of information that should be culled from reports.

**Poverty Profile**

The process should begin with a poverty profile that defines poverty in local terms, indicates its breadth within the local population, and identifies any particularly disadvantaged segment of the population. Figures, such as employment rates, salary ranges, levels of schooling and housing, access to water, sanitation, and medical care, should be cited. Much socioeconomic information could be useful to health specialists in identifying problems not readily apparent to those who compiled data. Absence of shoes, for example, could indicate infestations with intestinal worms, a widespread problem, which is often not reported in statistics, because mortality is low. Numbers of radios and televisions might indicate the difficulty in health outreach in targeting key audiences for diseases, such as AIDS, tuberculosis, or cholera. Identifying the needs of vulnerable groups should be emphasized more than compiling data. If data are not available at the local level, some indication of the buying power for food staples, housing, clothing, and other basic needs would be useful. A poverty profile should also reflect the views of the local population on their problems and proposals for solutions. Local views are important in determining perceptions of risks of environmental and health issues, which vary enormously by culture, religion, and socioeconomic status.

**Agriculture and Rural Development Profile**

Analyses of agriculture and rural development contain a wealth of information about rural-urban population movements, rural infrastructure, overall nutrition, and so on. In SSA, agriculture sector reports may fill in some of the gaps on periurban areas, especially because SSA is expected to undergo rapid urbanization. Agriculture reports can also help explain the spread of malaria.
**Agroindustry.** Agroindustry patterns can help explain some urban-rural mechanics and waste handling issues and identify potential risks from chemical exposures in the air shed or watershed of the plant and, likewise, in dust.

**Irrigation.** An understanding of irrigation activities can help determine the potential of agriculture projects to control or promote water-related and vector-related diseases.

**Food security.** Food security issues are frequently dealt with in agriculture reports and provide excellent background on overall nutrition-related issues. Food security analyses, however, do not necessarily delve into contamination of the food chain by pesticides and fertilizers.

**Energy Profile**

An energy profile can point out the potential for indoor and outdoor air pollution and for illness related to transport or household energy use. The profile can also identify high-risk groups, the potential contribution to climate change and global warming, and more. Possible health problems depend, in large measure, on the use of traditional or modern fuels.

**Traditional energy.** The degree of dependence on traditional energy can indicate (a) potential respiratory problems because wood, fodder, charcoal, and so on are more hazardous to humans than modern fuels (e.g., gas and oil) and (b) occupational hazards, for example, physical stress from collecting fuel and high pollution exposure when preparing and bagging charcoal.

**Modern energy.** The degree of modern energy use can indicate the type of ambient air pollution. Environmental health issues, however, tend to focus on ambient air pollution and often neglect indoor air pollution.

**Dams and irrigation.** Dams for power or irrigation can promote the spread of vector-related diseases such as malaria, which is spread by mosquitoes, or schistosomiasis, which is spread by snails. Consultant teams from industrialized countries sometimes inadvertently omit these factors in environmental assessments. Vector-related diseases in industrialized countries have largely disappeared, or vectors such as mosquitoes have become “nuisances” more than health problems and, therefore, often dropped from EA methodologies.

**Environment Profile**

An environment sectoral profile can provide a wide range of information that might not be available in health reports. Such information might include demographics, flora and fauna, climate and weather, topography, transportation networks, pollution levels, land use, housing patterns, energy consumption, health risks and responsibilities, and so on. All this information can be linked to disease transmission, but is not necessarily analyzed as such in typical health reports. Overall priorities are best designated, if possible, as general goals or as actual (budgeted) programs within a time frame. Environmental priorities are especially useful in determining the number of programs that can complement or compete with environmental health.

**Demographics.** Demographic information in an environmental report may include geographic population distributions, population movements, urban-rural migration, and so on. A health report, in comparison, might contain much of this information, but emphasize age and sex distributions and the availability of medical care. Demographic information may appear in a variety of sources other than environmental reports.
CLIMATE, WEATHER, AND GEOGRAPHIC FEATURES (e.g., flora, fauna, and topography). Climate and weather information can be essential in helping combat vector-related diseases by predicting their possible increase. This is because habitats of vectors (e.g., mosquitoes, flies, other insects, snails, rats, and other rodents) vary depending on temperature, humidity, and rainfall. In addition, information on climate can help communities prepare for reducing death and injury from storms, floods, heat waves, and so on.

Pollution. Understanding pollution is important from several perspectives. Often overlooked is its psychological value. Because public awareness of pollution is generally high, addressing pollution can provide an important rallying point, around which to promote other less visible or well-understood health factors. Looking at how different sources of pollution have been addressed, for example, solid waste, water, indoor and outdoor air, also measures local institutional capability to collaborate cross-sectorally. If pollution sources are varied, for example, for lead, it may be appropriate to clarify which ones are or are not being addressed in the project.

Health risks and responsibilities. It is appropriate to touch here on (a) the type and probability of health risks and (b) institutional responsibility for addressing them or subsequent damages. If appropriate, this should include practices such as indiscriminate dumping of wastes with potential health risks, for which no agency is clearly responsible. Although it may not be possible at this stage to get accurate information, identification of risks and responsibilities can help identify the range of stakeholders that should later be involved.

Box 5-2: A Note on Sub-Saharan Africa

The Bank has required all International Development Agency (IDA) borrowers, which includes all of SSA except South Africa, to prepare NEAPs. In SSA, therefore, it might be best to research the environment sectoral profile first, because a NEAP and EAs are likely to exist, and health assessments or other environmental health analyses are still not systematically prepared.

Source: Authors’ data.

Health Profile

A health profile can provide useful information on disease patterns, the overall importance of health problems, high-risk groups, concentration or dispersal of causes of health problems, and, above all, the potential to complement efforts to improve health outside the health care system. Identifying priorities of the ministry of health is crucial for understanding where environmental health improvements inside and outside the health care system can complement or compete with activities outside the health care system. It is also helpful to note if priorities are considered overall goals or budgeted time-bound programs and to determine how these priorities address the top ten causes of morbidity and mortality.

The top ten causes. A health profile should list at least the top ten causes of morbidity, mortality, and injury for the country or, preferably, the project area in question and identify any special circumstances or programs. The top ten along with government priorities can together help determine which of the most serious problems lend themselves to remedial measures outside the health care system.

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* IDA is one of five agencies that make up the World Bank Group, which also includes the International Bank for Reconstruction and Development (IBRD), International Finance Corporation (IFC), Multilateral Investment Guarantees Agency (MIGA), and International Center for Settlement of Disputes. IDA lends to the poorest countries, that is, those with a per capita GNP of less than US$800. The credits are, in effect, interest free. All SSA countries, except South Africa fall into the IDA lending category.
care system. A top ten list can also help identify needed agencies or specialties and, in turn, opportunities for adding components to other programs and attacking a problem from several angles.

Special problems. Identification in the profile of special problems or programs is important for many reasons, irrespective of their link to environmental health. For example, AIDS programs may have enormous budgetary implications and reduce the availability of resources within the health ministry for other health problems. Alternatively, because guinea worm is on the verge of eradication, it makes sense that every effort be made to ensure successful eradication, even through small components in rural projects might normally not address guinea worm.

Box 5-3: Truckers in SSA and AIDS

In SSA, truckers play a crucial role in spreading AIDS. Professional trucking groups could be tapped as a means to bring curative and preventative care to this high-risk group, as well as educate the public. Similarly, because malaria is “urbanizing” in SSA, infrastructure engineers could be tapped to adapt rural approaches to urban drainage and waste management.

Better Health in Africa has identified six categories, each comprising about 10 percent of the SSA burden of disease (see table 1-3): malaria, respiratory infections, diarrheal diseases, childhood cluster, HIV/AIDS, other sexually transmitted diseases (STDs), and injuries. These might be a useful starting point for the analysis, if a “top ten” list is not available.

Source: Authors’ data.

Data biases toward mortality. Typical morbidity and mortality data tend to underreport conditions related to environmental health. Health data, especially in SSA, more accurately reflect mortality than morbidity or injuries, because deaths are reported more systematically. Environment-induced diseases tend to manifest themselves as chronic, long-term conditions, except in extreme cases such as natural disasters or road fatalities (see box 5-4 and discussion on disability in chapter 1.)

Box 5-4: “Drop-Dead” Data

Decisionmakers outside the health care system need help in prioritizing remedial measures to health problems because traditional health data do not reflect causes or solutions. Health-related policy is still heavily influenced by death rates. Some critics have referred to this as reliance on “drop-dead” data. In reality, long-term disability is more significant and tends to be underrepresented for environment-related diseases, even by disability-adjusted life years (see chapter 1). For example, the ratio of disability to death measurements for developing countries is twice that of the developed countries, that is, 27.8 percent compared with 13.5 percent (see table 7-4). Indeed, disability due to intestinal worms, still a widespread problem in developing countries, is seldom even listed, because mortality from it is so low. Yet, the years lived with disability for this affliction are triple those from malaria.

Source: Authors’ data.

High risk groups. Four groups to examine, because they tend to be most vulnerable or at high risk are women, children (especially under five), the elderly, and workers. Separate data for these groups may not be available for the project area, but, suitable demographic information might be available in other project files or reports such as EAs.
Private sector activity. The strength or weakness of private sector healthcare givers can identify an important audience for remedial measures, especially when private sector activity occurs in the “murky sector,” as is so common in SSA. The data can also identify potential networks for promoting solutions, particularly through avenues of traditional medicine.

Health agency structure. An “organogram” (organization chart) would help determine the range of possible offices with which to establish contact for multisectoral programs.

Industry Profile

An industrial profile can help establish the relative importance of occupational hazards and pollution levels and the institutional capability to promote regulatory measures. The absence of widespread public health infrastructure, such as “health rooms,” health insurance, enforceable health and safety standards often means that health problems normally considered “occupational” become widespread public health hazards.

Privatization. The degree that public services are privatized may indicate potential health problems from business practices and policies that do not consider health consequences of their operations.” Neglect of health factors can also occur in government-run entities. The difference is one of degree and whether businesses automatically address health dimensions beyond those of safety.

Industrial size. The proportion of small-, medium- and large-sized industries can help determine the degree to which occupational health and safety problems may become widespread public health problems. In general, the larger industries, especially if owned by expatriate countries with strict environmental regulation, are likely to be less hazardous to workers because they are more likely to implement occupational health and safety measures. The reverse can, however, be true if foreign firms move operations to developing countries to escape the stricter environmental regulations of industrialized countries. In comparison, large “responsible” industries can also play an important role in health education or funding worthy causes that promote their image.

Industry type. The type of industry can determine the nature of health problems and high-risk groups. Agriculture, for example, entails exposure to vector-related diseases, pesticides, and fertilizers and sometimes dangerous machinery, depending on the local culture, for young to middle-aged males or females. In comparison, electronics industries are more likely to be hazardous to women, who are often subjected to solvent fumes. The two industries would have widely different risk groups and remedial measures.

Infrastructure Profile

An infrastructure profile can help establish a wide range of problems and solutions because of the broad set of subsectors involved: drinking water, sanitation, drainage, solid waste, housing, urban development, transportation (all modes), and telecommunications. Planning for these interlinking subsectors is, regrettably, not necessarily coordinated. Looking at priorities for all these subsectors at the same time could strengthen information on reducing diarrheal, respiratory, and vector-related diseases and injuries.

* “Private sector” and “privatization” can mean either privatizing health care or privatizing public services that may have health repercussions. In this case, the latter is intended.
Demographic information (see also “demographic profile” below). Demographic information presented in an infrastructure report could contain useful material on remedial measures pertinent to the environment, which might not be considered in analyses of population movements in other reports such as health or education.

Pollution levels (see also “environment profile” above). Pollution information presented in an infrastructure report could contain useful material on remedial measures pertinent to the environment that may not be considered in analyses of pollution in other reports. Reports on industry, for example, may concentrate on industrial pollution abatement at the source and not surrounding areas.

Levels of service. The level of service in providing drinking water (e.g., household compared with communal taps), can be an important indicator on diarrheas. Similarly, the adequacy of housing can relate to the extent of respiratory disease, although this link has not been statistically proven to the same degree as that of adequate quantities of safe drinking water with diarrheas.

Geographical features. (See also “environment profile” above.) Basic geographic information can help determine the risks of flooding or landslides. These events can be exacerbated in areas of marginal economic value, because the poor tend to live and work in such areas. Geographical analysis can also help identify relative risks and exposures to vector-related diseases, such as malaria and dengue.

Demographic Profile

Depending on information available from environmental reports, a demographic profile could help identify and prioritize vulnerable groups and high risk areas. The information would probably have to be culled from a combination of the sectors outlined in this chapter, in addition to education reports or, if available, a recent population census. A demographic profile should include overall levels of urbanization, land use characteristics, density, levels of periurban agriculture, local definition of “urban,” “suburban,” “periurban,” and “rural” population movements, and age and sex distribution.

The process of “social assessment” is currently increasingly being employed in Bank projects. If a social assessment has been conducted, it may not be necessary to compile additional demographic information (see also the sample needs assessment for Ghana in chapter 16).

Institutional Profile

The institutional profile can help determine the strengths and weaknesses of a multisectoral program. Useful information would include the overall organization of government agencies, their jurisdictions and responsibilities, an organogram, and, if possible, an assessment of various priorities and capacities to meet the legal responsibilities and stated priorities of the agencies involved. This could be helpful in determining the capability and willingness of different agencies to collaborate on multisectoral programs. During the regional cholera epidemic in Latin America of the 1980s, for example, Mexico devised a rapid response program by putting the water agency in charge of emergency services (e.g., providing or chlorinating water to villages) and the health agency in charge of publicity and communications.

Development Assistance Profile

The Development Assistance Profile is useful to understanding the multisectoral involvement and priorities of the aid community, especially the difference between loans and grants. If possible,
the profile should also clarify whether aid agencies have any sectoral or geographic priorities. Such priorities can be instrumental in finding complementary funding for the types of issues that fall between the cracks in a single sector analysis. Agencies funding transport improvement, for example, can do an excellent job on reducing air pollutants such as lead, whereas other sources of lead pollution may be neglected because they fall under the purview of several other ministries. (See table 7-4 for multiple sources of lead.)

Within the Bank, the CAS will probably be the most useful document in which to list potential involvement of different agencies, because it summarizes well the macroeconomic situation in the country as well as sectoral issues.

Analyzing the Data

The data compiled from the above profiles should be reviewed from several perspectives—disciplines that should ideally be represented on the environmental health assessment team, for example, public health or epidemiology, sociology or anthropology, economics, environment, and infrastructure. The value of the exercise lies in its multidisciplinary analysis, that is, demonstration of the interdisciplinary nature of environmental health problems. No set outline for the results is presented here as the results may vary depending on synergy from the discussion. Three examples from World Bank activities indicate the kind of revelations provided by multidisciplinary analyses.

- **Interpreting the same data from several perspectives.** Under poverty reduction analysis, an economist might cite the absence of shoes or radios as an indicator of economic benefits not trickling down to the poor. A public health specialist, in contrast, might interpret the absence of shoes as a risk factor in houses with dirt floors, poor hygiene, and inadequate water and waste disposal. The latter might indicate the possibility of intestinal worms, which penetrate the feet. The absence of a radio would indicate difficulty in reaching the poor to promote basic health hygiene, especially during flooding from heavy rainfall or an epidemic.

- **Uncovering potential cross-sectoral conflicts.** Energy and environmental goals may compete with public health goals. Tobacco production in SSA is a major foreign exchange earner. While environment staff were preparing a “best practice” note on more energy-efficient ways to cure tobacco, health staff were preparing a similar note advising staff that the Bank should not lend for tobacco because tobacco smoking exacted a high toll on human health. Discussions on the topic also heightened awareness that tobacco growing is “unhealthy” because of its heavy reliance on pesticides. Potential health and environmental damages from pesticide use and disposal would ideally be included in economic analyses of crops.

- **Increasing economic benefits.** A multisectoral approach can capture additional benefits from one project. Urban drainage might include malaria reduction among its health and economic benefits, because it eliminates breeding grounds. The same drainage measures could also reduce breeding sites of other mosquitoes that spread diseases such as dengue and filariasis. Similarly, rural irrigation and drainage measures may also reduce schistosomiasis (spread by snails, which breed in river banks and drainage canals).
Box 5-5: Employing an EHP in Ghana

Chapters 15 to 17 provide details on how an EHP in Ghana helped integrate three environmental recommendations into an existing project and list seven more priorities for eventual consideration in upcoming projects. The Bank’s Urban Environmental Sanitation project deals with Ghana’s top five largest cities. The process, from preparing the EHP to making recommendations to the projects, took about 6 months, beginning with a desk study in Washington to cull information from existing Bank and Ghanaian reports. With an idea of multisectoral problems and government priorities, three entry points were chosen (urban malaria, proper management of waste from health care facilities, and interlinkages among water, sanitation, and drainage) as the basis for an institutional needs assessment, which was first intended to test whether the local community agreed with these entry points as serious problems and then determine the institutions to involve in their resolution. This was followed by a three-day local workshop of about forty people from the institutions identified. The first day of the workshop focused on identifying the range of solutions needed to solve the problems. The second day of the workshop, attended by about 10 of the participants, focused on prioritizing the solutions and formulating them into practicable recommendations. These recommendations were presented on the third day to a meeting of the donor community.

A second one-day workshop was eventually held, involving representatives of the four other cities under the project, to examine whether the circumstances in their cities were similar enough to take advantage of the EHP and workshop to modify it and personalize it to all five cities. The participants agreed and then adapted the institutional needs assessment to include the names of their own institutions for the institutional needs assessment as well as the recommendations. The five cities, thus, expanded the initial entry points to a set of ten priorities and agreed on the top three to present to the project management. For the future, a list of ten priorities reflecting community ideas was prepared in the next six months. Costs were minimized by relying on the EHP as a desk study to arrive at a short list of issues and by maximizing the use of local consultants to prepare the needs assessment and organize and conduct the workshop.

EHPs help establish intersectoral problems and priorities, whereas social and environmental health mapping can help identify populations at risk. Like the profiles, environmental and social mapping can be compiled from existing information sources, with one important exception, GIS technology.

In the Ghana case study, social mapping was used to identify low-income groups living in high-risk areas for vector-related diseases, that is, malaria, schistosomiasis (bilharzia), and guinea worm, combined with the different remedial measures needed to combat the disease (see map 5-1). The map was particularly helpful in facilitating interagency collaboration, because the administrative area for the pilot study, Sekondi-Takoradi, one of Ghana’s top five largest cities, is actually an amalgam of rural and urban areas.

Source: Authors’ data.
Map 5-1: Environmental Health Needs Assessment Map for Sekondi-Takoradi, Ghana
CHAPTER 6: ADAPTING ENVIRONMENTAL ASSESSMENTS OR PREPARING ENVIRONMENTAL HEALTH ASSESSMENTS

For reasons explained in chapter 4, at some stage, multisectoral teams may decide to prepare a complete environmental health assessment, whether as a first step or following preparation of environmental health profiles. As outlined in chapter 4, two approaches exist: (a) adapting an existing environmental, health, social, or poverty assessment to serve as an environmental health assessment and (b) conducting a complete environmental health assessment. The advantages and disadvantages of each are also covered at the end of chapter 4. This chapter describes the steps involved in adapting an environmental assessment or preparing an environmental health assessment. The EA is used instead of the HA, SA, or PA, because EA techniques have been more widely utilized.

Adapting Existing Environmental Assessments to Serve as EHAs

Many EAs could be adapted to serve as EHAs. Existing EAs or even NEAPs can be tapped for information that may not be readily available in health agencies, especially because HIAs are scarce, compared with EAs. Bank staff familiar with EA procedures will find preparing EHAs easier if they follow the same general procedures. This section, therefore, outlines the basic similarities and differences between an EA and EHA.

A cautionary note is appropriate here on applying the Bank’s environmental assessment procedures. The Bank’s EA procedures do not systematically address environmental health, nor are there current provisions on incorporating separate environmental health documentation into the Bank’s existing range of “quality at entry” procedures or “Safeguard Policies,” which consist of “Operational Policies” (OPs), “Bank Procedures” (BPs) and “Good Practices” (GPs). This volume intends, among other things, to bridge the gap among these documents and between and among sectoral operations.

Adaptation is likely to remain the case in the Bank, because environmental health considerations are cross-sectoral and already partially addressed in various Bank policies. Moreover, it could be considered administratively cumbersome to add another tier of analyses for Bank borrowers, when it may be possible to integrate environmental health analyses into projects by adapting EA procedures that are already in place. This is especially the case in the Bank’s ten “Safeguard Policies,” whose primary objective is to ensure that Bank operations “do no harm” (see table 6-1 and the Bank’s policy on Environmental Action Plans [OP 4.02].) Tables 6-1 to 6-5 below set forth environmental health dimensions that “safeguard” and other policies do not necessarily cover.

Table 6-1: The World Bank’s Safeguard Policies

<table>
<thead>
<tr>
<th>Environment</th>
<th>Social Development</th>
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</thead>
<tbody>
<tr>
<td>OP 4.01: Environmental Assessment</td>
<td>OP 4.11: Management of Cultural Property</td>
</tr>
<tr>
<td>OP 4.04: Natural Habitats</td>
<td>OP 4.20: Indigenous Peoples</td>
</tr>
<tr>
<td></td>
<td>OP 4.30: Involuntary Resettlement</td>
</tr>
<tr>
<td>Rural Development</td>
<td>International Law</td>
</tr>
<tr>
<td>OP 4.09: Pest Management</td>
<td>OP 7.50: Projects on International Waterways</td>
</tr>
<tr>
<td>OP 4.36: Forestry</td>
<td>OP 7.60: Projects in Disputed Areas</td>
</tr>
<tr>
<td>OP 4.37: Safety of Dams</td>
<td></td>
</tr>
</tbody>
</table>

Tables 6-2 through 6-5 outline the contents of key Bank documents concerning EAs. Table 6-2 shows overall linkages between OP/BP/GP 4.01 and environmental health. Table 6-3 lists the main elements to include in an EA. Table 6-4 explains the outline of a management plan on implementing the recommendations of an EA. Table 6-5 presents a broad checklist of issues that could typically be included in an EA and how they could be expanded to include environmental health. Tables 6-3, 6-4, and 6-5 show how key elements (i.e., OP, BP, and GP) of Safeguard Policy 4.01 “Environmental Assessment” could be adapted to create an EHA or equivalent analysis. Table 6-6 takes advantage of more than a decade’s work done on environmental assessments, providing a list of existing NEAPs and the nature of environmental health information they contain. These could be used as a starting point for an EHA or equivalent.

**Table 6-2: Adapting Bank EA Procedures to an EHA or Equivalent**

<table>
<thead>
<tr>
<th>OP 4.01 Annex</th>
<th>Link to EHA</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. “Definitions” has eight entries: environmental audit, environmental impact assessment, environmental management plan, hazard assessment, project area of influence, regional EA, risk assessment, and sectoral EA</td>
<td>A. The Bank has no official definition of environmental health (see the glossary for definitions).</td>
</tr>
<tr>
<td>B. “Content of an Environmental Assessment Report for Category A Project.” For many category B projects, the EA may result in a management plan only.</td>
<td>B. Changes in the outline for an EHA are described in table 6-3.</td>
</tr>
<tr>
<td>C. “Environmental Management Plan” covers mitigation measures, monitoring, and institution strengthening</td>
<td>C. Changes to a standard environmental management plan are described in table 6-3.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BP 4.01 Annex</th>
<th>Link to EHA</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. “Environmental Data Sheet for Projects in the IBRD/IDA Lending Program”</td>
<td>A. No specific procedures exist for an environmental health data sheet.</td>
</tr>
<tr>
<td>B. “Application of EA to Dam and Reservoir Projects”</td>
<td>B. Environmental health problems include vector-related diseases (especially malaria and schistosomiasis) in the dam as well as the water used for drinking and irrigation.</td>
</tr>
<tr>
<td>C. “Application of EA to Projects Involving Pest Management”</td>
<td>C. Environmental health issues could also include contamination of the food chain well as drinking water (surface water, watershed, and groundwater).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GP 4.01 Annex</th>
<th>Link to EHA</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. “Checklist of Potential Issues of an EA”</td>
<td>A. Potential environmental health issues are identified in table 6-5.</td>
</tr>
<tr>
<td>B. “Types of Projects and Their Typical Classifications”</td>
<td>B. No specific procedures exist for environmental health screening.</td>
</tr>
</tbody>
</table>


**Table 6-3: Adapting EA Content to an EHA**

<table>
<thead>
<tr>
<th>MAIN ELEMENTS OF REPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIFFERENCES BETWEEN AN ENVIRONMENTAL ASSESSMENT (OP 4.01 Annex B) AND AN ENVIRONMENTAL HEALTH ASSESSMENT, SHOWN IN BOLDFACED TYPE</td>
</tr>
<tr>
<td>Executive Summary</td>
</tr>
<tr>
<td>Concisely discusses significant findings and recommended actions.</td>
</tr>
<tr>
<td>Policy, Legal, and Administrative Framework</td>
</tr>
<tr>
<td>Discusses the policy, legal, and administrative framework within which the EA is carried out and steps to harmonize environment and environmental health concerns within the framework. Explains the environmental and environmental health requirements of any cofinanciers. Identifies relevant international environmental agreements to which the country is a party.</td>
</tr>
<tr>
<td>Project Description</td>
</tr>
</tbody>
</table>
**MAIN ELEMENTS OF REPORT**

Concisely describes the proposed project and its geographic, ecological, epidemiological, social, and temporal context (See [m] in table 6-5), including any off-site investments that may be required (e.g., dedicated pipelines, access roads, power plants, water supply, housing, and raw material and product storage facilities). Indicates the need for any resettlement plan or indigenous peoples development plan (see also subpara. (h) of table 6-5). Normally includes a map showing the project site, the project’s area of influence and potential environmental health problems.

<table>
<thead>
<tr>
<th>Baseline Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assesses the dimensions of the study area and describes relevant physical, biological, epidemiological, and socioeconomic conditions, including any changes anticipated before the project commences. Also takes into account current and proposed development activities within the project area, including human communities downstream (watershed) and downwind (air shed) of the project, but not directly connected to the project. Data should be relevant to decisions about project location, design, operation, or mitigatory measures. The section indicates the accuracy, reliability, and sources of the data.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental Impact (Screening and Scoping)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicts and assesses the project’s likely positive and negative impacts, in quantitative terms (“back of the envelope estimates”) to the extent possible. Identifies mitigation measures and any residual negative impacts that cannot be mitigated. Explores opportunities for environmental enhancement and health risk reduction through a targeted collaboration among line agencies and stakeholders. Identifies and estimates the extent and quality of available data, key data gaps, and uncertainties associated with predictions and specifies topics that do not require further attention.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Analysis of Alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systematically compares feasible alternatives to the proposed project site, technology, design, and operation—including the “without project” situation—in terms of their potential environmental impacts, the feasibility of mitigating these impacts, their capital and recurrent costs, their suitability under local conditions, and their institutional, training, and monitoring requirements. For each of the alternatives, quantifies the environmental impacts and health risks to the extent possible and attaches economic values where feasible. States the basis for selecting the particular project design proposed and justifies recommended emission levels and approaches to pollution prevention and abatement.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covers mitigation measures, monitoring, and institution strengthening. See outline in OP 4.01, annex C.</td>
</tr>
</tbody>
</table>


**Table 6-4: Adapting an EA Environmental Management Plan to an EHA**

| SAMPLE ADAPTATION OF AN EA ENVIRONMENTAL MANAGEMENT PLAN CONTENT (OP 4.01 ANNEX C) TO AN EHA |
| (Additions shown in boldfaced type) |

<table>
<thead>
<tr>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The environmental management plan (EMP) identifies feasible and cost-effective measures that may reduce potentially significant adverse environmental impacts and health risks to acceptable levels. The plan includes compensatory measures, if mitigation measures are not feasible, cost-effective, or sufficient. Specifically, the EMP:</td>
</tr>
<tr>
<td>(a) Identifies and summarizes all anticipated significant adverse environmental impacts and health risks and population at risk (including those involving indigenous people or involuntary resettlement)</td>
</tr>
<tr>
<td>(b) Describes in technical detail each mitigation measure, including the type of impact to which it relates and the conditions under which it is required (e.g., continuously or in the event of contingencies), together with designs, equipment descriptions, and operating procedures, as appropriate</td>
</tr>
<tr>
<td>(c) Estimates any potential environmental impacts and health risks as well as population at risks of these measures</td>
</tr>
<tr>
<td>(d) Provides linkage with any other mitigation plans (e.g., for involuntary resettlement, indigenous peoples, or cultural property) required for the project.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental monitoring during project implementation provides information about key environmental and environmental health aspects of the project, particularly the environmental impacts and health risks, as well as population at risk of the project and the effectiveness of mitigation measures. Such information enables the borrower and the Bank to evaluate the success of mitigation as part of project supervision and allows corrective action to be taken when needed. The EMP, therefore, identifies monitoring objectives and specifies the type of monitoring, with linkages to the impacts assessed in the EA report and the mitigation measures described in the EMP. Specifically, the monitoring section of the EMP provides:</td>
</tr>
</tbody>
</table>
### SAMPLE ADAPTATION OF AN EA ENVIRONMENTAL MANAGEMENT PLAN CONTENT (OP 4.01 ANNEX C) TO AN EHA

(Additions shown in boldfaced type)

(a) A specific description and technical details of monitoring measures, including the parameters to be measured, methods to be used, sampling locations and population at risk, frequency of measurements, detection limits (where appropriate), and definition of thresholds that will signal the need for corrective actions.

(b) Monitoring and reporting procedures to (i) ensure early detection of conditions that necessitate particular mitigation measures and (ii) furnish information on the progress and results of mitigation.

### Capacity Development and Training

To support timely and effective implementation of environmental and environmental health project components and mitigation measures, the EMP draws on the EA’s assessment of the existence, role, and capability of environmental, health, and other units on site as appropriate or at the line agency and ministry level as appropriate. If necessary, the EMP recommends the establishment or expansion of such units, a coordination mechanism among them and the training of staff, to allow implementation of EA recommendations. Specifically, the EMP provides a specific description of institutional arrangements, that is, who is responsible for carrying out the mitigatory and monitoring measures (e.g., for operation, supervision, enforcement, monitoring of implementation, remedial action, financing, reporting, and staff training). To strengthen environmental and environmental health management capability in the agencies responsible for implementation, most EMPs cover one or more of the following additional topics: (a) technical assistance programs, (b) procurement of equipment and supplies, and (c) organizational changes and coordination.

### Implementation Schedule and Cost Estimates

For all three aspects (mitigation, monitoring, and capacity development), the EMP provides (a) an implementation schedule for measures that must be carried out as part of the project, showing phasing and coordination with overall project implementation plans and (b) the capital and recurrent cost estimates and sources of funds for implementing the EMP. These figures are also integrated into the total project cost tables.

### Integration of EMP with Project

The borrower’s decision to proceed with a project, and the Bank’s decision to support it are predicated in part on the expectation that the EMP will be executed effectively. Consequently, the Bank expects the plan to be specific in its description of the individual mitigation and monitoring measures and its assignment of institutional responsibilities, and it must be integrated into the project’s overall planning, design, budget, and implementation. Such integration is achieved by establishing the EMP within the project, so that the plan will receive funding and supervision along with the other components.


### Table 6-5: Adapting EA Checklists to an EHA or Equivalent Analysis

<table>
<thead>
<tr>
<th>Existing EA Procedures (GP 4.01 Annex A)*</th>
<th>Sample Adaptations for an EHA or Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where applicable, EAs should address the following issues, which are subject to the Bank policies and guidelines identified here:</td>
<td>Where applicable, EHAs should build on “Existing EA Procedures” (to the left) and also consider the following factors:</td>
</tr>
<tr>
<td>(a) Agrochemicals. The Bank promotes the use of integrated pest management (IPM) and the careful selection, application, and disposal of pesticides (see OP 4.09, “Pest Management”). Due to their impacts on surface and groundwater quality, the use of fertilizers must also be carefully assessed.</td>
<td>(a) Agrochemicals:</td>
</tr>
<tr>
<td>(b) Biological diversity. The Bank promotes conservation of endangered plant and animal species, critical habitats, and protected areas (see para. 9b of OMS 2.36, “Environmental Aspects of Bank Work,” to be reissued as OP/BP 4.01, “Environmental Assessment,” and OP/BP/GP 4.04, “Natural Habitats”).</td>
<td>(b) Biological diversity. The protection and use of plants and animals with medicinal uses.</td>
</tr>
<tr>
<td>(c) Coastal and marine resource management. The Guidelines for Integrated Coastal Zone Management is avail-</td>
<td>(c) Coastal and marine resource management.</td>
</tr>
<tr>
<td></td>
<td>(c) Coastal and marine resource management.</td>
</tr>
</tbody>
</table>

* Additions shown in boldfaced type.
<table>
<thead>
<tr>
<th><strong>Existing EA Procedures (GP 4.01 Annex A)</strong></th>
<th><strong>Sample Adaptations for an EHA or Equivalent</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Existing EA Procedures (GP 4.01 Annex A)</td>
<td>Energy, and industrial sources and agricultural runoff</td>
</tr>
<tr>
<td>b. Sample Adaptations for an EHA or Equivalent</td>
<td>Special health risks to aquaculture and drinking water supply from ports and harbor pollution.</td>
</tr>
<tr>
<td>b. Sample Adaptations for an EHA or Equivalent</td>
<td>Epidemic cholera, where appropriate.</td>
</tr>
<tr>
<td>(d) Cultural property. OP/BP 4.10, “Safeguarding Cultural Property in Bank-Financed Projects” confirms the Bank’s commitment to protect archaeological sites, historic monuments, and historic settlements.</td>
<td>(d) Cultural property. Health repercussions of visitors, especially foreigners, to tourist sites, which could spread some infectious diseases, including AIDS.</td>
</tr>
<tr>
<td>(e) Global externalities. When a project has potential global environmental externalities (i.e., emissions of greenhouse gases or ozone-depleting substances, pollution of international waters, or adverse impacts on biodiversity), the EA identifies the externalities, analyzes them in terms of their impacts, and proposes appropriate mitigation measures.</td>
<td>(e) Global externalities. Health repercussions include increased respiratory, eye, and circulatory system diseases; cases of skin cancer; vector-related diseases due to global warming and water use in water supply and irrigation projects; as well as food chain contamination.</td>
</tr>
<tr>
<td>(f) Hazardous and Toxic Materials. Guidelines are available from ENV on the safe manufacture, use, transport, storage, and disposal of hazardous and toxic materials.</td>
<td>(f) Hazardous and toxic materials.</td>
</tr>
<tr>
<td>- Occupational risks at the sources</td>
<td></td>
</tr>
<tr>
<td>- Risk to scavengers and children playing at disposal sites, including special provisions to limit access and segregate waste</td>
<td></td>
</tr>
<tr>
<td>- Risks of selling or recycling scavenged materials to purchaser or user.</td>
<td></td>
</tr>
<tr>
<td>(g) Indigenous Peoples. OD 4.20, “Indigenous Peoples” (to be re-issued as OP/BP 4.10, ‘‘Indigenous Peoples”), provides specific guidance for addressing the rights of indigenous peoples, including traditional land and water rights.</td>
<td>(g) Indigenous peoples. Special risk of communicable disease transmission to populations who may not have built up immunity to many diseases that are not endemic locally.</td>
</tr>
<tr>
<td>(h) Induced Development and Other Sociocultural Aspects. Secondary growth of settlements and infrastructure, often referred to as “induced development” or “boom-town” effects, can have major indirect environmental impacts, which relatively weak local governments may have difficulty addressing.</td>
<td>(h) Induced development and other sociocultural aspects</td>
</tr>
<tr>
<td>- Effects of inadequate drainage (often neglected), in addition to water and waste disposal (which tends to be addressed)</td>
<td></td>
</tr>
<tr>
<td>- Vector-related diseases that can be spread by or to “new” populations with no resistance or who travel back and forth to their former home</td>
<td></td>
</tr>
<tr>
<td>- Respiratory disease from poorly ventilated, overcrowded housing (often neglected)</td>
<td></td>
</tr>
<tr>
<td>(h) Sexually transmitted diseases, especially AIDS.</td>
<td></td>
</tr>
<tr>
<td>(i) Industrial Hazards. All energy and industry projects should include a formal plan to prevent and manage industrial hazards. See Techniques of Assessing Industrial Hazards: A Manual (Technical Paper No. 55, Washington, D.C.: Technica, Ltd. and World Bank, 1988).</td>
<td>(i) Industrial hazards. In areas around industry:</td>
</tr>
<tr>
<td>- Residential areas, for factors considered under “(h) Induced Development” above</td>
<td></td>
</tr>
<tr>
<td>- Pollution effects beyond immediate surroundings, possibly the watershed and air shed.</td>
<td></td>
</tr>
<tr>
<td>(j) Industrial Pollution. The Bank supports an integrated approach to pollution control, viewing pollution prevention as generally preferable to reliance on end-of-pipe pollution controls alone. It encourages the adoption of “cleaner production” and stresses the need for good management and operating practices. Guidance on industrial projects is provided in the Pollution Prevention and Abatement Handbook (The World Bank Group, Washington, D.C., 1999).</td>
<td>(j) Industrial pollution. As appropriate:</td>
</tr>
<tr>
<td>- Environmental health considerations, including respiratory, eye, and circulatory system diseases; cases of cancer due to chemical interaction and water and irrigation; as well as food chain contamination in areas surrounding the pollution source as well as the watershed and air shed</td>
<td></td>
</tr>
<tr>
<td>- Laws and standards cover environmental health</td>
<td></td>
</tr>
<tr>
<td>- Private sector arguments that health considerations are too costly or impracticable.</td>
<td></td>
</tr>
<tr>
<td>Existing EA Procedures (GP 4.01 Annex A)</td>
<td>Sample Adaptations for an EHA or Equivalent</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>------------------------------------------</td>
</tr>
</tbody>
</table>
| (k) **International Treaties and Agreements on the Environment, Natural Resources, and Cultural Property.** The EA should review the status and application of such current and pending treaties and agreements, including their notification requirements. The Legal Department, which maintains a list of international treaties, can obtain the information required on applicable laws in individual countries. | (k) **International Treaties and Agreements on the Environment, Natural Resources, and Cultural Property.** As appropriate:  
- Environmental health considerations  
- Laws and standards covering environmental health  
- Private sector arguments that health considerations are too costly or impracticable. |
| (l) **International Waterways.** OP/BP/GP 7.50, “Projects on International Waterways,” provides guidance. This statement exempts from notification requirements any rehabilitation projects that will not affect the quality or quantity of water flows. | (l) **International waterways**  
- Provisions to avoid contamination of waterways with vehicle septage and garbage and, as appropriate, for land-based facilities in which to place it  
- Possibility that tourists or traveling workers, such as truckers, will spread diseases  
- Short-term risk of spreading cholera, as appropriate. |
| (m) **Involuntary Resettlement.** OD 4.30, “Involuntary Resettlement,” to be reissued as OP/BP 4.12, “Involuntary Resettlement,” renders guidance. | (m) **Involuntary resettlement.**  
- Possible malnutrition from food crops that may need time to mature before producing food  
- Health care facilities and assistance for mental health problems arising from change  
- Proper water, sanitation, drainage, and waste disposal services, especially where vector-borne diseases are endemic. |
| (n) **Land Settlement.** Due to the complex physical, biological, socioeconomic, and cultural impacts, land settlement should generally be carefully reviewed. | (n) **Land settlement**  
- As for “Involuntary Resettlement.” |
| (o) **Natural Habitats.** OP/BP/GP 4.04, the Bank is committed to protecting natural habitats and provides for compensatory measures when lending results in adverse impacts. | (o) **Natural habitats**  
- Protection of biodiversity for medicinal plants and animals  
- Exposure of indigenous populations to vector-borne diseases. |
| (p) **Natural Hazards.** The EA should review whether the project may be affected by natural hazards (e.g., earthquakes, floods, and volcanic activity) and should propose specific measures to address these concerns when appropriate (see OP/BP/GP 8.50, “Emergency Recovery Assistance”). | (p) **Natural hazards**  
- Adequate provisions for safe food, water, waste disposal, and access to emergency health care  
- In hazard-prone areas, preventive measures could include maintenance of roads and bridges and retrofitting buildings to stabilize roofs. |
| (q) **Occupational Health and Safety.** All industry and energy projects, and projects in other sectors where relevant, should include formal plans to promote occupational health and safety (see World Bank, Occupational Health and Safety Guidelines, Washington, D.C., 1988). | (q) **Occupational health and safety.** Residential areas surrounding industrial/energy premises, often low-income areas with highly vulnerable populations. |
| (r) **Ozone-Depleting Substances.** Use of ozone-depleting substances (e.g., chlorofluorocarbons and methyl bromide), which is widespread in such applications as refrigeration, foams, solvents, and fumigation, is regulated under the Montreal Protocol (OP/BP/10.21) and Vienna Convention. Guidance on ozone-safe alternatives is available from the Montreal Protocol Operations Unit in the Bank’s Global Environment Coordination Unit (ENV). | (r) **Ozone-depleting substances.** Health repercussions include the following:  
- Skin cancer and eye diseases  
- Possibility of malnutrition from adverse effects of ozone of food production (photosynthesis). |
| (s) **Ports and Harbors.** Guidelines are available from the Transportation, Water, and Urban Development Department on addressing common environmental concerns associated with port and harbor development (see | (s) **Ports and harbors**  
- As for the three points under “International Waterways” above  
- Offloading facilities and transport of hazardous... |
Existing EA Procedures (GP 4.01 Annex A)\(^3\)


Sample Adaptations for an EHA or Equivalent

- Chemicals, including pesticides and their components
- Risks of respiratory diseases in surrounding areas from large scale granaries.

\((t)\) Tropical Forests. Guidance is provided by the Bank’s July 1991 paper Forest Policy; OP/GP 4.36, “Forestry”; and OP/BP/GP 4.04, “Natural Habitats.”

\((u)\) Watersheds. Bank policy promotes the protection and management of watersheds as an element of lending operations for dams, reservoirs, and irrigation systems (see OP 4.07, “Water Resource Management” and para. 6 of OD 4.00, annex B, “Environmental Policy for Dam and Reservoir Projects,” to be reissued as OP/BP 4.01, “Environmental Assessment.”

\((v)\) Wetlands. The Bank promotes conservation and management of wetlands (e.g., estuaries, lakes, mangroves, marshes, and swamps). OP/BP/GP 4.04, “Natural Habitats” covers this subject.

\((u)\) Watersheds
- Possible contamination of food chain and water supply with pesticide and fertilizer runoff
- Vector control on a watershed basis

\((v)\) Wetlands
- Possible breeding grounds for malaria could be addressed by:
  - Including health agencies to assist with preventive measures
  - Consideration of land reclamation for malaria control
  - Protection of biodiversity for medicinal plants and animals.


---

Table 6-6: Environmental Health in NEAPs

<table>
<thead>
<tr>
<th>Country</th>
<th>Date</th>
<th>Health Concerns Identified by the Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angola</td>
<td>No action(^b)</td>
<td>Urban and industrial pollution, flooding, and transport</td>
</tr>
<tr>
<td>Benin</td>
<td>1993</td>
<td>Urban water pollution</td>
</tr>
<tr>
<td>Botswana</td>
<td>1990</td>
<td>Urban water pollution</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>1991</td>
<td>Sanitation and water supply, solid and industrial waste, and pesticides</td>
</tr>
<tr>
<td>Burundi</td>
<td>1993(^a)</td>
<td>Water supply and sanitation, sewage, solid and industrial waste, pesticides, fertilizers, and disaster mitigation</td>
</tr>
<tr>
<td>Cameroon</td>
<td>1996(^c)</td>
<td>Pollution, solid and toxic wastes, and water supply and sewage</td>
</tr>
<tr>
<td>Cape Verde</td>
<td>1994(^a)</td>
<td>(No translation from Portuguese available.)</td>
</tr>
<tr>
<td>Central African Republic</td>
<td>No action(^b)</td>
<td></td>
</tr>
<tr>
<td>Chad</td>
<td>No action(^b)</td>
<td></td>
</tr>
<tr>
<td>Comoros</td>
<td>1994(^c)</td>
<td>Water quality (water-borne diseases), sanitation, sewage, and solid waste</td>
</tr>
<tr>
<td>Congo, Democratic Republic of</td>
<td>Expected completion date 2000(^c)</td>
<td>Urban air pollution</td>
</tr>
<tr>
<td>Congo, Republic of</td>
<td>1994(^d)</td>
<td>Urban air pollution</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>1993(^c)</td>
<td>Infectious and parasitic illnesses (linked to water supply, sanitation, waste management, and housing)</td>
</tr>
<tr>
<td>Djibouti(^d)</td>
<td>(\times)</td>
<td></td>
</tr>
<tr>
<td>Equatorial Guinea</td>
<td>No action(^b)</td>
<td></td>
</tr>
<tr>
<td>Eritrea</td>
<td>1993(^d)</td>
<td>Human health and environmental issues: sanitation, vector-borne diseases (malaria, schistosomiasis, leishmaniasis, and onchocerciasis), water-borne diseases (diarrheas, shigellosis, amebiasis, and gastroenteritis), nutrition-deficiency diseases, and the working environment</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>1994(^c)</td>
<td>Sanitation and water supply</td>
</tr>
<tr>
<td>Gabon</td>
<td>2000(^c)</td>
<td>Urban pollution, water-borne diseases (diarrhea, cholera, and so on), and vector-borne diseases</td>
</tr>
<tr>
<td>Gambia</td>
<td>1992</td>
<td>Water supply, sanitation, waste management, fertilizers, pesticides, urbanization, coastal pollution, groundwater degradation, physical planning, infra-</td>
</tr>
</tbody>
</table>
## Conducting a Complete EHA

An environmental health assessment should, above all, identify the broad picture, on which to base priorities among practicable remedial measures for a given project. The environmental health assessment process is new and rapidly changing, so no established procedures exist to be followed. This section describes the kinds of information that are useful in an environmental health impact assessment and necessary to identifying remedial measures based on intersectoral

<table>
<thead>
<tr>
<th>Country</th>
<th>Date</th>
<th>Health Concerns Identified by the Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ghana</td>
<td>1989</td>
<td>Sanitation and water supply, solid and liquid waste, land use, facilities shortage, mining, and pesticides</td>
</tr>
<tr>
<td>Guinea</td>
<td>1994a</td>
<td>Water supply, sanitation, and waste management</td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>1994a</td>
<td>Potential for lead in motor fuel</td>
</tr>
<tr>
<td>Kenya</td>
<td>1994a</td>
<td>Adverse effects of motor fuels</td>
</tr>
<tr>
<td>Lesotho</td>
<td>1989a</td>
<td>Sanitation, solid waste, air pollution, and pollution regulation</td>
</tr>
<tr>
<td>Liberia</td>
<td>No actionc</td>
<td></td>
</tr>
<tr>
<td>Madagascar</td>
<td>1988</td>
<td>Housing, water treatment, and solid waste</td>
</tr>
<tr>
<td>Malawi</td>
<td>1994</td>
<td>Water supply and waste management, and occupational hazards, including chemicals</td>
</tr>
<tr>
<td>Mali</td>
<td>1996a</td>
<td>Sanitation, water, industrial management, pesticide residues, agrochemicals, and air pollution</td>
</tr>
<tr>
<td>Mauritania</td>
<td>Ongoing but no due dateb</td>
<td></td>
</tr>
<tr>
<td>Mauritius</td>
<td>1988</td>
<td>Water supply, sewage, solid waste, land- and sea-based pollution, and agrochemicals</td>
</tr>
<tr>
<td>Mozambique</td>
<td>1993a</td>
<td>Urban (Maputo-Matola) sanitation and waste management, potable water, infectious/parasitic diseases, and urban pollution</td>
</tr>
<tr>
<td>Namibia</td>
<td>No actionc</td>
<td></td>
</tr>
<tr>
<td>Niger</td>
<td>1996a</td>
<td>Water, public hygiene and sanitation, and pollution</td>
</tr>
<tr>
<td>Nigeria</td>
<td>1990a</td>
<td>Water supply, sanitation, wastewater, solid waste, pollution in general (no mention of vehicles), and soil erosion (threatens food supply)</td>
</tr>
<tr>
<td>Rwanda</td>
<td>1991a</td>
<td>Health and quality of life, sanitation, population growth, vector-borne diseases, and war (refugees)</td>
</tr>
<tr>
<td>Sao Tome and Principe</td>
<td>1993a</td>
<td>Water supply, solid waste, water-borne diseases, waste (human, hospital, and hazardous), malaria, agrochemicals, and pesticides</td>
</tr>
<tr>
<td>Senegal</td>
<td>1997a</td>
<td>Malaria, poverty, water supply, unclean living conditions, water, soil and air pollution, food contamination, sanitation, diarrhea, malnutrition, vaccine for targeted diseases, pesticides, and health care wastes</td>
</tr>
<tr>
<td>Seychelles</td>
<td>1990</td>
<td>Sewage, animal waste, and vehicle and other pollution</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>1994a</td>
<td>Poverty, water supply, waste disposal, sewage, soil erosion, and industrial and commercial pollution</td>
</tr>
<tr>
<td>Somalia</td>
<td>No actionc</td>
<td></td>
</tr>
<tr>
<td>South Africa</td>
<td>Not requiredd</td>
<td></td>
</tr>
<tr>
<td>Sudan</td>
<td>No actionc</td>
<td></td>
</tr>
<tr>
<td>Swaziland</td>
<td>No actionc</td>
<td></td>
</tr>
<tr>
<td>Tanzania</td>
<td>1994a</td>
<td>Urban pollution, water supply, sanitation, solid waste, sewage, pesticides, industrial wastes, cholera, dysentery, and typhoid</td>
</tr>
<tr>
<td>Togo</td>
<td>1999a</td>
<td>Urban pollution, water-borne diseases (diarrhea, cholera, and so on), and vector-borne diseases</td>
</tr>
<tr>
<td>Uganda</td>
<td>1994a</td>
<td>Water supply and sanitation and water-related diseases; malaria; also notes malnutrition (kwashiorkor and marasmus) in preschool children</td>
</tr>
<tr>
<td>Zambia</td>
<td>1994a</td>
<td>Water supply, industrial and domestic wastes, pollution, and agrochemicals</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>1993a</td>
<td>Water supply, sanitation and wastes, air pollution, and occupational health</td>
</tr>
</tbody>
</table>

---

a. Not yet implemented.

b. Not yet prepared or published.


d. As of October 1999, Djibouti is part of the Middle East and North Africa Region at the World Bank.

e. South Africa is not an IDA country, therefore, a NEAP is not required.

Source: Country NEAPs.
linkages. Given the practical realities of acquiring accurate data, adapting information from alternative sources can be a useful option.

Box 6-1 below outlines the core content of an environmental health assessment as detailed in this section. Two other sample outlines, carefully thought through by health assessment practitioners, appear in boxes 4-3 and 4-4. The outline below differs from them by integrating the broader multisectoral perspective presented in this discussion paper. This perspective will benefit any multidisciplinary team required to plan and implement an EHA by ensuring that all team members share the same point of departure and contribute on a variety of issues, not merely those reflecting their professional expertise.

<table>
<thead>
<tr>
<th>Box 6-1: Core Outline for an Environmental Health Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. Environmental Health Analyses</strong></td>
</tr>
<tr>
<td>A. Broad Picture and Overall Context</td>
</tr>
<tr>
<td>B. Definition of Key, Confusing, and Misused Terms</td>
</tr>
<tr>
<td>(Table on “Main Environmental Health Linkages”)</td>
</tr>
<tr>
<td>C. Individual Sector Factors and Issues</td>
</tr>
<tr>
<td>D. Typical Loans from the Sector</td>
</tr>
<tr>
<td><strong>II. Environmental Health Assessment Checklist</strong></td>
</tr>
<tr>
<td>A. The Proposed Project</td>
</tr>
<tr>
<td>B. Institutional Strengths and Weaknesses</td>
</tr>
<tr>
<td>C. Occupational, High Risk, and Vulnerable Groups</td>
</tr>
<tr>
<td>(Table on Occupational, High Risk, and Vulnerable Groups)</td>
</tr>
<tr>
<td>D. Hot Spots, Special Cases, and Key Pollutants</td>
</tr>
<tr>
<td>E. Inadvertent Professional Biases and Policy Options</td>
</tr>
<tr>
<td>F. On the Horizon</td>
</tr>
<tr>
<td>G. Research and Information Gaps</td>
</tr>
<tr>
<td><strong>IV. Recommendations</strong></td>
</tr>
</tbody>
</table>

*Source: Authors’ data.*

The following sections detail the kinds of information to include in an environmental health assessment, following the above outline. The material should be organized to be easily skimmed, using headers and bullets. Depending on its dissemination, it may be appropriate to hire a professional editor to avoid or clearly define technical jargon.

*Environmental Health Analyses*

*Broad Picture and Overall Context*

- Include brief background material on the upcoming project and, as appropriate, its relation to potential health repercussions, positive or negative. Many users of this discussion paper will probably not have background in health or environment and perhaps neither; it is important that an EHA provide some at the start. This background material should be available in source reports from the environmental health profiles (if they have been prepared) or from various sector reports. Background should interest readers in learning more, not drive them away by too technical a level of writing or an emphasis on
negative outcomes and complex solutions. The multidimensional aspects of an EHA is an opportunity for collaboration.

- **Summarize multisectoral linkages.** This could take the form of a chart, such as the one in table 6-7 (see also chapters 8–14 for more detailed examples, often by subsector).

### Table 6-7: Sample Environmental Health Linkages of Bank Lending by Sector

<table>
<thead>
<tr>
<th>Environmental Issues by Sector</th>
<th>Possible Links and Health Effects</th>
<th>Cross-Sectoral Dimensions</th>
<th>Remedial Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agriculture and Rural Development:</strong> Deforestation, agricultural chemicals, water resource management, e.g., irrigation and drainage, dams and reservoirs, and fisheries</td>
<td>Contamination of water and the food chain with pesticides and fertilizers, spread of disease vectors, increased resistance to pesticides, loss of medicinal plants, and injury or death from flooding</td>
<td>Waste management, land use, soil and chemical runoff, depletion of carbon sink, loss of habitat, erosion, resettlement, and so on</td>
<td>Land use management and integrated pest management, watershed management, comprehensive water resource management, and affordable protective gear and equipment for pesticide application</td>
</tr>
<tr>
<td><strong>Infrastructure:</strong> Water supply and sanitation, housing and urban development, transport, and telecommunications</td>
<td>Diarrheal, respiratory, and vector-related diseases; traffic injuries; and decreased IQ from lead poisoning in transport fuels</td>
<td>Sexually transmitted diseases, including AIDS, spread by truckers or construction crews; waste disposal; vector breeding sites; and resettlement</td>
<td>Outreach to truckers, build awareness of work crews as part of contracts, land use management, waste management, and traffic law enforcement</td>
</tr>
<tr>
<td><strong>Energy:</strong> Deforestation, indoor air pollution, outdoor air and water pollution, global warming, and dams</td>
<td>Respiratory disease, physical stress from getting firewood, vector-related diseases, and contamination of the food chain from lead in fuels or other sources of lead</td>
<td>Depletion of carbon sink, deforestation, and vector breeding sites</td>
<td>Economic instruments, regulatory measures, moral suasion, stove and vehicle efficiency, alternative energy sources, and land use and water resource management</td>
</tr>
<tr>
<td><strong>Industry:</strong> Air, water, and land pollution; climate change and global warming; and occupational exposures</td>
<td>Air, land, water, coastal, and marine pollution leading to diarrheal, respiratory, and vector-related diseases, and contamination of the food chain</td>
<td>Waste disposal, vector breeding sites, and chemical contamination</td>
<td>Occupational health and safety measures, economic instruments, regulatory measures, moral suasion, and land use management</td>
</tr>
<tr>
<td><strong>Health:</strong> Respiratory and diarrheal diseases, AIDS, malaria, and injuries</td>
<td>Medical waste from health facilities leading to various diseases, e.g., AIDS, cancers, diarrheas, and respiratory illnesses</td>
<td>Sexually transmitted diseases, including AIDS spread by truckers or construction crews; waste disposal; and vector breeding sites</td>
<td>Improved waste collection, trucker outreach, building awareness of work crews as part of contracts, and affordable protective gear and equipment</td>
</tr>
<tr>
<td><strong>Environment and Natural Resources:</strong> Forestry, biodiversity, and marine management</td>
<td>Potential for new medications, and contamination of food chain</td>
<td>Climate change, global warming, and ozone depletion</td>
<td>Management of land use, watershed, and marine and coastal zones; and pollution control</td>
</tr>
<tr>
<td><strong>Multisectoral:</strong> Privatization of public services</td>
<td>Absence of health considerations from the business agenda</td>
<td>Increased exposure of workers and general public to health risks</td>
<td>Lending instruments and management procedures</td>
</tr>
<tr>
<td><strong>Global:</strong> Climate change and global warming</td>
<td>Resistance to drugs, spread of vector-borne diseases, skin cancer and cataracts from ozone depletion, death and injury from climate extremes, e.g., storms and heat waves</td>
<td>Individual sector contributions aggravate overall problem</td>
<td>Lending instruments, training, and grants to help address the issue; and awareness campaigns</td>
</tr>
</tbody>
</table>

*Source: Authors’ data.*
Definition of Key, Confusing, and Misused Terms

• Define basic technical jargon and cite differences in interpretation of terms. Basic concepts, which are often not explained in reports intended for audiences from the same profession, can confuse multidisciplinary audiences. “Sanitation” and “sewerage,” for example, imply different technologies and policies that most infrastructure sector engineers take for granted (see glossary and box 13-3 for definitions of sanitation terms) Likewise, some communities may refer to malaria only as “fever,” causing an outside project designer to misinterpret problems and design incorrect solutions that could exclude vector control.

Individual Sector Factors and Issues

• Explain those factors particular to the sector. The determinants of “indoor air pollution,” for example, will vary according to their rural or urban setting. These could include such confounding factors as the addition of industrial and vehicular air pollution, density of living conditions, costs of heating, and lighting and cooking fuels.

• Explain specific issues pertaining to the sector(s) involved with the project, as appropriate. This section would complement the “Broad Picture and Overall Content” section above, for example, by citing overall objectives, policies, and specific strategies or special programs for a given sector. It may also be appropriate to show how, for SSA, sectoral projects can help address AIDS. This section can clarify for the multidisciplinary team aspects of the sector that are taken for granted as common knowledge by sector specialists.

Typical Loans from the Sector

• Explain the basic types of loans from the sector for the benefit of those outside it. This need not be detailed. Give a flavor of the breadth of activities or recent trends to clarify a sector’s objectives and priorities, for example, that housing loans do not generally deal with indoor air pollution or other health factors. This section could clarify for the multidisciplinary team aspects of the sector that are common knowledge for sector specialists.

• Begin to draw associations among health problems linked with different sectors and the potential to address those problems within a project. Table 6-8 summarizes these links for the infrastructure sector in SSA.

Table 6-8: Main EHA Points for SSA Infrastructure

<table>
<thead>
<tr>
<th>Sample Project or Component</th>
<th>Disease or Condition</th>
<th>Sample Steps for EHA</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Housing</td>
<td>Respiratory disease</td>
<td>• Determine levels of respiratory disease and overcrowded housing (in health, housing, urban planning, or school records)</td>
</tr>
<tr>
<td>• Community facilities</td>
<td>Respiratory infections</td>
<td>• Determine levels of uncontrolled burning and other dust from waste management sites and unregulated dumps</td>
</tr>
<tr>
<td>• Traffic management</td>
<td>Tuberculosis</td>
<td>• Determine degree of transport and industrial air pollution monitoring</td>
</tr>
<tr>
<td>• Air pollution abatement</td>
<td></td>
<td>• Determine degrees of regular flooding, because dampness can contribute to respiratory disease</td>
</tr>
<tr>
<td>• Sites and services schemes</td>
<td></td>
<td>• Review geographic information system (GIS) information to determine flood-prone zones and frequency of flooding</td>
</tr>
</tbody>
</table>

• Vector control

• Storm water drainage

• Sanitation

• Solid waste

• Sites and services schemes

| Vector related               |                      | • Review health records to determine presence of malaria and other vector-borne diseases and inquire at the ministry of health if records for diseases other than malaria are not kept systematically |
| • Malaria                    |                      | • Determine degree of transport and industrial water pollution monitoring |
| • Schistosomiasis           |                      | • Assess conditions of drains in project area |
| • Filariasis                 |                      | • Review GIS information to determine flood-prone zones and |
| • Guinea worm                |                      | |
| • Onchocerciasis            |                      | |

99
### Environmental Health Assessment Outline

#### The Proposed Project

- **Describe the proposed project.** Cite its overall objectives and possible positive and negative environmental health repercussions.

#### Institutional Strengths and Weaknesses

- **Explain the primary problems.** This section can help the multidisciplinary team clarify aspects of the sector that are common knowledge for sector specialists. Among possible topics are interagency communication, fragmented administration, absence of legal jurisdiction, and outdated equipment. Institutional issues may sometimes be more important than technical issues, but are often not accorded the same importance. Precision is important, for example, cite staffing and budgets or refer to proposals already prepared that address such issues (see the Ghana needs assessment in chapter 16).

- **Discuss, if appropriate, proposed solutions that are being discussed or tried.**

#### Occupational, High Risk, and Vulnerable Groups

- **Describe the main occupational, high risk, and vulnerable groups.** Summarize them in a table (see table 6-9, for example).

Occupational groups should include any groups exposed to occupational hazards, focusing on widespread cottage industries or other economic activities not likely to be covered by occupational health infrastructure, for example, “health rooms,” protective clothing, health insurance, and ambulance services.

Poor families are the most sensitive and vulnerable to the adverse effects of all sorts of environmental degradation due to high exposure levels. Poor families live in undesirable parts of the city, where it is often technically difficult to provide water and waste management services. They also have the least access to other basic infrastructure and often...
live near dumps. They live in crowded, poorly ventilated housing and are forced to cook, heat, and light with the cheapest but most polluting fuels.

- **Identify and target populations at risk for geographic, ethnic, or economic reasons for appropriate interventions.** These populations might include resettled people or laborers from construction crews.

**Table 6-9: Sample Occupational, High Risk, and Vulnerable Groups**

<table>
<thead>
<tr>
<th>Main Activity</th>
<th>Potential High-Risk Groups and Related Hazardous Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use and Sale of Pesticides</td>
<td><em>Basic health risks include (a) acute poisoning from short-term exposure and (b) accumulation in body fat, leading to cancer or birth defects from long-term exposure.</em></td>
</tr>
<tr>
<td></td>
<td><em>Farmers and other farm workers from mixing and spraying pesticides</em></td>
</tr>
<tr>
<td></td>
<td><em>Women and children from improper storage and housekeeping activities, especially family members washing farmer’s clothing</em></td>
</tr>
<tr>
<td></td>
<td><em>Retailers and wholesalers from (a) improper handling, storage, repackaging, or reformulating (mixing chemicals to become pesticides) and disposal of pesticides and containers and (b) recycling containers, e.g., bottles for beverages or drums for storage or incineration containers</em></td>
</tr>
<tr>
<td></td>
<td><em>Dockworkers and truckers from exposures from improper storage and transport</em></td>
</tr>
<tr>
<td></td>
<td><em>Community at large from (a) short- and long-term exposure in nearby fields, especially the first few days after spraying and (b) exposure from improper disposal of excess pesticides and empty containers and from runoff from the fields</em></td>
</tr>
<tr>
<td>Use of Traditional (Biomass) Fuels</td>
<td><em>Basic health risk from (a) acute or chronic respiratory disease from short- or long-term exposure and (b) lung cancer from long-term exposure</em></td>
</tr>
<tr>
<td></td>
<td><em>Women and children from (a) gathering wood and other biomass fuels, which exposes them to safety problems, especially falls, and some vector-related diseases when fetching wood in endemic areas and (b) cooking, especially in an enclosed space with poor ventilation, which increases the likelihood of respiratory and eye diseases</em></td>
</tr>
</tbody>
</table>

*Source: Authors’ data.*

**Hot Spots, Special Cases, and Key Pollutants**

- **Identify areas that might require explicit attention beyond those covered by the project.** This could include motorways with exceptionally high pollution or numbers of accidents, market areas with high activity and refuse, arsenic in the soil of a particular area, areas requiring special programs to address AIDS or guinea worm (which is on the verge of eradication), market gardening that provides year-round breeding sites for mosquitoes, major population movements, vulnerability to weather extremes created by El Niño or La Niña, and so on.

- **Identify key pollutants.** Depending on local circumstances, pollutants addressed by the proposed project may have multisectoral sources which are not addressed by the project. Multiple sources should be described and suggestions made for other agencies that could complement project activities.

**Inadvertent Professional Biases**

- **Describe the team and their individual contributions to the report** (e.g., engineering, economic, sociological, legal, public health, and so on). This optional section can benefit multidisciplinary teams, because specialists will not necessarily raise issues that are common knowledge within their profession, including policy implications or the advantages and disadvantages of different technologies and clarify inadvertent professional biases. Lack of understanding of health repercussions or their policy implications by team members from different specialties or the general public can lead to counterproductive and expensive overreactions, often sensationalized into front-page headlines in the popular press, rather than resolved through balanced exchange in professional journals and conferences.
  - Private sector research may be at the cutting edge, but its potential for bias depends on the type of industry.
• Ignorance in industrialized countries that basic problems, such as diarrheal diseases, still exists.
• At the community level, legitimate concern can turn into hysteria because scientific reports are taken out of context. For example, chlorination of drinking water can produce carcinogenic byproducts (trihalomethanes). Public health specialists and engineers understand that water purification comes with tradeoffs, that is, elimination of most biological contaminants that could otherwise pose a major public health threat to the entire population against a smaller, high-risk group, such as pregnant women.

On the Horizon

• **Cover, as appropriate, upcoming general activities or events.** This might include the passage of laws, acquisition of funding, or opening of new facilities.

Research and Information Gaps

• **Comment on pertinent research or information gaps that would help the current project or similar projects.** Examples could include regulatory measures at the municipal level (as opposed to the national level), AIDS prevention strategies, and so on.

Recommendations

• **Make recommendations** on (a) solving environmental health problems in the short and long term, (b) potential benefits from multisectoral collaboration, and (c) including pilot projects, as appropriate, to foster multisectoral approaches.
Part 2: Environmental Health Assessment Guidelines
Basic knowledge about groups of diseases and individual diseases is essential to preparing an environmental health assessment or equivalent analysis, especially if some team members lack health background. This chapter presents basic environmental health material that is useful background for subsequent chapters, which deal with environmental health linkages by sector.

The chapter discusses three categories of information—leading health problems, diseases for special consideration, and key cross-cutting issues—that is pertinent to all sectors. The health effects of pesticides, for example, usually considered under agriculture, are actually multisectoral and relevant to periurban agriculture, mosquito control in health projects, transport and disposal of hazardous materials, among others. The introductions of sectoral chapters 8–14 discuss environmental health information relevant only or primarily to that sector.

**Leading health problems:**
- Malnutrition
- Malaria and vector related diseases
- Diarrheas and gastroenteric diseases
- Respiratory diseases and diseases related to air pollution
- Injuries and accidents
- Mental health and stress

**Diseases for special consideration:**
- AIDS
- Epidemic cholera
- Guinea worm infection

**Key cross-cutting issues:**
- Pesticide use
- Biodiversity and traditional medicines

*Source: Authors’ data.*

General presentations of health data usually break down diseases and other conditions into two types— infectious and noninfectious—based on the seriousness of the disease. Infectious or “communicable” diseases are transmitted among humans by interpersonal contact, such as AIDS or flu, or through disease vectors, such as mosquitoes that spread malaria. Noninfectious diseases arise from other factors, such as pollution. In contrast to an approach based on the seriousness of disease, this discussion paper uses the above three categories, which are based on the types of interventions used to help solve problems. This innovative system of classification, new in this discussion paper, maintains the focus on tapping health benefits outside the health care system, complementing and not replacing traditional health data.

**Leading Health Problems**

As already noted, infectious diseases, such as diarrheas, respiratory ailments, AIDS, and malaria, predominate in developing countries. This discussion paper only mentions noninfectious diseases, such as cardiovascular disease and cancers, in reference to pollution, because of its emphasis on SSA, where, aside from indoor air quality, air and water pollution have not yet reached the scale found in other regions, particularly, industrialized developing countries. The discussion of leading

*Annex D presents detailed one-page descriptions on about twenty of the most important diseases, as does WHO’s web site (<http://www.who.int/home>).*
health problems that follows covers key interventions outside the health care system and does not comprehensively cover health problems in SSA or developing countries.

Malnutrition

About 24,000 people die every day from hunger or hunger-related causes. Three-fourths of the deaths are children under five, and 10 percent of children in developing countries die before the age of five. An estimated 800 million people in the world suffer from hunger and malnutrition or about 100 times those who actually die from it each year. Malnutrition also impairs vision, stunts growth, complicates other health problems, and reduces natural resistance, predisposing the body to infection. Malnutrition can easily go unnoticed, unless it is severe. Table 7-1 summarizes the role that malnutrition plays in the overall burden of disease.

Table 7-1: Major Risk Factors in Less Developing Countries (LDCs)

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Percent of Total LDC Deaths</th>
<th>Percent of Total LDC DALYs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malnutrition</td>
<td>14.9</td>
<td>18.0</td>
</tr>
<tr>
<td>Water, hygiene, and sanitation</td>
<td>6.7</td>
<td>7.6</td>
</tr>
<tr>
<td>Solid fuel use</td>
<td>4.7</td>
<td>4.3</td>
</tr>
<tr>
<td>Unsafe sex and unwanted pregnancies</td>
<td>2.5</td>
<td>3.7</td>
</tr>
<tr>
<td>Alcohol</td>
<td>1.6</td>
<td>2.7</td>
</tr>
<tr>
<td>Occupation</td>
<td>2.3</td>
<td>2.5</td>
</tr>
<tr>
<td>Traffic injuries</td>
<td>1.8</td>
<td>2.2</td>
</tr>
<tr>
<td>Tobacco</td>
<td>3.7</td>
<td>1.4</td>
</tr>
<tr>
<td>Hypertension</td>
<td>3.8</td>
<td>0.9</td>
</tr>
<tr>
<td>Illicit drugs</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Outdoor air pollution</td>
<td>0.7</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>42.9</strong></td>
<td><strong>44.1</strong></td>
</tr>
</tbody>
</table>


Malnutrition is frequently equated with extreme food shortages, that is, starvation or famine. Although prominent in the popular press, such shortages occur only in pockets, representing the tip of the malnutrition iceberg. Famine and wars cause just 10 percent of hunger deaths, whereas the majority are caused by chronic malnutrition. The most widespread problem combines deficiencies in certain food groups with long-term or intermittent shortage of food. This is hunger, not famine. (See chapter 8, table 8-2, for information on famines caused by desertification and drought.)

Imbalance or inadequacy in nutrients contributes as much to malnutrition as starvation. Severe malnutrition is irreversible and can cause permanent brain damage and stunted physical growth. Two of the most common serious forms of malnutrition entail protein-carbohydrate and vitamin deficiencies. Vitamin A, for example, protects the mucus lining of the nose and mouth, which functions as the body’s first line of defense against respiratory infections, one of the leading causes of death and disability in developing countries. Protein deficiency is a serious problem, because the body cannot itself manufacture certain proteins (“essential” amino acids). Protein sources (e.g., meat, fish, egg, dairy products, certain vegetables, and legumes) tend to be expensive.

Discussion on malnutrition generally revolves around food security and diet, but malnutrition has several other environmental health dimensions. The link with sanitation, for instance, is often forgotten. The health of a malnourished child is more severely compromised by infections with intestinal parasites, mostly worms, caused in large part by deficiencies in sanitation. The most prevalent worm, ascaris, diverts nutrients to itself. Table 7-5 below summarizes the six most prevalent intestinal parasites.
Respiratory diseases cover a broad range of chronic and acute illnesses of the nose, ears, throat, and lungs (i.e., colds, influenza, pneumonia, tuberculosis, bronchitis, asthma, and lung cancer). Until the past decade, the literature has somewhat neglected indoor air pollution, largely because global interest in and technical capability to monitor industrial and vehicular pollution has instead focused on systematic ambient air monitoring, mainly in the industrialized countries. Recognition of the larger share of human health impacts due to indoor air pollution from cooking, heating, and lighting and tobacco smoke is increasing.

Respiratory infections are transmitted by airborne particles, droplets, or physical contact, which are extremely difficult to confront using typical Bank project and component interventions, largely because interventions must involve behavioral change. Hygiene education is vital. Airborne irritants—often overlooked in the transmission of respiratory diseases—cause diseases as well as predispose the body to respiratory diseases such as influenza or pneumonia. High-density living in slums and squatter settlements and poor quality housing in general intensify the risk of such diseases. Overcrowding itself is not the problem (high-density cities, such as Hong Kong and New York, have high health standards), but rather several negatively reinforcing factors. Smoke from cooking and heating with wood, charcoal, and kerosene irritate mucous membranes of the respiratory tract. Overcrowding increases exposure to droplet-spread infections, because poor ventilation inhibits their dispersion and lack of sunshine prevents natural sterilization of the air by sunlight.

Tuberculosis (TB). Emphasis on ambient air pollution has also tended to overshadow the resurgence of TB, especially in developing countries and among the poor in developed countries. Each year, of about 3.8 million cases of TB reported globally, 2.6 million prove fatal. The initial infection may subside with no further symptoms, but still infect others. Most common in adults, TB is usually more serious in infants, children, and adolescents. The infection can be reactivated after years of quiescence. The weakened immune system of HIV-infected individuals may cause an old TB infection to flare up or increase the risk of a new infection. The pandemic of HIV infection and an increase in multi-drug-resistant TB bacteria have profoundly worsened this public health burden.

Epidemiological evidence shows that decreasing overcrowding could reduce TB—something that housing projects could partially address—but reduction of respiratory infections requires more, including medical care and improved hygiene. Upsurge in air travel is helping to spread infectious diseases internationally, particularly, TB.

Diseases related to air pollution. Respiratory diseases figure among the top burdens of disease throughout developing countries (see table 1-1). Major pollution sources are indoor and outdoor air pollutants and environmental tobacco smoke. Somewhat neglected, heart, skin, and eye diseases are also partially attributable to air pollution. Fine particles (significant in sizes of less than 10 microns in diameter and capable of penetrating deeply into the lung at under 2.5 microns) are serious offenders as indoor pollution, because people spend so much time indoors. Biomass fuels, especially from burning wood, are the major culprits, followed by fossil fuels (see definition in box 8-2).

Although the main respiratory diseases vary little in rural compared with urban areas, risk and exposure factors differ considerably, as do pollution sources. For indoor air pollution, traditional fuels used for cooking, lighting, and heating in rural areas include a mixture of biomass fuels, such as charcoal, twigs, dung, and so on, and fossil fuels, such as kerosene and coal. These tradi-

* Infection with tuberculosis requires prolonged exposure; risks are greatest for family members or coworkers, as physical closeness and recycled air appear adequate to facilitate its spread.
tional fuels tend to harm health more than cleaner modern fuels, such as gas and electricity. A key factor is exposure time. In a study of 500 children in Gambia, for example, children strapped to their mothers’ backs were six times more likely to develop respiratory illness than other children, because of increased exposure to fumes from cooking and heating. 92

Rural populations may be regularly exposed outdoors to high levels of dust; those working in agriculture can be periodically exposed to intensive, high levels of fumes from slash and burn, airborne pesticides, fertilizer residues, and chaff and other dusts from food processing, especially smoking fish or meats. Small particles in dust can penetrate deeply into the lungs and compromise breathing. Dust can also compromise the body’s first line of defense against respiratory illness, the mucous lining of the mouth and throat.

Human exposure to indoor air pollution in rural areas of developing countries is estimated to be sixty times greater than in urban areas of developed countries and overall daily exposures about 20 times greater. 93 About one-third of energy consumption in developing countries comes from burning wood, crop residues, and animal dung, mostly in rural areas. Nearly 2 billion people do not have access to electricity and oil and will probably continue to rely on biomass fuels for up to fifty years.

A recent World Bank energy study shows that, as people move up the economic ladder, they change fuels for heating and lighting, but not necessarily cooking. 94 Although cooking is a relatively minor end use of energy consumption in industrialized countries and Eastern Europe, it is the largest home energy use in developing countries, where the main cooking fuels are liquid petroleum gas (LPG), biogas, kerosene, efficient charcoal, charcoal, household coal, wood, crop residues, and animal dung. 95 A major concern is the low conversion efficiency rate of biomass stoves (about 12–18 percent), which, thus, produce high levels of pollution. 96 In eight countries studied, this indoor pollution ranged from four to ninety times the WHO standard for peak pollution guidelines. 97

About Air Pollutants
The literature generally refers to six “criteria” pollutants—particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, lead, and ozone—which correspond mainly to outdoor or “ambient” air pollution. No comparable criteria pollutants gauge indoor air quality. This imbalance in measurement capability has contributed to the relative neglect of indoor compared with outdoor air problems. Indoor air pollution is mistakenly disregarded as a problem in many parts of the world where people generally cook outside or windows and doors are kept open most of the time. Recent evidence shows that people create intense spikes in pollution whenever they stir fires. Although not equivalent to prolonged indoor exposure, these temporary increases in exposure cause significant respiratory irritation that can predispose people to disease. Tables 7-2, 7-3, and 7-4 list the major sources of respiratory illness and main pollutants.

Table 7-3 lists the main components of ambient air pollution and their sources. Two categories have been added to the “criteria pollutants” to accommodate the role of indoor pollution, that is, “other smoke and fumes,” and “inorganic dust.” Table 7-4 indicates the range of sources for lead, for which automobile exhaust is only a minor source, even though it is often considered the main source, whereas other equally important factors are neglected.
Table 7-2: Air-Pollution-Related Respiratory Illness

<table>
<thead>
<tr>
<th>Pollution Type</th>
<th>Main Sources</th>
<th>Remedial Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoor</td>
<td>Cooking, heating, and lighting fumes; intrusion of outdoor pollution; and dust</td>
<td>Better ventilation; less polluting fuel source for cooking, lighting, and heating; protection from external air pollution and dust; adjustments in fuel prices; and education.</td>
</tr>
<tr>
<td>Outdoor</td>
<td>Vehicular exhausts; traffic, construction, and solid waste dust; industrial and energy emissions; and dust</td>
<td>Pollution abatement; traffic management, emission standards, vehicle maintenance, and adjustments in fuel prices; protection from dust as appropriate, e.g. tree barriers; and education</td>
</tr>
<tr>
<td>Tobacco Smoke</td>
<td>Important as predisposing or exacerbating factor, because contains concentrations of many indoor and outdoor pollutants</td>
<td>Better ventilation, education, specific antismoking campaigns, and tobacco levies as appropriate</td>
</tr>
<tr>
<td>Occupational</td>
<td>Varies</td>
<td>Varies</td>
</tr>
</tbody>
</table>

Source: Authors’ data.

Table 7-3: Major Components of Air Pollution

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Main Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particulate matter</td>
<td>Essentially refers to suspended matter small enough to penetrate the lungs (less than 10 microns). Includes virtually anything that produces dust or smoke (also referred to as SPM, TSP, TPM, PM&lt;sub&gt;10&lt;/sub&gt;, PM&lt;sub&gt;5&lt;/sub&gt;, PM&lt;sub&gt;2.5&lt;/sub&gt;).&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Carbon monoxide (CO)</td>
<td>Primarily from transport sector (vehicular exhaust), and household emissions from cooking and heating, and tobacco smoke</td>
</tr>
<tr>
<td>Sulfur oxides (SO&lt;sub&gt;x&lt;/sub&gt;, SO&lt;sub&gt;2&lt;/sub&gt;)</td>
<td>Combustion of coal, petroleum, wood (electricity, cooking, space heating, oil refineries, smelters, paper manufacture, and refuse burning). Major components of tobacco smoke.</td>
</tr>
<tr>
<td>Nitrogen oxides (NO&lt;sub&gt;x&lt;/sub&gt;, NO&lt;sub&gt;2&lt;/sub&gt;)</td>
<td>Combustion of coal, oil, natural gas, and motor vehicle fuel. Biomass and fossil fuels especially important for indoor pollution. Tobacco smoke, whose effects worsen in the presence of motor vehicle emissions. Component of smog.</td>
</tr>
<tr>
<td>Lead</td>
<td>Primary source is vehicular emissions and smelters, but other sources can be more detrimental to health (see table 7-4).</td>
</tr>
<tr>
<td>Ozone (O&lt;sub&gt;3&lt;/sub&gt;)</td>
<td>Main component of smog; reacts with NO&lt;sub&gt;x&lt;/sub&gt; and other pollutants, especially hydrocarbons, with sunlight; used in food industry to extend shelf-life; emitted by high-voltage electrical equipment; used to purify water and sugar</td>
</tr>
<tr>
<td>Other smoke and fumes</td>
<td>Fossil fuels, such as coal, oil, kerosene, and natural gas; biomass fuels, such as wood, charcoal, vegetable matter, dung, and biogas (also referred to as volatile organic compounds (VOCs); and polyaromatic hydrocarbons (PAHs))</td>
</tr>
<tr>
<td>Inorganic dust and other miscellaneous</td>
<td>Essentially other factors not considered separately under another chemical designation and leading to a wide range of respiratory illnesses, including mites, mold, mildew, hair, stored products (e.g., household cleaning and pesticide), residues from building materials, and so on</td>
</tr>
</tbody>
</table>

<sup>a</sup> Suspended particulate matter, total suspended particulate, total particulate matter, particulate matter less than 10 microns, particulate matter less than 5 microns, and particulate matter less than 2.5 microns.

Source: Authors’ data.

Practical interventions by Bank projects to reduce respiratory illness could address poor air quality, overcrowded housing, and infectious irritants to the respiratory tract. Any housing construction projects should incorporate proper aeration and sunlight in designs to help reduce person-to-person transfer and proper ventilation to eliminate smoke and fumes. Outdoor exposure, for example, vehicle exhaust, especially near markets and stations, and recurrent exposure to dust and other particulate matter, is also significant. Small components often play a sizeable role in reducing the basic irritation that predisposes people to respiratory infections.

Air pollution abatement needs to address collectively the major indoor, outdoor, and occupational sources. Lead, as a major pollutant, is unquestionably a serious public health problem globally, but its role, especially in SSA cities, may be overstated, because studies of equally important factors have been less publicized, even in industrialized countries. Routine mention of lead in envi-
ronmental assessments does not necessarily make it important, unless associated with areas of high exposure, for example, populations in markets near bus stations, where vehicle emissions are excessively high. Table 7-4 lists lead’s varied sources.

Table 7-4: Multiple Sources of Lead

<table>
<thead>
<tr>
<th>Medium (Method)</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air (inhaled)</td>
<td>Automobile emissions; primary and secondary lead smelters; foundries producing other metals; factories producing ceramics, glass, and armaments; weathering of lead-painted surfaces; combustion of lead-painted materials and solid waste; recycled motor oil used as fuel for industry and energy; and dust recycled within the environment for up to 30 years</td>
</tr>
<tr>
<td>Water (drunk)</td>
<td>Lead-lined storage tanks; lead pipes, fittings, and couplings; and air-borne particulate settling on water</td>
</tr>
<tr>
<td>Food (ingested)</td>
<td>Soil and dust deposits eaten directly in food; air deposits taken up in food, fertilizers, and irrigation water; food in contact with lead solder in cans and lead-glazed cookware and plates; chips from painted surfaces eaten and pencils chewed on by children; and flour from traditional stone mills, reinforced with lead joints</td>
</tr>
<tr>
<td>Occupational</td>
<td>Smelter workers, traffic police, and garage mechanics</td>
</tr>
<tr>
<td>Other</td>
<td>Diarrheal remedies and cosmetics (especially eye, e.g., kohl)</td>
</tr>
</tbody>
</table>

Source: Authors’ data.

**Gastroenteric Diseases**

Gastroenteric diseases cover a wide range of diseases from food poisoning to cancer. Two diseases—diarrheas and intestinal worms—for example, are responsible in developing countries for some of the greatest burden of disease. Gastroenteric diseases are diseases of the stomach (gastro) and intestines (enteric). Most are simply and cheaply preventable by keeping drinking water free of contamination and providing sufficient amounts of water and education to enable people to maintain good personal hygiene. Some 10 to 20 million children die yearly due to diarrheal diseases. Equally significant is high morbidity in the general population from intestinal parasites, primarily caused by inadequate disposal of excreta and lack of personal hygiene. These parasites currently infect some 3.5 billion people in developing countries and cause about 160,000 deaths per year. Even though their mortality rate—under 1 percent of the infection rate—is much less dramatic than infant mortality, the incalculable loss in human productivity is certainly significant.

**Diarrheas**

Diarrheas remain one of the greatest causes of death and disease, despite progress during the International Drinking Water Supply and Sanitation Decade of the 1980s. Epidemiologically, mortality from diarrheas, if untreated, can be high due to dehydration and depletion of essential body chemicals. Diarrheas are the main symptom of more than thirty diseases, but are also side reactions to other diseases or their treatments, or from travel, change of diet, or stress.

Diarrheas radically upset absorption of nutrient fluids in the intestines, which expel fluids that should remain in the body. This can sufficiently alter the body’s fluid/nutrient/electrolyte balance to cause death. Diarrheas are particularly devastating for children, who are more fragile and susceptible to fluid loss. Due to the size of their intestines relative to body weight, the effects of dehydration and shock are more pronounced in children.

* About 8 liters of water daily pass through the intestines of the average adult. Only about 2–3 liters come from food and drink; the remainder comes from body fluids (e.g., mouth, stomach pancreas, liver, and small intestines). Of this, the large intestine expels only about 0.1 liter as water and the rest is absorbed or excreted in urine.
Humans may inadvertently ingest small amounts of feces containing the pathogens that cause diarrhea. Inadequate excreta removal is probably the single greatest reason, followed closely by poor personal hygiene, accounting for hand-to-mouth transmission, and drinking contaminated water. Inadequate drainage compounds the problem, especially in slums and squatter settlements, when storm drains clog with all types of waste, exposing infants and children who play outside to high risks. Crowded housing conditions worsen the situation due to poor personal and domestic hygiene and food preparation practices, especially during cholera epidemics. Table 7-5 shows the main excreta-related diseases, including diarrheas.

**Table 7-5: Main Excreta- and Water-Related Diseases**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Main Transmission Routes and Effects</th>
<th>Main Control Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diarrheas:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) General</td>
<td>(a) Includes such fecal-oral routes as interpersonal contact, drinking water, contaminated food, and unwashed hands. Causes dehydration, vomiting, and cramps. Even in low doses, can cause death, especially in children.</td>
<td>(a) <em>General:</em> waste disposal to avoid water contamination in the first place and ensure personal and food preparation hygiene. <em>Water quantity</em> crucial for hygiene.</td>
</tr>
<tr>
<td>(b) Dysentery (Amoebiasis)</td>
<td>(b) As above. Rapid onset of “bloody diarrhea,” causing anemia, fever, vomiting and cramps. Even low doses can cause infection.</td>
<td>(b) <em>General:</em> medication and oral rehydration therapy (ORT) and immunization of carriers, e.g., typhoid</td>
</tr>
<tr>
<td>(c) Cholera</td>
<td>(c) As above. Water and food contaminated by infected person. Rapid onset of diarrhea, vomiting, cramps, dehydration, and shock. Mortality high if untreated.</td>
<td>(c) <em>General:</em> heavy chlorination in epidemics, e.g., for cholera</td>
</tr>
<tr>
<td>(d) Typhoid (Salmonellosis)</td>
<td>(d) As above. Intestinal infection causing fever and headache. Can be fatal.</td>
<td></td>
</tr>
<tr>
<td><strong>Intestinal Worms:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Ascariasis</td>
<td>(a) Ingested on food contaminated with worm eggs. Worm inhabits intestines. Main effects are malnutrition. Can cause other problems.</td>
<td>(a) <em>General:</em> deworming medication</td>
</tr>
<tr>
<td>(b) Hookworm</td>
<td>(b) Worm larvae penetrate feet or lower legs. Blood-sucking worm “hooks” itself to small intestine. Can cause severe anemia.</td>
<td>(b) Improved sanitation, especially near living quarters (children are the main reservoir); personal hygiene; and food preparation</td>
</tr>
<tr>
<td><strong>Vector-related:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Malaria</td>
<td>(a) Spread by mosquitoes.</td>
<td>(a) <em>General:</em> curative and preventive medication</td>
</tr>
<tr>
<td>(b) Schistosomiasis</td>
<td>(b) Spread by snails, Very debilitating bladder infection with worm and eggs. Spread to perirurban areas from rural to urban migration.</td>
<td>(b) Control of mosquito breeding grounds, e.g., through landfills or insecticides</td>
</tr>
<tr>
<td>(c) Filariasis</td>
<td>(c) Spread by mosquitoes. Worm infections can cause headaches, nausea, fever, and painful swelling of legs, genitals, and breasts.</td>
<td>(c) Improved sanitation; avoiding human exposure to larvae; and eliminating snail habitat</td>
</tr>
<tr>
<td>(d) Leptospirosis</td>
<td>(d) Direct exposure to rodent urine or in water, especially during rainy season. Sudden onset of fever and aches, hemorrhaging. Can cause kidney failure and death.</td>
<td>(d) Ventilated, improved pit (VIP) latrines effective in dealing with odors and insect breeding</td>
</tr>
<tr>
<td>(e) L. welshimeri</td>
<td></td>
<td>(e) Protective clothing, education, and medications for workers and scavengers at waste disposal sites (especially where rats are present)</td>
</tr>
</tbody>
</table>
**Intestinal Parasites**

Intestinal parasitic and protozoan infections are among the most common infections worldwide. An estimated 3.5 billion people are affected, of which 450 million, mostly children, are ill. Multiple infections with several parasites (e.g., hookworms, roundworms, and amoebae) are common; their harmful effects are often aggravated by malnutrition or micronutrient deficiencies (see table 7-6). These parasites interfere with digestion, absorb needed nutrients, and cause anemia and diarrhea. Each of these factors can, in turn, evolve into serious problems, such as stunting of growth, dehydration, and even asthma in poor communities—all more severely in children.

Hookworm causes higher levels of anemia than malaria and schistosomiasis. Even though many curative medicines are effectively administered, the frequency of reinfection keeps the prevalence of these infections high, in part due to relative neglect in their research and control since World War II. Intestinal parasites remain an important health problem and contributing factor to malnutrition, even though the death rate—under 1 percent of the infection rate in the six examples cited—is much less dramatic than, for example, for infant diarrhea.

**Table 7-6: Major Intestinal Parasites**

<table>
<thead>
<tr>
<th>Infection Rate/Year</th>
<th>Mortality Rate/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worms</td>
<td></td>
</tr>
<tr>
<td>Roundworms (e.g., ascaris)</td>
<td>1,000,000,000</td>
</tr>
<tr>
<td>Hookworms (e.g., ancylostoma and necator)</td>
<td>900,000,000</td>
</tr>
<tr>
<td>Tapeworms (e.g., taenia)</td>
<td>50,000,000</td>
</tr>
<tr>
<td>Whipworms (e.g., trichuris)</td>
<td>500,000,000</td>
</tr>
<tr>
<td>Other parasites</td>
<td></td>
</tr>
<tr>
<td>Amoebas (e.g., Entamoeba histolytica)</td>
<td>500,000,000</td>
</tr>
<tr>
<td>Giardia</td>
<td>200,000,000</td>
</tr>
</tbody>
</table>

*Source: WHO web site, <who.int/ctd/html/intest.html> (accessed September 2000).*

Deficient sanitation primarily explains continuing high rates of infection by worms, chiefly ascaris and hookworm. Ascaris, an important contributor to malnutrition, spreads through interpersonal contact and ingestion of eggs deposited on poorly washed or uncooked vegetables that have come into contact with feces during growth or processing. Water that is used to keep vegetables fresh after picking is often contaminated. Hookworm is an important factor in anemia and one of the most common causes of hospitalization. Hookworm eggs deposited in moist soils develop into larvae. Inadequate feces disposal spreads the disease, when larvae penetrate the feet, commonly around defecation sites (see annex B). With increased urbanization globally and more people living in shantytowns with poor sanitation, WHO expects infection levels to increase.

**Malaria and Vector-Related Diseases**

Vector-related diseases tend to be predominantly “rural” diseases, because they require an intermediate host, such as a mosquito or snail, whose habitats are more plentiful in rural areas. Malaria, the most significant (see table 1-3), is widespread; 2.4 billion people, more than one-third the world’s population, are at risk. This rural predominance could be changing; malarial mosquitoes are adapting to urban areas, many of which have extended mosquito breeding habits by increasing periurban cultivation and year-round supplies of water, which are often not properly drained. The mosquito species that transmits dengue fever is also becoming firmly entrenched in many urban areas. This group of diseases may be neglected, partly because vector-related diseases have been downgraded to “nuisances” in industrialized countries. They, thus, do not gain as much attention in public health literature, environmental health assessment processes, and university education, all of which tend to focus on pollution-related issues.
Schistosomiasis is another widespread vector-related disease. It is spread by snails, which favor slow-moving water, the type of habitat that dams create. Neglect of vectors in hydropower or irrigation projects has worsened the spread of schistosomiasis, for which 600 million people are currently at risk (see table I-3). Prior to the 1985 damming of the Senegal River, for example, only one recorded case of schistosomiasis had occurred along the river. After damming, 187 villages were infected.

The effects on the local population of vector-related diseases less widespread than malaria or schistosomiasis can still be devastating. Black flies, for example, spread river blindness; these flies breed in fast-moving water in rivers, streams, spillways, and drainage canals (aerated water provides larvae the high amounts of oxygen needed for development), precisely where people wash clothing, fish, bathe, swim, and collect water. Socioeconomic costs of river blindness are high, because up to 50 percent of the local population can be infected—impairing vision for 30 percent and blinding 10 percent. People often abandon entire villages for higher ground, resulting in great economic costs, including less fertile soil and long travel distances to water. The disease often affects 50 percent of a village in endemic areas. About 30 percent of cases result in incapacitation, about 0.5 percent in permanent disability and 0.1 percent in mortality. Disability ranges from five to ten weeks in untreated cases. In western Nigeria, for example, the average disability lasted for 100 days. Table 7-7 summarizes transmission routes for major vector-related diseases. Annex B provides one-page descriptions of transmission and remedial measures.

**About Mosquitoes**

Three mosquito species— aedes, anopheles, and culex—are important in transmitting malaria and the diseases noted above. Their different breeding habits call for different approaches to breaking the transmission cycle (see table 7-7). The implications for projects stem from the type of habitats that projects can create, alter, or eliminate. Because, for example, anopheles mosquitoes breed in natural marshes and impounded water, nature’s role may be far more significant than water or irrigation projects. Culex mosquitoes, in contrast, breed in organically polluted water, and aedes in clean standing water; therefore, infrastructure projects can significantly alter the extent of breeding habitat.

The implications of mosquito breeding habits are obvious for water, sanitation, or urban sector and irrigation and rural development projects and components. Drainage and waste disposal emerge as important as water provision itself. Despite specific breeding preferences, mosquito adaptability is impressive; they can breed in fresh, salt, or brackish waters and virtually anywhere where water collects in tree holes, fallen leaves, coconut shells, cut bamboo, gourds, cans, plastic residue, drying river beds, hoof prints, discarded car parts, and plant axils or leaves of pineapple, banana, cocoa, yams, and paw. Mosquitoes thrive on living organic matter, but can eat almost anything small enough to ingest. Their potential flight range extends as far as 300 kilometers, but usually remains within 3.2 kilometers and averages about 1.2 kilometers. In most cases, comprehensive environmental sanitation measures up to 1.6 kilometers are effective. A rule of thumb might be to consider the area extending a mile in all directions beyond human inhabitation as containing potential mosquito-breeding grounds.

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**Various species of mosquitoes have different breeding and feeding habitats, which calls for different approaches to breaking the transmission cycle in malaria and other diseases. Indeed, malaria is sometimes informally referred to as “urban,” “industrial,” “irrigation,” and “forest.”**
Table 7-7: Transmission of Main Vector-Related Diseases

<table>
<thead>
<tr>
<th>Disease</th>
<th>Breeding Environment and Primary Means of Transmission</th>
<th>Diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mosquitoes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anopheles</td>
<td>Fairly clean, slow-moving brackish or fresh water, e.g., irrigation water, ponds, and marshes. Flight range up to 3 miles (5 kilometers).</td>
<td>Malaria and filariasis</td>
</tr>
<tr>
<td>Aedes</td>
<td>Clean, fresh, and salt standing water, e.g., water pots, cisterns, small containers, temporary pools, and periodic flooding. Potential flight range of up to 160 kilometers. Feeding flights most likely 1.6 kilometers.</td>
<td>Yellow fever, dengue, and filariasis</td>
</tr>
<tr>
<td>Culex</td>
<td>Fresh and salt water polluted with organic matter, e.g., pit latrines, clogged storm drains, open sewers, waste stabilization ponds, and soaking pits. Flight range up to 16 kilometers. Feeding most likely less than 8 kilometers.</td>
<td>Filariasis</td>
</tr>
</tbody>
</table>

| **Other Vectors** |                                                                                                                          |                           |
| Snail            | Breeds along river and lake banks or irrigation and drainage canals. Worm eggs in excreta develop into larvae (miracidia) that infect snails. Snail eggs hatch into larvae (cercariae) that penetrate skin. Larvae need to find host within 6 to 48 hours. | Schistosomiasis (bilharzia) |
| Rodents (rats)   | Breed in and feed on uncollected solid waste and waste disposal sites, Urine and feces can spread disease through direct contact or ingestion. | Leptospirosis (Weil’s disease) and plague |
| Water flea (Cyclops) | Breeds in small freshwater ponds. Humans ingest water flea (copepods) in drinking water.” “Flea” develops into a worm that causes ulcers on leg and foot. Worm sheds eggs into water, completing the cycle. | Guinea worm (dracunculiasis) |
| Black fly        | Breeds on vegetation and rocks near or in fast-moving waters, e.g., dam spillways and irrigation channels. Disease is spread through fly bites. Flight range is more than 160 kilometers. | River blindness (onchocerciasis) |

Source: Authors’ data.

Bright light, dark clothing, carbon dioxide (from breath), warmth, and moisture attract mosquitoes. They bite most frequently at dusk, although precise habits depend on the species. Spraying is effective in reducing exposure, but long-term effectiveness requires repeated (e.g., every four months) and comprehensive efforts (see “Vector Control” and “DDT” below). In most species, the female sucks the blood to produce eggs and lives, on average, about one month. Mosquito breeding takes from three to seven days from hatching to adulthood, shorter at high temperatures (e.g., 30°C) and longer at lower temperatures (e.g., 16°C).

Current research shows change in some breeding, feeding, and biting habits, as predominantly rural diseases appear in urban areas. It is not yet clear whether these changes are due to urbanization (e.g., creating year-round habitats independent of seasonal change), global warming (e.g., geographic extension of habitat), pesticide application (e.g., genetic changes), or spreading the human host pool through population movement. Evidence shows that anopheline mosquitoes are adapting to urban conditions. Aedes mosquitoes, likewise, appear to be spreading to urban areas, but, because this species breeds in water storage containers found in both areas, it is less clear why. Its spread to urban areas might account for the increase of dengue fever in Central and Latin America, already considered a regional epidemic by some, and in some Asian cities. Dengue fever exists in Africa, but is not as important as the other diseases listed above. Its relative importance could increase, nonetheless, based on its spread to urban areas, but it is difficult to assess because WHO does not systematically track dengue as part of the “Tropical Cluster.”
Vector Control

Vector control is a complicated matter and not always suitable as a typical Bank project component, because curative and preventive measures will probably require years beyond the project cycle and miles outside the project zone. Neglect, however, can lead to devastating consequences; nonetheless, numerous short-term measures can be incorporated into projects by (a) providing technical assistance for designing an appropriate response outside the project, (b) adapting some of those measures as appropriate into the project zone, and (c) engineering designs to reduce breeding habitats.

Because irrigation, solid waste, and drainage components can be designed to reduce or eliminate vector breeding habitat, they should always consider vector control in endemic areas. In periurban and rural areas, irrigation has permitted a sequence of multiple crops that no longer allows for a natural interruption of breeding sites in the dry season. Breaking the cycle of transmission entails (a) interrupting breeding patterns through infrastructure interventions and killing the vector and larvae, proceeding with extreme caution in applying pesticides and (b) interrupting human exposure, inducing behavioral change, and providing medication.

Considerable information on pesticide use is available on the agricultural dimensions of integrated pest management, which combines natural resistance and biological control (e.g., natural predators, cultural practices, and pesticides), when nonchemical methods fail to keep pests below economically damaging levels. 101 (See also OP 4.09 “Pest Management” and GP 4.03 “Issues in Pesticide Use,” the latter of which deals with general pesticide hazards and some health hazards. See also “Key Cross-Cutting Issues” below, which provides significant detail on the impacts of pesticide use.)

If vector-related diseases are a local problem or local populations consider mosquitoes a nuisance, the team manager should consult with the ministry of health on what programs exist or could be extended to the project area. NGO interventions or a community participation component could promote self-help preventive measures and include studies to establish basic ecological and epidemiological background information (e.g., identification of species, their habitats and feeding and breeding habits, socioeconomic description of the local population, designation of the population at risk, and so on) and the type of follow-up needed by the ministry of health and community. Recommendations are, in general, best executed outside the project, but a component could support a pilot project or work within the project zone. Ongoing monitoring by a project would, however, be appropriate. Table 7-7 above shows the linkages with diseases for which water and excreta disposal play an important role in vector transmission.

Integrated vector control. Integrated vector control, an extension of integrated pest management, adapts to the needs of disease vectors, particularly mosquitoes, snails, and flies. It is based on the Bank’s OP 4.09, which promotes strategies using biological or environmental control and reduces reliance on synthetic chemical pesticides. A Zambian tsetse fly control component, for example, reduced total pesticide application by applying less than 100 liters of endosulfan to traps instead of spraying 600 liters of deltamethrin.

DDT. DDT use for widespread pest control has been banned in many countries (see table 7-8), but WHO still approves of DDT for limited public health uses, such as malaria control (mosquito spraying) in and around houses. Increasing evidence, still under study, however, postulates that DDT is carcinogenic in humans; hence, this approval may change (see “DDT” below). Research on alternate strategies, such as using several other pesticides in combination or sequence, is being pursued, mostly in Asia, not SSA. It is not yet clear what problems transport, storage, and disposal of new pesticides and disposal of obsolete stocks might pose. Because of the seriousness of malaria in SSA and the large volumes of pesticides used, box 7-1 summarizes some of the risks drawn from actual projects.
Table 7-8: Summary of Persistent Organic Pollutants (POP) Use and Restrictions by Country

<table>
<thead>
<tr>
<th>POP</th>
<th>World Wildlife Fund List of Countries Where Permitted (SSA in bold)</th>
<th>Countries Where Banned or Restricted in Italics (SSA in bold italics)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDT</td>
<td>• Permitted for import to Bhutan, Bolivia, Ethiopia, Guinea, India, Kenya, Malaysia, Mauritania, Mexico, Nepal, Philippines, Sri Lanka, Sudan, Switzerland, Tanzania, Thailand, República Bolivariana de Venezuela, and Vietnam</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Banned in Argentina, Australia, Austria, Bulgaria, Colombia, Costa Rica, Côte d’Ivoire, Cuba, Cyprus, Denmark, Dominican Republic, Egypt, El Salvador, Ethiopia, Finland, Fiji, Hong Kong (China), Indonesia, Japan, Republic of Korea, Lebanon, Liechtenstein, Mozambique, New Zealand, Nicaragua, Paraguay, Poland, Santa Lucia, Singapore, Switzerland, the United States, Yemen, and Zimbabwe</td>
<td></td>
</tr>
<tr>
<td>Aldrin</td>
<td>• Permitted in Canada for below-ground termite control</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Permitted for import to Republic of Congo, Ethiopia, Malaysia, Nepal, Sri Lanka, Sudan, Tanzania, Thailand, Trinidad and Tobago, and República Bolivariana de Venezuela</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Used in Kenya for tsetse fly control and the United States for dipping nonfood roots or tops and moth proofing during manufacturing processes in closed systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Banned in Russia and the United States</td>
<td></td>
</tr>
<tr>
<td>Dieldrin</td>
<td>• Permitted for import to Republic of Congo, Ethiopia, Malaysia, Nepal, Sri Lanka, Sudan, Tanzania, Trinidad and Tobago, Uganda, and República Bolivariana de Venezuela</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Used in Kenya for banding coffee trees and in the United States for dipping nonfood roots or tops and moth proofing during manufacturing processes in closed systems</td>
<td></td>
</tr>
<tr>
<td>Endrin</td>
<td>• Used in the Dominican Republic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Manufactured or imported in the United States, Philippines, and Japan</td>
<td></td>
</tr>
<tr>
<td>Chlordane</td>
<td>• Used in Mexico, Canada, China, United Kingdom, Belgium, Belize, and Cyprus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Permitted for import to Australia, Cuba, Ethiopia, Malaysia, Mexico, Oman, Philippines, Sri Lanka, Sudan, Tanzania, Thailand, and Trinidad and Tobago</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Banned in Austria, Belgium, Bolivia, Brazil, Chile, Colombia, Costa Rica, Denmark, Dominican Republic, European Union (EU), Ecuador, El Salvador, Fiji, Germany, Guatemala, Hong Kong (China), Ireland, Italy, Kenya, Republic of Korea, Lebanon, Liechtenstein, Mozambique, Netherlands, Norway, Panama, Paraguay, Philippines, Poland, Portugal, Santa Lucia, Singapore, Spain, Sweden, Switzerland, Tonga, Turkey, the United Kingdom, Yemen, and Yugoslavia</td>
<td></td>
</tr>
<tr>
<td>Heptachlor</td>
<td>• Permitted for import to Burkina Faso, Costa Rica, Ethiopia, Pakistan, Sudan, Tanzania, Thailand, Togo, and Trinidad and Tobago</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Used in Mexico, Bulgaria, and the United States for limited agriculture purposes</td>
<td></td>
</tr>
<tr>
<td>Hexachlorobenzene</td>
<td>• Exported by both Organisation for Economic Co-operation and Development (OECD) and non-OECD countries</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Banned in Austria, Belgium, Czech Republic, Denmark, EU (as a pesticide), Germany, Hungary, Liechtenstein, Netherlands (as a pesticide), Panama, Russia (as a pesticide), Slovak Republic, Switzerland, Turkey, the United Kingdom (as a pesticide), and Yugoslavia</td>
<td></td>
</tr>
<tr>
<td>Mirex</td>
<td>Currently known manufacturers and no production data available</td>
<td></td>
</tr>
<tr>
<td>Toxaphene</td>
<td>• Manufactured in China, Pakistan, and Nicaragua</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Banned in Austria, Belgium, Belize, Bolivia, Brazil, Bulgaria, Burkina Faso, Costa Rica, Cuba, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, EU, Germany, Guatemala, Ireland, Kenya, Republic of Korea, Liechtenstein, Mexico, Mozambique, Panama, Paraguay, Peru, Philippines, Portugal, Santa Lucia, Singapore, Switzerland, Thailand, Tonga, and the United Kingdom</td>
<td></td>
</tr>
<tr>
<td>PCBs</td>
<td>• Use has been restricted to closed electrical systems, for which they remain in use throughout most of the world</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Banned in Austria, Czech Republic, Finland, Germany, Liechtenstein, Netherlands, Norway, Slovak Republic, Switzerland, and the United States</td>
<td></td>
</tr>
<tr>
<td>Dioxins and furans</td>
<td>Not applicable</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Note: Although numerous industry and government programs are investigating sources of dioxins and furans and developing control technologies, no known uses or emission data specific to dioxins and furans are available at this time.</td>
<td></td>
</tr>
</tbody>
</table>

Note: Some analysts estimate global cumulative production of DDT at 1.36 million tons. |
Box 7-1: Potential Risks Associated with Pesticide Use in Malaria Control in SSA

Transport. Some projects involve large volumes of pesticides, for example, a project in Madagascar provided about 1,000 tons of DDT or about fifty shipping containers or truckloads. International transport of pesticides is governed by regulations based on U.N. norms for dangerous goods, for example, the International Maritime Dangerous Goods Code. National legislation, however, often does not regulate transport within SSA. Bad roads and old vehicles, often passing through densely populated areas, contribute to the risks.

Storage. Pesticide stores in SSA do not meet basic safety standards. In Zanzibar, DDT and malathion were stored inside a wooden shed on school grounds. In another case, they were stored inside corroded shipping containers within the compound of the Ministry of Health, located next to another school, which regularly complained about strong pesticide vapors in the classrooms.

Diversion for other uses. Public health pesticides get diverted to agricultural purposes and cause significant residue problems and subsequent risk to consumers. DDT is occasionally reported in food residues and blood samples.

Environmental impact. DDT and its metabolites remain biologically active a long time. In the long term, a significant proportion of 1,000 tons of DDT applied inside houses is likely to end up outside.

Occupational risks. Respiratory protection masks (or cartridges for them) need to be changed regularly but are not always available in sufficient quantities or affordable to many workers.

Obsolete stock. Tanzania, for instance, has a serious contamination problem due to about 300 tons of obsolete DDT. Such stockpiles pose a hazardous waste problem in Tanzania and Malawi, but have been removed at high cost (US$ 4,000 per ton) from Zanzibar and Zambia. South Africa also had large stocks but these may have been removed by now. The total of obsolete pesticide stockpiles in Africa is estimated at 20,000–30,000 metric tons.

Re-use of containers. Empty containers, widespread in SSA, have economic value and are typically used for storage or as building materials. For many pesticides, containers cannot be cleaned to hold water or food, although they are still used in this way. Most countries also do not have safe disposal facilities for contaminated packaging, which is also hazardous. A thousand tons of pesticides in 200 liter drums will result in 5,000 contaminated drums, whereas 1,000 tons in 25 kilogram bags result in 40,000 contaminated bags.

Source: Memorandum, Harry van der Wulp, Pesticide Specialist, World Bank (November 11, 1999).

The Bank’s Operational Policy 4.09 stipulates that Bank projects addressing pest management or vector control should promote strategies using biological or environmental control and reduce reliance on synthetic chemical pesticides. If nonchemical methods alone are insufficient, the Bank may finance the purchase of pesticides. These should have negligible adverse human health effects and minimal effects on the natural environment. In view of OP 4.09 and the trend in POP negotiations, malaria projects requiring chemical control should not automatically fall back on DDT, but explore less persistent alternatives in which Bank client countries have experience.

Pesticide storage. Improper pesticide storage can generate substantial local pollution with wide-ranging effects, if pesticides seep into ground and surface waters. Improper storage results from

The Bank has been working closely with countries that still employ DDT for malaria control to reassess their reliance on spraying as a control method and to develop strategies for reducing their use of DDT. As the alternatives are viewed as more expensive (because they are employed differently and have different levels of effectiveness), costs are implied in making the transition (training, new procurement, safeguards, and equipment). The Bank has stated its willingness to consider requests from clients seeking financial assistance in making the transition. India, Madagascar, and Eritrea are good examples of where this is currently happening.
(a) purchase of more than what can be used before the expiration date, (b) unprotected storage
areas promoting deterioration of pesticide containers, often nothing more than paper or cloth
sacks, and (c) improper labeling. Human health risks associated with acute and chronic exposure
depend on location and use, the size of the company or farm, and the degree to which the facili-
ties involved are set up to handle dangerous or hazardous materials. Locations include:

- **Ports and harbors**, where risks extend to workers as well port users
- **Transport facilities**, including temporary truck stops
- **Formulation centers**, where standards can be relaxed because individual components
  mixed into pesticides are not harmful
- **Wholesalers**, who may repackage pesticides into containers marked as hazardous
- **Retailers**, who repackage pesticides, are exposed to spills and leakages and rarely have
  the necessary equipment and gear to handle and clean up products safely
- **Households**, where the risk of poisoning is high.

Control of migratory pests pose a special hazard due to the lack of proper temporary facilities for
large quantities.

Pesticide overuse or misuse. A wide range of factors lead to the overuse and misuse of pesticides:
(a) repackaging of bulk quantities, often in unmarked packages, for possibly illiterate users, (b)
using the wrong concentrations, for example, of persistent pesticides on vegetables, (c) using
equipment without protective gear, (d) cleaning clogged equipment, (e.g., sprayers) without
proper tools, (e) applying higher doses when pesticides do not appear to work immediately, (f)
“using up” excess old stock, and (g) using restricted pesticides such as DDT for other uses than
allowed. Overapplication can build up resistance, rather than killing more pests. Pesticides are
used in food for human consumption and poured into rivers and ponds to kill fish, rodenticides
are used to kill wild game, and fungicides and other pesticides are used as food preservatives. In
addition, birds, locusts, and grasshoppers killed in emergency pest control campaigns are sold in
markets.

Expired or obsolete pesticides. Expired or obsolete pesticides, even though no longer considered
appropriate for effective application, and their empty containers remain hazardous materials, re-
quiring precautions often not available in rural areas. As a result, stocks deteriorate and contami-
nate the local environment and water table. Companies from industrialized countries often donate
pesticides that are nearly expired or already obsolete to developing countries for tax benefits in
their home country. In SSA, donations for emergency locust control have resulted in excess exp-
pired stocks.

Transport of pesticides. Often neglected, this aspect raises health concerns from the port of entry
to transport of containers to a disposal site; the transport system may not be equipped to reduce
human exposure at all levels in the following ways:

- **Ports and harbors**: (a) handling and locking up hazardous materials, (b) protecting bulk
  supplies, often in paper or cloth sacks, from wind, rain, and sun, (c) distinguishing haz-
  ardous from nonhazardous materials intended for reformulation into pesticides in order to
  take appropriate precautions, (d) protecting the general public and port employees from
  exposure when reloading material for intra- and inter-city transport
- **Intra- and inter-city transport system**: (a) segregation of pesticides from other cargo, (b)
  proper loading and unloading at different stages, that is, from intermediate dollies and
  from carts to trucks, (c) safely repackaging containers damaged in storage or loading, (d)
  protecting cargo at truck stops, especially in the rainy season when roads may be blocked
  for several days, (e) cleaning and monitoring trucks for carrying pesticides after having
  carried food.
- **Disposal**: (a) proper temporary storage of discarded chemicals and their empty contain-
ers, (b) safe loading of stored material to collection vehicles for transfer or final disposal,
(c) safe consolidation and transfer to final disposal site by truck, boat, or train, and (d) proper disposal at the final destination, and (e) protecting material at the disposal site from scavenging or improper recycling.

**Injuries and Accidents**

“Unintentional injuries” include a broad range of accidents, primarily, in terms of mortality, traffic, falls, drowning, burns, poisoning, and occupational injuries. Falls account for nearly half the years lived with disability in the world and less for traffic, because of high mortality in this category. The transport sector has for years integrated the most easily addressed causal factors, that is, road safety. Many other injuries are work related and easily prevented using existing best practices. In most developing countries, however, no safety net exists for people suffering occupational injuries. Structural designs in the neighborhood or the house can often address drowning, household falls, and burns.

**Agriculture.** Around the world, farming is one of the highest-risk occupations, partly due to inaccessibility of health care after accidents. In developing countries, the situation is aggravated by illiteracy and poverty, which often means faulty, poorly maintained, or inadequate equipment and no protective clothing or gear. Few data are available, unfortunately, concerning farming accidents and injuries in SSA.

**Housing.** Not all projects can control construction designs and standards, but, when they do, projects can build in low-cost modifications to stoves and cooking areas, protective barriers or catwalks in housing projects near or over water, fencing around landfills, and so on. A technical assistance component may help identify practical risks and recommend solutions to implement outside the project. This is especially helpful when behavioral change is needed and an accident prevention component is administratively difficult to incorporate directly into a project.

**Traffic.** Apart from fatalities, data on traffic injuries are difficult to obtain, except as broad categories. Injuries are particularly high among teenagers. The transport subsector has already dealt with remedial measures for traffic accidents, but erosion’s role in causing pedestrian and vehicular accidents needs strengthening. Erosion can eat away the shoulder of a road, forcing pedestrians to walk in traffic. In extreme cases, erosion can eat into the roadway itself, forcing vehicles into another lane.

Because the remaining broad categories of injuries and accidents are difficult to define, it is also difficult to design precise project interventions. Remedial measures could include safety measures and education implemented by a local NGO. To prevent falls, task managers can follow best practices that are often standardized safety precautions during project construction. The ministry of health or local health agency or NGO may be able to indicate the seriousness of drownings, burns, and poisonings. It is helpful to:

- Determine the extent to which children slip into water bodies next to paths or fall from catwalks or residences in housing built over water
- Determine the degree to which burns are caused by home cooking, lighting, and heating fires
- Separate out, if possible, cases due to intentional poisoning and suicides, which might account for the majority, and determine the degree to which poisonings are caused by improper storage.

Subsector sections discuss respective occupational measures.
Physical and Mental Stress

Poverty creates much stress: women and children routinely spend hours every day finding drinking water and household fuel, and poor people live in areas of marginal economic value, exposed to noise, air, and water pollution and uncollected solid waste. Although data on physical and mental stress are difficult to find, especially for SSA, WHO estimates that mental stress will substantially increase worldwide in the next decade and its effects will increase its share of the burden of disease.

The scientific community is examining another form of stress: violence. Still limited research, however, makes it difficult to demonstrate causality in a manner that Bank-type projects could incorporate. In rural areas, some pesticides have been shown to be neurotoxic, which may lead to violent behavior.

Diseases for Special Consideration

AIDS, epidemic cholera, and guinea worm infection are special cases of diseases, which demand or have demanded unique approaches.

AIDS

In SSA, AIDS has become a major problem affecting all facets of society (see box 1-4). Four activities play an important role in transmitting AIDS—urban and rural transportation (most notably truckers), food markets, construction work crews, and rural-to-urban migration. These all provide opportunities for addressing the problem, because they are frequent components in Bank projects. They also can facilitate access of health personnel to do AIDS prevention or provide the framework for interventions outside the health care system. Various project interventions could include:

- **High-risk groups in infrastructure and energy projects.** Compared with other sectors, infrastructure and energy projects tend to contain large construction components, in which workers often live in temporary camps. Many operations have been or are being privatized, but the private sector is not prepared to deal with AIDS prevention (indeed, many firms hire “duplicate” employees, because they expect to lose staff to AIDS).
- **Urban market associations.** Many urban projects contain components improving management of markets (especially waste disposal). These markets often contain strong merchant groups.
- **Urban “addressage” components.** Many urban projects contain components for mapping streets and assigning addresses to residences. This provides a good opportunity to do AIDS prevention, as well as provide health ministries with address records.
- **Municipal management.** Although the bulk of AIDS treatment and prevention falls on ministries of health, just as many outcomes fall on the shoulders of municipal governments, for example, coping with a shortage of burial plots or housing and caring for orphans and “street kids.”
- **Trucker groups.** Compared with other Bank Regions, SSA still relies heavily on truck transportation, which is both an asset and a risk. It is a risk because truckers help spread AIDS, especially at regular truck stops (where, in the rainy season, truckers can sometimes wait days because roads are blocked). It can be an asset because trucker associations are well organized to send public health messages effectively to peers.
- **Waste management.** With decentralization, many municipalities must cope with disposal of medical waste, but do not have regulatory measures in place. This is an important factor for waste containing blood and syringes (which are recycled in Ghana as hair curlers!).
**Epidemic Cholera**

Bank projects are, in general, not designed for epidemics or emergency relief measures except on an impromptu basis for technical assistance or rehabilitation and reconstruction. Cholera could be such a case. It is important because it strikes the victim rapidly, spreads throughout a community quickly, and, untreated, can have a high mortality rate. Furthermore, if an epidemic lasts long enough to become endemic, based on history, eradication may take up to 50 years. Cholera epidemics are increasingly associated with global warming, because one possible impact, increased algal blooms, are known to spread cholera (see chapter 14). Projects, particularly existing water and sanitation projects, coordinating with the water agency and ministry of health, can rapidly implement six interventions for cholera epidemics:

- Chlorinating water supply in key areas
- Providing water trucks to key areas
- Purchasing trucks and chlorination equipment through appropriate budget alterations or schedules or linkages with other projects
- Providing transportation and logistical support to health personnel to help administer care and medications, primarily oral rehydration therapy (ORT), to the victims
- Promoting public education campaigns through newspapers, television and radio spots, and fliers, focusing on areas not effectively addressed by the above through, for example, NGOs or religious groups
- Changing the geographic distribution of project works as appropriate to prevent the spread of future epidemics.

Governments are often reluctant, however, to declare a cholera epidemic due to potential negative repercussions to trade and tourism.

**Guinea Worm Infection**

Guinea worm disease is nearly eradicated worldwide, thanks to the Global 2000 Program; most remaining cases occur in SSA. *Guinea worm is the only disease spread exclusively through water.* If humans drink water containing the small water flea (cyclops), within two to three months, the flea develops into a 1-meter-long worm, causing pain, fever, and nausea. Long-term effects include recurring infections, arthritis, tetanus, and crippling. The worm typically migrates to the lower extremities, where the female emerges through the skin, causing an open ulcer. Immersion in water triggers the worm to shed eggs when people fetch water or try to cool the itching and burning from the blister with water.

Where endemic, this debilitating, mainly rural disease can infect as much as 50 percent and incapacitate up to 30 percent of a population for up to three months, devastating agricultural productivity or those who depend on seasonal labor. Consequently, any rural project in an endemic area should examine the feasibility of including a small water supply, filtering, or monitoring component. Protecting water sources with stepping stones and well caps to prevent immersion of feet and legs in water can controlled the disease.

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* Guinea worm exists in Benin, Burkina-Faso, Cameroon, Chad, Côte d’Ivoire, Ethiopia, Ghana, Kenya, Mali, Mauritania, Niger, Nigeria, Senegal, Sudan, Togo, and Uganda.
Key Cross-Cutting Issues

The issues of pesticide use and biodiversity are particularly multisectoral and deserve greater attention, because they are typically handled as environmental or agricultural issues, thus, limiting the understanding of their widespread impacts on health.

Pesticide Use

Chemical and biological contamination of soil, land, and water in rural areas can come from agroindustry, farming, livestock, and aquaculture, as well as domestic and municipal or village waste. The primary chemical contaminants come from application of pesticides and fertilizers, processing wastes, and agricultural runoff. Pesticide contamination of humans occurs by:

- Consuming food with pesticide residues not removed from fruit and vegetable skins in food preparation or absorbed by edible roots and foliage
- Consuming meat, fish, and dairy products from animals whose tissue and organs have accumulated pesticides
- Direct occupational exposure or indirect exposures to fields after spraying.

Repeated application of some pesticides to perennial crops can with time increase pesticide concentrations in crop plants. When consumed by people, some contaminants are “flushed” from the body naturally or through medical treatment, but others, especially fat-soluble pesticides and other pollutants, may accumulate and reach harmful levels in the body.

Box 7-2: Key, Confusing, and Misused Terms on Pesticides

**DDT** or **dichloro-diphenyl-trichloroethane**. One of the best known POPs (see below) and formerly the most widely used pesticide. It has been banned in many countries, because of its ecological toxicity.

“Dirty dozen.” Originally a list of pesticides slated for phase out as part of an international NGO campaign. Now sometimes used synonymously with POPs (see below).

**Endocrine disrupters**, also, **endocrine mimickers**. Group of pesticides and by-products that, when absorbed by the body, can mimic hormone activity leading to negative impacts in humans and animals, such as birth defects or breast cancer.

**Organochlorines**. Class of chemicals common in pesticides. Important because they can dissolve in body fat and accumulate to harmful levels.

**Persistent organic pollutants (POPs)**. Group of chemicals, including eight pesticides, that are especially hazardous to humans and animals, because they (a) take so long to break down chemically to harmless substances and (b) can be absorbed into body fat and accumulate to harmful levels in the food chain. Sometimes used synonymously with “the dirty dozen” (see above).

**Pesticides**. General term for substances used to kill plant or animal pests. Pesticides include insecticides (for killing nuisance insects and disease vectors), fungicides (for killing molds), herbicides, “weedicides,” nematocides (for killing worms in soil or plants), rodenticides, and growth regulators (for inhibiting growth of pests).

*Source: Authors’ data.*

Any discussion of the human health effects of pesticides must raise the trade-offs between beneficial and harmful uses. Pesticides have certainly contributed to public health by improving crops for food, clothing, and shelter and reducing vector-borne diseases, such as malaria and yellow fever. DDT spraying during World War II decreased hospital admissions for army personnel by more than half. In SSA pesticides helped control black flies, substantially reducing onchocerciasis
The problem with pesticides is not so much their toxicity, as how they can be misused, that is, unnecessary and excessive application, choosing highly toxic pesticides over less toxic alternatives, which are affordable, readily available, and convenient to use even with protective gear. This section mainly examines the potential negative effects of pesticides, so development projects can avoid them.

Pesticides have received inadequate attention as a cross-sectoral issue, which primarily means as an occupational hazard to farmers and their families and a threat to rural populations from exposure to residues after application. Nonetheless, pesticides directly affect urban populations through (a) pesticide buildup in the food chain, (b) recurring exposure to residues on fruits and vegetables, (c) improper storage of bulk pesticides at entry points and their later transport and storage in or through cities to points of use, (d) hazards of manufacturing or reformulating pesticides in or near urban areas, (e) reuse of containers for water storage or makeshift housing parts in slums and squatter settlements, and (f) exposure from rodent and insect control in small towns as well as apartment buildings. (See “Small Town and Urban Pesticide Usage” below.)

Three other aspects relate to rural, as well as urban and periurban populations: (a) depletion of fish and seafood resources, a major source of protein, due to contamination of rivers, lakes, and coastal waters over time, (b) proliferation of new pesticides whose health effects, singly, incrementally, or in conjunction with other pollutants, are not known, and (c) seasonal variations in concentrations of pollutants in waters used for drinking, and watering and washing vegetables.

“The International Code of Conduct on the Distribution and Use of Pesticides” deals with many of these above issues, and most SSA countries have passed legislation in line with this code. Institutional capability for enforcement, however, remains problematic; little intercountry collaboration exists to help find solutions to these problems.

**Integrated pest management.** This system controls pests by combining natural predators and better management of natural resources and local ecosystems. Integrated pest management is intended, overall, to reduce and, if possible, eliminate primary reliance on synthetic and chemical pesticides. For details, consult Operations Policy (OP) 4.09, “Pest Management” and its webpage and Good Practices (GP) 4.03, “Agricultural Pest Management.” The policy makes two key provisos concerning health, as shown in box 7-3.

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**Box 7-3: Health Aspects of World Bank Policy on Pest Management (OP 4.09)**

*Pest management in public health:* In Bank-financed public health projects, the Bank supports controlling pests primarily through environmental methods. Where environmental methods alone are not effective, the Bank may finance the use of pesticides for control of disease vectors.

*Criteria for pesticide selection and use:* The Bank refers to WHO in applying the following four selection criteria: pesticides have negligible adverse human health effects, are shown to be effective against the target species, and must be demonstrated to be safe for inhabitants and domestic animals in the treated areas, as well as for personnel applying them, when used in public health programs, and use must take into account the need to prevent the development of resistance in pests.

Any pesticides the Bank finances should be manufactured, packaged, labeled, handled, stored, disposed of, and applied according to standards acceptable to the Bank. The Bank does not finance pesticides in WHO classes IA and IB, or in WHO Class II, if the country lacks restrictions on their distribution and use or they are likely to be used by or be accessible to lay personnel, farmers, or others without adequate training, equipment, and facilities to handle, store, and apply these products properly.

*Source:* World Bank OP 4.09 and Authors’ data.
Health effects. Negative health effects from pesticides fall roughly into two categories: (a) poisonings and intoxications from short-term (acute or single) exposures and (b) cancers, reproductive disorders, and neurological damage from long-term exposures. Both categories are life threatening.

- **Acute exposures** cause (a) rashes and skin disfigurement, (b) headache and giddiness, (c) nausea and vomiting, (d) blurred vision, nervousness, and rapid heart rate, (e) cramps, convulsions, coma, and anxiety, (f) numbness, and (g) death. Underreporting of poisonings is common, perhaps because farmers find it too expensive or inconvenient to seek medical care or because many take it for granted that they will get sick after applying pesticides. Depending on the pesticide, its toxicity, dosage, and length of exposure, these effects can be immediate or occur up to a few months after exposure; some of the symptoms persist for years.

- **Long-term exposures** can result in (a) cancers, such as leukemia, breast cancer, and perhaps liver cancer, (b) reproductive disorders, such as birth defects, sterility, and miscarriages, (c) neurological effects, such as paralysis, impaired mental development, and aggressive behavior, and (d) compromised immune systems.

Disorders to the reproductive system have recently been linked to chemical pollutants, including pesticides, caused by “endocrine disrupters” (see glossary). These chemicals mimic hormones in the body, which reacts accordingly. (Endocrine glands produce the human sex hormones, estrogen and androgen.) Environmental estrogens from pesticides such as DDT and heptachlor appear to be among the most serious human health threats, as they come from organochlorines (see box 7-2 above and paragraph below), which are fat soluble in the body, have been shown to cause breast cancer in animals, and are suspected of doing so in humans.

Three salient points to consider in human health are (a) whether a pesticide can be absorbed by body fat, (b) the duration of its potency after application, and (c) the extent of exposure, especially to children.

Pesticides absorbed in body fat pose additional hazards to infants, because pesticides can be passed to infants in mother’s milk. Potential damage from pesticides is more significant and pronounced in fetuses, infants, and children, whose organs are still developing, than in adults. Research has revealed specific “windows” in human development when sensitivity to toxic chemicals is greatest, for example, during fetal development or, for the infant, when the mother begins to lactate. Nonetheless, broadly speaking, the benefits of breast feeding still appear to outweigh the risks of chemical contamination.

**Potential damage from pesticides is more significant and pronounced in fetuses, infants, and children, whose organs are still developing, than in adults.**

Classification systems. Pesticide terminology varies among references to agricultural, manufacturing, health, and environmental repercussions and can be, at best, extremely confusing, because they were designed for specific uses, for example, food or worker protection. Two classification systems pertinent to human health, WHO hazard ratings and chemical types, are described below.

**WHO hazard ratings** use four categories, based on the direct hazard from toxicity, to classify human health effects:

- Class I A is “extremely hazardous” and class I B is “highly hazardous”
- Class II is “moderately hazardous”
- Class III is “slightly hazardous”
- Class IV is “unlikely to present an acute hazard in normal use”
The chemical type system classifies pesticides into about a dozen types* based on their chemical properties and toxic effects. Of these, these guidelines address two types, organochlorines and organophosphates, because they are used so widely and cited so frequently in the literature. Numerous other pesticide types, however, could likewise be harmful.

- **Organochlorines.** These can be absorbed in body fat, break down slowly in the environment, and are slowly released to the rest of the body in the long term and may lead to cancers, reproductive disorders, and neurological damage. Examples are DDT, mirex, aldrin, kepone, lindane, heptachlor, and toxaphene.

- **Organophosphates.** Many of these are extremely toxic and can easily penetrate the skin and eyes, for example, during application or afterward as residue in dusts, so that even small amounts can be serious or fatal, making proper handling and labeling essential. They break down relatively quickly into harmless substances, for example, diazon and parathion. (Some organophosphates, such as malathion, are slightly toxic.)

Individual classification systems, designed for specific purposes, such as occupational health, food safety, or cancer risk identification, may fail to capture the full range of health repercussions, sometimes because of inadvertent professional bias (see chapter 1). Pesticide regulations for commercial vegetable production, for example, focus on occupational and ecological hazards, but not necessarily on exposures of people who grow, sell, or purchase flowers, because flowers are not food. In comparison, dioxin, a by-product of pesticide manufacture, is a known carcinogen, but its carcinogenic properties break down in soil, making it “less hazardous” in soil relative to other carcinogens. Dioxin, however, is known to cause reproductive and immunological disorders, properties that do not break down in soil, and has found its way into the food chain in cow’s milk and human breast milk. Citing potential hazards without referring to specific reasons for which the classification system was designed and, thus, its limitations may, therefore, miss many risks.

In other cases, classification systems may not account for bioaccumulation of pesticides, which is not harmful to plants, but may be to humans. Copper sulfate, for example, is used extensively in coffee production and builds up after repeated applications, for instance, in each harvest of coffee beans. These potentially overlooked human health hazards are especially pertinent in considering persistent organic pollutants, some of the most potent pollutants. These limitations of classification systems underscore the need for multidisciplinary teams to make sure that technical information is not used out of context.

**Persistent organic pollutants.** Because of the importance of POPs to agriculture and industry (eight are used mainly as pesticides), they receive more attention. Intergovernmental agencies and NGOs are striving to ban POPs; many governments have already done so or otherwise restricted their use (see table 7-9). Nonetheless, many other harmful pesticides with less persistent effects are still used with food and other cash crops.

| In spite of government limitations on POPs, many other harmful pesticides, whose effects are not so persistent, are still used with food and other cash crops. |

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* Carbamates, chloronitrophelom derivatives, organochlorine compounds, organomercury compounds, organophosphorous compounds, organotin compounds, pyridyl derivatives, phenoxyacetic acid derivatives, pyrethroids, triazine derivatives, and thiocarbamates.
Table 7-9: Main Uses of POPs

<table>
<thead>
<tr>
<th>Name</th>
<th>Uses and Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aldrin, chlordane, dieldrin, endrin, toxaphene, and hexachlorobenzene</td>
<td>Mainly to protect crops, livestock, and wooden structures (against termites). Also to control rodents, soil insects, and textile pests.</td>
</tr>
<tr>
<td>DDT and heptachlor</td>
<td>Main use as an insecticide. Both have been used for malaria control, but more often DDT.</td>
</tr>
<tr>
<td>Mirex</td>
<td>As an insecticide; otherwise, its main uses are industrial.</td>
</tr>
<tr>
<td>Dioxins, furans, and polychlorinated biphenyls</td>
<td>Mainly used in industry or are generated by-products from production of other chemicals. Dioxin is released in pesticide production, by incineration of medical, municipal, hazardous wastes, coal, peat, and wood, and from car emissions.</td>
</tr>
</tbody>
</table>

Source: Authors' Data.

Suicides and poisonings. Developing countries carry the greatest burden in negative health effects from pesticides. In 1985 WHO estimated that industrial countries used about 80 percent of the world's agrochemicals, but probably suffer only 1 percent or less of deaths due to acute poisoning. The dimensions of the problem have not changed markedly since then. Moreover, models have projected increasing numbers of pesticide poisonings throughout the world. In 1972 poisonings were estimated at 500,000 cases yearly, increasing to 25,000,000 in 1990. Data on pesticide poisoning are regrettably poor; pesticides are frequently used for suicides, and data suitable for use in the model’s projections come mainly from Thailand and the United States.

Small town and urban pesticide usage. Pesticide usage in small towns and urban areas includes control of (a) rodents, mainly rats, (b) termites, (c) roaches and other household pests, (d) weeds, insects, and fungi in vegetable and ornamental gardens, (e) insects and mold for food protection, and (f) fleas, lice, and ticks on pets. The potential hazardous effects of pesticide application in these instances can be more intensive because confined spaces can intensify exposures, and wind, sun, and rain do not dilute, disperse, or degrade the pesticides. In homes sprayed with a legal pesticide (chlorpyrifos) to control fleas, for example, absorption by infants was one to five times the “no observable effect level.”

Biological Diversity and Traditional Medicines

Traditional medicines have enormous untapped social and economic value. Many of today’s wonder drugs are based on traditional medicines that have been synthetically reproduced. Biological diversity (biodiversity) among plant and animal species, which harbor potential medicines and other values to humankind, is jeopardized by, among others, human encroachment, agriculture, climate change, stratospheric ozone depletion, chemical pollution, acid rain, introduction of incompatible alien species, overexploitation, and fragmentation, degradation, and reduction of habitat. Although such threats are global, their consequences are far more severe in “megadiverse”—chiefly developing—countries.

Megadiversity refers to richness in biodiversity based on national boundaries, not ecosystems. Seventeen countries contain 60–70 percent of total global terrestrial, freshwater, and marine biodiversity. Three of the seventeen—South Africa, Madagascar, and Democratic Republic of the Congo—occur in SSA. Three areas of the world—the Amazon Basin, Congo Basin, and New

* The seventeen countries are Australia, Brazil, China, Colombia, Democratic Republic Congo, Ecuador, India, Indonesia, Madagascar, Malaysia, Mexico, Papua New Guinea, Peru, Philippines, South Africa, United States, and República Bolivariana de Venezuela.
Guinea/Melanesian Islands—contain major, virtually intact tropical wilderness areas. These “hot-spots,” that is, ecosystems with great biodiversity most severely threatened with destruction, contain roughly two-thirds to three-quarters of the most endangered species of plants and animals in the world. The potential for medicinal and public health uses of threatened species in these hot-spots has not been fully evaluated. Until such research is done, the “precautionary principle” argues that the risk to traditional medicines be from the same list of countries. Three examples may help illustrate the potential economic, social and public health value of threatened biological resources.

- **Plants.** The Pacific yew tree was not considered a commercially viable species in the Pacific Northwest, especially for logging, and was routinely discarded. Then, “taxol,” a substance that can kill cancer cells and found in these trees, turned out to be one of the most promising new medicines for breast and ovarian cancer.

- **Marine.** A compound (peptide) contained in snails inhabiting threatened coral reefs shows promise for blocking pain and keeping nerve cells alive, but does not necessarily cause addiction or drowsiness and may be much stronger than morphine. A new drug derived or based on this compound could potentially contribute enormously to heart surgery and treatment of head injuries, strokes, and chronic pain, particularly for AIDS and cancer patients.

- **Animals.** Some bear species are endangered because of habitat destruction and overhunting for their organs, believed in some cultures to have medicinal value. Bear gallbladders are worth eighteen times their weight in gold! Yet, the ability of bears to hibernate—without eating, drinking, urinating, defecating, or losing bone or body mass for up to 7 months—and then deliver and nurse young is poorly understood by modern medicine. Knowledge of the physiology of hibernation could help prevent osteoporosis, renal failure, and a variety of other health problems.
CHAPTER 8: CROSS-SECTORAL LINKAGES:
AGRICULTURE AND RURAL DEVELOPMENT SECTOR

This chapter discusses a broader range of environmental health issues than those traditionally associated with agriculture and rural development, that is, food security and ecological damages from pesticide use. The first five sections of the chapter weave together many, seemingly unrelated topics, with an emphasis on rural infrastructure in food production, for which linkages are strong with health. They are:

- **Human settlements.** What are the risks, especially in farming, of living conditions in villages and small towns?
- **Land use and natural resource management.** What human health risks are associated with farming, forestry, and other activities?
- **Water and waste management.** How is health linked with irrigation and drinking water? What risks link wastes to food and farmers?
- **Rural transportation.** What type of health risks are associated with transporting products from the fields to markets?

The sixth section, an environmental checklist, looks at these same issues in terms of Bank lending.

### Key Environmental Health Issues

The most common environmental health linkages in the agriculture and rural development sector involve food production and other aspects of low-density rural life, such as poor access to water, sanitation, transportation, and electricity. These linkages can set in motion sometimes interlinked health consequences, including malnutrition, spread of infectious diseases, deaths and injuries related to flooding, and so on. (See chapter 14 on how some of these effects are linked to climate change.) The most common linkages include:

- Pollution from excessive use of agrochemicals (especially pesticides and nitrates from fertilizers)
- Creation of nearly permanent vector breeding areas and other changes through, for example, year-round cultivation of food staples and impact of forestry projects
- Malnutrition from inadequate food supply or contamination of the food chain
- Water and soil contamination from inadequate processing of agricultural and animal wastes
- Respiratory diseases from use of biomass fuels for cooking, heating, and lighting, as well as injuries from gathering fuels.

Table 8-1 summarizes the intersectoral environmental health linkages with the agriculture sector.

| **Table 8-1: Main Intersectoral Environmental Health Linkages with the Agriculture Sector** |
|---|---|
| **Sector** | **Main Linkages** |
| Infrastructure and urban development | Water pollution (mostly nitrates), the common practice of periurban agriculture (production of food primarily for urban consumption), land clearing for agriculture or settlement, aquaculture, pesticide transport and storage, keeping animals in human settlements, crop losses from air pollution, and so on |
| Energy | Polluting biomass fuels for heating, cooking, and lighting; particulate matter causing crop |

129
<table>
<thead>
<tr>
<th>Sector</th>
<th>Main Linkages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sector Main Linkages</td>
<td>losses; energy deficit compromising provision of health care (e.g., no cold storage of medicines or sterilization of syringes); charcoal production and respiratory impacts; and spread of vector-borne disease from hydropower dams and irrigation and resultant standing water in fields</td>
</tr>
<tr>
<td>Industry</td>
<td>Variety of health impacts from air, water, and land pollution as well as climate change and global warming</td>
</tr>
<tr>
<td>Health</td>
<td>Contamination of food chain, exposure to pesticides and risk of accidents due to illiteracy of agricultural workforce, stress from rural-urban migration (mental health problems, unemployment, and noisy or undesirable living conditions), food security and basic nutrition, population pressures on agricultural productivity, and vector-related diseases (spread by mosquitoes, snails, and flies)</td>
</tr>
<tr>
<td>Environment and natural resources</td>
<td>Deforestation, desertification, and land degradation and their effects on food production, biodiversity, and traditional medicines and in flooding and so on</td>
</tr>
</tbody>
</table>

Source: Authors’ Data.

The following four sections—human settlements, land use and natural resource management, water and waste management, and rural transportation—describe, in no order of priority, some of the most important environmental health issues relating to the agriculture and rural development sector and its thirteen subsectors (table 8-13 summarizes impacts of each at the end of the chapter).

### Human Settlements

This section primarily deals with conventional issues relating to rural human settlements, that is, housing, energy use, and periurban agriculture and livestock, whereas the next section on land use and natural resource management addresses issues more traditionally associated with agriculture.

It is important to note first, however, the special, important, and often neglected health concerns presented by rural-to-urban migration and environmental refugees in human settlements, mentioned here because most migrants move to periurban areas, which have many rural characteristics. Health concerns include:

- **Physical and mental stress.** It is difficult to document stress and, thus, elaborate on precise sources of health risk; however, they broadly include inadequate provision of basic shelter, water, sanitation, waste removal, household energy, medical care, schooling, and control of industrial and traffic noise, among others.
- **Propensity for accidents.** Even though data are scarce, accident levels, especially pedestrians hit by motor vehicles, are high among recent migrants. This stems partly from the “automobile culture clashing with immigrant culture.” Poor road quality in rural areas, which often restricts vehicle speed, coupled with low pedestrian density makes basic activities such as fetching water, shopping, or visiting others potentially less hazardous. Inmigrants to urban areas, generally pedestrians, are less accustomed to automobile traffic and, thus, more vulnerable to being hit and injured.
- **Temporary or emergency housing.** “Environmental refugees,” whether from natural disaster or warfare, need temporary shelter that often becomes long term. Although the factors discussed below are pertinent, planning temporary and permanent settlements should generally be approached differently. The choice of site and types of services financed by emergency relief, for example, may not be optimal or cost-effective as long-term solutions.
Box 8-1: Key, Confusing, and Misused Terms on Human Settlements

**Rural-periurban.** Strictly speaking, the terms “rural” and “urban” reflect administrative designations of governments or types of economic activity and are not necessarily based on population size. “Periurban” refers to areas surrounding cities retaining rural characteristics of low density and substantial agricultural activity. From an environmental health point of view, periurban agriculture can (a) facilitate breeding of mosquitoes that spread malaria (which tends to be a rural disease) and (b) pollute water with agricultural and animal waste.

**Kitchen or cooking area.** Areas used for food preparation. Defined by culture, cooking areas range from a one-room hut with no windows, a separate room with or without ventilation, or an outside area. Health consequences include exposure to smoke from cooking fires and oils and the risk of burns, especially for children, from exposure to cooking fires or the contents of pots.

*Source:* Authors’ Data.

**Housing**

Health linkages often focus on the structure of housing, but health repercussions also derive from poor indoor air quality and accidents, among others. The main aspects of housing quality that impinge on human health are housing quality and proper ventilation, especially of cooking fumes. Choice of fuel for cooking, lighting, and heating can also lead to several negative health repercussions (see “Energy Use” below.)

**Structure.** Basic housing is essential to protect people from extremes of heat and cold and inclement weather, all significant determinants of disease in malnourished populations. Dampness contributes to respiratory disease; recent research specifically highlights molds as a factor.117 Shoddy structures can harbor disease-spreading insects, such as the “cone nose” bug, which lives in cracks and crevices of walls and can cause Chagas’ disease (common in Latin America).

**Location.** Housing for the poor is often erected in economically marginal areas prone to flooding (from occasional storms or flooded water bodies), landslides, and so on. Other hazards include accidents and, in houses erected over or near water, drowning.

**Dirt floors.** Dirt floors present significant health hazards through long-term, recurrent exposure to dust and exposure to intestinal worms that penetrate the feet, particularly in areas with poor sanitation. Intestinal worms are common throughout developing countries and responsible for substantial disability, although mortality rates from worms are low.

**Ventilation.** Ventilation may be the single most important factor in housing that impacts health, because of the direct links to indoor air pollution, particularly from cooking, heating, and lighting fumes. Proper ventilation can help reduce respiratory infections, which derive from close personal contact, as well as reduce the irritation of smoke, which worsens or predisposes people to respiratory illnesses. At the same time, in areas with endemic mosquito-borne diseases, indoor smoke has the “beneficial” effect of keeping mosquitoes away.

**Cooking area.** Exposure to cooking fumes (from cooking fires or the food itself) and accidents, primarily burns, are the main risks. High levels of exposure occur even in outside cooking areas, because of the long periods spent close to the source of fumes. Indoor exposure is compounded by cigarette smoking. Numerous, often energy-based programs have increased stove efficiency, benefiting human health.
Energy Use and Generation

The broad range of energy-health linkages goes well beyond air pollution, often focusing on industrial and vehicular sources. Access to electricity in rural and urban areas is crucial to improving the quality of life. It permits the “cold chain” sequence of refrigeration that ensures a reliable supply of medications in pharmacies and health care facilities. Access to modern fuels also reduces some of the risks of indoor air pollution from burning cheaper, but more polluting traditional fuels. The various factors influencing health are covered in the following sections.

Box 8-2: Key, Confusing, and Misused Terms about Rural Energy

*Biomass fuels* (wood, twigs, leaves, grasses, crop wastes, other vegetation, and dung). Renewable energy in the form of plant and animal matter that can be used as fuel. As a group, do not burn as cleanly as fossil fuels (see definition below), which include a range of clean and “dirty” fuels. Tend, therefore, to be more harmful to health, as incomplete combustion greatly contributes to indoor air pollution. Poor households, however, tend to rely more on the cheaper biomass fuels.

*Dust.* Suspended particulate matter. Receives less attention than chemical pollutants, but virtually ubiquitous in rural areas. An important respiratory irritant contributing to high rates of respiratory disease, one of the most important burdens of disease in developing countries. Range from large particles, which adhere to the surface of nose, mouth, and throat, to those small enough to penetrate deeply into the lungs. Chemical substances may adhere to or be incorporated into these particles.

*Fossil fuels* (coal, oil, kerosene, natural gas, and liquefied petroleum gas [LPG]). Nonrenewable energy sources, basically fossilized remains of plants and animals with a high carbon and hydrogen content and varying levels of sulfur contamination. Sulfur reacts with air and other compounds to form air pollutants, for example, sulfuric acid and other acid aerosols, which have varying impacts on agriculture, such as, damage to the foliage of food crops, and the human lungs. Vehicular and industrial sources generate the main ambient air pollutants from fossil fuels. Coal, kerosene, and oil are generally more hazardous to human health than natural gas and LPG. (See *biomass fuels* above.)

*Greenhouse gases* Mainly carbon dioxide (CO$_2$), methane (CH$_4$), ozone (O$_3$), and chlorofluorocarbons (CFCs). Direct effects as irritants, causing respiratory disease, the most important direct health consequence. Indirect effects can be considerable and wide ranging, such as vector-borne diseases (malaria and schistosomiasis), which could spread as global warming extends vector breeding habitats.

*Vector-borne, vector-related diseases.* Diseases transmitted by an intermediate animal host. Broadly include pathogens transferred mechanically by flies or rats. Specifically involve development of a parasite within the intermediate host, such as mosquitoes or snails, which eventually infects humans.

Source: Authors’ Data.

Traditional Fuels

Reliance on traditional fuels presents a series of household occupational and health hazards resulting mainly in respiratory, skin, eye, and, in some cases, heart diseases. In addition, such reliance can lead to accidents while gathering biomass fuels and, in extreme cases, when fuel collection causes erosion, accidents and drowning from flooding in the rainy season. (See “Respiratory Diseases, Tuberculosis, and Diseases Related to Air Pollution” in chapter 7).

*Charcoal.* A major source of fuel in rural areas, charcoal presents both household and occupational hazards. Entire families may be exposed to high levels of charcoal smoke from household cooking and, less so, heating. Occupational exposures range from the carbonization process (i.e., burning wood slowly to create coals) to bagging charcoal for wholesale and retail sales. Rebagging for sale and household use of charcoal entail high exposure to charcoal dust. Women should
be considered a high-risk group, because they are often vendors and the most common household user.

Wood fuels. Hazards include exposure to fumes from burning and physical strain, accidents, injury, and, in severe cases, miscarriages from collecting wood fuels. In periurban areas or small towns, gathering fuel wood may also increase exposure to disease vectors with habitats within a few kilometers of residences.

Stoves. Stoves present hazards from pollution, accidents, and burns. The type of stove determines fuel efficiency and the pollution generated. Of particular concern is the low conversion efficiency of biomass stoves; traditional stoves convert energy at about a 12–18 percent efficiency rate, producing high levels of pollution. Indoor pollution from biomass combustion in eight countries studied ranged from four to ninety times the WHO standard for peak pollution. In addition, stoves can cause household fires, accidents, and burns, especially to children. Areas with poor quality and flammable housing risk neighborhood fires, more a problem in periurban than rural areas in SSA.

Community use. Many villages use traditional fuels for curing meat and fish, often for prolonged periods, mainly by smoking. Such exposures can cause a range of diseases related to air pollution.

Modern Fuels
Household and community use. The health risks from modern fossil fuels depend on the degree to which pollution is (a) produced during indoor burning, (b) vented outdoors, and (c) dispersed in the community. Fossil fuels range from dirty to clean, roughly as follows: coal, kerosene, oil, natural gas, and LPG.

Distribution, storage, and use. The risks attached to distributing modern fuels depends on the fuel. These risks also vary among periurban areas, small towns, and rural areas. All trucks transporting bulk fuel risk accidents, but tankers carrying kerosene and LPG also risk explosion. At the wholesale level, dust from coal storage can pollute the local environment. Oil and kerosene drums can pollute groundwater.

Stoves. Coal and kerosene stoves present a high risk of indoor air pollution. In China, where coal is a common household fuel, women have the highest rates of lung cancer in the world for those who do not smoke tobacco. Stoves also present the risk of fires and accidents, especially for children. Coal stoves are often designed to keep the elements out and not for efficient ventilation. Some are even designed to keep smoke within homes to drive out insects; in areas with endemic mosquito-borne illnesses, those implementing stove programs to reduce air pollution should consider alternative means of mosquito repellants.

Power Generation
Fuel production. In general, large-scale power generation should benefit health overall by reducing dirty fuel use in households. Its main health risks stem from industrial accidents and from occupational and local exposures from contamination around power plants. The risks to local and regional populations from air pollution vary depending on the production process, that is, coal-fired or hydro. (Because the Bank does not lend for nuclear power, these guidelines do not consider its risks.)

Spread of vector-borne diseases. The spread of vector-related diseases in power generation is often overlooked. Hydropower dams and irrigation canals and resulting standing water in fields, for example, may spread schistosomiasis and malaria by expanding habitat for snails and mosquitoes.
Solar and wind (also known as eolic or eolian) energy. As a clean technology, the benefits of solar and wind energies far outweigh their risks. Limitations in storage and transmission capabilities restrict them, regrettably, to local uses. Health risks include those presented by battery disposal, which can pollute groundwater.

Periurban Agriculture and Livestock

Periurban agriculture and livestock activities affect periurban settlements because of the higher density of population than in rural areas. Such activities range in scope from households to agribusinesses. Although accurate data are scarce, those available suggest substantial periurban agriculture exists. In Lusaka, for example, 37 percent of urban households surveyed (1991) produced food, and 29 percent raised livestock. In Jakarta, a poultry plant employs 800 people;\textsuperscript{121} and, in Khartoum, 27 percent of all solid waste was eaten by cattle.\textsuperscript{122}

Market gardening and food crops. Small-scale cultivation of food, flowers, and ornamental plants for resale, primarily a periurban phenomenon, has been increasing. Much food is also grown for household consumption. The main risks are:

- Provision of year-round habitat for disease vectors, mainly mosquitoes
- Contamination of the local water table and surface water sources with pesticide and fertilizer runoff
- Exposure to pesticide residues on crops for household consumption or sale
- Where sewerage treatment facilities exist, improper use of sewage effluent, which can also contaminate the water table and local surface waters, spreading diarrheal diseases and diseases related to pesticide and fertilizer exposure.

Livestock. It is common for people in periurban and low density areas to keep animals. The main health risks arise from:

- Contamination of the water table and surface water sources with nitrate runoff
- Contamination of water table and surface waters by slaughtering facilities, which can lead to a range of diseases, exacerbated by the rainy season
- To a lesser extent, traffic injuries caused by animals.

Land Use and Natural Resource Management

This section covers environmental health risks presented by food production, processing, storage, and transport as well as in land use and forestry.

Food Production, Processing, Storage, and Transport

Food security and malnutrition, followed by pesticides and malaria, tend to dominate discussions of the health dimensions of agriculture and rural development and are discussed below. Other environmental health linkages, however, also exist, for example, with livestock and animal husbandry, fisheries and aquaculture, and food processing, storage, and transport.

Crops, Food Security, and Nutrition

Land degradation. Pressures to increase food production and find household fuel can lead to overfarming, overgrazing, and stripping land of its vegetation. Energy policies or local market forces that result in overpricing of fodder and fuel wood can aggravate such pressures. All these factors can cause erosion, a decrease in arable land, loss of soil fertility and nutrient productivity, and eventually malnutrition. During the rainy season, particularly in China and India, land degra-
Land degradation can also lead to injuries and deaths from flooding. In severe cases, land degradation may result in drought, famine, and mass movements of populations, frequent events in SSA (see box 8-3). Land degradation can increase water pollution by reducing the absorptive capacity of the soil. This increases runoff of agricultural chemicals into surface waters, which, in turn, increases turbidity, interfering with chlorination and decreasing biological and chemical water quality.

**Droughts and desertification.** The health repercussions of droughts consist of malnutrition and infectious diseases due to poor personal hygiene because of inadequate water and waste disposal, which worsen when victims are dislocated. Adequate services such as these are crucial in most of SSA, where rainfall is the main environmental determinant affecting human activity (see box 8-3).

### Box 8-3: Drought in Sub-Saharan Africa
The Sahel region has been hit hardest by drought, adversely affecting about 750,000 people in 1973–74 and in northeast Africa. 4.3 million people in early 1991. In 1985, 70 percent of Ethiopian children in refugee camps for drought victims were malnourished. Between 1990 and 2000, the number of people affected by droughts increased dramatically from hundred of thousands to several millions. (It is not clear, however, whether the increases between 1990–2000 are due to worsening conditions or better data gathering.) No estimates exist of the collective toll of desertification.

### Table 8-2: Health Consequences of Drought, Selected Examples 1970–2000

<table>
<thead>
<tr>
<th>Year</th>
<th>Place</th>
<th>Consequence</th>
<th>Number of Persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>Sahel</td>
<td>Famine-related deaths</td>
<td>100,000</td>
</tr>
<tr>
<td>1974</td>
<td>Niger</td>
<td>Dependence on food aid</td>
<td>200,000</td>
</tr>
<tr>
<td>1974</td>
<td>Mali</td>
<td>Food refugees</td>
<td>200,000</td>
</tr>
<tr>
<td>1974</td>
<td>Mauritania</td>
<td>Destitution</td>
<td>250,000</td>
</tr>
<tr>
<td>1990</td>
<td>Niger</td>
<td>Food shortage</td>
<td>1,630,000</td>
</tr>
<tr>
<td>1991</td>
<td>Sudan</td>
<td>Drought</td>
<td>8,600,000</td>
</tr>
<tr>
<td>1993</td>
<td>Ethiopia</td>
<td>Food shortage</td>
<td>6,700,000</td>
</tr>
<tr>
<td>2000</td>
<td>Ethiopia</td>
<td>Drought</td>
<td>10,000,000</td>
</tr>
<tr>
<td>2000</td>
<td>Kenya</td>
<td>Drought</td>
<td>2,700,000</td>
</tr>
<tr>
<td>2000</td>
<td>Sudan</td>
<td>Drought</td>
<td>2,500,000</td>
</tr>
</tbody>
</table>


**Locust control.** Locusts and locust control present a number of health problems, particularly the impacts of malnutrition from crop losses and improper pesticide use. Aerial pesticide spraying, in addition to occupational hazards, can contaminate village residents and their exposed food and water supply. Wide areas must be covered rapidly, leading to problems of scale, for example, (a) decentralized stocks become obsolete and rural farmers are ill equipped to dispose of them properly, (b) application by untrained farmers leads to high incidences of intoxication, and (c) the pesticides, often distributed free, are used for other, possibly unsuitable purposes.
Cash crops. By and large, cash crops improve health because of added income in the local economy. Cash crops, however, can lead to several unintended negative effects on health, depending on the scale of operations: Neglect of nutritious food crops can cause malnutrition in local populations. Improper use of pesticides and fertilizers can lead to contamination of the local and regional food chain. Although, the economic and sometimes environmental costs of pesticides and fertilizers required for different crops tends to be calculated, the sometimes considerable human health effects tend to be neglected (see “Use of Pesticides and Fertilizers” below).

Slash-and-burn agriculture. Difficult to measure but often significant, exposures to fumes from slash and burn tend to be neglected. Slash and burn (see box 8-4) can lead to disease from local and regional exposure. First, seasonal burning of old crops creates high occupational risks through intense, recurrent exposure to smoke and dust. Second, burning to clear land for other purposes, depending on the scale, may also pose regional health hazards. Uncontrolled fires in drought conditions can exacerbate the situation. This occurred in Asia in 1997, exposing an estimated 20 million Indonesians to dangerously high levels of air pollution; in Malaysia, air pollution indices recorded values four times as high as unhealthy values.8

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Box 8-4: Key, Confusing, and Misused Terms on Agriculture

*Slash and burn, swidden agriculture, or shifting cultivation.* Traditional agriculture, primarily by seminomadic peoples, that burns forest or fields for temporary cultivation (e.g., 1–5 years), after which the cultivated areas are abandoned.

Source: Authors’ Data.

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Slash and burn does have a health benefit by returning nutrients to the soil, improving soil productivity and indirectly improving nutrition. This benefit, however, needs to be weighed against the long-term cost of soil depletion and erosion and their negative effects on nutrition.

Animal waste fertilizer. Subsistence agriculture uses animal waste as a fertilizer, which, with time, can lead to nitrate and fecal contamination of drinking water. Nitrate contamination presents a high risk to infants with blue baby syndrome (methemoglobinemia) and for gastric, bladder, and esophageal cancers, for which nitrates have been implicated.

Use of Pesticides and Fertilizers

Pesticide application. Three levels of health exposures occur:

- **Occupational**, mainly for farmers, but also those involved in transport, storage, and repackaging
- **Family members**, for example, washing clothes or storing equipment
- **Community**, for example, access to sprayed areas or animals too soon after application of pesticides and contamination of water sources from washing equipment, containers, and clothing after application.

Reasons for high exposure include:

- **Unnecessary and excessive use**, often due to promotion by agrochemical companies
- **Inadequate packaging**, for example, lack of labels, instructions, or their translation, or re-use of empty containers, especially beverage bottles

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8 Fang and others (1999). “[An] air pollution index as high as 839 has been reported in Malaysia. API is calculated based on the five pollutants: NO2, SO2, O3, CO, and respirable suspended particulates (PM10). It ranges in value from 0 to 500. An index above 101 is considered to be unhealthy, and a value over 201 is very unhealthy.”
Inadequate application equipment, for example, sprinkling pesticides with brooms because appropriate equipment is not available or too expensive

Inadequate protective gear, because, for example, appropriate gear is not available for sale, too expensive, or too hot to wear

Training, for example, poor commonsense precautions because of inadequate labeling or instruction (e.g., blowing through sprayers to unplug them)

Farmer ignorance, for example, illiteracy or lack of understanding of the proper dosage or hazards (some farmers expect to get sick after pesticide use)

Inadequate parts or service, for example, spare parts and maintenance services are unavailable or unaffordable.

A study of 161 women sprayers in Indonesia showed that they mixed pesticides with their bare hands, filled backpack sprayers with ordinary buckets, and had clothing soaked with pesticide touching their skin. Almost none had gloves, and about 20 percent cleaned blocked nozzles with their mouths.\footnote{126}

Excessive use can stem from even well-intentioned promotional activities by agrochemical companies facilitated by (a) subsidized or free pesticides, (b) marketing concentration on chemical approaches, as opposed to integrated pesticide-vector management, and (c) sales commissions.

Several factors can increase human health risks. In SSA, most pesticides and application equipment are imported or donated, creating problems for supply and standardization of spare parts. In addition, small-scale farmers share, borrow, or rent equipment, exacerbating the risks of exposure, partly because of poor equipment maintenance. Commercial suppliers may not package pesticides in quantities small enough to be affordable to many farmers, increasing the likelihood of improper repackaging and attendant hazards. Farmers may also use whatever is on hand, applying persistent pesticides intended for other uses to food crops. Women may not know they are pregnant when using pesticides, thus, increasing risks to the fetus. Moreover, symptoms of pesticide poisoning are often misdiagnosed by users, supervisors, and medical staff, resulting in improper first aid or long-term care, if needed. Large-scale commercial operations tend to reduce some of these risks.

In SSA sleeping in poorly ventilated rooms while burning mosquito coils, which are often not considered pesticides, adds to exposure. (Mosquito coils have also been linked to lung cancer.)

Inappropriate application of pesticides can also lead to pest resistance, because farmers skimp on dosages to save money, put on too much pesticide to make sure it works, or shorten the duration because the pests seem to have died off. This has two public health repercussions: (a) pests can build up resistance to pesticides and (b) parasites that infect humans can build up resistance to medications. For example, in 1976, drug-resistant malaria was confined to Southeast Asia; now it is global. This is further complicated by the mosquito’s resistance to DDT and its potential carcinogenicity, because an ecologically suitable yet equally effective substitute is not yet available.

Packaging and resale. Few pesticides are manufactured in SSA; the bulk are imported or reformulated, for example, in Angola, Mozambique, Tanzania, Zambia, and Zimbabwe. Pesticides are repackaged in Malawi, Swaziland, Tanzania, Zambia, and Zimbabwe.\footnote{127}

Use on major crops. Table 8-3 lists the major crops that use pesticides and fertilizers and the potential health effects of pesticide use. Large-scale national integrated pest management programs in Asia have demonstrated that drastic reduction of present use of insecticides on rice, vegetables, and cotton will not affect yields and increase farmers’ net profits.
Table 8-3: Most Important Crops and Chemical Use, World and SSA (1970–91)

<table>
<thead>
<tr>
<th>Crops</th>
<th>Chemicals Used</th>
<th>Health Effects and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>Mostly organophosphates, carbamates, and pyrethroids; sometimes organochlorines</td>
<td>Acute poisoning is common among applicators due to a lack of education and training on protection procedures and equipment and safety in their use. Storage problems lead to household exposures, especially endangering children. Although these chemicals have varying hazard scores, the risk of poisoning remains high in developing countries because of management problems. Organochlorines are generally persistent in the environment and can contaminate the food chain.</td>
</tr>
<tr>
<td>Cottonseed</td>
<td>Same as above</td>
<td>According to FAO, more insecticides are used on cotton than in any other crop. See comments under rice.</td>
</tr>
<tr>
<td>Coffee, tea, and cocoa</td>
<td>Same as above; in addition, copper compounds as fungicides</td>
<td>See comments under rice. In addition, high copper content in plants may lead to retardation and other effects. Deficient intake, however, poses more health problems than excessive intake, except perhaps for individuals with a genetic sensitivity to copper in their diet.</td>
</tr>
<tr>
<td>Fruits and vegetables</td>
<td>Mainly organophosphates, carbamates, and pyrethroids</td>
<td>See comments under rice.</td>
</tr>
</tbody>
</table>


*Use on animals.* Disposal of pesticide dips poses a special hazard, because they contain a large quantity of water that is often emptied into pits, increasing the risk of groundwater contamination.

*Fertilizer application.* Compared with the wide array of documented negative consequences of pesticides, fertilizers are relatively harmless to wildlife, livestock, and human health (see box 8-5). In humans, however, they can cause two types of diseases: blue-baby syndrome (methemoglobinemia, which also affects livestock) and cancers of the stomach, bladder, and esophagus. Blue baby syndrome is clearly linked to excess ingestion of nitrates, a basic component of fertilizers and animal waste, the latter of which can run off into drinking water or enter crops when applied as manure. The linkages with the three cancers are not as well understood. Neither blue baby syndrome nor these cancers are global problems, but they can be quite serious regionally. For example, gastric cancer is rare in Africa, Southeast Asia, and Central America, but common in Chile, Colombia, Costa Rica, parts of Brazil, and parts of China (Shanghai and Singapore’s Chinese population). In Egypt bladder cancer comprises about 30 percent of all cancers in males and 12 percent in females. Esophageal cancer is common in some provinces of northern China, where mortality rates reach as much as 150 per 100,000. Other research shows that fertilizers may contribute to the growth of cancer-causing algae, which can be transported long distances in the air.

Box 8-5: Key, Confusing, and Misused Terms on Fertilizers

*Fertilizers.* Plant nutrients. Commercial fertilizers are primarily composed of nitrogen, phosphate, and potassium. Livestock manure is also used, as well as appropriate types of garbage, that is, biodegradable waste from commercial, industrial, or household sources. The main health consequences consist of occupational exposures and high nitrate levels in drinking water, which can lead to “blue baby syndrome” (methemoglobinemia) and to diarrheas in localized areas.

*Soil conditioners.* Improvements to soil moisture, for example, humus and mulch. As moisture increases, so can microbes in the soil. This can extend mosquito habitat, which would otherwise dry up in dry seasons, producing the main human health consequence.

Source: Authors’ Data.

*Livestock and Animal Husbandry*

*Animal-to-human transmission of diseases.* A wide range of diseases transmitted from animals to humans (see table 8-4) occurs through occupational exposures, such as in animal husbandry and
fishing or by living near areas where animals are kept. Pigs and birds (mainly ducks and chicken) are part of a complicated cycle in the development of viruses that spread human influenza. The influenza virus breeds first in poultry, then moves to swine, and then to humans. Direct exposure is not a common global problem, but can be important locally, most frequently in Asia. Broad public health consequences arise from flu-type epidemics that spread, often annually, before a suitable vaccine can be developed.

Animals that transmit diseases to humans fall roughly into four categories:

- **Farm and food supply animals.** Poultry, goat, sheep, cattle, pigs, and horses
- **Common domestic animals.** Cats, dogs, and birds
- **Insects.** Mosquitoes, lice, fleas, ticks, mites, and flies
- **Others.** Snails and rodents.

The main diseases transmitted by animals to humans are malaria, schistosomiasis, Africa sleeping sickness, and leptospirosis (Weil’s disease).* (See also chapter 7 on “Gastroenteric Diseases” and table 8-4 below.)

### Table 8-4: Diseases Transmitted from Animals to Humans

<table>
<thead>
<tr>
<th>Main Animals</th>
<th>Some Associated Diseases</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm/food animals:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Poultry</td>
<td>Anthrax, brucellosis, tetanus, Q Fever, Rift Valley fever, and other arthropod-borne diseases; enteric diseases; and skin diseases</td>
<td>Pesticides similar to those used on plants are also used on animals to prevent infestation by ticks, lice, and other microorganisms. High-risk populations are caretakers and workers in slaughterhouses. The general public is also at risk when eating infected meat.</td>
</tr>
<tr>
<td>• Goats and sheep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Cattle and horses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Pigs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic animals:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Cats</td>
<td>Asthma, toxoplasmosis, psittacosis, enteric diseases, and skin diseases</td>
<td>Caretakers and handlers are generally considered the high-risk group.</td>
</tr>
<tr>
<td>• Dogs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Birds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insects:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Mosquitoes</td>
<td>Malaria, dengue, and yellow fever and other arthropod-borne diseases, such as rickettsia and trypanosomiasis</td>
<td>High-risk groups include farmers, forest workers, miners, construction workers in endemic areas, animal caretakers, and children.</td>
</tr>
<tr>
<td>• Lice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Fleas and ticks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Mites</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Flies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other vectors:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Snails</td>
<td>Schistosomiasis and leptospirosis (Weil’s disease)</td>
<td>High-risk groups are farm workers, freshwater fishermen, and individuals who live in areas prone to flooding.</td>
</tr>
<tr>
<td>• Rodents</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Source: Authors’ Data.*

**Other concerns.** Pesticides are often used on animals, presenting a similar range of human hazards as in crop application. Compared with crop use, pesticides to control animal pests tend to receive less attention. (See also “Use of Pesticides and Fertilizers” above.)

In addition, runoff from feeding areas can contaminate water sources. Solid waste problems also exist with feed, waste, and slaughterhouses.

As the most widely consumed meat globally, chickens deserve special mention. Dust at all stages of poultry production—from feedlots to processing plants—is a significant occupational hazard. *Salmonella* is an extremely common form of food poisoning, readily spread by poor hygiene in poultry processing, even in industrialized countries.

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*Leptospirosis (Weil’s disease), considered the most widespread animal-to-human disease in the world, spreads through exposure to mammalian urine, most frequently rats. It is generally an occupational hazard for those involved in waste management, animal husbandry, and meat processing, but sometimes becomes a public health problem in residential areas when poor drainage and heavy rains cause flooding that carries animal excreta.
Nitrate contamination of drinking water. Animal wastes contaminate the water table and individual wells. In rural areas, animals kept near residences and in feedlots are the source. In some instances, wells have been sunk away from residences to avoid such contamination, unintentionally resulting in reduced use of water, leading to poor hygiene. This could result in diarrheas that are more serious than nitrate-related diseases, for which the highest risk group is infants. (See also “Use of Pesticides and Fertilizers” above.)

Fisheries and Aquaculture

Diseases from livestock are generally more hazardous than those from fish (see table 8-5). A high rate of accidents, however, especially drowning, in open waters and the high seas, makes fishing one of the most hazardous of all occupations. Aquaculture is comparatively less hazardous. Occupational health hazards include schistosomiasis (see “Malaria and Vector-Related Diseases” in chapter 7) and skin and eye diseases due to long-term exposure to water and dampness. Hepatitis and parasitic infections can be transmitted from eating uncooked fish and seafood, both of which are common sources of food poisoning from poor storage.

Table 8-5: Diseases Transmitted from Fish and Seafood to Humans

<table>
<thead>
<tr>
<th>DISEASE</th>
<th>EFFECTS</th>
<th>TRANSMISSION</th>
<th>CONTROL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish tapeworm (Diphyllobothriasis)</td>
<td>Normally not serious. Can cause bloating, diarrhea, and anemia.</td>
<td>Parasite spread in human feces, which infects a copepod (“water flea”), which, in turn, develops into a tapeworm in freshwater fish, and is then transmitted to humans, who eat them undercooked or raw.</td>
<td>Sanitation; not eating undercooked or raw fish; and medication</td>
</tr>
<tr>
<td>Lung fluke (Paragonimiasis)</td>
<td>Symptoms similar to bronchitis</td>
<td>Two-vector series: spread to humans by eating uncooked freshwater crabs, which have been infected by freshwater snails, which have been infected by larvae in human, cat, dog, and pig feces.</td>
<td>Better sanitation and breaking cycle of transmission with education on uncooked crabs</td>
</tr>
<tr>
<td>Hepatitis A (also known as infectious hepatitis and jaundice)</td>
<td>Infection of the liver causing fever, discomfort, and severe fatigue lasting up to several months</td>
<td>Transmitted in feces and urine. Person-to-person contact is the main route. Epidemics occur due to contaminated water. Can also be spread in milk and undercooked mollusks.</td>
<td>Improved sanitation, personal hygiene, and food preparation</td>
</tr>
<tr>
<td>Schistosomiasis, (Bilharzia)</td>
<td>Infection of bladder with worm and eggs, causing complications. Can be extremely debilitating</td>
<td>Worm eggs in human feces and urine hatch into larvae (miracidium) which infect snails that, in turn, shed eggs that hatch into larvae (cercariae) that penetrate the skin.</td>
<td>Break cycle of transmission by preventing eggs from reaching water, humans from exposure to larvae, or eliminating snail habitat</td>
</tr>
<tr>
<td>Food poisoning</td>
<td>Nausea, vomiting, and diarrhea</td>
<td>From fish and seafood that is raw, undercooked, or spoiled in storage</td>
<td>Proper cooking and cold storage</td>
</tr>
</tbody>
</table>

Source: Authors’ Data.

Food Processing, Storage, and Transport

Health linkages entail processing facilities that generate animal and plant wastes.

Animal waste. Health hazards include solid and liquid wastes that arise from inadequate disposal. Solid animal wastes are generated in abattoirs, slaughterhouses, feedlots or the equivalent, and fish drying. Liquid waste, frequently containing solids, is often dumped into the nearest water body. In many developing countries, even if pollution emission standards exist, they are often not enforced. Transferring animal waste to a disposal site may only move the health hazard to a different location, unless the site is operated as a proper sanitary landfill.
Diseases include leptospirosis (Weil’s disease), diarrheas, filariasis (spread by mosquitoes that breed in anaerobic conditions, such as latrines or improperly discarded animal waste). Smells from fish drying pose more of a nuisance than a health hazard. (See also footnote on leptospirosis above, paragraph on nitrate contamination of drinking water above, and table 8-4 above for a list of diseases transmitted by animals to humans.) In addition, smoking meats and fish can cause cancers from smoke residue that escapes from the “smoker” or collects on the meat or fish.

Plant wastes. Health hazards associated with plant wastes, often viewed as less serious because plants do not contain animal blood and feces, are, in fact, merely different and more subtle. Hazards include water pollution with pesticide and fertilizer residues and high exposures to dust, chaff, and chemical residues in processing grains.

Mills and granaries also pose hazards from (a) high exposures to grain dusts, which can lead to lung diseases in mill workers and those delivering grains for grinding and (b) lead poisoning from lead binding in the grinding wheels. (Grinding wheels sometimes consist of several large stones bound together with lead straps or have lead fillings in the gaps or holes of individual stones.)

Noise. Stress from noise pollution, for example, from on-site threshing machines and 24-hour processing factories can pose hazards for workers and nearby residents. Noise may be a seasonal reality, increasing during harvesting season, and boost the rate of accidents by preventing adequate sleep in workers and adding to on-the-job stress.

Storage facilities. Food storage facilities, such as granaries and mills, contain the following four main types of risk, which generally do not pose major occupational or public health hazards. Local circumstances determine their seriousness.

Molds from grain storage at local level. Risks from molds (aflatoxins), known carcinogens generated by humidity, vary with local weather conditions. In addition to occupational exposure, molds can make their way into the food chain in staples, such as breads and baked goods. Aflatoxins are also known hallucinogens, affecting entire communities in unusually long wet seasons.

Dust and molds from storage and transport. Storage of grains for commercial use changes the risks somewhat by increasing the scale: in addition to worker exposure, large facilities may extend these risks to the community.

Snake bites. Storage facilities attract rodents, which in turn, attract snakes.

Hanta virus. Hanta virus is one of the recently discovered diseases attributable to global change in the past twenty years (see chapter 14). The disease is spread to humans through rodent urine (mainly rats and mice). Humans are exposed in dwellings near fields or food storage areas, when rodents enter them.

Transport. Transport of food to processing areas, wholesalers, or markets entails hazards in road safety and food contamination. The latter comes primarily from:

- “Unprotected” vehicles, in which food is exposed during transport to a wide range of contaminants, for example, pesticides, fuels, and oils
- Inadequate refrigeration to protect food from spoilage, shortening its “shelf life”
- Contaminated vehicles not reserved solely for or properly maintained for food. To avoid a return trip empty, for example, trucks sometimes haul garbage or hazardous materials.
Land Clearing for Agriculture or Settlement

Land use is linked to an array of familiar human health repercussions, ranging from the spread of vector-related diseases to death and injury from flooding. Complicated interactions in land use lead to transmission of human diseases originating in animals, thus, presenting risks in animal husbandry.

Land clearing has four potentially major health repercussions through (a) change of vector habitat, (b) erosion, desertification, and other forms of land degradation, (c) floods, and (d) salinization. The indirect consequences of expansion of agriculture or settlements, for example, for foraging for food, fodder, and firewood, can be equally destructive in the long term. Each of the four repercussions cited above has many other causes besides land clearing, for example, climate change (see chapter 14). The information below provides an idea of the health dimensions and does not necessarily attribute causality, although land clearing may help cause or exacerbate the problems.

Spread of vector-borne disease. Although land clearing would seem to eliminate mosquito vector habitats, in reality, it only changes them. More than 3,000 different species of mosquitoes exist, indicating that mosquitoes are extremely adaptable in finding new breeding sites with slightly different breeding habits in terms of salinity, moisture, temperature, and so on. For example, in Indonesia and South America, two species of mosquitoes that spread malaria disappeared after deforestation, but the reverse occurred in the Indo-Australian region with the intrusion of three species. About fifty species (anopheles) spread malaria, undoubtedly the most widespread vector-borne disease; two other mosquito species (culex and aedes) also spread diseases of global importance (see also annex B).

Erosion, desertification, land degradation, and salinization. The potential result from a health perspective is the same for each: (a) compromised food supply, leading to malnutrition and lowered resistance to other diseases, (b) physical stress from foraging for food, fodder, and firewood, (c) irregular supply of water for food, and (d) in extreme cases, resettlement, coupled with infectious diseases related to poor personal hygiene, due to inadequate water and waste disposal. These factors worsen when victims are dislocated.

In addition, salinization of soils increases salts in water, which, among other impacts, can compromise nutrition by reducing water use for drinking and irrigation and is linked to high blood pressure in residents near saltwater bodies because they breathe in salt in the air. The Aral sea, for example, contains salts up to twice WHO standards.

Floods. The main health repercussions from floods are deaths (mostly drowning), injuries, lost housing and jobs, contaminated water and food, malnutrition, spread of vector-borne diseases, electrocution (from power lines), and inoperable emergency services. Mortality ranges from 500,000–800,000 in China (1969) to 2,000 each for the Netherlands (1953) and Italy (1963). Epidemics caused by flooding can also be significant. In Bolivia, flooding related to the El Niño Southern Oscillation (ENSO) in 1983 increased salmonella poisoning by 70 percent; similar increases were reported in Bangladesh, Brazil, Chile, Mauritius, Sudan, and the United States. In July 1996, 1,500 died in floods across China; in the city of Hubei alone, tens of thousands fell sick or were injured, leading to nearly 400 deaths, and 2.36 million became homeless.

Although a global phenomenon, flooding tends not to be as severe in SSA, compared with Asia during the monsoon season or Latin America, as measured by death rates. As the most urbanized region in the world, Latin America has large numbers of housing settlements up hillsides on marginal and degraded land surrounding urban areas. Some of the lower death rates may be due to lower population density in SSA. Between 1990 and 2000, however, flooding became a serious problem in SSA; about 15 million people have been affected, and 6,500 deaths have occurred in

Floods have an indirect effect in SSA where road transportation is more important than other forms of transport for commerce. When flooding occurs and roads are either blocked, sometimes for days, or washed out, road barriers are often erected at the nearest town or “truck stop” to alert drivers. Many of these areas are frequented by prostitutes, contributing to the spread of AIDS by the truckers. Floods also destroy important infrastructure, ranging from roads to irrigation systems, each with negative effects in the short term on providing emergency services, as well as, in the long term, producing food.

In addition to its immediate effects on injury and death, flooding can also cause long-term physical and mental stress (“post-traumatic syndrome”), even suicides. These latter health effects tend not to be reported in health statistics related to flooding.

**Forestry, Biodiversity, and Traditional Medicines**

Forest management projects have five broad environmental health repercussions from:

- Spread of vector-related diseases, especially as roads penetrate into forested areas
- Use of pesticides
- Unsustainable land use
- Spin-off activities, such as opening up forested areas for logging, agriculture, farming, or human settlements
- Threat to medicinal plants.

The first four topics are covered in chapters 7, 8, 13, and 14, whereas the effects on traditional medicines are considered here.

Medicinal plants in tropical forest and nonforest habitats are highly important sources of traditional medicines. An estimated 80 percent (4.8 billion people) of the world’s population depend on medicinal plants for health care; in rural areas, the figure is more likely to be 100 percent. Medicinal plants are generally free or available at affordable cost. The range of benefits for humans and livestock from traditional herbal medicines, however, generally escape economic analysis.

**Box 8-6: Medicinal Plants and Ghana**

In the northern savanna regions of Ghana, residents rely on locally available medicinal plants for the majority of health care needs, but are exploiting them at an unsustainable rate. The Ministry of Health estimates that Ghana has one traditional healer per 400 people and one allopathic doctor per 10,000. The Ministry of Lands and Forestry under the Savanna Resource Management Program is working with northern rural residents to identify collaborative resource management strategies for community-dependent habitats for sustainable harvest of medicinal plants."135

Source: Authors’ Data.

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Medicinal plants are increasingly threatened by logging operations, deforestation, expanding agricultural lands, burning, and grazing. All user groups lose out from overexploitation of natural stocks of such plants. Developing countries, especially African countries, are the greatest losers, as they depend greatly on medicinal plants, particularly in traditional health systems (healers and birth attendants) and by mothers for primary health care needs. Forty percent of the plants important in treating the top eleven human and four livestock diseases (see table 8-6) are presently threatened.

Table 8-6: Human and Livestock Diseases Treated by Plant Species

<table>
<thead>
<tr>
<th>Human Disease</th>
<th>Northern Region</th>
<th>Upper West Region</th>
<th>Upper East Region</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(number of species/number of species threatened)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malaria</td>
<td>12/4</td>
<td>14/4</td>
<td>3/2</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>11/1</td>
<td>7/5</td>
<td>5/4</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>12/0</td>
<td>7/3</td>
<td></td>
</tr>
<tr>
<td>Hypertension and stroke</td>
<td>14/9</td>
<td>1/1</td>
<td></td>
</tr>
<tr>
<td>Dysmenorrhea</td>
<td>20/2</td>
<td>–</td>
<td>2/1</td>
</tr>
<tr>
<td>Sinusitis, headaches, and colds</td>
<td>12/5</td>
<td>3/1</td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>14/6</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Pelvic inflammatory disease</td>
<td>13/3</td>
<td>–</td>
<td>7/5</td>
</tr>
<tr>
<td>Stroke</td>
<td>11/4</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Snake bite</td>
<td>–</td>
<td>7/5</td>
<td></td>
</tr>
<tr>
<td>Piles</td>
<td>–</td>
<td>3/1</td>
<td>5/2</td>
</tr>
</tbody>
</table>

| Animal Disease                       |                  |                   |                  |
| Diarrhea                             | 10/4             | –                 | 2/1              |
| Anthrax                              | 15/7             | –                 |                  |
| Liver fluke                          | 14/8             | –                 |                  |
| Newcastle disease                    | –                | –                 | 2/1              |


Table 8-7 indicates the type of agriculture threatening wild sources of medicinal plants by listing production trends for the four types of major crops in terms of areas harvested during 1970–91. Table 8-3 above lists some of the human health effects resulting from use of chemicals in the production of these four major crops. Rice harvest and acreage roughly doubled. Agricultural intensification offers opportunities for farmers and the ministry of agriculture to identify cultivation methods and practices for medicinal plants that are compatible with agricultural crops. Such additional crops would offer alternate income. In agricultural and rural development projects that concern these crops, considering how to reduce the threat to medicinal plants or promote their conservation may be appropriate.

Table 8-7: Most Important Crops Grown in the World and SSA (1970–91)

<table>
<thead>
<tr>
<th>Crops</th>
<th>World Production (millions of tons)</th>
<th>Area Harvested (1000s of hectares)</th>
<th>SSA Production (millions of tons)</th>
<th>Area Harvested (1000s of hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>316,519</td>
<td>517,875</td>
<td>133,122</td>
<td>146,970</td>
</tr>
<tr>
<td>Cottonseed</td>
<td>22,480</td>
<td>38,438</td>
<td>34,144</td>
<td>34,958</td>
</tr>
<tr>
<td>Coffee, tea, cocoa</td>
<td>6,664</td>
<td>11,107</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>Fruits and vegetables</td>
<td>509,608</td>
<td>797,544</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
</tbody>
</table>

Note: N.A. Not Available.

Water and Waste Management

This section covers environmental health risks related to drinking water supply, irrigation and drainage, and agricultural and domestic waste management.

Rural Community Drinking Water Supply

According to a recent World Bank study on health, rural water supply, and sanitation, global coverage for water supply was 61 percent in 1990 for rural and urban areas combined and only 50 percent for rural areas. By 1994 global rural coverage reached 70 percent, which means that 30 percent of the world still have no water in the house. For sanitation, the challenge is even more daunting. WHO estimates that more than 3 billion people are without adequate means of excreta disposal. Sanitation coverage, however, fell globally in the 1990s from 36 percent in 1990 to 34 percent in 1994. WHO estimates 3.3 million people die every year from diarrheal diseases and 1.5 million suffer at any one time from parasitic worm infections stemming from human excreta and solid wastes in the environment.136 During the International Drinking Water and Sanitation Decade, 1981–90, SSA experienced an increase in water supply coverage from 32 to 46 percent, whereas sanitation coverage increased from 28 to 36 percent. Progress since, however, has stagnated, and more people lack adequate services in Africa today than in 1990.137 Despite these gloomy statistics, considerable progress has been made in nearly eradicating two scourges, Guinea worm disease and river blindness (see box 8-7).

Box 8-7: Two Successes in Eradicating Guinea Worm Disease and River Blindness

Guinea worm disease. The eradication of guinea worm disease (dracunculiasis) is an encouraging story and salient to this discussion, because the infrastructure sector took the most important measures in close collaboration with health, agriculture, and rural development sectors.

Guinea worm, first described in Egyptian medical texts in the fifteenth century BC, is the only disease spread exclusively by drinking water and is restricted to sixteen African countries. According to a Nigerian study, guinea worm infections cost an estimated US$20 million in lost labor each year and cause about 60 percent of school absenteeism in that country.

Guinea worm eradication was initiated during the U.N. International Drinking Water Supply and Sanitation Decade of the 1980s. WHO officially called for its eradication in 1986 when cases reached an estimated 3.5 million and 100 million at risk due to unsafe water supply. By 1998 protection of water supplies, mainly digging wells and boreholes, applying larvacide, and filtering water, had dropped infection rates to less than 80,000. It is hoped that, by the year 2001, guinea worm eradication will be added to smallpox eradication as one of the major accomplishments of the twentieth century—the result of practical collaboration among health programs outside the health sector.

River blindness. A second case illustrating the power of interagency collaboration is the Onchocerciasis (River Blindness) Control Programme (OCP) in western Africa, begun in 1974. Eradication of this disease has been even more daunting, because (a) its vector, the black fly, has a flight range of up to 400 kilometers, (b) the population at risk covers eleven countries from Senegal to Benin, mostly along main rivers, (c) individuals carrying the disease can remain infective for 10–15 years, and (d) remedial measures must continue for 20 or more years.

The black fly breeds in fast-moving waters of rivers, streams, spillways, and drainage canals (where the aerated water provides the larvae the high amounts of oxygen they need to develop). This is precisely where people wash clothing, fish, bathe, swim, and collect water. Socioeconomic costs of the disease have been high, because up to 50 percent of the local population can be infected, 30 percent with impaired vision and 10 percent blind. Often, entire villages have been abandoned for higher ground with less fertile soil. Remedial measures have centered on insecticide application, medication, education, and, to a limited extent, promotion of sustainable resettlement of areas brought under control.
OCP initially entailed collaboration among seven poor countries in western Africa, but was expanded in the early 1980s to eleven countries to control all black fly–breeding locations throughout the West African subregion. Launched in December 1995, the African Programme for Onchocerciasis Control (APOC) is following up on OCP by attacking the problem in the remaining nineteen countries eastward where onchocerciasis still exists, from Benin to Ethiopia and, in central Africa, from Angola and Malawi. OCP virtually eliminated the disease within the eleven western African countries and is scheduled conclude in 2002. Some 18 million people are currently infected in the remaining nineteen countries of APOC, which will end in 2007. At that point, national governments, local communities, and NGOs will take over responsibility for drug distribution.


Rural water supply projects sometimes fall under the aegis of health or agriculture agencies, which do not necessarily have the in-house competence to deal effectively with engineering and maintenance of drinking water supply and sanitation services. Conversely, periurban water supply under the water supply and sanitation agency may not have the in-house competence to deal with essentially rural conditions. Both types of projects could benefit from a component to deal with institutional weaknesses in engineering and maintenance, hygiene education, or health risk assessment. Many of these activities (or components) have been successfully introduced into water and sanitation sector projects. In addition, many periurban settlements around African cities resemble rural villages with characteristics that have important health repercussions. Even high-density areas contain zones that require a rural approach to an urban problem. Chapter 13’s last section on infrastructure water supply and sanitation discusses issues in rural water supply.

Guinea worm. Because guinea worm is the only disease linked exclusively to drinking water, control measures should focus on preventing people from immersing their feet and lower legs in water sources when fetching water. Boiling, filtering, and treating water are also effective measures, but not holding tanks because the water flea (copepod), which spreads the disease, can survive in holding tanks for long periods.

Stress on women and children fetching water. Fetching water can consume several hours per day, a factor sometimes overlooked by those not familiar with rural water supply, and explained in box 8-8. The physical stress can predispose people to other illnesses.

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Box 8-8: The Stressful Facts about Rural Water Supply

Taking South Africa as an example, an estimated 16 million people or 3.2 million households (averaging 5 persons each) have no operating water supply and must travel an average of 1 kilometer each way to fetch water. Assuming that each household sends one member, usually a woman, twice a day for water, she must walk an average of 4 kilometers a day. Collectively, then, these women walk 12.8 million kilometers a day. If the average distance to the moon is 384,000 kilometers, this means that together they walk 33 times the distance to the moon just to fetch water every day.

If each trip takes an average of 1 hour to walk to the water source, wait in a queue, collect the water, and walk back, they collectively make 6.4 million trips taking 6.4 million hours a day. This represents nearly 3,500 working years each day fetching water (assuming 21 working days a month for 11 months a year). These figures are just for South Africa; if you consider the rest of Africa, they become staggering. These women walk to fetch only 10 liters of water each trip, usually of suspect quality. The figures are estimated, but of a tight order of magnitude.

**Arsenic.** Arsenic is a naturally occurring pollutant in soil and groundwater, often bound in ores of copper, lead, and zinc. Arsenic is also a common ingredient in pesticides. Chronic, low-dose exposure can cause problems with the skin, liver, and circulatory, nervous, and respiratory systems.

**Irrigation and Drainage**

Irrigation generally contains four types of components: (a) dams, watersheds, and reservoirs, (b) diversion and intake facilities, (c) wells, pumping stations, canals, ditches, and pipelines for water supply and drainage, and (d) distribution systems for sprinkle and drip irrigation. Irrigation generally refers to the use of surface waters, but, for the past thirty years, tube wells have been used to tap groundwater in parts of Asia, for example, India, Pakistan, and China. Groundwater use poses the same environmental health hazards as surface waters, but the water may also contain naturally occurring contaminants such as arsenic or manganese.138

Two factors link irrigation to cities. Overall population growth and continuing migration to cities have increased competition for water for drinking, irrigation, and industrial uses. Developing new water sources that are increasingly farther away from the point of use has also increased costs. This encourages skimping on expenditures and compromise on environmental issues, such as capital investments (e.g., drainage) or recurrent costs (e.g., operations and maintenance). A well-developed literature exists on these long-recognized topics, but implementation still presents problems in the field.

Table 8-8 summarizes the potential negative environmental impacts of irrigation and their health impacts. The major environmental health risk entails the spread of vector habitats (see “Malaria and Vector-Related Diseases” in chapter 7). For example, a recent study in Ethiopia showed a sevenfold increase in malaria among about 7,000 children under 10 years living within 3 kilometers of small dams, compared with children living outside mosquito flight ranges.139 The overall negative impacts need to be weighed, however, against benefits in improved nutrition that dams permit in arid areas, tempering the devastating effects of drought, such as famines in 1974 and 1984.140 Such dual effects underscore the need to make single sector decisions within a broad environmental health context.

Risks other than the spread of vector habitats are discussed below.

**Table 8-8: Potential Environmental Health Impacts from Irrigation**

<table>
<thead>
<tr>
<th>Negative Environmental Impact</th>
<th>Potential Negative Health Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water logging and salinization of soils</td>
<td>Diminished crop productivity and malnutrition, and, in extreme circumstances, relocation of the population</td>
</tr>
<tr>
<td>Expansion of habitat for snails and mosquitoes</td>
<td>Increased incidence of water-related diseases, in particular, schistosomiasis and malaria</td>
</tr>
<tr>
<td>Resettlement</td>
<td>Diarrheas, respiratory diseases, malaria and other vector-borne diseases, malnutrition, mental stress, and aggravation of normal health problems because of inadequate health facilities</td>
</tr>
<tr>
<td>Increased pesticide use from expanded agriculture. Pesticide runoff can kill local populations of frogs and fish that keep mosquito larvae in check.</td>
<td>Possible increase in malaria or other mosquito-borne diseases</td>
</tr>
<tr>
<td>Increases in agricultural pests and diseases resulting from elimination of dry season die-back and creation of a more humid microclimate</td>
<td>Spread of vector-borne diseases and possible malnutrition from decreased food production</td>
</tr>
</tbody>
</table>

*Source: Authors’ Data.*

**Potential Impacts from Increased Agriculture**

The expansion and intensification of agriculture made possible by irrigation also may also cause problems (see table 8-9).
Table 8-9: Potential Health Impacts from Increased Agriculture

<table>
<thead>
<tr>
<th>Potential Impacts from Increased Agriculture</th>
<th>Potential Negative Health Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased erosion</td>
<td>Death and injury due to floods, especially in rainy season</td>
</tr>
<tr>
<td>Pollution of surface and groundwater from agricultural biocides</td>
<td>Contamination of the food chain</td>
</tr>
<tr>
<td>Deterioration of water quality</td>
<td>Decreased water usage and possible increase in water-related diseases and personal hygiene</td>
</tr>
<tr>
<td>Increased nutrient levels in the irrigation and drainage canals, resulting in algal blooms, proliferation of aquatic weeds, and eutrophication in irrigation canals and downstream waterways</td>
<td>Contamination of the food chain and, depending on local conditions, promotion of cholera by conveyance in algal blooms</td>
</tr>
</tbody>
</table>

Source: Authors’ Data.

**Potential General Ecological Disturbances**

Large irrigation projects have a number of potentially negative environmental health repercussions. Three already discussed include (a) biodiversity loss and the risk to traditional medicines, (b) flooding and the risk of injury and drowning, and (c) spread of vector-related diseases through change of habitat. A fourth repercussion is the involuntary or voluntary resettlement of populations.

**Involuntary resettlement.** Involuntary settlement involves such direct and indirect health repercussions as:

- Diarrheal and respiratory diseases stemming from the absence of basic infrastructure (water, sanitation, drainage, housing, and basic community infrastructure)
- Malnutrition from inadequate food supply, especially when people grow their own food crops, and inadequate food security and nutrition, for example, some crops and trees do not bear fruit for a year or two after planting
- Spread of malaria (and other vector-borne diseases) by transferring an infected population to a noninfected area or vice versa on a temporary or permanent basis, exposing new populations
- Aggravated illnesses and injuries from inadequate health facilities, at least compared with the level migrants had before (if the basic environment and population have changed as a result of the resettlement)
- Mental stress from being uprooted, especially on old people, may require social service outreach to compensate for the stress of upheaval.

The World Bank’s Safeguard Policies OD 4.30 and GP 4.12 “Involuntary Resettlement” deals with some of these factors, but lack detail on specific health repercussions (see “Human Settlements” above).

**Voluntary or seasonal resettlement.** Voluntary and seasonal resettlement could involve all the conditions noted above, but may pose additional conditions stemming from spontaneous or unplanned growth:

- Diarrheal and respiratory diseases related to temporary unplanned settlements
- Vector-related diseases and health and safety hazards related to solid and liquid waste management, when economic activity, such as harvests or fishing spurs resettlement
- Spread of AIDS among temporary workers and local residents.

In SSA, for example, voluntary resettlement has occurred in areas where river blindness (onchocerciasis) has been controlled (see box 8-7).

Economic activity can also spur voluntary, but often unplanned, resettlement. For example, in Senegal, the Lac de Guiers was dammed in the 1980s to furnish a constant supply of water drawn from the Senegal River, which feeds the lake, to Dakar and other cities.

148
Marshes and Other Wetlands

“Wetlands are not wastelands!” Marshes and other wetlands and have a vital role to play in maintaining human health by naturally purifying water of fecal and some chemical contaminants and by absorbing excess flood waters. Wetlands, however, also provide habitat for mosquitoes that spread disease. Human settlement and transport projects considering drainage management should take these contrasting roles into account.

Reuse of Wastewater

Reuse of wastewater for irrigation is practiced throughout the world, especially in Latin America and Asia, and will no doubt increase in use due to future population growth and water shortages. Wastewater is also reused in aquaculture, the practice of raising fish and seafood in specific areas. It primarily involves reuse of sewage and industrial waste (see “Fisheries and Aquaculture” above and table 8-5). Table 8-10 shows the major health hazards of such practices:

Table 8-10: Major Hazards in Reuse of Wastewater

<table>
<thead>
<tr>
<th>Irrigation</th>
<th>Aquaculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Food chain contamination</td>
<td>• Occupational hazards, such as skin and eye diseases</td>
</tr>
<tr>
<td>• Spread of vector-related diseases</td>
<td>for fishermen with long-term exposure to water and accidents and drowning (on boats and in deep water)</td>
</tr>
<tr>
<td>• Pollution from pesticides, fertilizers, and animal waste. Their adherence to food surfaces may be more hazardous than their absorption by plants.</td>
<td>• Contamination of the food chain through accumulating pesticides and heavy metals in the organs of fish and other seafood</td>
</tr>
<tr>
<td>• Plant absorption of heavy metals. In SSA, these risks are highest near mining activities, which produce tailings that wash away sometimes into irrigation water downstream.</td>
<td>• Diarrheal diseases spread by fecal contamination of fish and seafood, if not properly cooked.</td>
</tr>
</tbody>
</table>

Source: Authors’ Data.

Agricultural Waste Management

Animal and crop waste pose a number of environmental health risks (see table 8-11).

Table 8-11: Major Health Hazards of Agricultural Waste Management

<table>
<thead>
<tr>
<th>Animal Waste</th>
<th>Crop Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Occupational exposures, mainly diarrheal diseases, for those disposing of or reusing waste as fertilizer or slaughtering and dressing animals and for those working in abattoirs and food processing plants</td>
<td>• Fertilizer runoff, in particular, nitrates</td>
</tr>
<tr>
<td>• Diarrheal diseases from fecal contamination of water supply</td>
<td>• Occupational exposures, mainly to pesticide residues</td>
</tr>
<tr>
<td>• Nitrate contamination of water, which, in extreme cases, can lead to blue baby syndrome (methemoglobinemia).</td>
<td>• Diarrheal diseases from fecal, biological, and chemical contamination of water</td>
</tr>
<tr>
<td></td>
<td>• Change in vector habitats, which permits mosquito breeding.</td>
</tr>
</tbody>
</table>

Source: Authors’ Data.

Domestic Waste Management

Wastewater and periurban waste pose specific environmental health risks.

Wastewater

The health hazards of rural wastewater are mainly:

• Diarrheal diseases from inadequate disposal facilities
• Vector-related diseases because of poor drainage.
Sanitation technologies range from small bore sewers for small towns to on-site latrines for rural and low-density urban areas. Small towns and rural areas mostly rely on systems such as septic tanks and latrines, but sewerage systems may possibly be appropriate for dense populations in regional centers depending on the capability of local institutions to sustain a water and sewerage authority. For a detailed discussion of sanitation, see “Infrastructure: Water Supply and Sanitation” in chapter 13.

Periurban Waste
Periurban agriculture is growing, partly due to continued urbanization. Health hazards due to periurban waste combine hazards already addressed under urban and rural waste, although circumstances vary according to local conditions. Municipal administrations are not set up to deal with urban and rural problems simultaneously, so addressing health problems face administrative as well as technical difficulties. (See also “Periurban Agriculture and Livestock” above.)

Rural Transportation
Roads are often managed by a central transport ministry and suffer from a lack of budget and subordination to urban concerns. Health repercussions are largely the same as in urban areas with differences in scale, institutional capability, education levels of affected populations, and availability of resources to address problems.

Roads, Trails, and Paths
Rural roads fall roughly into three categories: (a) paved and graded roads, (b) paths, trails, and access roads, and (c) post-harvest roads (something more than tracks in fields, which are used only at harvest time). Hazards are roughly the same for the three, and local factors determine their relative importance. Primary health hazards include:

- Injuries from accidents, unsafe driving habits, and poor maintenance of vehicles and roads
- Occupational hazards, including respiratory diseases in truckers from, for example, exposure to petroleum-based fuels, and injuries to farm workers from poorly maintained paths and trails and harvest vehicles
- Respiratory diseases from air pollution, especially dust
- Spread of AIDS by truckers at truck stops, especially at temporary stops due to blocked roads in storms, and from work crews involved with road construction, rehabilitation, and maintenance
- Lead pollution in heavily traveled areas, which may be absorbed by some crops and also ingested by children.
- Dust. Dust is an important health hazard that is often underestimated due to an emphasis on fuel-derived vehicular air pollution and cancers. Risks derive more from the size of particles than their chemical composition, as small particles penetrate deeply into lungs, impeding breathing.
- Lead. Lead from heavy nearby traffic could contaminate crops and, therefore, the food chain. Similarly, lead that settles along heavily traveled roads, particularly during the harvest season, put children at risk of lead poisoning (children acquire lead from eating soil and putting toys into their mouths, a source of lead that tends to be neglected in the literature). Lead can recirculate in the environment for up to 30 years, accumulating to harmful levels.
River Transport

Fishing is one of the most hazardous occupations that exists, particularly because of injuries and drowning due to rough waters, especially, on the high seas and large lakes. The lower risks of river transportation are, however, similar in nature and include occupational health hazards such as (a) injuries to and drowning of boat crew members, (b) accidents and injuries to dock loaders and others involved in loading crops and other materials, especially at harvest, (c) exposure of boat crews to fuel emissions, (d) exposure to hazardous materials transported, and (e) exposure to vector-borne diseases.

Environmental Health Assessment Checklist

This section presents a set of tools that can be used to determine a broad range of environmental health issues, from which to view direct and indirect repercussions, determine which are most important, and then set priorities according to institutional capabilities and budgets. This intentionally broad approach gives a better idea of the range of institutions that may need to be involved in finding solutions. In keeping with the overall poverty reduction objectives of this discussion paper, the material also describes the main high risk and vulnerable groups.

Typical Loans and Components from the Sector

The official World Bank designations for the agriculture and rural development sector are as follows: rural development, natural resources, fishing, livestock, irrigation and drainage, perennial crops, research and extension, food security, forestry and so on, sector loan, marketing, agroindustry, perennial crops, research and extension, food security, forestry, and other agriculture.

Occupational, High Risk, and Vulnerable Groups

The main occupational health and safety issues concern pesticides, accidents, and exposure to vector-related diseases (see table 8-12).

Table 8-12: Occupational, High Risk, and Vulnerable Groups for Agriculture Sector

<table>
<thead>
<tr>
<th>Activity</th>
<th>Potential Health Risk</th>
</tr>
</thead>
</table>
| Use and sale of pesticides | Basic health risks, include (a) acute poisoning from short-term exposure and (b) long-term exposure, which may lead to accumulation in body fat, leading to cancer or birth defects.  
- Farmers and other farm workers: mixing and spraying of pesticides  
- Women and children: (a) improper storage and (b) housekeeping activities, especially family members washing the farmer’s clothing  
- Retailers and wholesalers: (a) improper handling, storage, repackaging or reformulating (mixing chemicals to become pesticides) and disposal of pesticides and containers and (b) containers often recycled, for example, bottles for beverages or drums for storage or incineration containers  
- Dockworkers and truckers: exposures from improper storage and transport  
- Community at large: (a) short- and long-term exposure in nearby fields, especially the first few days after spraying, (b) improper disposal of excess pesticides and empty containers, (c) runoffs from the fields, and (d) spills from transport accidents. |
| Farming | Inaccessibility to health care after accidents, in part explaining why farming is one of the highest-risk occupations internationally  
- Exposure to malaria, in Africa, particularly women. |
| Women and children fetching fodder and water | Physical stress, because these activities can take up to 8 hours a day  
- Exposure to accidents  
- Exposure to malaria, in some periurban areas where urban malaria is not en- |
Activity | Potential Health Risk
--- | ---
water | endemic.

Silage storage and loading at ports and harbors | Occupational exposures
Exposures to food dusts and molds and pesticide residues by people living in surrounding areas

Rural housing | Exposure to indoor air pollution by general population from poorly ventilated traditional housing, for example, huts, and other locations with concentrations of fumes

Traditional fuels preparation and sales | Exposure to charcoal dust in preparing, packaging, and selling charcoal, which tends to be a cottage industry run largely by women

Agroindustry | Exposure to pesticide residues, dusts, and molds from food processing
Exposure to carcinogens from smoking foods.

Source: Authors' Data.

Environmental Health Checklist for the Sector

The Agriculture Sector Environmental Health Checklist (table 8-13) shows the range of agriculture sector projects by subsector, identifies the main potential environmental health problems, and suggests remedial measures.

Table 8-13: Agriculture Sector Environmental Health Checklist*

<table>
<thead>
<tr>
<th>Typical Agriculture Projects and Components</th>
<th>Probable Environmental Health Issues</th>
<th>Remediable Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agency Reform</strong>&lt;br&gt;Generally, involve development or restructuring of institutional capacity in agriculture. Some contain studies on rural water supply, watershed management, or irrigation.</td>
<td>Rural water supply, watershed management, or irrigation projects could entail diarrheal diseases, skin diseases, eye infections, vector-related diseases, especially malaria, schistosomiasis, and onchocerciasis.</td>
<td>Besides water provision (quantity and quality), preparation of terms of reference (TORs) for rural water supply and sanitation projects should determine if disease is or has been endemic. If so, the project could assign responsibilities for monitoring stagnant water and drainage to stakeholders. If disease is still endemic, the project should provide for protecting the water source and appropriate education. TOR implementation should provide for proper O &amp; M outside the ministry of health or agriculture (MOH/MAO), if appropriate. A community participation component may be needed for O &amp; M and cost recovery.</td>
</tr>
<tr>
<td><strong>Agricultural Credit</strong>&lt;br&gt;Deal with financial services and restructuring.</td>
<td>Only relevant if funds are “on-lent” to buy inputs, for example, fertilizers and pesticides and to other subsectors, but without EAs or EHA reviews</td>
<td>See “Agroindustries”</td>
</tr>
<tr>
<td><strong>Agricultural Extension</strong>&lt;br&gt;Generally involve development or restructuring of institutional capacity in agriculture.</td>
<td>Same as for “Agency Reform” subsector</td>
<td>Same as for “Agency Reform” subsector</td>
</tr>
</tbody>
</table>

* These and other sectoral checklists are available at <http://www.worldbank.org/afr/environmentalhealth/>.
<table>
<thead>
<tr>
<th>Typical Agriculture Projects and Components</th>
<th>Probable Environmental Health Issues</th>
<th>Remediable Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Adjustment</td>
<td>Involve environmental management, including environmental education and some studies on vector control and climate change.</td>
<td>As part of studies and training, environmental health issues, such as vector-related diseases, should be included in preparation of TORs, when appropriate.</td>
</tr>
<tr>
<td>Agroindustry and Marketing</td>
<td>Main objectives involve increasing agricultural productivity and marketing efficiency. Common components include (a) pesticide use and fertilizer distribution, (b) rehabilitation and/or construction of rural roads to increase access to markets, (c) small-scale water schemes, and (d) food processing and storage.</td>
<td>For (a)–(d), implementation TORs should include procedures for health hazard awareness campaign and provide for affordable protective gear and equipment.</td>
</tr>
<tr>
<td><strong>Pesticide and fertilizer use:</strong></td>
<td>(a) Acute poisoning to farmers and family members due to storage problems in houses (b) Fertility and reproductive problems, for example, spontaneous abortions (c) Weakened immune system (d) Other possible long-term effects, such as cancer and birth defects.</td>
<td></td>
</tr>
<tr>
<td><strong>Rehabilitation and construction:</strong></td>
<td>Implementation TORs should include: (a) Provision for affordable protective gear and equipment (b) Appropriate road design and better law enforcement (drunk driving, seat belts, and so on) (c) Better law enforcement (emission control) and awareness campaign for population at risk (d) In the short term (preparation TOR should identify population at risk), Vitamin A supplement for population at risk, and, in the long term, introduction of nonleaded fuel (e) AIDS and STD awareness in conjunction with MOH campaign targeting workers (labor unions and associations) and truckers (associations), a clause on AIDS and STDs (and possibly hygiene) in the subcontractor contract, and distribution of condoms as appropriate.</td>
<td></td>
</tr>
<tr>
<td>(a) Accidents during construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Increased vehicle use can cause traffic injuries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) Increased exposure to vehicle fumes can cause respiratory diseases in populations along roadsides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) Lead-related conditions such as anemia and neurological effects, especially in children</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e) AIDS spread by construction workers and truckers.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food processing and storage: Contamination with pesticides or other chemicals and/or microorganisms may occur during handling, transport, or storage of foodstuffs resulting in: (a) Acute poisoning (b) Diarrheal diseases</td>
<td>For (a) and (b), implementation TORs should include a health hazard awareness campaign.</td>
<td></td>
</tr>
<tr>
<td>Typical Agriculture Projects and Components</td>
<td>Probable Environmental Health Issues</td>
<td>Remediable Measures</td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>-------------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Small-scale water systems: See “Irrigation and Drainage”</td>
<td>See “Irrigation and Drainage”</td>
<td></td>
</tr>
<tr>
<td>Annual Crops</td>
<td>Similar to “Agroindustry and Marketing”</td>
<td>Similar to “Agroindustry and Marketing”</td>
</tr>
<tr>
<td>Fisheries and Aquaculture</td>
<td>Fishing and processing: (a) Drowning and accidents from falls (b) Skin diseases due to constant moisture, especially the extremities (c) Occupational injuries and physical stress, e.g., overexertion and back pains (d) Vector-borne diseases, e.g., schistosomiasis, onchocerciasis, and malaria</td>
<td>For (a)–(b), implementation TORs should include awareness campaign and affordable protective gear and equipment and for (c) counseling and (d) affordable protective gear and equipment, including insect repellant.</td>
</tr>
<tr>
<td>Forestry</td>
<td>(a) Vector-related diseases, especially malaria (b) Accidents, e.g., falls, cuts, and abrasions (c) Snake and animal bites (d) Occupational injuries and physical stress, e.g., overexertion, back pains</td>
<td>For (a), implementation TORs should include affordable protective gear and equipment including insect repellent and for (b)–(d) awareness campaigns.</td>
</tr>
<tr>
<td>Irrigation and Drainage</td>
<td>(a) Vector-related diseases (b) Diarrheal diseases from improper drainage and sanitation; (c) Long-term, low-level exposure to pesticides due to reuse and exposure of irrigation waters.</td>
<td>For (a)–(c), implementation TORs should include vector control targeting drainage, sanitation, and stagnant water (stakeholder involvement in monitoring and introduction of larvivorous [larva-eating] fish as appropriate) as well as an awareness campaign including hygiene behavior.</td>
</tr>
<tr>
<td>Livestock</td>
<td>Health issues mostly related to exposure of workers to animal waste: (a) Brucellosis and anthrax from contact with infected cattle, swine, goats, and sheep (b) Other infectious diseases from occupational exposures to livestock, poultry, and abattoirs, for example, Q fever, asthma, psittacosis, fungal and parasitic diseases, and leptospirosis (Weil’s disease) (the latter of which can be spread to communities during heavy rains in areas of poor access)</td>
<td>For (a)–(c), implementation TORs should include awareness campaigns and affordable protective gear and equipment.</td>
</tr>
<tr>
<td>Typical Agriculture Projects and Components</td>
<td>Probable Environmental Health Issues</td>
<td>Remediable Measures</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>--------------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td>heavy rains in areas of poor drainage)</td>
<td>See “Agroindustry and Marketing”</td>
</tr>
<tr>
<td></td>
<td><em>(c)</em> Diarrheal diseases in workers and village due to contamination of drinking water. Other effects may include the nuisance of smells and aesthetics.</td>
<td>See “Agroindustry and Marketing”</td>
</tr>
<tr>
<td></td>
<td><em>Food processing:</em> See “Agroindustry and Marketing”</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Water resources:</em> See “Irrigation and Drainage”</td>
<td>See “Irrigation and Drainage”</td>
</tr>
<tr>
<td><strong>Other Agriculture</strong></td>
<td>As covered above.</td>
<td>As covered above.</td>
</tr>
<tr>
<td>Focus on food security, nutrition, finance, road upgrading, water supply, crop technology, irrigation, livestock, veterinary services, and infrastructure</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Perennial Crops</strong></td>
<td>As covered above in other subsectors, especially agroindustry.</td>
<td>As covered above in other subsectors, especially agroindustry.</td>
</tr>
<tr>
<td>Focus on pest management, research, breeding, road rehabilitation, factory and infrastructure rehabilitation, and irrigation</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Research</strong></td>
<td>Varies</td>
<td>Varies</td>
</tr>
<tr>
<td>Varies</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Source: Authors’ Data.*
CHAPTER 9: CROSS-SECTORAL LINKAGES WITH THE ENERGY SECTOR

This chapter provides a brief overview of key environmental health and energy sector linkages. It was based on a review of the literature conducted during preparation of the 1996 volumes of *Bridging Environmental Health Gaps*, the stage of work preceding the research and writing of this discussion paper. The chapter concludes with an environmental health checklist for the sector. Future versions of this paper will expand coverage overall. For the moment, the chapter concentrates on infrastructure sector linkages with the energy sector. As such, more detailed information than is described below is available in chapter 7 on “Respiratory Diseases,” chapter 8 on “Human Settlements,” and chapter 13 on “Housing and Urban Development.” The literature review concentrates on policy determinants of energy policies as they impinge on human health, because policy issues are less likely to change in the short term relative to technical issues, which are changing rapidly.

Key Environmental Health Issues

The main links between environment and health in the energy sector stem from indoor air pollution for heating, lighting, and cooking and resultant accidents (mainly burns) from fires, ambient air pollution from coal-fired electricity plants (although this tends to be more an ecological than environmental health problem), spreading of vector habitat (mainly snails and mosquitoes) from dams, and physical stress and injuries from getting firewood.

Energy policies in developing countries have not given adequate attention to the health consequences of the different stages of energy production, that is, extraction, distribution or transmission, consumption, and pricing. Deforestation has led to added stress and threatens to reduce nutrition in poor households, in which women spend ever-increasing amounts of time gathering firewood. Policies to increase wood fuel reserves rarely consider households suffering from “fuel poverty,” the tendency of the poor to use cheaper, more polluting fuels. Efforts have been directed at increasing domestic fuel efficiency, but only recently has attention been devoted to improving housing and cook stoves in terms of health risks associated with chronic in-house exposure to fumes from biofuels (see box 8-2 for definitions of energy terms). The health effects of household smoke from cooking, heating, and lighting tend to take a backseat to tobacco smoke, which is known to be a confounding, if not more important, factor in respiratory illness. Fuel subsidies have not taken health and pollution into consideration, nor have they promoted nonpolluting, safe fuels. Pricing policies tend to favor urban areas, where ambient air pollution is generally greater, over rural areas. Hydropower, especially large dams, remains high on development priority lists. Yet, associated health risks still do not figure prominently in project preparation and implementation.

Findings of a Literature Review

In general, literature on this sector addresses environmental health considerations mainly in terms of pollution—increasingly air pollution—and the risks of nuclear power. For pollution, the literature has focused on the impacts of individual ambient air pollutants, especially lead, and not more broadly on those of other pollution sources, such as indoor air pollution and, in particular, tobacco smoke, as it relates to respiratory disease. (Tobacco smoke has long been established as a predisposing and exacerbating factor and, more recently, expanded to include the role of passive
Discussion of the social context—that is, physical stress from fetching fuel, the cost implications of household fuel prices on nutrition, and so on—has been lacking.

Environmental health has also received ample consideration in other areas, for example, spreading disease vectors (e.g., snails and mosquitoes) through dam construction and hydropower, although their relative importance in the literature appears to be declining. The most important strides have been made in thinking out the economic dimensions of petroleum use and associated damages to human health. In terms of overall health, respiratory infections directly linked to air pollution have recently increased in importance in the literature, offsetting diarrheal diseases as the major source of morbidity and mortality. This might have occurred because the literature was overdue in finding what was already there.

The concepts of “fuel poverty” and the “energy ladder” are gaining in acceptance. The poor tend to use cheaper fuels, which are more detrimental to health. As they move up the “energy ladder,” they use more expensive, more efficient, and less polluting fuels and suffer fewer respiratory ailments.

Ambient air pollution. The bulk of the literature on health and energy (as well as transport) tends to focus on ambient air pollution, with a particular emphasis on vehicular sources, even though indoor air pollution is a serious problem in rural and periurban areas. Fuel subsidies encourage use of modern, less polluting fuels, but are often directed at urban areas and those who have already have climbed the “energy ladder,” rather than helping rural and periurban poor move up that ladder to use less polluting fuels.

Emphasis on ambient air pollution stems in part from three factors. First, the earliest studies in the 1950s were provoked by drastic episodes of this kind of pollution in London and Donorra (Pennsylvania), although resultant studies inevitably drew attention to indoor pollution as predisposing or confounding factors. Second, indoor air pollution research in the industrialized countries has focused on tobacco smoke, which, however important, diverted attention from a range of other factors, such as heating, cooking, and lighting fuel, plus a wide array of chemicals emanating from building materials, such as carpeting, paint, and asbestos that, in extreme cases, result in “sick building syndrome.” Third, serious widespread indoor air pollution, excluding tobacco smoke, is largely a rural and periurban phenomenon linked with poverty and, thus, has had less influence on research directions.

Epidemiological evidence is increasing on the links among energy use, outdoor air pollution, and the incidence of respiratory illness and cancer; although few studies have recommended regulatory measures or identified high risk populations or areas for special attention.

Indoor household pollution. Given the importance of respiratory ailments, indoor household pollution has been poorly represented in the literature and in developing countries, although it is growing in importance relative to current emphasis on ambient air pollution. Literature has documented the relationship among domestic fuel use, respiratory infections, and low birth weights, identifying biofuel use as a major hazard. This information, however, has not yet been integrated into energy policies mitigating urban or rural indoor air pollution. Developing countries need better analysis of the effects of fuel gathering, its shortage, fuel substitution, and food preparation.

Approximately one-half the world’s population cooks with biofuels, that is, firewood, dung, twigs, and crop residues, whose use in cooking accounts for about one-third of this fuel’s consumption. In developing countries, women and children encounter the greatest risk because of poor ventilation in poor housing. Estimates of exposure to rural indoor air pollution in developing countries are sixty times greater than those in urban areas of developed countries, and overall daily exposures are about twenty times greater. In addition to biofuels, coal is also a major con-
tributor to indoor air pollution (although coal does not constitute a major energy source in Africa). Research is under way to improve stove designs that can improve fuel efficiency, but the research does not necessarily aim to reduce smoke. Nor is such research currently a high priority in the energy sector.

Household fuel supply. Fuel supply, or more commonly, fuel scarcity, has received ample attention in the ecological literature, in particular the link between deforestation and fuel poverty. Wide-ranging health consequences—the physical stress from gathering firewood, diminished nutrition because of fuel prices, and the disproportionately higher impacts on women and children—have received less attention. The caloric energy expended to do daily chores, of which large shares are devoted to fetching fuel and water, can consume one-third of a woman’s daily energy expenditure. To earn income, many women prepare food for sale, using several stoves at once or extending their cooking time in general. Both consume more fuel and increase exposure to cooking fumes. Conversely, to save on cost, some women shorten cooking time or flame intensity, resulting in undercooked foods that can cause diarrheas and worm infections or, in some cases, poisoning (e.g., some pesticides are broken down by heat). Similarly, low-cost fuels tend to emit higher levels of pollution.

Industrial energy supply. Industrial energy supply has received considerable attention in the literature; a range of new studies have been devoted to the economic evaluation of damage to human health. In this regard, large cities in developing countries encounter a double-edged sword: high levels of industrial and vehicular pollution coupled with the range of indoor air pollution discussed above. Because Africa has a low level of industrial activity relative to other parts of the world, industrial energy supply is not a regional problem there, except in pockets. Most of the literature on the health effects of such pollution tend to be based on monitored air quality, extrapolated to humans and combined with health statistics, such as hospital emergency room admissions. Studies of ambient air pollution dealing with the air as it enters the lungs, for example, in the form of acid aerosols, are few. In terms of mining, occupational health literature, for example, on black lung disease and accidents, is well established.

Hydroelectric power. The environmental health consequences of hydroelectric power have been similarly well documented. Dam safety has been considered integral in best practices for engineers, and vector-related diseases, most notably schistosomiasis and malaria, was the subject of some of the first environmental backlashes by the public described, due to development projects that neglected environmental analyses during planning. Onchocerciasis is also a problem in dam spillways. Temporary concentrations of workers and the permanent settlements that may later develop from them can spread these and other diseases. These risks, according to WHO, have regretfully “rarely been adequately addressed.” The literature has also extensively described resettlement associated with dams. Two main analytical contexts seem to exist but do not necessarily dovetail: one addresses socioeconomic issues such as tenure, access to credit, community participation, and so on, and the other, with many fewer citations, deals with a wide array of health-related issues. The latter includes a decline in nutrition status from the upheaval, exposure to pollutants from industries that cluster nearby hydroelectric facilities, poor community health services that were initially intended to deal with work accidents, and so on.

Competition between environmental and health objectives have unusual results and negative trade-offs. To reduce deforestation and oil imports, many developing countries are promoting coal as a substitute for wood. Where coal might not provide a feasible alternative for widespread industrial use, countries can produce or even import enough for household use. As a household fuel, coal is a particularly noxious pollutant because household stoves (compared with industrial ovens) tend to burn it inefficiently, expelling fumes within houses, which are usually designed to

* The tsetse fly that spreads “river blindness” needs high oxygen content water for breeding.
keep the elements out and not for efficient ventilation. (Indeed, sometimes they are designed to keep smoke in to keep insects out.)

Table 9-1: Main Environmental Health Linkages with the Energy Sector

<table>
<thead>
<tr>
<th>Sector</th>
<th>Linkages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture and rural development</td>
<td>Spread of malaria and schistosomiasis from all sized dams; indoor air pollution from use of biomass fuels; food chain contamination and food poisoning including lead poisoning in granaries using traditional millstones reinforced with lead joints</td>
</tr>
<tr>
<td>Infrastructure and Urban Development</td>
<td>Household ventilation to reduce indoor air pollution; water pollution caused by vehicular/industrial fuels (diarrhea and food chain contamination); outdoor air pollution from: vehicular/industrial fuels (especially from inefficient combustion of two-stroke engines); waste management facilities generate dust (e.g., from trucks on access roads) and toxic fumes (from incineration); health effects of climate change and global warming due to various uses of fuel</td>
</tr>
<tr>
<td>Health</td>
<td>Vector-related diseases spread through dams; acute respiratory diseases from use of poor quality household fuels; diminished operation of health facilities from energy deficit (e.g., basic lighting, no cold storage of medicines or sterilization of syringes); women’s and children’s health problems from fetching heavy loads of biomass fuels (e.g., injuries, miscarriages for women), child and peri-natal health problems due to household fuel shortages (e.g., malnutrition from fewer cooked meals, diarrheas from unboiled water)</td>
</tr>
<tr>
<td>Industry</td>
<td>Health consequences of fuel changes in small and medium sized industries; contributions to indoor air and water pollution and climate change and global warming; lead smelters; health and safety inside industrial power plants as well as surrounding areas.</td>
</tr>
<tr>
<td>Environmental and Natural Resources</td>
<td>Injury and disease from effects from deforestation (e.g., floods, landslides), desertification, land degradation from foraging for biomass fuels</td>
</tr>
</tbody>
</table>

Source: Authors’ Data.

Environmental Health Assessment Checklist

This section presents a set of tools that can be used to determine a broad range of environmental health issues, from which to view direct and indirect repercussions, determine which are most important, and then set priorities according to institutional capabilities and budgets. This intentionally broad approach gives a better idea of the range of institutions that may need to be involved in finding solutions.

Occupational, High Risk, and Vulnerable Group

In keeping with the overall poverty reduction objectives of this discussion paper, table 9-2 describes the main high risk and vulnerable groups.

Table 9-2: Occupational, High Risk, and Vulnerable Groups for the Energy Sector

<table>
<thead>
<tr>
<th>Activity</th>
<th>Potential Health Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gathering traditional (biomass) fuels</td>
<td>Accidents, exposure to disease vectors, and physical stress</td>
</tr>
<tr>
<td>Fuel use, e.g., cooking, heating, and lighting</td>
<td>Exposure to indoor air pollutants (e.g., upper respiratory diseases and lung cancer), and accidents (mainly burns)</td>
</tr>
<tr>
<td>Traditional energy production, e.g., charcoal preparation and sales</td>
<td>Extremely high occupational exposures to charcoal dust from bagging and sales (e.g., upper respiratory diseases and lung cancer)</td>
</tr>
<tr>
<td>Modern energy (LPG) use</td>
<td>Accidents and explosions (e.g., mainly burns)</td>
</tr>
<tr>
<td>Modern energy transport</td>
<td>Truck calamities</td>
</tr>
</tbody>
</table>

Source: Authors’ Data.
Environmental Health Checklist for the Sector

The Energy Sector Environmental Health Checklist (table 9-3) shows the range of energy sector projects by subsector, identifies the main potential environmental health problems, and suggests remedial measures.

Table 9-3: Energy Sector Environmental Health Checklist

<table>
<thead>
<tr>
<th>Typical Energy Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution and transmission Aside from installation and improvement of transmission lines or distribution system, also includes upgrading, maintenance, and rehabilitation of power facilities; provision of workshop equipment and maintenance vehicles; management information system; technical assistance; and institutional strengthening</td>
<td>(a) Occupational health and safety issues such as exposures to chemicals, excessive heat, dust, noise, biological agents such as mosquitoes (malaria) and the like, and ergonomic hazards for workers during construction, maintenance, rehabilitation, and/or upgrading of power facilities, including installation or improvement of transmission or distribution system. (b) Ambient air pollution is an issue especially for populations living within a certain distance from power plants. Most common pollutants are SO$<em>2$, PM$</em>{10}$, CO, and other chemicals. NO$_x$ may also be present, especially in areas in which vehicular traffic may increase due to activities related to the installation or upgrading of power plants and/or transmission systems. Respiratory diseases in the exposed population may increase due to such activities. (c) Some studies show childhood cancers due to exposure to electromagnetic fields (EMFs) in people living around high-voltage installations or equipment. (d) Physical and mental stress due to displacement of populations from construction of power plants and transmission lines. (e) Safety concerns for the surrounding communities due to the danger of fire and explosions from accidents in the power plants and transmission system. (f) Herbicide exposures from intensive use of herbicides underneath and around electricity power lines and oil pipelines.</td>
<td>Implementation TORs should include: (a) Awareness campaign and affordable protective gear and equipment (b) Gradual reduction of emissions to reach WHO standards through (as appropriate) regulatory measures, economic instruments and moral suasion; demand management programs; improvement of production processes; alternative energy sources; and so on (c) Resettlement of population at risk (d) Counseling (e) Adequate mitigation and preventive measures and awareness campaign (f) Awareness campaign</td>
</tr>
<tr>
<td>Electric power and other energy adjustment Similar to former</td>
<td>Refer to above</td>
<td>Refer to above</td>
</tr>
<tr>
<td>Hydro</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* This and other sectoral checklists can be found at [http://www.worldbank.org/afr/environmentalhealth/](http://www.worldbank.org/afr/environmentalhealth/).
<table>
<thead>
<tr>
<th>Typical Energy Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Similar to former, but more focused on hydroelectric generation</td>
<td>Refer to above. In addition, water and vector-related diseases, such as schistosomiasis and malaria, must be considered. Safety concerns from accidental drowning may also be considered.</td>
<td>Refer to above. Implementation TORs should include possible alteration of habitats for snails (schistosomiasis) and mosquitoes (malaria) and awareness campaign.</td>
</tr>
<tr>
<td>Other power and energy conversion: Similar to hydro. In addition, includes development and adaptation of other types of power generation, e.g., bagasse-coal plants, environmental projects, e.g. tree planting, forest protection, and so on</td>
<td>Refer to above. However, coal-fired power plants and bagasse have been shown to be especially polluting in terms of SO$_2$ and dust particulate, thus, emphasis must be given to respiratory diseases.</td>
<td>Implementation TORs should include gradual reduction of emissions to reach WHO standards through (as appropriate) regulatory measures; economic instruments and moral suasion; demand management programs; improvement of production processes; alternative energy sources, and so on.</td>
</tr>
<tr>
<td>Thermal Similar to former but focused on gas and steam turbine generator sets and exploring geothermal sources</td>
<td>Refer to above. In addition, drillings for geothermal may unearth certain heavy metals that may pollute surface and groundwater, thus, giving rise to certain diseases depending on the chemical or heavy metal.</td>
<td>Implementation TORs should include proper disposal of unearthed soil.</td>
</tr>
</tbody>
</table>

_**Source:** Authors’ Data._
CHAPTER 10: CROSS SECTORAL LINKAGES:
ENVIRONMENT SECTOR

This chapter briefly reviews environmental health and environment sector linkages. Coverage will be expanded in future versions of these guidelines, which, for the moment, concentrate on infrastructure sector linkages. As such, more detailed information than described below is available in Chapter 8: Cross-Sectoral Linkages Agriculture and Rural Development Sector, in chapter 13 on infrastructure, and in chapter 14 on global issues. The literature review concentrates on policy determinants of environment policies as they impinge on human health, because policy issues are less likely to change in the short term relative to technical issues, which are changing rapidly.

Key Environmental Health Issues

The main links between environment and natural resource management and environmental health not already covered in chapter 8 are the changing patterns of vector-related disease due to climate change and global warming; lost potential for medicinal drugs due to loss of flora and fauna; cancers and cataracts due to ozone depletion; and multisectoral interactions. (For purposes of this study, various types of pollution are considered under the sector that generates them, not under environment.)

Findings of a Literature Review

Literature on environmental health is expanding rapidly, and the topic is recognized as a separate discipline within the health field. Enormous strides have been made in precisely identifying the roles of individual factors in the etiology of morbidity and mortality. Drawing attention to the costs of human health, the literature is especially useful in categorizing and economically evaluating the effects of environment-related diseases; however, the topic of pollution tends to dominate. Scientific studies on pollutants tend to be focused and depend heavily on statistical significance, complicating their application to society at large. They are also often too technical to be read by a nontechnical audience, limiting the utility of their findings.

The literature devotes a high degree of attention to the deleterious effects of pollution and spin-off subjects dealing with regulatory and economic consequences. Beyond these, it has been uneven in its treatment of environmental health issues. As a health field or discipline, “occupational and environmental health,” despite its name, concentrates on the former. Environmental assessment procedures and their literature have been instrumental in drawing attention to a broad range of previously neglected health issues. Nonetheless, integration of multidisciplinary factors is still relatively weak compared with the knowledge base and the breadth of the literature. Treatment is extensive for ambient air issues, but often uncoordinated for indoor air pollution, which can be equal to or even more important than ambient air. Uneven treatment is partly due to the predominance of specialists compared with generalists in modern society. This has led, for example, to attention on water pollution, but not the stress of fetching water or fuel at a distance from residences, common in much of Africa, nor the socioeconomic dimensions that can lead to the spread of vector-borne diseases, such as malaria or filariasis, which are often treated as health sector problems.

The newest topics to enter the literature in the past decade and, thus, the least developed academically are the health consequences of global warming and ozone depletion (see table 14-1). Cancers and cataracts due to ozone depletion probably do not rank among the top ten in developing
countries, given the level of existing respiratory and diarrhea illnesses and accidents. In comparison, the numbers that global warming and climate change could potentially affect are enormous, because of the direct consequences of the spread of vector habitats, in particular mosquitoes, and the effect of change in water temperatures on aquatic pathogens. Although the particulars of climate change are still under discussion, the reality of endemic vector-related diseases is not. The important point is that, once established, vector-related diseases, such as malaria and schistosomiasis, and waterborne diseases, such as cholera, may take 50–100 years to eradicate.

Table 10-1: Main Environmental Health Linkages with the Environment Sector

<table>
<thead>
<tr>
<th>Environment Sector</th>
<th>Linkages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture and rural development</td>
<td>Land clearing issues, e.g., loss of plant species with potentially important medicinal uses; pesticide runoff; animal waste management; flooding; land pollution; marine life destruction, eventually affecting food supply</td>
</tr>
<tr>
<td>Infrastructure and urban developement</td>
<td>Air, water, and land pollution, especially solid waste management</td>
</tr>
<tr>
<td>Energy</td>
<td>Air pollution, land clearing issues, and change in animal vector habitat and behavior</td>
</tr>
<tr>
<td>Industry</td>
<td>Air, water and land pollution; climate change and global warming</td>
</tr>
<tr>
<td>Health</td>
<td>Resettlement issues: domestic waste management, choice of housing areas, and water supply and sanitation</td>
</tr>
</tbody>
</table>

Source: Authors’ data.

Environmental Health Assessment Checklist

This section presents tools that can be used to determine a broad range of environmental health issues, from which to view direct and indirect repercussions, determine which are most important, and then set priorities according to institutional capabilities and budgets. This intentionally broad approach gives a better idea of the range of institutions that may need to be involved in finding solutions.

The Environment Sector Environmental Health Checklist (table 10-2) shows the range of environment sector projects by subsector, identifies the main potential environmental health problems, and suggests remedial measures.

Table 10-2: Environment Sector Environmental Health Checklist

<table>
<thead>
<tr>
<th>Typical Environment Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Adjustment</td>
<td>Vector-related diseases, such as malaria, schistosomiasis, filariasis, and others, for communities living near or within the management areas and areas where public works are being done. Occupational health issues for workers both for the environmental management projects and public services construction and rehabilitation, e.g., prolonged exposure to the sun and heatstroke, exhaustion, and, in the long term, skin cancer.</td>
<td>Implementation TORs should include: Vector control, especially drainage, targeting stagnant water, and introducing larvivorous (larva-eating) fish (tilapia) as appropriate. Awareness campaigns and affordable protective gear and equipment.</td>
</tr>
</tbody>
</table>

* This and other sectoral checklists can be found at <http://www.worldbank.org/afr/environmentalhealth/>. 
<table>
<thead>
<tr>
<th>Typical Environment Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accidents</strong></td>
<td>Accidents, such as drowning, falls, and animal bites, especially for those engaged in forestry and marine conservation activities as well as in the community near the activities.</td>
<td></td>
</tr>
<tr>
<td><strong>Environmental Institutions</strong></td>
<td>Similar to above</td>
<td>Similar to above. and preparation TORs should attempt to harmonize environmental and environmental health strategies and other sectoral strategies as appropriate, and foster multisectoral collaboration through entry points.</td>
</tr>
<tr>
<td>Concerned with developing institutional and technical capabilities for environmental monitoring, policy formulation and coordination, and dealing with management issues in environmental action plans. Also, conducts program, pilot, or otherwise on preventing soil degradation and erosion and further degradation of fragile ecosystems.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Natural Resource Management</strong></td>
<td>Similar to the above. In addition, due to the waste management component, skin diseases, parasitic and other infectious diseases could be prevalent among those living near waste disposal areas and, especially, the scavengers. Exposure to chemical pollutants in the water and air from the waste may also be prominent.</td>
<td>Similar to the above, and implementation TORs should include adequate landfill management and restriction of waste disposal areas to workers; awareness campaign; and creation of an interface that allows for using the environmental information system to map and prevent environmental health risks.</td>
</tr>
<tr>
<td>Similar to environmental adjustments. In addition, village, regional, and local level investments to set up natural resource management plans and environmental information systems. Other projects may include fisheries management, research and studies, policies and laws, water quality monitoring, industrial and municipal waste management, land use and wetland management, soil conservation, and reforestation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pollution Control and Waste Management</strong></td>
<td>Monitoring of respiratory diseases for air pollution and heavy metal poisoning for both air and water pollution must be considered. For other relevant diseases, refer to the natural resource management subsector</td>
<td>Implementation TORs should include an awareness campaign and emission reduction targeting population at high risk of exposure first. For other relevant diseases, refer to the natural resource management subsector and table 9-3 for energy.</td>
</tr>
<tr>
<td>Mostly pollution management projects on water, air, and land</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Resettlement</strong></td>
<td>Mental and physical stress due to displacement.</td>
<td>Counseling</td>
</tr>
<tr>
<td>Issues of resettling populations, e.g., tribal groups from ancestral homes</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other Environment</strong></td>
<td>Similar to the above. In addition, focus on urban infrastructure brings in road accidents as a safety risk.</td>
<td>Similar to the above, and implementation TORs should include law enforcement (drunk driving, seat belts, insurance liabilities, and so on).</td>
</tr>
<tr>
<td>Similar to the above with more focus on urban infrastructure and services, including studies on sanitary landfills, industrial parks, marine conservation, and so on</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Source: Authors’ data.*
This chapter provides a brief overview of linkages between environmental health and the health sector (see box 11-1 on this and other terms). Coverage will be expanded in future versions of these guidelines, which, for the moment, concentrate on infrastructure sector linkages. See also “Devising Entry Points” in chapter 2 and chapter 16 on one attempt to bridge the gaps. The literature review concentrates on policy determinants of health policies as they impinge on human health, because policy issues are less likely to change in the short term relative to technical issues, which are changing rapidly.

Box 11-1: Key, Confusing, and Misused Terms on the Health Sector

Health care system. Refers to provision of health care through a health care delivery system, consisting of a network of personnel and services providing medical, dental, nursing or convalescent care, and physical therapy, and a network of providers for the equipment and medications to do so.

Health sector. Term with several uses that can refer to (a) the health care system, (b) lending and investments that tend to reflect the health care system, or (c) an even broader notion to include measures to protect and promote human health inside and outside the health care system. The broader public health notion would include environmental protection, private sector research, regulatory measures, and so on.

Public health service. Branch of government in some countries charged with maintaining public health and safety through various services, such as occupational health and safety, sanitation, quarantines, and so on, mainly through preventive measures. Usually considered part of the overall health care system or health sector, depending on definition.

Source: Authors’ data

Key Environmental Health Issues

The main links between environment and public health stem from factors outside the purview of ministries of health. These include respiratory diseases from poor housing; diarrheal diseases from poor water supply and sanitation; respiratory disease due to tobacco smoking and air pollution from transport, energy, and industry; contamination of the food chain from air and water pollution and poor storage of food; accidents; and injuries, illness, and deaths from extreme weather events, climate change and ozone depletion.

Findings of a Literature Review

The most important finding of the literature review was that health factors do not play an important role in policy setting, except for the health sector itself. The literature has firmly anchored the importance of tobacco smoking as a detriment to health and of nutrition as an oft-forgotten factor. The literature also reveals good understanding of both health care services as a sector, rather than simply focusing on treatment of individual diseases, and the important role of institutional factors, such as health legislation and insurance. In addition, after years of neglect, the crucial role of micronutrients in nutrition and links to female literacy, coupled with women’s advocacy, have made their way into the literature. The literature, however, still tends to focus on the health care system, relatively neglecting the influences of forces outside the health sector. Literature on nutri-
tion establishes a link with anemia and parasitic infections, but concentrates on iron deficiency rather than deficiencies in sanitation as a contributing cause. Similarly, basic research priorities and, thus, the literature bear the mark of teaching hospitals and not basic public health.

Despite enormous progress in combating individual diseases, fine-tuning health statistics, and developing areas of economic evaluation, many remaining health sector problems in developing countries, especially HIV/AIDS, still appear insurmountable. This notion stems, in large part, from continued consideration of the health sector as social overhead. Some problems are being slowly overcome by advances in health economics, advocacy of women’s groups, and recognition of interlinkages between population growth and degradation of the natural resource base and between fertility and female education. Nonetheless, much promotion of female participation has been stronger on attaining a voice, than on specifics of women’s occupational or environmental health. One example is the risk of cancer from exposure to pesticides (although some articles appear on the subject). Similarly, literature on anemia concentrates on iron deficiency, but gives scant attention to a major causal factor, that is, deficient sanitation and personal hygiene.

The intersectoral dimensions of the health sector are still poorly developed. For example, occupational health is often under the ministry of industry, which usually has little in-house capacity to deal with problems of such a scale. In Africa, the ministry of health (MOH) might be responsible for rural water supply, but not have the in-house engineering capacity, for example, to deal with preventive remedial measures for diarrheas and malnutrition, for example, sanitation and water supply. Human fertility analyses, for example, often do not link environment to carrying capacity, urban squalor, degradation of the natural resource base for fuel, and so on. Likewise, works on tobacco and addictive substances do not draw the link between tobacco-related health problems as a predisposing factor to other air pollution-related health problems.

MOHs are notoriously weak financially and, although willing to cooperate, might not possess the competence or resources to take on additional work without compromising existing activities. Similarly, it is highly probable that they might not be able to budget for recurrent expenses, even if they have staff available. Although this statement can potentially be made about any ministry in a developing country, MOHs tend to be the weakest, except in cases of national emergencies or epidemics. The actual influence of an MOH is, thus, curtailed, because they only have input into setting environmental and occupational standards, whereas enforcement, even if adequately funded in different ministries, lies outside their portfolio.

A variety of occupational health problems have been documented in developing and industrialized countries, but only a few in-depth studies exist on the subject. Particularly lacking are studies on newer technologies and their consequences, for example, neural toxicity of substances other than heavy metals, such as lead, and reproductive effects of pesticides. Mental health problems, for example, stress, have been even more neglected than in industrialized countries. Inadequate data are a major hurdle. Existing research on occupational health concentrates on large factories, which only covers approximately 15 to 20 percent of the workforce. Workers in small industries, agriculture, and fisheries face different occupational and environmental hazards in precisely those areas in which health facilities, adequate financial resources, and political pressures are weakest. The “chemicalization” of agriculture and agricultural processing are particularly important factors. Some research indicates that health problems are, indeed, more severe in these areas.

Children and women are at special risk, because they form the largest pool of cheap labor. Malnutrition and communicable diseases are already high in these low-income groups, and resistance to other health problems is proportionately reduced. Those working in export zones, as opposed to the informal sector, appear to be healthier overall, probably because of higher incomes.
By and large, occupational health standards are severely lacking and, if they do exist, are not enforced or inappropriately modeled after distinct conditions in industrialized countries. Training in occupational health overall has not been a priority in either the industrial or health sector.

Table 11-1: Main Environmental Health Linkages with the Health Sector

<table>
<thead>
<tr>
<th>Sector</th>
<th>Main Linkages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture and rural development</td>
<td>Food security and population pressure outstripping capacity</td>
</tr>
<tr>
<td>Infrastructure and urban development</td>
<td>Stress and mental health problems from rural-urban migrations</td>
</tr>
<tr>
<td>Energy</td>
<td>Indoor air pollution as a major determinant of respiratory infections</td>
</tr>
<tr>
<td>Industry</td>
<td>Air, water, and land pollution and hazardous waste disposal</td>
</tr>
<tr>
<td>Environmental and natural resources</td>
<td>Climate change, ozone depletion, and global warming</td>
</tr>
</tbody>
</table>

Source: Authors’ data.

Environmental Health Assessment Checklist

This section presents tools that can be used to determine a broad range of environmental health issues, from which to view direct and indirect repercussions, determine which are most important, and then set priorities according to institutional capabilities and budgets. This intentionally broad approach gives a better idea of the range of institutions that may need to be involved in finding solutions. In keeping with the overall poverty reduction objectives of this discussion paper, the material also describes the main high risk and vulnerable groups.

The Health Sector Environmental Health Checklist (table 11-2) shows the range of health sector projects by subsector, identifies the main potential environmental health problems, and suggests remedial measures.

Table 11-2: Health Sector Environmental Health Checklist*

<table>
<thead>
<tr>
<th>Typical Health Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Proposed Remedial Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Targeted health</strong></td>
<td>Same as above. In addition, emphasis must be made for occupational health issues for health caregivers dealing with hepatitis B and HIV. Also in the Africa region, transmission of STDs via the truckers and work crews must be given importance.</td>
<td>Implementation TORs should include AIDS and STD awareness in conjunction with MOH campaign targeting worker (labor unions and associations) and truckers (associations), a clause on AIDS and STDs (and possibly hygiene) in the subcontractor contract, and distribution of condoms as appropriate.</td>
</tr>
<tr>
<td><strong>Medical waste</strong></td>
<td>Health hazard from contaminated medical wastes</td>
<td>Preparation TORs should include identification of the type of medical waste and ways they are segregated.</td>
</tr>
<tr>
<td><strong>Other population, health, and nutrition</strong></td>
<td>Similar to the above</td>
<td>Similar to the above</td>
</tr>
</tbody>
</table>

Source: Authors’ data.

* This and other sectoral checklists can be found at <http://www.worldbank.org/afr/environmentalhealth/>.
CHAPTER 12: CROSS-SECTORAL LINKAGES: INDUSTRY SECTOR

This chapter provides a brief overview of environmental health and industry sector linkages. Coverage will be expanded in future versions of these guidelines, which, for the moment, concentrate on infrastructure sector linkages. The literature review concentrates on policy determinants of industry policies as they impinge on human health, because policy issues are less likely to change in the short term relative to technical issues, which are changing rapidly.

Key Environmental Health Issues

The main links to industry are (a) air, water, and land pollution from nonhazardous wastes, coupled with the special circumstances associated with disposal of toxic materials and their by-products, including contamination of the food chain, especially with heavy metals, (b) noise pollution, (c) widespread occupational health and safety deficiencies, and (d) human settlements near industrial concentrations. The strengths of the literature on the industry sector stem from extensive work done on a huge array of topics, which, in turn, has been applied to general living conditions.

Findings of a Literature Review

Literature on pollution generation, control, and evaluation has been especially extensive. Most literature on environmental health in industry, however, deals with occupational health, which, for years, has been extremely well covered in industrialized countries.

Industrial Pollution and Waste

Even though data on actual industrial pollution levels have increased in the past decade, only rough estimates are available for developing countries that are generally not suitable for proper analysis of the effects of pollution on health. Literature on air and water pollution is still too inconclusive to permit precise determination of cause and effect by industry or pollutant on a given population, although high degrees of association are possible. Several factors have hindered research, that is, inadequate data on populations, time lags (up to 30 years) between exposure and actual disease, absence of monitoring equipment, costs of monitoring, and poorly understood theoretical effects applied to defined topographical conditions or applied to the siting of pollution-intensive industries.

According to the UNEP/WHO Global Environment Monitoring System (GEMS), 70 percent of populations live in areas with “unacceptable” annual averages of air quality. A promising trend does appear to exist in that the number of areas in which air quality is improving is greater than the number in which it is deteriorating. The high rates of illness in some areas appear to be associated with topographical factors that inhibit the natural dispersion of pollutants. The adverse effects of water pollution, similarly, are most acute in areas where industrial waste is dumped into waters near large populations. Seasonal variation of water tends to concentrate pollutants. The absence of licensing requirements for industry in developing countries makes prediction of the effects of new chemicals problematic.

Research on the health risks of hazardous chemical waste is still in its formative stages, even in industrialized countries, which have a wide range of regulatory agencies and research institutes.
Quantification and classification have been limited by problems of definition and inadequate data collection. UNEP and WHO have developed a system to analyze hazardous waste “from cradle to grave,” and INFORM (a U.S.-based environmental research organization) has proposed a waste management hierarchy, consisting of (a) reduction in waste production, (b) recycling, (c) destruction, and (d) disposal. Nonetheless, developing countries cannot coordinate all the various stages of hazardous waste monitoring, that is, production, transport, and disposal. Moreover, industrialized countries rely too heavily on pollution control rather than on broader objectives of pollution management, which reduces generation of pollution in the first place and creates institutional, regulatory, and economic incentives for businesses, industries, and municipalities. Pollution management is more difficult to implement in developing countries and, in some cases, can have unintended effects. For example, regulatory measures may inadvertently make it harder to monitor transport and disposal of wastes if they are too stringent and drive service providers to clandestine operations.

**Occupational Health**

Research on occupational health in industry, although extensive, has dealt primarily with accidents and exposures to pollutants, but not their underlying causes, inside and outside the workplace. Researchers have emphasized the need for adjustments in health policy where the potential for change seems the greatest, for example, standards, availability of health services, training, and safe equipment, rather than overall strategies and policy changes from within those industries themselves.

Occupational health literature also does not extend to areas outside the workplace, for example, to the risks of populations living in the surrounding air shed and watershed (as opposed to general pollution analyses), and is poorly developed regarding problems in developing countries, where problems of injuries and accidents and environmental hazards of catastrophic dimensions, such as Bhopal, are particularly important. The difference in institutional responsibilities for dealing with environmental and occupational health at the municipal, state, and national levels has also not been developed.

The tendency exists to consider occupational health a distinct specialty applying to the workplace and, therefore, only of tangential importance to environmental or public health. This is a fair generalization in industrialized countries, because a much greater portion of the labor force is employed by industries in which some form of health care or preventive measures are provided by the companies themselves, national occupational health and safety regulations, or health insurance. In developing countries, however, approximately 60 to 85 percent of the labor force is not similarly covered, because they work in small-scale industry or agriculture, in which such provisions are absent. In Africa, these figures would probably be higher. If some national regulatory measures do exist, the likelihood is high that monitoring and enforcement are also absent. The huge difference in proportion of direct and indirect coverage, therefore, changes the dimensions of the problem and blurs the distinction between the general population and the workplace. An occupational health problem in developing countries, then, becomes a public health issue.

**Research on the Role of Governments**

The role of government in industrialized and developing countries in setting policy to promote economic growth has received considerable attention in the literature. The unintended consequences of these actions to occupational and environmental health, however, have not. Many countries, particularly developing, have specialized in areas in which they did not have prior experience in producing or regulating the industries involved. Economic analysis has often not considered socioeconomic costs, such as pollution, health, and safety. Even though these considerations have increased in importance for governments, enforcement capacity has not been able to keep pace.
Similarly, export processing zones, compared with industrial estates, were designed to attract foreign industry, rather than control known or predictable pollutants. Industrial estates as well as export processing zones attract a large labor pool, which is potentially at high risk because of the absence or weakness of adequate environmental, health, or safety provisions. In addition, the health risks of populations living in air sheds and watersheds near industrial concentrations have received relatively little attention from governments or in the literature, compared with in-plant hazards, except in the case of large-scale accidents.

Governments often see industrial dispersion as a means to distribute income potential and reduce population pressures on capital cities. Countering this tendency is the penchant to site industries in urban areas away from neighborhoods where wealth and political influence are strongest. Industrial areas initially situated outside cities have later been swallowed up by rapid growth, typically unplanned, resulting in increased health and safety risks to the surrounding population (e.g., Bhopal). Industrial dispersion and concentration, thus, have both positive and negative aspects, depending on local circumstances. Governments often inadequately weigh the benefits of either trend against repercussions on health, housing, and the natural environment.

Governments have emphasized industrial growth and social welfare by considering types of industrial specialization, ownership, and siting, for example, industrial zones, “with relatively little attention to the consequences for health.” Many developing countries are actively promoting growth of their private sector by emphasizing small- and medium-sized industries, which tend to be more lax in complying with environmental, occupational, health, and safety regulations. These trends have consequences for low-income factory workers or inhabitants near industries, resulting in part from a lack of understanding of the clear-cut cause and effect of pollution and deterioration of health. Current emphasis on occupational health and safety issues is being directed inside factories, whereas surrounding communities remain a low priority. The deleterious effects of water and air pollution and hazardous waste control have, however, been receiving increased attention. Nonetheless, more work is needed in developing countries on understanding the health consequences of heavily polluted areas, in particular the multiple sources of different pollutants and their relative effects on the body.

A Note on the Role of the Private Sector

The trend toward privatization of industry and infrastructure in general is increasing, a process that will rely more heavily on economic criteria and cost reduction than on public health. Virtually no literature exists in this area, however, analyzing the long-term consequences for environmental health. Most related literature deals with the legal dimensions and standards of privatization, not its potential health consequences.

The literature has not conclusively shown how foreign or domestic ownership influences environmental degradation or health risks. It is clear, however, that domestic firms, even though they tend to be smaller and less pollution intensive than foreign firms, are harder to regulate, leading to greater occupational hazards. Likewise, domestic firms in developing countries use and produce hazardous chemicals that have been banned or strictly regulated in industrialized countries. Although multinational firms might close individual facilities rather than incur the cost of pollution abatement, domestic firms do not have the capital to do so and continue operation with increased risk to workers and the environment. The type of ownership also accounts for double standards that multinational firms maintain regarding their domestic branches with breaches in occupational health and safety measures (e.g., protective clothing, training, and so on) and the use and production of hazardous materials (e.g., asbestos, DDT, or other hazardous pesticides). Multinational firms do not necessarily resist added expenses associated with these improvements, but are not asked or forced to do so by domestic governments.
**Table 12-1: Main Environmental Health Linkages with the Industry Sector**

<table>
<thead>
<tr>
<th>Industry sector</th>
<th>Main linkages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture and rural development</td>
<td>Toxic waste management and land use conflict possibly threatening food supply</td>
</tr>
<tr>
<td>Infrastructure and urban development</td>
<td>Periurban agriculture and pollution management (water, air, and solid and toxic waste)</td>
</tr>
<tr>
<td>Energy</td>
<td>Ambient air pollution</td>
</tr>
<tr>
<td>Health</td>
<td>Resettlement issues</td>
</tr>
<tr>
<td>Environmental and natural resources</td>
<td>Land clearing issues (can spread malaria)</td>
</tr>
</tbody>
</table>

*Source: Authors' data.*

**Environmental Health Assessment Checklist**

This section presents tools that can be used to determine a broad range of environmental health issues, from which to view direct and indirect repercussions, determine which are most important, and then set priorities according to institutional capabilities and budgets. This intentionally broad approach gives a better idea of the range of institutions that may need to be involved in finding solutions. In keeping with the overall poverty reduction objectives of this discussion paper, the material also describes the main high risk and vulnerable groups.

The Industry Sector Environmental Health Checklist (table 12-2) shows the range of industry sector projects by subsector, identifies the main potential environmental health problems, and suggests remedial measures.

**Table 12-2: Industry Sector Environmental Health Checklist**

<table>
<thead>
<tr>
<th>Typical Industry Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fertilizer and other chemicals</strong></td>
<td>Methemoglobinemia and some cancers, such as gastric, esophageal, and bladder, have been associated with exposure to fertilizers. Acute poisoning must also be considered with exposures to any chemical as well as malignancies due to low-level long-term exposure. Due to exposure to night soil or manure as fertilizer, parasitism and diarrhea may also occur among farmers and other farm workers.</td>
<td>Implementation TORs should include awareness campaign through research and extension and affordable protective gear and equipment.</td>
</tr>
<tr>
<td><strong>Industrial adjustments</strong></td>
<td>Occupational health and safety issues for workers in industrial estates. Toxic waste may also be a problem, thus, poisonings, malignancies, and fertility problems may be of concern</td>
<td>Same as above</td>
</tr>
</tbody>
</table>

*This and other sectoral checklists can be found at <http://www.worldbank.org/afr/environmentalhealth/>.

174
<table>
<thead>
<tr>
<th>Typical Industry Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industrial restructuring</strong></td>
<td>Same as above</td>
<td>Same as above</td>
</tr>
<tr>
<td>Includes projects that restructure new industrial investments, retraining and lending program to assist displaced workers in the industrial sector, rehabilitation of enterprises, technical assistance, among others.</td>
<td>Same as above. In addition, due to improper waste disposal—a typical problem among small scale enterprises—diarrhea and other infectious diseases and exposure to toxic waste may be prevalent in the surrounding community.</td>
<td>Same as above. Implementation TORs should include, in the short term, the identification of populations at risk and determination of mitigative measures and, in the long term, introduction, as appropriate, of regulatory enforcement (polluter pays principle), economic instruments, and moral suasion.</td>
</tr>
<tr>
<td><strong>Small-scale enterprises</strong></td>
<td>Same as above. In addition, due to improper waste disposal—a typical problem among small scale enterprises—diarrhea and other infectious diseases and exposure to toxic waste may be prevalent in the surrounding community.</td>
<td>Same as above. Implementation TORs should include, in the short term, the identification of populations at risk and determination of mitigative measures and, in the long term, introduction, as appropriate, of regulatory enforcement (polluter pays principle), economic instruments, and moral suasion.</td>
</tr>
<tr>
<td>Some projects include developing export processing zones, providing capital for investment projects of small- and medium-scale enterprises, human resource development, support for domestic enterprises, and institution strengthening.</td>
<td>Same as above. In addition, due to improper waste disposal—a typical problem among small scale enterprises—diarrhea and other infectious diseases and exposure to toxic waste may be prevalent in the surrounding community.</td>
<td>Same as above. Implementation TORs should include, in the short term, the identification of populations at risk and determination of mitigative measures and, in the long term, introduction, as appropriate, of regulatory enforcement (polluter pays principle), economic instruments, and moral suasion.</td>
</tr>
<tr>
<td><strong>Mining</strong></td>
<td>Occupational health and safety issues for the miners and other workers in the mines including silicosis and other diseases of the lung (pneumoconiosis). Malaria for mine workers in endemic areas, especially when opening new mines. Also, other vector-related diseases. For small-scale miners of gold, use of mercury is rampant. This may result in acute poisoning and/or neurological problems. Respiratory diseases have also been shown to increase among those exposed to mercury. If mercury is used within the household, imminent risk also exists to other members of the household and to the community at large due to air pollution and toxic waste disposal.</td>
<td>Implementation TORs should include awareness campaigns and affordable protective gear and equipment, including insect repellent; vector control targeting stagnant water; burrow pits; and introduction of larvivorous (larva-eating) fish as appropriate.</td>
</tr>
<tr>
<td>Some components of projects in this subsector include attracting more investments in the mining sector; assistance to small-scale miners; rehabilitation of mines to increase output, improve efficiency, and reduce safety hazards; and supporting the mines department.</td>
<td>Occupational health and safety issues; much concern for problems of workers in off-shore drilling operations; road traffic accidents; fatal accidents from fires, explosions, and chemical disasters; long-term exposure to toxic waste (refer to industrial adjustment subsector); physical and mental stress for displaced populations; and respiratory diseases for populations surrounding refineries that may not have air pollution control.</td>
<td>Implementation TORs should include awareness campaigns and affordable protective gear and equipment; law enforcement (drunk driving, seat belts, insurance liabilities, and so on); counseling; and gradual reduction of emissions to reach WHO standards (see table 9-3).</td>
</tr>
<tr>
<td><strong>Oil and gas</strong></td>
<td>Occupational health and safety issues; much concern for problems of workers in off-shore drilling operations; road traffic accidents; fatal accidents from fires, explosions, and chemical disasters; long-term exposure to toxic waste (refer to industrial adjustment subsector); physical and mental stress for displaced populations; and respiratory diseases for populations surrounding refineries that may not have air pollution control.</td>
<td>Implementation TORs should include awareness campaigns and affordable protective gear and equipment; law enforcement (drunk driving, seat belts, insurance liabilities, and so on); counseling; and gradual reduction of emissions to reach WHO standards (see table 9-3).</td>
</tr>
</tbody>
</table>

Source: Authors’ data.
CHAPTER 13: CROSS-SECTORAL LINKAGES:
INFRASTRUCTURE SECTOR

This chapter covers the environmental health linkages with the infrastructure sector, weaving together many seemingly unrelated topics with a common thread—urban and periurban human settlements—for which linkages are strong with health. Sections on cross-cutting issues and each of the four infrastructure subsectors present a broader range of environmental health issues than those traditionally associated with physical infrastructure:

- **Cross-cutting issues.** What are the key broad and cross-cutting environmental health issues, and what is special about their urban settings?
- **Housing and urban development.** What risks are presented by living conditions in big cities and surrounding areas? How, if at all, do secondary cities differ?
- **Telecommunications.** How are rapid changes in modern telecommunications technologies affecting health?
- **Transportation.** What type of health risks are associated with transporting products from rural fields to urban markets?
- **Water supply and sanitation.** How are health risks linked with drinking water, drainage, waste disposal and sanitation services?

Discussion of each subsector concludes with an environmental health checklist.

**Key Cross-Cutting Environmental Health Issues**

Four environmental health issues—"brown" issues, vector-related diseases, food chain contamination, and AIDS—impinge on all four subsectors:

**“Brown” Issues**

"Brown" environmental issues—in contrast to “green” issues, which deal with ecology—concern pollution, a reflection of cities’ inability to accommodate the effects of economic growth and rural-to-urban population migrations. Traffic congestion and air and water pollution figure among the most pressing problems internationally; these are coupled in developing countries with inadequate solid waste disposal. An understanding their economic dimensions, particularly costing the effects of pollution on human health, has gained brown issues significant attention. But they are only partially understood, because many studies have only looked at a few pollutants or their sources and not captured the full range of health repercussions. Sections on the four subsectors will explain these in more detail below; the overall picture, however, is daunting. In SSA, for example, populations in the seventy largest cities are expected to increase by 140 million inhabitants in 1990–2020. By 2020 a thousand medium-sized cities (50,000–500,000) will house 175 million new urban dwellers—more than the total urban population in 1990. In 1990 no SSA cities had more than 5 million inhabitants; by 2020, five will have reached that size.153

**Vector-Related Diseases**

Vector-related diseases (see chapters 1, 8, and 9) are frequently associated with rural areas, which provide much of the habitat for the main disease vectors—mosquitoes, snails, and flies. In the
past few decades, migrants to periurban areas with some rural geographical features have expanded vector breeding habitat to urban areas. Another factor is provision of drinking water to urban areas, which has created year-round breeding habitats for vectors that were once limited by the sequence of dry and rainy seasons.

Many development projects have not yet fully accepted as health risks the links among vector diseases, construction sites, and workers’ camps. Technical assistance could help define relative risks by identifying potential vectors, their breeding and feeding habits, the distribution of susceptible population, and the roles of drainage and construction camps. If reasonable risk exists, appropriate mitigating measures should be designed.

**Food Chain Contamination**

Although addressing malnutrition problems has become an accepted part of health care in the past decade, the impacts of food chain contamination have not. At best, studies call attention to pesticide use and, to a lesser extent, selected industrial pollutants, for example, mercury. The growth of agribusiness and periurban agriculture has increased pesticide and fertilizer use and reuse of wastewater, all with known risks, from diarrheas to cancer. Technical assistance can help assess practical risks by examining food sources, agricultural practices, and consumption patterns. (See “Food Production, Processing, Storage, and Transport” in chapter 8.)

**Special Note on AIDS**

All four infrastructure subsectors can play a significant role in AIDS prevention, mainly by facilitating contact of health professionals with groups at risk. Compared with other sectors, infrastructure projects usually entail work crews, who sometimes reside in camps away from home, thereby presenting a high risk for contracting and spreading AIDS. Local project managers are usually in a position to provide a venue for health professionals to offer AIDS awareness education. In addition, many infrastructure projects, especially urban projects, deal with construction or upgrading of commercial centers, such as food markets, cottage industries, or industrial centers, possibly providing an effective means of communicating to hard-to-reach audiences. In the transport sector, well-organized trucker organizations could be tapped for educational efforts, as truckers play a significant role in spreading AIDS; this is particularly the case in SSA, where trucking is an important mode of transport for goods.

**Housing and Urban Development**

This section first looks at the broad picture of environmental health issues in housing and urban development, then examines key environmental health issues: housing quality and ventilation, energy use, and land degradation.

**The Broad Picture**

The main links between environmental health and housing and urban development include indoor air pollution, inadequate provision of basic shelter, drowning, accidents from poor housing sites, exposure to waste disposal, and physical stress. Housing and urban development subsector projects can help alleviate respiratory disease, accidents, and vector-related diseases in many ways. Better ventilation, improved cook stoves, and reduction in overcrowding should help, but the number of variables involved have prevented statistically significant associations between these remedial measures and actual health improvement. Improvements to neighborhood environments,
for example, modifying paths, walkways, and cooking areas, can help reduce accidents. Improved water supply, sanitation, and drainage—frequent components in housing and urban development—when linked with increased awareness and hygiene education, can markedly reduce diarrheal and vector-related diseases. In areas with houses already constructed over water, upgrading projects can help control drownings, mainly of infants and toddlers.

Additional links include:

- Search for employment and housing by rural-to-urban migrants, creating mental stress
- Underlying policy factors, such as building restrictions, tenure, allocation of public services, and others, which result in poor quality housing and related health problems
- High costs of some housing (sometimes government), leading to diminished food expenditures in low-income populations and possibly lowering nutritional intake
- The tendency of marginal areas to have inadequate physical infrastructure and public services and lack consumer protections, such as property leases.

Box 13-1: Key, Confusing, and Misused Terms on Human Settlements

**Periurban.** Strictly speaking, the terms “rural” and “urban” reflect governmental administrative designations and are not necessarily based on size. Periurban refers to areas surrounding cities that have retained low-density characteristics and have substantial agricultural activity. From an environmental health point of view, periurban agriculture can (a) facilitate breeding of mosquitoes that spread malaria (which tends to be a rural disease) and (b) pollute water with agricultural and animal waste.

**Kitchens and cooking areas.** Areas used for food preparation. Defined by culture. Range from a single-room hut with no windows or a separate room with or without ventilation to a place in the open. Health consequences involve exposure to smoke from cooking fires and oils and the risk of burns, especially for children, from cooking fires or contents of pots.

**Markets.** Covers a broad range of activities in developing countries, including sales of fresh food, clothing, household items, live animals, automobile parts, among others, or a collection of stalls for sewing clothing or producing artisanal goods for tourists. Take place in the open or in partially covered or permanent structures. May be vast or tiny, filthy or clean, muddy or dry, with or without electricity or refrigeration, and with or without toilets, depending on local arrangements for waste management and proper drainage. Do not refer to “supermarkets” modeled on those in industrialized countries, which are also common.

**Ambient air pollution.** In contrast to indoor air pollution, refers to outside air pollution. Pollution risks entail the six major criteria pollutants defined below, but do not generally account for the variety of other individual pollutants or those chemically combined with others, for example, aerosols of sulfuric acid, which can jeopardize human health more than the pollutants monitored.

**Indoor air pollution.** In contrast to “ambient” air pollution, refers to air pollution inside houses, workplaces, schools, and other buildings. Indoor air pollution is not monitored as regularly as ambient air pollution.

Source: Authors’ data.

**Key Environmental Health Issues**

The following sections describe issues that housing and urban development projects could address.

**Housing Quality and Ventilation**

**Structure.** Basic housing provides essential protection from extremes of heat and cold and inclement weather, all of which can be significant determinants of disease in malnourished popula-
Dampness also contributes to respiratory disease; recent research points to the presence of molds.\textsuperscript{154} Shoddy structures may harbor insects that spread disease, such as the “cone nose” bug, which lives in cracks and crevices of walls and causes Chagas’ disease.

**Location.** Housing location influences health as much as structure. Housing for the poor is often erected in economically marginal areas that are prone to flooding (from occasional storms or in flood plains), landslides, and so on. Other hazards include accidents (e.g., due to steepness of hills or proximity to traffic or industry) and, in houses erected over or near water, drowning.

**Dirt floors.** Dirt floors present two significant health hazards: \(a\) long-term recurrent exposure to dust and \(b\) exposure to intestinal worms that penetrate the feet, particularly in areas with poor sanitation. Common throughout developing countries, intestinal worms are responsible for substantial disability, although low mortality.

**Ventilation.** Ventilation may be the single most important health factor in housing, because of direct and causal health links with indoor air pollution, particularly cooking, heating, and lighting fumes. Proper ventilation can reduce respiratory infections, which are spread through close personal contact, as well as respiratory irritation from smoke, which can worsen or predispose people to respiratory illnesses.

**Cooking area.** The main health risks are exposure to cooking fumes (from cooking fires or the food itself), followed by accidents, mainly burns. Even cooking in the open produces high levels of exposure, because people spend a great deal of time close to the source. Indoor exposure to cooking fumes can be compounded by cigarette smoking. Numerous, often energy-related programs have increased stove efficiency, indirectly benefiting human health.

**Ambient air pollution.** Environmental health linkages with outdoor air pollution are addressed in discussion of the transportation subsector below.

**Energy Use**

Energy-health linkages cover a broad spectrum that go well beyond air pollution, which is reasonably well recognized and often tends to focus on industrial and vehicular sources. Access to electricity in rural areas is crucial to improving quality of life in many ways. It permits the “cold chain” sequence of refrigeration, ensuring a reliable supply of medications in pharmacies and health care facilities. Access to modern fuels also reduces some of the risks of indoor air pollution from burning cheaper, but more polluting traditional fuels. The section on “Housing: Indoor Air Pollution” below describes various factors.

**Land Degradation**

Land degradation can lead to injuries and deaths from landslides and flooding. Land degradation is indirectly linked to economic policies; for example, policy-related increases in fuel or land costs may encourage people to gather fuel wood or construct housing in areas prone to erosion.

**Table 13-1: Main Environmental Health Linkages for Housing and Urban Development**

<table>
<thead>
<tr>
<th>Sector or Ministry</th>
<th>Linkages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture and rural development</td>
<td>“Urbanization” of rural diseases, e.g., malaria and dengue (periurban water supply and urban commercial gardens provide year-round vector breeding habitats); food chain contamination by pesticides and fertilizers from rural and periurban agriculture; indoor air pollution and accidents from storing agrochemicals; waste from periurban agriculture and food production for urban markets</td>
</tr>
<tr>
<td>Energy</td>
<td>Contribution of heating, lighting, and cooking fuels to indoor air pollution</td>
</tr>
<tr>
<td>Sector or Ministry</td>
<td>Linkages</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Environment</td>
<td>Deforestation and land degradation</td>
</tr>
<tr>
<td>Health</td>
<td>Provision of health services for health impacts in subsectors, and medical facility waste</td>
</tr>
<tr>
<td>Industry</td>
<td>Settlements sited near industrial areas: risk of large-scale accidents and exposure to toxic chemicals and air, water, land, and noise pollution</td>
</tr>
<tr>
<td>Infrastructure: telecommunications</td>
<td>Better communications warn or prepare for “extreme events” (e.g., floods or storms) and facilitate emergency responses to these and industrial accidents. Other minor linkages: reduction of traffic congestion; improved emergency communications; spread of vector habitat in temporary holes created for transmission line poles</td>
</tr>
<tr>
<td>Infrastructure: transportation</td>
<td>Major contributor to pockets of localized air pollution, and minor contributor to respiratory illness through traffic fumes and dust (in African cities); pedestrian traffic accidents due to lack of road maintenance, erosion, and flooding; and traffic accidents involving children fetching water</td>
</tr>
<tr>
<td>Infrastructure: water supply and sanitation</td>
<td>Deficient water supply, sanitation, and drainage (major sources of excreta-related diseases); deficient drainage (major contributor to insect-borne diseases and flooding, which can cause food contamination, injury, or death); risk of accidents to children fetching water</td>
</tr>
</tbody>
</table>

Source: Authors’ data.

**Environmental Health Assessment Checklist**

This section presents tools for use in identifying and prioritizing a range of environmental health issues and their direct and indirect repercussions and in setting priorities according to institutional capabilities and budgets. This intentionally broad approach gives a better idea of the array of possible institutions to involve in finding solutions. In keeping with the overall poverty reduction objectives of these guidelines, the material also describes the main high-risk and vulnerable groups.

**Typical Loans and Components from the Sector**

The official World Bank designations for the urban development subsector are urbanization, housing, housing finance, urban development, and other urban. Many projects within the housing and urban development subsector are actually multisectoral, because they contain components from the transportation and water supply and sanitation subsectors.

**Construction Activities and Mosquito Breeding**

Beyond being an important public health problem, in nonendemic areas, mosquitoes are nuisances and not considered significant enough to include in a public health project. Nonetheless, mosquitoes may still be important enough a problem to local residents for them to take remedial measures. Household measures could focus on water storage containers, roof catchments, and a range of water-retaining receptacles near living areas, for example, discarded tires and tins, defunct vehicles, and so on. Malaria is statistically the most significant disease, but filariasis, dengue, and yellow fever are also important locally (see “Malaria and Vector-Related Diseases” and table 7-6 for a description of mosquito breeding.) Studies have shown that mosquitoes favor housing construction sites for breeding.

**Housing: Dirt Floors and Intestinal Worms**

The most common worms are hookworm and ascaris. Hookworm is commonly spread near defecation sites, which are frequently near households, schools, and places of employment. Because
the larvae penetrate the feet, it is more common in poor areas where people do not wear shoes. Schools often have deworming campaigns, but reinfection levels (recidivism) are high because children are easily re-exposed at home. Deworming campaigns should be based on regular cycles, for example, three times per year, emphasizing breaking the transmission cycle within a five-year period. (Ascaris, which is spread mainly through food, is not covered here. For details on both ascaris and hookworm, see annex B.)

**Housing: Indoor Air Pollution**

Indoor air pollution is a major contributor to respiratory infections, but is neglected in housing and urban development components. It readily lends itself to remedial measures, such as adaptations in housing design to improve aeration, sunlight, and ventilation of smoke from cooking, lighting, and heating sources. Technical assistance based on actual and changed consumption patterns in income groups would help identify high-risk groups and fuels that exacerbate household pollution, especially cooking fuel, which appears not to change as incomes rise.\(^{155}\)

**Proximity to Large-Scale or Hazardous Pollution**

The main sources of hazardous or dangerous materials include the following:

- **Industrial sources**: facilities involved with wood preservation, paints, chemicals and pharmaceuticals, agrochemicals (fertilizers and pesticides), explosives, petroleum refining, iron and steel, textiles and dyeing, tanning, electroplating, smelting, cement, and pulp and paper. In addition, industrial waste that has entered the environment and is trapped in sediment can be recirculated by human activities, such as dredging or construction in areas of former industrial activity.
- **Food processing sources**: slaughterhouses (abattoirs) and feedlots.
- **Granaries, silos, and grain storage near ports and harbors**: facilities with frequent emissions of contaminated grain residue (from fumigation to prevent spoilage of stored grain in silos), which settles in the immediate area. (Much food processing waste is not necessarily toxic, but poses ecological problems, because of its high organic strength, which depletes oxygen and can create indirect health hazards.)
- **Industrial parks or export-processing zones**: Facilities that are harder to characterize, because they can contain such a wide variety of industries. They are potentially, if not often, dangerous, for example, if they handle hazardous materials or produce toxic wastes. Such facilities are often run by local business groups or international companies that follow proper waste management procedures, or, as in the case of large-scale garment manufacturing, do not produce hazardous waste.
- **Municipal dumps and specialized markets**: facilities whose waste becomes hazardous due to its volume, for example, animal feces from the sale of animals as well as motor vehicle waste, such as used motor oil and battery acid from vehicle maintenance. Vehicle graveyards and mounds of used tires can furnish excellent sites for mosquito breeding.

Settlements near any of these sources should be examined for potential exposures and accidents. These factors are likely to be considered in projects with new construction, but harder to deal with in upgrading projects, because project scope cannot include changes in the surrounding area. Remedial measures in these cases should be to assist communities in devising self-help methods to, among others:

- Build protective enclosures or barriers
- Monitor pollution at the neighborhood level (e.g., low-cost monitoring kits alerting authorities when permissible pollution standards are surpassed)
- Devise first-aid or emergency responses to accidents
- Recycling
- Tree planting.
In the many cities where a “potential hazard” inventory has never been prepared, a local university, NGO, or other development agency could do one at low cost. Such inventories may be as useful in identifying neglected areas, such as pollution threats that are exaggerated or underplayed because they are not known or well understood.

A word of caution is needed here: many pollution abatement issues are politically explosive because of treatment in the local press or other information that is based on political posturing, vested interests, and inaccurate information. Advice is available from staff who have dealt with such issues before, for example, the country offices, regional environment divisions, the Environment Department, or others with experience dealing with community participation, resettlement, and access to project-related information. (See also, OD4.12 Involuntary Resettlement, OP/BP/GP 17.50 Disclosure of Operational Information, and OD14.70 Involving NGOs in Bank Operations.)

Tinkering, Cottage Industries, and Artisanal Markets
Hazards in informal or small-scale shops that produce or repair products may still create hazards great enough to affect people, at least in the immediate area. Of particular importance and often neglected is exposure to lead in processing brass, copper, silver, and gold. Jewelers and metal-workers are at risk occupationally, but also generate lead waste affecting the local community. Dyeing cloth and tanning are common and impact local surface water particularly severely. Remedial measures for proper disposal of this waste are similar to those for large-scale operations, but probably more labor intensive and more difficult, because of their scale.

General Markets
Waste from general markets (see definition above) can create a variety of health problems, as described below under “Municipal and Domestic Waste Generation.” Likewise, markets create congestion resulting in air pollution and pedestrian accidents. (See “Passenger Transport: Train, Bus, Rail, and Taxi Stations” in discussion of the transportation subsector below)

An urban project could make a substantial contribution to improving health by undertaking basic studies appropriate to overall fiscal management and potentially the basis for revenue generation, where such basic information is lacking. These would entail, among others, a market inventory, flow of products in or out, traffic patterns, and specific water, sanitation, and drainage issues. A component could outline the overall framework for conducting such studies over the long term, with technical assistance if necessary. Or a component could build on existing information to recommend procedures for better management of environmental factors.

Household-Related Injuries
Risks for injury include the following:

- **Fire.** Low-income groups commonly cook, heat, and light using methods such as kerosene lamps, charcoal, or various biomass fuels, which greatly threaten children with the risk of burns. The risks are great of spreading fire throughout areas built of wood and other combustible materials. As income rises and people climb the energy ladder, so do the types of fuel for heating and lighting, and eventually cooking, ultimately lowering the risk of fire.

- **Falls.** Falls are a common source of injury. Low-income housing is often constructed with inferior materials and without proper support to prevent falls from stairs and railings. Uncollected domestic waste can also cause falls.

- **Drowning.** Low-income housing sites (in particular, latrines) are often constructed over or near water. The risk of infants and toddlers falling into the water are high.
Disasters and “extreme events.” Flooding, storms, and earthquakes result in a high toll of injury and death and set the stage for a wide range of diseases, many of which are exacerbated by poor quality housing, drainage, and other conditions, especially in disaster-prone areas.

Mudslides and erosion. Housing on or near hillsides and flood plains can be destroyed in storms, leading to the same effects as disasters and extreme events.

A community education, “safe stove” component in the project could help address these risks through self-help and modest constructions. Considerable work throughout Africa on stoves has more often had an ecological than safety basis. Health and safety dimensions could, nonetheless, be added. Modifications to housing designs can help prevent storm damage. In flood-prone areas, basic infrastructure, for example, retaining walls, drainage canals, and so on, can help reduce impacts of flooding. Planting vegetation in areas prone to erosion, especially hillsides, can help reduce risks of mudslides and similar hazards. Fear of fire could be a strong motivation for community participation, even if fire reduction is not necessarily part of the project.

Occupational, High Risk, and Vulnerable Groups

Table 13-2: Occupational and Vulnerable Groups for Housing and Urban Development

<table>
<thead>
<tr>
<th>Activity</th>
<th>Potential Health Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fetching fuel and water</td>
<td>Child accidents</td>
</tr>
<tr>
<td>Fuel use, e.g., cooking, heating, and lighting</td>
<td>High exposure, especially of women and children, to indoor air pollutants (resulting in, e.g., lung cancer) and accidents (mainly burns)</td>
</tr>
<tr>
<td>Solid waste management</td>
<td>Accidents and exposure to excreta and toxic materials at solid waste sites of workers, scavengers, and children playing after hours</td>
</tr>
<tr>
<td>Housing construction</td>
<td>Added risk of accidents for children playing after hours in unfinished construction</td>
</tr>
<tr>
<td></td>
<td>Unprotected cutting or handling by workers of asbestos construction material</td>
</tr>
</tbody>
</table>

Source: Authors’ data.

The Housing and Urban Development Sector Environmental Health Checklist (table 13-3) shows the range of sector projects by subsector, identifies the main potential environmental health problems, and suggests remedial measures.

Table 13-3: Housing and Urban Development Sector Environmental Health Checklist*

<table>
<thead>
<tr>
<th>Typical Housing and Urban Development Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing construction (including temporary worker housing)</td>
<td>a) Pools of standing water and flooding can lead to increased incidence of malaria and other mosquito-borne diseases, especially during the rainy season; workers and local residents are at risk.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) Poor ventilation associated with cooking, heating, and lighting</td>
<td>(a) Preparation TORs should ensure proper measures are taken during construction and afterward to eliminate breeding and feeding grounds and accommodate proper drainage in flood-prone areas, especially in rainy seasons. May also be appropriate to include community education component.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(b) If housing designs are to be specified, preparation TORs should include provisions to.</td>
</tr>
</tbody>
</table>

* This and other sectoral checklists can be found at <http://www.worldbank.org/afr/environmentalhealth/>.
## Typical Housing and Urban Development Projects and Components

<table>
<thead>
<tr>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>sources (other than electricity or gas) can lead to respiratory diseases, especially important to women when cooking and children who spend time indoors.</td>
<td>should include provisions to maximize ventilation and, as appropriate, exhaust cooking area. If designs are completed, it may be appropriate during implementation to include technical assistance in a community participation or other type of component. If malaria is endemic, housing design should include option of window screens.</td>
</tr>
<tr>
<td>c) Accidents can occur during construction, when workers and nearby residents are at risk from flooding, erosion, and mudslides and children are at risk playing after hours at construction sites; during or after implementation, when children risk burns from unprotected cooking, heating, and lighting sources; and in housing near or over water, where infants and children risk drowning.</td>
<td>(c) Implementation TORs should ensure that proper occupational health and safety measures are provided for workers and access of children is limited after hours. If housing designs are not complete, preparation TORs should accommodate ventilation and safety features (the latter may be pertinent in a community education component).</td>
</tr>
<tr>
<td>d) Work crews can be at high risk for AIDS.</td>
<td>(d) Preparation TORs should arrange for health agencies to reach out to work crews.</td>
</tr>
</tbody>
</table>

### Sites and services

<table>
<thead>
<tr>
<th>Sites and services</th>
<th>(a) See “Housing Construction.”</th>
</tr>
</thead>
<tbody>
<tr>
<td>(b) Poor maintenance of neighborhood services can lead to a full range of excreta- and vector-related diseases; main weak points include clogged storm drains, poor drainage at water distribution points, inadequate trash collection, and special needs of markets for proper waste management.</td>
<td>(b) Preparation or implementation TORs should provide for community education and, as appropriate, cost recovery schemes to cover maintenance costs; might be appropriate to involve local community (informal and formal leaders) and NGOs, religious groups, and others. Preparation TORs should ensure that adequate water, sanitation, and drainage services are included as a component.</td>
</tr>
</tbody>
</table>

### Drainage

<table>
<thead>
<tr>
<th>Drainage</th>
<th>Poor drainage, quite common after storms, can lead to leptospirosis (Weil’s disease), which is spread through rodent urine and poor drainage in construction (see “Water and Sanitation”)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TORs should provide for adequate drainage.</td>
</tr>
</tbody>
</table>

### Dredging

<table>
<thead>
<tr>
<th>Dredging</th>
<th>See “Ports” in table 13-9</th>
</tr>
</thead>
</table>

### Public facilities: markets

<table>
<thead>
<tr>
<th>Public facilities: markets</th>
<th>(a) Vehicular congestion contributes to air pollution and injuries (see also table 13-9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Preparations or implementation TORs should ensure that proper measures are taken to identify groups at risk of pedestrian injury or regular exposure to vehicle exhausts and propose remedial measures as appropriate. As feasible, include measures to lessen existing and prevent new congestion around public mar-</td>
<td></td>
</tr>
<tr>
<td>Typical Housing and Urban Development Projects and Components</td>
<td>Major Health-Related Issues</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td><strong>(b)</strong> Frequently lack toilets, trash receptacles, as well as drainage from uses of drinking water, market cleaning, and rainfall.</td>
<td></td>
</tr>
<tr>
<td><strong>(c)</strong> Improperly managed solid waste can clog storm drains, cause flooding, create garbage heaps in surrounding areas, and provide breeding and feeding grounds for mosquitoes, flies, and rodents. Collectively, these can cause diarrheas, parasitic infections, and injuries. Separate attention is needed to accommodate waste of specialized markets, such as live animals or automobile repairs, e.g., animal excreta and motor oils.</td>
<td></td>
</tr>
<tr>
<td><strong>(d)</strong> See also “Water and Sanitation,” table 13-13, for waste management by the markets themselves.</td>
<td></td>
</tr>
<tr>
<td><strong>Public facilities: washing and bathing and toilets</strong></td>
<td>See table 13-13</td>
</tr>
<tr>
<td><strong>Public facilities: public buildings</strong></td>
<td></td>
</tr>
<tr>
<td><strong>(a)</strong> Pools of standing water and flooding can lead to increased incidence of malaria and other mosquito-borne diseases, especially during the rainy season, placing workers and local residents at risk.</td>
<td></td>
</tr>
<tr>
<td><strong>(b)</strong> Public facilities often fall into disrepair for lack of maintenance, setting the stage for accidents and poor waste management.</td>
<td></td>
</tr>
<tr>
<td><strong>(c)</strong> Hospitals should always be considered a special case (see “Water Supply and Sanitation Subsector”)</td>
<td></td>
</tr>
</tbody>
</table>

**Water supply** | See table 13-13 |
**Sanitation** | See table 13-13 |
<table>
<thead>
<tr>
<th>Typical Housing and Urban Development Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste management</td>
<td>See table 13-13</td>
<td></td>
</tr>
<tr>
<td>Urban transport</td>
<td>See table 13-9</td>
<td></td>
</tr>
<tr>
<td>Traffic management and road rehabilitation</td>
<td>See table 13-9</td>
<td></td>
</tr>
<tr>
<td>Motor parks</td>
<td>Covered motor parks can lead to buildup of air pollution from vehicle fumes inside and exhaust streams to areas and buildings nearby. Gasoline and oil leaks from vehicles can pose safety hazards.</td>
<td>Implementation TORs should incorporate appropriate ventilation procedures and monitoring, where appropriate, and, if feasible, cleaning up gasoline and oil leaks.</td>
</tr>
<tr>
<td>Capacity and institution building</td>
<td>Community involvement is an important aspect in devising curative and preventative measures for health. Local talent is often not tapped, because of poor community organization, rather than lack of technical knowledge.</td>
<td>Design component to reflect the level of organization of local community groups and problems being addressed. It may be useful during preparation to solicit help of NGOs for topics difficult to deal with during works or after project cycle, e.g., accident prevention; collection of contributions for operation and maintenance of communal facilities; appropriate methods to eliminate improper water storage, standing pools of water, or clogged drains where mosquitoes can breed; household methods to reduce injuries (especially burns and drowning); and efficient waste management of markets and other community facilities</td>
</tr>
</tbody>
</table>

<Source: Authors’ data>
Telecommunications

Telecommunications subsector projects mostly have indirect effects on health, shown in table 13-4 below. Health benefits of interventions are, therefore, also not significant. Direct benefits from use of telecommunications, however, can be great in the case of extreme events, such as storms and floods or major industrial accidents. In these cases, better communication facilitates rapid response of emergency health services and advance warnings for weather events.

Other linkages of note exist. Of particular note for SSA, increased use of satellites can avoid extension of mosquito habitats due to hole digging for transmissions poles. Satellite and other wireless communications may also reduce the need for relay stations and, thus, air conditioning. This would decrease the use of chlorofluorocarbons (CFCs), lessening contributions to depletion of the ozone layer, which can cause cataracts and skin cancers (minor health problems in SSA compared with infectious diseases). Other slight benefits from better telecommunications, such as faxes and computers, might be to help reduce use of motor vehicles and, thus, air pollution. An emerging literature on global warming implicates transportation pollution as an important contributor. Increased temperatures can move vector habitats inland from coastal areas and farther north toward temperate climates, spreading diseases such as malaria and precipitating increases in epidemics such as cholera and plague.

Table 13-4: Occupational and Vulnerable Groups for Telecommunications

<table>
<thead>
<tr>
<th>Activity</th>
<th>Potential Health Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installing telephone poles, and other infrastructure.</td>
<td>Exposure to vector-borne diseases, especially malaria, of road crews or local populations not already exposed</td>
</tr>
<tr>
<td>Working at video display terminals (VDT)</td>
<td>Compromised use of wrist and arm muscles (e.g., carpal tunnel syndrome), back and spine problems from poor posture during use, and possible link to cancers from extended exposure</td>
</tr>
<tr>
<td>Using portable telephones</td>
<td>Increase in automobile accidents due to distraction of telephone use (same for other machinery or dangerous equipment) and possible link to cancer from extended use</td>
</tr>
</tbody>
</table>

*Source: Authors’ data.*

The Telecommunications Sector Environmental Health Checklist (see table 13-5) presents tools that can be used to determine a broad range of environmental health issues, from which to view direct and indirect repercussions, determine which are most important, and then set priorities according to institutional capabilities and budgets. This intentionally broad approach gives a better idea of the range of institutions that may need to be involved in finding solutions. In keeping with the overall poverty reduction objectives of this discussion paper, the material also describes the main high risk and vulnerable groups. The table shows the range of sector projects by subsector, identifies the main potential environmental health problems, and suggests remedial measures.

Table 13-5: Telecommunications Sector Environmental Health Checklist

<table>
<thead>
<tr>
<th>Typical Telecommunications Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation of telephone lines</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Can spread vector-borne diseases, especially for malaria and dengue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Can expose work crews to AIDS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Preparation TORs should include provisions for vector control and procedure for health agency to reach workers.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Implementation TORs should monitor malaria and AIDS and respond with remedial measures.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Source: Authors’ data.*

*This and other sectoral checklists can be found at <http://www.worldbank.org/afr/environmentalhealth/>. 
Transportation

This section covers environmental health issues linked with transport, providing the broad picture, key environmental health issues, and typical loans and components from the sector. An environmental health assessment checklist concludes the section.

Key Environmental Health Issues

The main linkages between transportation and environmental health are (a) air, water, and land pollution from fuel sources, (b) indiscriminate waste disposal of river and maritime vessels, (c) water and land pollution from maintenance of vehicles and vessels, and disposal of maintenance by-products and defunct vehicles and vessels, some of which are hazardous, (d) spread of mosquito habitats from discarded tires and vehicles, (e) spread of diseases, in particular malaria, through transport projects, (f) accidents from erosion of roads and transportation of chemicals and hazardous substances, and (g) contribution of transportation fuels to ozone depletion, global warming, and climate change. Health impacts of mining for construction materials, for example, includes accidents due to erosion of roads and pedestrian shoulders and spread of vector habitat from mining for gravel. Transport also plays an indispensable role in road safety, providing access to health care, schools, markets, and other services that directly affect human health.

The single most important environmental health aspect treated under transportation is air pollution. This focus on ambient air pollution from transport, industry and energy sources stems from its importance in industrialized countries; this emphasis has tended to overshadow the health effects of indoor air pollution in developing countries. Other factors, however, are more localized, for example, mosquito breeding from road construction and rehabilitation and in discarded tires or wrecked vehicles. In addition, the role of truckers in spreading AIDS in SSA is important as a general health risk.

Table 13-6: Main Cross-Sectoral Environmental Health Linkages for Transport

<table>
<thead>
<tr>
<th>Sector or Ministry</th>
<th>Linkages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture and rural development</td>
<td>Transport, storage, and shipment of agricultural products, including pesticides or other hazardous materials used in formulating pesticides; periar urban agriculture; rural roads as a factor in spreading vector-related diseases; acid rain (from energy and transport), which can harm food crops</td>
</tr>
<tr>
<td>Energy</td>
<td>Contribution of outdoor air pollution to (a) indoor pollution (from cooking, heating, and lighting fuel) exacerbating its effects and (b) global warming from inefficient energy production and use; global warming can spread vector-borne diseases, such as malaria, by extending vector habitats or diarrheas, such as cholera, by allowing pathogens to survive longer in the warmer water</td>
</tr>
<tr>
<td>Industry</td>
<td>Type of industrial development facilitated by transport system and type of industries clustering around ports</td>
</tr>
<tr>
<td>Infrastructure: housing and urban development</td>
<td>Contribution to indoor air pollution from vehicular emissions and to global warming, which can spread vector-borne diseases, such as malaria, by extending vector habitats, turning predominantly rural diseases into urban ones)</td>
</tr>
<tr>
<td>Infrastructure: telecommunications</td>
<td>Minor contribution to reducing air pollution by reducing traffic</td>
</tr>
<tr>
<td>Infrastructure: water supply and sanitation</td>
<td>Disposal of vehicles contributing to spread of mosquito habitats; risk of accidents to children fetching water and disposing of garbage; special waste disposal needs of ports, railways, airports, and motor vehicles (can be hazardous, e.g., oils and battery acid)</td>
</tr>
</tbody>
</table>

Source: Authors’ data.

Regarding air pollution abatement, even though vehicular air pollution is not widespread in Africa because the population/vehicle ratio is low, transport-related respiratory disease is serious for the population at large around public transportation depots and an occupational hazard for traffic
police and others exposed to vehicle congestion for long periods. (Nigeria is the only country in SSA currently considering the phase out of leaded gasoline in the medium term.) In addition, dust is an important pollutant, which is often neglected in analyses that focus on fuel-based pollution.

An additional link with transport in SSA is AIDS, because of the role truckers play in contracting and spreading the disease. Besides the toll in human lives, the economic effects can be staggering. For example, a Zimbabwean trucking company reported that 3,400 of its 11,500 employees were seropositive, costing the company about $1 million in 1997 or 20 percent of their profits. (See chapter 3 for more details on environmental health costs.) Fortunately, trucker groups are well organized in SSA, which can facilitate education on preventive measures.

Transport has many other indirect linkages, such as facilitating disaster preparedness and emergency responses. Transport also plays a major role in stabilizing food prices by keeping rural areas linked with markets. Interruptions to markets can increase food prices, especially for staples, in a matter of days.

Although health analyses of transport often focus on motorized transport, nonmotorized village transport can reduce the burden of access to crop fields and water sources.

A number of project interventions can help reduce health impacts in the transport subsector, for example, efforts to decrease ambient air pollution, a contributing factor of respiratory disease in congested urban areas. In addition, better port management can help reduce water pollution and improve handling of hazardous materials. Improved drainage can help reduce water pollution and curtail the spread of vector habitats. Enhanced road maintenance can reduce traffic fatalities and injuries, and better traffic management can help reduce air pollution, which contributes to respiratory disease in congested areas. Furthermore, proper disposal of vehicles can help reduce the spread of mosquitoes, and doing the same for wastes from vehicles (e.g., oils and batteries) and transport maintenance workshops can help reduce water pollution. For other areas, project interventions are less clear, but do exist. Air travel is contributing to the spread of tuberculosis, which is currently staging a global comeback, and remediation of asbestos insulation in railway cars can reduce lung disease.

Table 13-7: Environmental Health Risks Associated with Transport

<table>
<thead>
<tr>
<th>Mode of Transport</th>
<th>Environmental Health Risk</th>
</tr>
</thead>
</table>
| Roads and highways | • Road injuries to drivers and pedestrians from poor driving habits, poor vehicle and road maintenance, and road erosion  
• Water and land pollution from vehicle maintenance and road runoff and from poor disposal of vehicles, oil, batteries, and construction debris  
• Spread of mosquito habitat from poor disposal of vehicles and tires and road construction  
• Widespread occupational exposure of drivers to gasoline and exhaust fumes  
• Spread of AIDS and other sexually transmitted from work crews’ temporary residences  
• Special problems of train, bus, and rail stations, including widespread exposures to fumes  
• Noise pollution  
• Transport and storage of hazardous materials, including pesticides |
| Rail | • Air pollution from vehicle congestion and servicing at stations  
• Water pollution from runoff  
• Water and solid waste pollution from vehicle maintenance  
• Noise pollution |
| Ports and harbors | • Water pollution from (a) domestic, sanitation, commercial, and bilge waste, (b) runoff from pesticides and other hazardous chemicals in storage, (c) vehicles using the port, and (d) vessel |

* WHO uses two standards for lead exposure: 50 micrograms per cubic meter for 8 hours and 0.5 micrograms per cubic meter for ambient air (measurement at one point in time). The U.S. Environmental Protection Agency (EPA) sets the ambient air standard at 1.5 micrograms per cubic meter (measurement at one point in time).
<table>
<thead>
<tr>
<th>Mode of Transport</th>
<th>Environmental Health Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>and vehicle maintenance and disposal of defunct vessels</td>
</tr>
<tr>
<td></td>
<td>• Injuries and exposure to hazardous chemicals from loading activities</td>
</tr>
<tr>
<td></td>
<td>• Silage-related problems, including exposure to fumigants and dust and grain chaff and exposure to hazardous materials and chemicals in storage</td>
</tr>
<tr>
<td>Airports</td>
<td>• Runoff and localized air and stratospheric pollution from runways</td>
</tr>
<tr>
<td></td>
<td>• Spread of disease by humans and vectors, including possibly tuberculosis</td>
</tr>
<tr>
<td></td>
<td>• Water pollution from plane and service vehicle maintenance</td>
</tr>
</tbody>
</table>

Source: Authors’ data.

Box 13-2: Key, Confusing, and Misused Terms on Air Pollution

Indoor air pollution. See box 13-1.

Ambient air pollution. See box 13-1.

Criteria pollutants. Six common pollutants often monitored in ambient air are (a) sulfur dioxide (SOx,) mainly from industrial and energy (heating) sources, (b) oxides of nitrogen (NOx), carbon monoxide (CO), ozone (O3), and lead (Pb), mostly from motor vehicles, and (c) total suspended particulate (TSP) or particulate matter (PM), a general measure capturing all sources of pollution, including dust. (For more information, see the glossary.)

Source: Authors’ data.

Environmental Health Assessment Checklist

This section presents tools that can be used to determine a broad range of environmental health issues, from which to view direct and indirect repercussions, determine which are most important, and then set priorities according to institutional capabilities and budgets. This intentionally broad approach gives a better idea of the range of institutions that may need to be involved in finding solutions. In keeping with the overall poverty reduction objectives of this discussion paper, the material also describes the main high risk and vulnerable groups.

Typical Loans and Components from the Sector

The official World Bank designations for the transport subsector are urban transport, rural roads, railways, highways, ports and waterways, aviation, and other transportation.

Injuries

Accidents and road safety have been a fundamental part of transportation sector projects for years. Factors contributing to road accidents include (a) lack of driver and pedestrian education (drunken driving remains a major factor), (b) poor maintenance of vehicles and roads, (c) inadequate inspection of vehicles, (d) erosion of roads and shoulders, and (e) inadequate sidewalks, pedestrian paths, signs, and stoplights. Mitigation of these factors relies on behavioral change—generally demanding more time and labor than possible within the timeframe of the typical Bank project—and carefully designed programs with Bank help, for example, insurance and liability schemes. Children fetching water or disposing of garbage are often the victims of road accidents, especially after dark, a neglected element of accident programs. To help prevent these injuries, a component could provide lighting, signs, protective barriers, paths, crosswalks or pedestrian bridges, and education.

Train, Bus, Rail, and Taxi Stations

Although ambient air pollution is not considered a major health problem in SSA, the low level of vehicle maintenance coupled with the use of leaded fuel makes it potentially severe in urban
pockets, where the population is subjected to widespread, long-term, high-dose exposure to fumes. Clusters around public transport facilities, such as bus and taxi stations, are often near open air markets, where trucks exacerbate the problem. Occupational exposures tend to be hazardous for traffic police, drivers, and service station attendants, among others. Similarly, the location of schools along or near major urban thoroughfares puts children at risk. Project interventions include identification of risk groups, protective barriers, change in traffic flow, if appropriate, economic incentives or construction (e.g., space for a proper terminal) and alternatives to disperse congestion.

**Ports and Harbors**

Traditional approaches have focused on safety and on wastes from the port itself and vessels using it, emphasizing ecological, not human health threats. Port waste covers five categories, based on the International Convention for the Prevention of Pollution from Ships (MARPOL [1973, modified in 1978]) of the International Maritime Organization (IMO): oil, noxious liquid substances shipped in bulk, harmful substances carried in packaged form, sewage from ships, and garbage from ships.

In addition to the MARPOL categories for vessels, typical port waste includes oil residues (dirty ballast and bilge water, sludge, and fuel residues), liquid residues from transported materials, materials damaged in shipment, septage, domestic waste, and materials lost or damaged during loading and storage. Fishing industries, maritime commerce, and, if appropriate, naval operations are major players.

Relatively little has been done on other pollution linkages, for example, analysis of the types of industries that tend to cluster near ports and their relative risks to the health of nearby people. These industries might include granaries and other kinds of grain storage and fumigation of silage (to prevent spoilage) resulting in exposure to fumigants by local residents and dock workers (shipping and receiving) and those cleaning vessel holds. Careful attention tends to be given to storage of flammable gases (liquefied petroleum gas [LPG], propane, and butane), especially those normally needing pressure and refrigeration (e.g., ammonia), fuels (jet, diesel, and regular gasoline), and other petroleum products, because the consequences, ranging from fires to disasters, are reasonably well known.

Careless storage of hazardous materials, such as industrial chemicals, pesticides, and fertilizers, is more problematic, because of the larger number of people affected. Some chemicals, such as ammonium nitrate, that are common components of fertilizers become hazardous, because they are stored in large quantities, which can lead to explosions of toxic clouds. Another example are the large amounts of chlorine required by power stations and water treatment plants to disinfect water. Weak points in the system are ship-to-shore transfer, temporary and permanent port storage, delivery to bulk user, and distribution to and repackaging for the ultimate user.

**Air pollution** at ports and harbors depends on the volume of traffic and the nature of commercial activities clustering around the port. These would be more appropriately covered under industry, waste management, or urban development activities.

Only one SSA project, Mauritius: Port Development and Environmental Protection (1995), has had a health risk assessment of port activities. Where local capabilities or an overall port and harbor management plan are lacking, remedial measures could help set up a mechanism to deal with long-term solutions, providing technical assistance if needed.
Dredging

Dredging operations can spread accumulated sewage and toxic materials to surrounding areas, contributing to diarrheas, skin and eye irritations, and poisonings for those in contact with the water. Disposal of the sludge can contaminate local groundwater and surface water. In some cases, dredging can cause saltwater intrusion in drinking water, forcing local populations to rely on other sources of poor quality or more expensive water. Likewise, suspended sludge can also contaminate the food chain, if fish and shellfish are harvested. In addition, dredging can recirculate industrial and toxic waste trapped in sediment. The health dimensions of inland navigation are similar to those of dredging and port management.

Airports

The environmental health hazards of airports fall into two broad categories: airport operating hazards and passenger hazards. For the former, the major health hazards are pollution and ozone depletion from jet emissions. Planes create noise pollution, greatly contributing to physical stress, which, in turn, reduces the body’s overall resistance to disease. Airport runoff can contaminate water supplies. Planes and vehicle traffic contribute to air pollution in general, raising it to hazardous local levels. Jet fuel contributes to ozone depletion, which can cause cataracts and skin cancer (the latter does not rank high among SSA health priorities).

Vehicle-Related Pollution Control

Vehicle-related pollution presents a wide spectrum of potential health repercussions. Disposal of vehicles contributes to water pollution from petroleum products and batteries. Discarded tires and stripped-down auto bodies provide vector breeding habitat for mosquitoes. Regular vehicle maintenance contributes to ground and surface water pollution from washing and oil changes; however, used motor oil, if applied judiciously, can control mosquito breeding, because an oil layer on water deprives mosquito larvae of needed oxygen. Air pollution from vehicles can be considerable in localized areas and become an occupational hazard for drivers, traffic police, and vehicle service employees.

Remedial measures could include technical assistance to help establish systematic recycling of vehicles and parts. This could help reduce environmental health hazards created by haphazard practices currently based largely on an item’s value for reuse or resale. Depending on current recycling activities, technical assistance could help set up long-term measures as part of an overall program for recycling and internalizing disposal costs and health risks. Road project components can assist in the safe disposal of transport waste. Traffic management projects could provide high-risk groups with protective measures, for example, education, protective clothing and masks, and work schedules, and help overcome air pollution, for example, through protective barriers near markets and stations.

Lead reduction. Inadvertent professional bias has given lead in gasoline considerable attention, diverting attention from other sources of lead (see table 7-4) posing at least as great (if not greater) health hazards. The seriousness of lead pollution, thus, depends on local conditions, particularly urban vehicular emissions and these other sources. Unleaded fuel has been used in Brazil since 1993, but the literature is weak on any health aspects that may have led to the switch and no monitoring programs follow health repercussions closely. (Unleaded fuels produce by-products, aldehydes, which can produce an aerosol of formaldehyde, a known carcinogen.)

Construction and Vector-Related Diseases

The transportation sector contributes in three major ways to spreading vector-borne diseases, of which malaria, filariasis, and schistosomiasis are most important. First, construction activities can spread habitat for mosquitoes and snails, for example, burrow pits, sand and gravel mining, tem-
porary or permanent excavations, deposition of construction debris, and holes for utility poles.
Second, drains and drainage areas that are not adequately constructed or maintained retain water,
allowing mosquitoes and snails to breed and spreading diseases to nonendemic areas. Third, road
crews can either bring in or be susceptible to various vector-related diseases. The use of “im-
ported” road crews, however, appears to be declining. A major problem relates to construction
activities, particularly the spread of malaria, although typically the role of truckers in spreading
disease tends to receive more attention.

Where drainage and waste disposal and risks of exposing local populations and road crews to
vector-borne diseases exists, projects with construction activities might include vector-control
components. Technical assistance would probably be available from the ministry of health for
education and prophylactic medications.

Roads
In general, Bank road and highway projects deal with existing rehabilitation or upgrading of ex-
isting networks. Health consequences derive from the condition of the road or highway and the
driving abilities of users. Road safety is a generally accepted practice in such projects. In addi-
tion, inadequate drainage and waste disposal at construction camps can contribute to spreading
diarrheas among workers and the local population.

Mining for construction materials present several health repercussions that might be significant in
localized areas. Quarries and burrow pits can spread mosquito habitat and also increase the risk of
accidents for workers and local children. Mining for sand and small gravel can cause erosion of
roadways leading to vehicle and pedestrian accidents. Deposition of construction materials can
contribute to accidents and the spread of mosquitoes. Although contractors are still often recruited
from abroad, road crews from local villages are often employed, reducing the potential for
spreading epidemics.*

When temporary construction camps become long-term or even permanent worker shelters and
equipment storage areas, potential health risks markedly increase. Asphalt plants, storage of blast-
ing materials, and fuel can increase the risk of accidents and cause local pollution, in addition to
the normal range of problems involved in providing shelter, water, and waste services. In these
larger operations, blasting can create accidents as well as air and water pollution.

Road projects could contain components for controlling pollution and vectors. Projects entailing
the mining of construction materials could provide for proper disposal of debris, worker safety,
and protection of mining sites through public education and barriers, giving special consideration
to children. Where truckers are an appropriate audience, a component could address risk aware-
ness, with technical assistance available from the ministry of health.

Railways
Asbestos insulation in railroad cars is primarily an occupational hazard during their construction
(not an important economic activity in Africa). A significant hazard exists, however, for workers
refurbishing imported older railroad cars and maintenance workers, particularly when recycling
or “cannibalizing” parts; when asbestos maintenance is inadequate, train attendants and frequent
passengers are also at risk. Railway projects could contain a component on waste disposal,

* Resistance to disease can be limited to only one of a large number of strains. “Imported” workers may not have been
exposed to local disease strains and could fall victim to serious illness that might be mild to locals. Conversely, “im-
ported” workers could carry a strain of malaria or another disease that could get passed on to local populations, for
example, by mosquito bites, and cause a local epidemic.
worker and pedestrian safety, and worker protection from exposure to asbestos (the latter might require expatriate technical assistance).

**Table 13-8: Main Occupational, High Risk, and Vulnerable Groups for Transport**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Potential Health Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Transport-related construction</td>
<td>• Exposure of drivers and mechanics to fuel and exhaust fumes, road crews to dust and surfacing fumes, and merchants to air pollution near heavily traveled roads, congested intersections, and passenger stations</td>
</tr>
<tr>
<td>• Vehicle maintenance</td>
<td>• Exposure of road crews not already exposed to vector-borne diseases</td>
</tr>
<tr>
<td>• Traffic management</td>
<td></td>
</tr>
<tr>
<td>• Operation of public transport</td>
<td></td>
</tr>
<tr>
<td>• Truck transport</td>
<td>• Risk of truckers acquiring and spreading AIDS through prostitutes at various types of truck and rest stops</td>
</tr>
<tr>
<td>• Road maintenance and construction project work crews</td>
<td>• Risk of work crews acquiring and spreading AIDS through prostitutes at various temporary work camps</td>
</tr>
</tbody>
</table>

*Source: Authors’ data.*

The Transport Sector Environmental Health Checklist (table 13-9) shows the range of transport sector projects by subsector, identifies the main potential environmental health problems, and suggests remedial measures.

**Table 13-9: Transport Sector Environmental Health Checklist**

<table>
<thead>
<tr>
<th>Typical Transport Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roads: rehabilitation and maintenance</td>
<td>(a) Mosquito-related diseases, especially malaria and dengue, can be spread by extending breeding areas in water that has accumulated in disposed construction materials and holes dug for sand and gravel.</td>
<td>(a) Preparation TORs should determine the importance of malaria locally and risks of its spreading and include provisions for appropriate mosquito control in work sites.</td>
</tr>
<tr>
<td></td>
<td>(b) Pollution of local water from improper disposal of excreta and domestic waste at work camps, leading to vector-related diseases, particularly malaria, filariasis, and, sometimes, schistosomiasis.</td>
<td>(b) Preparation TORs should determine importance of vector-related diseases locally and risks of their spread. Should include provisions for proper waste disposal and vector control as appropriate.</td>
</tr>
<tr>
<td></td>
<td>(c) Road erosion due to digging for sand and gravel, leading to pedestrian and vehicle accidents</td>
<td>(c) Preparation TORs should contain provisions for safety, with appropriate instructions for subcontractors providing the materials and conditions for disposal of debris.</td>
</tr>
<tr>
<td></td>
<td>(d) Flooding and extension of vector habitats from improperly disposed mining debris.</td>
<td>(d) Preparation TORs should contain provision for safe disposal of mining debris.</td>
</tr>
<tr>
<td></td>
<td>(e) Asphalt production and work dust can cause local air pollution, aggravating respiratory disease.</td>
<td>(e) Preparation TORs should include provisions for worker health and safety. Implementation TORs should contain provisions for reducing air pollution as appropriate. Designs should incorporate provisions accordingly.</td>
</tr>
<tr>
<td></td>
<td>(f) Communal and rural road projects may require special assistance to educate community on hazards described above</td>
<td>(f) TORs should contain provisions for community education awareness with help from local NGOs as appropriate.</td>
</tr>
<tr>
<td></td>
<td>(g) See also “Roads: Drainage”</td>
<td>(g) See also “Roads: Drainage”</td>
</tr>
</tbody>
</table>

*This and other sectoral checklists can be found at <http://www.worldbank.org/afr/environmentalhealth/>.*
<table>
<thead>
<tr>
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<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Roads: construction</strong></td>
<td><em>(a)</em> Conditions and risks are similar to those of “Rehabilitation and Maintenance,” except on a large scale. <em>(b)</em> On a large scale, greater probability of established work camps and expatriate personnel contributing to the spread of vector-related diseases and AIDS</td>
<td><em>(a)</em> See “Rehabilitation and Maintenance.” <em>(b)</em> Implementation TORs should cover worker protection and education (as appropriate) and basic on-site health facilities (as appropriate).</td>
</tr>
<tr>
<td><strong>Roads: drainage</strong></td>
<td><em>(a)</em> Blockage of storm drains plus inadequate drainage of general area can cause flooding, contaminating water supply and causing injuries. This can cause vehicle and pedestrian accidents and spread mosquito-related diseases. <em>(b)</em> In rural and periurban areas near dams and irrigation schemes, blocked drains can extend snail habitat and spread schistosomiasis. <em>(c)</em> See “Drainage” in Water and Sanitation subsector below.</td>
<td><em>(a)</em> Implementation TORs should provide for regular maintenance of storm drains, possibly requiring a component for community education and participation. Designs should include appropriate provisions for proper drainage of project zone and contiguous areas. <em>(b)</em> If schistosomiasis is endemic in the general region, implementation TORs should provide for appropriate preventive measures to keep drains from spreading habitat. A health component might also be appropriate to curtail further spread. <em>(c)</em> See “Drainage” in table 13-13.</td>
</tr>
<tr>
<td><strong>Roads: workshops</strong></td>
<td>Liquid and solid waste from workshops can contaminate local ground and surface water supply and spread vector habitat by creating breeding grounds. (notably, motor oil can be reused for mosquito control.)</td>
<td>Designs should include proper waste disposal facilities.</td>
</tr>
<tr>
<td><strong>Roads: safety</strong></td>
<td>Safety components can be useful in addressing a wider range of issues than traffic accidents: <em>(a)</em> accident prevention in construction activities, <em>(b)</em> safe handling of hazardous chemicals and wastes, and <em>(c)</em> AIDS and sexually transmitted diseases (STDs), including immunizations for vector-related diseases and STDs.</td>
<td>Implementation TORs should incorporate, as appropriate, these wider health and safety concerns.</td>
</tr>
<tr>
<td><strong>Roads: private sector development</strong></td>
<td><em>(a)</em> Improper disposal of excreta and domestic waste at work camps can pollute local water leading to vector-related diseases, particularly malaria (and sometimes schistosomiasis). <em>(b)</em> Work crews, particularly not local, can introduce vector-related diseases and can spread AIDS and sexually transmitted diseases.</td>
<td><em>(a)</em> Preparation TORs should determine the importance of vector-related diseases locally and risks of their spread. Implementation TORs should include provisions for proper waste disposal and vector control as appropriate. <em>(b)</em> Preparation TORs should provide for appropriate immunizations and education.</td>
</tr>
<tr>
<td><strong>Roads: conservation management</strong></td>
<td>Ecological issues could be enhanced to include preventive measures for workers spreading disease vectors.</td>
<td>Preparation TORs could also address reduction of disease vectors in consultation with the MOH as appropriate.</td>
</tr>
<tr>
<td><strong>Traffic management</strong></td>
<td>Air pollution can be an important direct or predisposing factor for respiratory disease and increased lead level in the blood of the population at risk (resulting in lowered IQs for children and cardiovascular diseases for elders). High-risk groups are traffic police and concentrations of people at congested areas (especially)</td>
<td>Preparation TORs should define appropriate high-risk groups and current air pollution monitoring efforts, assess relative hazard with the MOH, and propose designs as appropriate, e.g., protective kiosks and masks and barriers, Vitamin A supplements for children with lead in the blood in the short term and introduction of unleaded fuel in the</td>
</tr>
<tr>
<td>Typical Transport Projects and Components</td>
<td>Major Health-Related Issues</td>
<td>Main Remedial Measures and Comments</td>
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</tr>
<tr>
<td>cially bus and taxi stations) and markets, schools, and workplaces near heavily traveled roadways.</td>
<td>long term.</td>
<td></td>
</tr>
<tr>
<td>Pollution management</td>
<td>(a) For air pollution see “Traffic Management.” (b) For water pollution, see “Ports” below.</td>
<td>(a) For air pollution see “Traffic Management.” (b) For water pollution, see “Ports” below.</td>
</tr>
<tr>
<td>Railways: rehabilitation</td>
<td>(a) Passenger trains can contribute to excreta- and vector-related diseases in congested areas where toilets empty directly onto tracks. (b) Combustion engine smoke can be major contributor to respiratory disease to residents in railway air shed. (c) Rehabilitation of railroad cars can expose workers to asbestos (used in insulation).</td>
<td>(a) Preparation TORs should determine if excreta removal is a problem. If so, implementation TORs should recommend locally acceptable methods for collection, removal, or disinfection. Community education component might be advisable during implementation. (b) Preparation TORs should determine if smoke is a problem. If so, recommend locally acceptable methods. Might require design modifications or other protective measures, including using trees as barriers for pollution. Community education component might be advisable during implementation. (c) Implementation TORs should include worker protection measures.</td>
</tr>
<tr>
<td>Ports</td>
<td>(a) Storage and transport of hazardous chemicals can cause serious damage to workers and any local population exposed to regular transport or accidents. (b) Traffic congestion can lead to air pollution and accidents. (c) Vessels can cause pollution from domestic and hazardous waste (see “Ports: Marine Pollution”).</td>
<td>(a) Preparation TORs should determine types and volume of hazardous chemicals passing through, and, as appropriate, implementation TORs should design safety component. (b) Preparation TORs should include provisions for assessing traffic management data on congestion, pollution, and port accidents, and implementation TORs should include recommendations for improvements. (c) See “Ports: Marine Pollution.”</td>
</tr>
<tr>
<td>Ports: dredging</td>
<td>Improper disposal of sludge can (a) pollute surface water and groundwater and lead to diarrheas and poisoning (from chemical content) and (b) create mosquito breeding grounds causing malaria and filariasis and other vector-borne disease.</td>
<td>Preparation TORs should contain provisions for appropriate disposal of sludge in terms of pathogen removal, chemical content, and vector breeding.</td>
</tr>
<tr>
<td>Ports: petroleum and cement terminal</td>
<td>(a) Petroleum refinement and shipping can cause air and water pollution. Uncontained fires and accidents at refineries can become world-class disasters. (b) Cement dust is primarily a nuisance, but an important irritant to workers and residents in the air shed, causing skin and eye disease and predisposition to respiratory disease.</td>
<td>(a) Preparation TORs should make provisions for appropriate treatment of waste, controls for air pollution, emergency procedures, and first aid. May require formal loan and credit covenant. (b) Preparation TORs should ensure that assessment of dust is considered. Implementation TORs should make appropriate recommendations for dust reduction from manufacture and local transport.</td>
</tr>
<tr>
<td>Typical Transport Projects and Components</td>
<td>Major Health-Related Issues</td>
<td>Main Remedial Measures and Comments</td>
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<tr>
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<tr>
<td>Ports: marine pollution</td>
<td>( (a) ) Discharge of domestic wastes from pleasure craft, commercial boats, and passenger transport, worsened by absence of convenient onshore waste discharge points, can lead to excreta-related diseases and skin and eye infections. ( (b) ) Discharge of maintenance and bilge cleaning can contaminate food supply, if seafood and shellfish are harvested locally.</td>
<td>( (a) ) Preparation TORs should recommend provisions for pleasure, commercial, and passenger boats. Solid waste component might be advisable. Implementation TORs should include consumer education and might also require special consideration for signs, translations, and so on. ( (b) ) Implementation TORs should include provisions for pollution monitoring in ports and make appropriate recommendations.</td>
</tr>
<tr>
<td>Rivers</td>
<td>See “Ports”</td>
<td>See “Ports”</td>
</tr>
<tr>
<td>Airports and aviation</td>
<td>( (a) ) Air and water pollution from plane fumes and fallout can exacerbate respiratory illness. Noise pollution can contribute to stress for workers and nearby residents. Ozone depletion caused by jet fuel can contribute to cataracts and cancers. ( (b) ) Traffic congestion from vehicles servicing airports can lead to air pollution (and possibly accidents) ( (c) ) Hazardous chemicals (including temporary storage and transits) ( (d) ) Possibility of air accidents ( (e) ) Basic health precautions for international travelers</td>
<td>( (a) ) Preparation TORs should ensure provisions are made to reduce air-noise-water pollution as much as possible. They might entail designs for physical barriers and zoning plans and laws to control flights. Response to ozone might be appropriate in collaboration with Global Environment Facility activity. ( (b) ) Implementation TORs should contain provisions for proper traffic management. ( (c) ) Preparation TORs should contain provisions for handling, storing, and transporting hazardous waste, including first-aid and washing facilities for workers. ( (d) ) Implementation TORs should contain provisions for formulating and implementing emergency airport procedures. ( (e) ) Implementation TORs should contain provisions for collaboration with MOH on appropriate inspection, inoculation, and quarantine procedures as appropriate.</td>
</tr>
<tr>
<td>Airports and aviation workshops</td>
<td>See “Roads: Workshops”</td>
<td>See “Roads: Workshops”</td>
</tr>
<tr>
<td>Capacity and institution building: public health and safety</td>
<td>( (a) ) Inadequate attention to road and driver safety can cause accidents from a myriad of factors: poor maintenance of vehicles, drunk driving, and no driver education or seat-belt campaigns, among others. ( (b) ) Truck drivers are at high risk of spreading or getting sexually transmitted diseases. See below for AIDS.</td>
<td>( (a) ) Preparation TORs should contain provisions for maintenance, enforcement, and public awareness campaigns as appropriate. Involving NGOs in community participation might be advisable. ( (b) ) See “Capacity and institution building: AIDS awareness and prevention” below.</td>
</tr>
<tr>
<td>Capacity and institution building: AIDS awareness and prevention</td>
<td>Truckers can be major factor in spreading AIDS and other sexually transmitted diseases. In small towns, depots, and places where flooding has forced travelers to congregate local circumstances might allow for a tailored response not possible in cities. An education component is appropriate for truckers. It may also be appropriate to consult with the MOH, religious groups, or NGOs to “tailor” a response and, if appropriate, incorporate it into the project.</td>
<td></td>
</tr>
</tbody>
</table>

*Source: Authors’ data.*

198
Water Supply and Sanitation

This section covers environmental health issues linked to water supply and sanitation. It first discusses the broad picture and key environmental health issues, then concludes with an environmental health assessment checklist.

The Broad Picture and Key Environmental Health Issues

Water, sanitation, and drainage have their greatest impacts on diarrheas and vector-related diseases. Provision of clean drinking water can markedly reduce diarrheas by providing basic hygiene, but must go hand in hand with improvements in sanitation; lack of it is one of the major reasons that water is contaminated. Improved sanitation reduces intestinal parasites. Better waste management and drainage plus improved water storage at the household level can reduce the spread of mosquito habitat and reduce flooding, which causes injury and death and may lead to food and water contamination. Proper management of waste disposal sites can help reduce water and air pollution that affects workers and residents near disposal sites.

Table 13-10: Main Environmental Health Linkages for Water Supply and Sanitation

<table>
<thead>
<tr>
<th>Sector or Ministry</th>
<th>Linkages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture and rural development</td>
<td>Transport, storage, and shipment of agricultural products (waste problems, traffic injuries, and air pollution); rural road construction, maintenance, and work crews (spreading vector-related diseases); water supplies (contamination with pesticides and fertilizers)</td>
</tr>
<tr>
<td>Energy</td>
<td>Contribution to indoor and outdoor air pollution from cooking, heating, and lighting fuels and to global warming from inefficient energy production and use. Global warming can spread vector-borne diseases, such as malaria, by extending vector habitats or diarrheas, such as cholera, by allowing pathogens to survive longer in the warmer water.</td>
</tr>
<tr>
<td>Industry</td>
<td>Type of industrial development facilitated by transport system and the type of industries clustering around ports (air pollution, hazardous waste, exposure of nearby residents to industrial accidents)</td>
</tr>
<tr>
<td>Infrastructure: housing and urban development</td>
<td>Contribution to indoor air pollution from vehicular emissions and to global warming (can spread vector-borne diseases, such as malaria, by extending habitats, turning predominantly rural diseases into urban ones)</td>
</tr>
<tr>
<td>Infrastructure: telecommunications</td>
<td>Minor contribution to reducing air pollution by reducing traffic</td>
</tr>
<tr>
<td>Infrastructure: water supply and sanitation</td>
<td>Disposal of vehicles contributing to spread of mosquito habitats; risk of accidents to children fetching water and disposing of garbage; and special waste disposal needs of ports, railways, airports, and motor vehicles (can be hazardous, e.g., oils and battery acid)</td>
</tr>
</tbody>
</table>

Source: Authors’ data.

Key, Confusing, and Misused Terms

Confusion abounds in the use of waste management terminology. Because so many systems worldwide consist of sewerage and buried storm drains, many terms have acquired meanings pertinent to industrialized countries, but that adopted by professionals around the world. Their application, however, is not always appropriate in developing countries. Engineers recognize each other’s “dialects” and readily overcome semantic differences. Misinterpretation and misuse occurs, however, when nonspecialists—task managers to mayors—use the terms in project management. The problem is exacerbated when multidisciplinary teams work together—a factor to be encouraged—but, one that leads to many health dimensions falling between the cracks, because terms of reference and other documentation do not always include definitions. For example, in some places, “sanitation” refers mainly to street cleaning, but an environmental dictionary also defines it as culling diseased branches from trees. The job of a “sanitary inspector” changes from...
maintaining overall neighborhood cleanliness in one country to surveying the food industry in another.

The definitions in box 13-3 refer to the main health dimensions of waste management as used in this work (also see the glossary). Sanitation and drainage represent two ends of a spectrum of services in waste management with different emphases and, together with medical care, are at the core of public health.

**Box 13-3: Key, Confusing, and Misused Terms on Sanitation**

Sanitation. Deals with wastewater and solid waste (see below). Removal of human excreta should be considered uppermost, coordinated with its appropriate treatment and proper disposal, which will depend on local circumstances. The importance of solid waste will vary depending on its content and amount, but can be equally important.

Wastewater. Generally refers to the removal of liquid waste, which consists of sewage (mainly excreta) and sullage (also known as gray water (from bathing, laundry, and food preparation in domestic, industrial, and commercial uses). Sewage and sometimes sullage are conveyed in sewers. The sewer network is sewerage. Sludge is a residue from sewage treatment. Sewage treatment consists of three interrelated stages, for which the full sequence is not always considered necessary: “primary treatment” focuses on physical removal, for example, of grit, grime, and grease; “secondary treatment” emphasizes biological quality for the receiving waters; and “tertiary treatment” addresses the remainder not eliminated in primary and secondary stages. (Even after tertiary treatment, however, water is not necessarily suitable for drinking.) No commonly used term exists for the wide range of nonsewerage options, such as latrines or septic tanks.

Solid waste. Refers to nonliquid waste emanating from domestic, commercial, and industrial sources. “Municipal waste,” “domestic waste,” and “garbage” generally refer to the same thing and constitute the bulk of solid waste. It can, however, contain some excreta, deposited directly or as sludge. Solid waste also covers toxic and hazardous waste. “Hazardous” and “toxic” waste are generally synonymous and require special handling, but have a slightly different emphasis. Material can be hazardous in terms of a risk of fire and injury without necessarily being toxic. More important is the distinction between industrial wastes, which will vary in type and volume from city to city, and hospital waste, which is likely to consist of the same types of waste.

Drainage. Deals with the removal of excess storm water and gray water or sullage. The overriding concern of drainage is removing water, which has not necessarily been contaminated. Prevention of flooding and attendant risks of injury, drowning, loss of housing, and contamination of drinking water are the prime health concerns. The spread of vector (e.g., mosquito) habitats will vary depending on local circumstances.

*Source: Authors’ data*

**Environmental Health Assessment Checklist**

This section presents tools that can be used to determine a broad range of environmental health issues, from which to view direct and indirect repercussions, determine which are most important, and then set priorities according to institutional capabilities and budgets. This intentionally broad approach gives a better idea of the range of institutions that may need to be involved in finding solutions. In keeping with the overall poverty reduction objectives of this discussion paper, the material also describes the main high risk and vulnerable groups.

**Typical Loans and Components from the Sector**

The official World Bank sector designations for the water supply and sanitation subsector are rural water supply and sanitation, urban water supply, and other water, solid waste, water supply and sanitation, and sewerage.
Project interventions can play an important role in control of water and sanitation-related diseases and hinge on three key factors:

- Protection of drinking water quality and provision of adequate quantity
- Provision of adequate sanitation and drainage
- Hygiene education that covers personal, domestic, and food preparation habits.

Hygiene education is as important as water quantity and quality, sanitation, and drainage, but is not discussed below, because the likely type of project response would be a component based on the socioeconomic and behavioral aspects of water and waste management. Such components are not unique to infrastructure, but would be in keeping with the general desirability of community involvement.

**Water Quality and Quantity**

Basic water supply services include, among others, open wells with buckets, boreholes with pumps, roof catchment systems, communal fountains and standpipes, and yard taps and house connections. Infrastructure projects even outside the water and sanitation subsector can contribute in a variety of ways to eliminating diarrheas through components that address any of the three factors noted above. The primary lesson from the literature points squarely to the need for water and waste management as an integrated set of services. Oral rehydration therapy (ORT), that is, providing packets of essential nutrients to replenish those lost through dehydration, is one of the most important curative interventions, which should also be considered to combat diarrheas.

**Sanitation and Drainage**

From a health perspective, water supply, sanitation, drainage, and hygiene education should always be considered as a package, although project responses will vary enormously and not necessarily contain all four. About 75 percent of the water introduced into areas for domestic and industrial uses, plus rain water, need to be removed. Nonetheless, sanitation and drainage are frequently neglected, because political pressure is strongest for promoting water supply rather than sanitation and drainage; politicians like to cut ribbons at dams and airports, not at sewage treatment plants and latrines! The range of complementary services between the two consist of collection, removal, and disposal of:

- Excreta, in solid and liquid forms
- Liquid wastes, whether contaminated or not with excrement, and excess water from precipitation,
- Solid wastes, whether domestic or industrial, contaminated or not with excrement and hazardous materials.

The emphasis accorded to each depends on local conditions. Because sanitation and drainage tend to be forgotten, they are described in detail below.

Sanitation technologies for the safe collection, removal, treatment, and disposal of human excreta range from off-site sewage treatment plants to on-site latrines. The key factors in all the above situations are the degree to which fecal matter can be rendered biologically safe through natural or biochemical methods to release to the natural environment or kept from reaching humans, while still pathogenic.

In this regard, the choice of on-site and off-site options are important, because the reliability of the system will, in turn, determine the potential for exposure. Because excreta removal is so important to the control of water and sanitation-related diseases, table 7-5 above lists the main excreta-related diseases and their control measures.
Sewage treatment spans a wide spectrum of options, selected according to local circumstances. Too often, the “latest and the best” are bought for political rather than technical reasons. Even if they are expensive, off-site systems may be appropriate in high-density urban areas for disposing of excreta, but they can also be disasters, for example, when frequent power outages, service cuts and scheduling, or low pressure are inadequate to maintain the self-cleansing capacity of sewerage. An insufficient quantity of water means that solids and suspended solids may settle and clog the system; in extreme cases, the sewage can evaporate and become a solid crust.

Many on-site or off-site alternatives have been designed to accommodate smaller amounts of water or have other factors adapted for collection, treatment, and disposal in developing countries. Small bore sewers, for example, have the added advantage of not needing to be buried so deeply, allowing for reduction of construction and maintenance in appropriate situations. Where land is available, waste stabilization ponds allow nature to do most of the work after wastewater is conveyed to the ponds through conventional sewers or other means. Long retention time allows pathogens to die off or otherwise lose their viability; worm eggs settle to the bottom and can be removed in the sludge. Many of these are low-cost systems designed to be upgraded. Ventilated improved pit (VIP) latrines, septic tanks, pour-flush, and low-volume flush toilets all have interesting features, which provide different service levels that can accommodate the needs of different users.

“Gray water” or sullage is frequently discharged from buildings without any treatment, but needs to be considered separately for two reasons. First, accumulated water should be removed to avoid providing mosquitoes with breeding habitat or exposing children playing nearby to contaminated water. Second, treatment needs of gray water are different, because, theoretically, it does not contain fecal pathogens; gray water often does, however, contain high pathogen levels, because of overall poor sanitation. Gray water can be accommodated by soakage pits, drainage pits, or a range of lined and unlined and covered and uncovered drains and is often emptied into sewers. The key factor in avoiding health hazards is the degree to which the drains can be kept flowing freely, ponding avoided, and accidents posed by the drains themselves prevented.

Disposal and Treatment of Human Excreta

Sewage, septage, night soil, gray water, and other forms of wastewater and their sludges can all contain fecal matter responsible for a broad range of diseases that include diarrheas (most common or serious are dysentery, gastroenteritis, cholera, and giardiasis), intestinal worms (most common or serious are hookworm and ascariasis, but others include tapeworm, threadworm, and whipworm), hepatitis, typhoid, polio, and a range of fevers and blood parasites. In addition, filariasis and schistosomiasis are spread to humans indirectly by mosquitoes, and snails, respectively, which depend on excreta for their life cycles (see tables 7-5 and 7-7). The diarrheas and intestinal worms are epidemiologically important and their economic impacts significant throughout Africa; the others can be important in pockets (see table 7-6).

Animal excreta is an important factor where exposure to animal urine exists. Leptospirosis (Weil’s disease) is spread by exposure to urine of rodents (especially rats), dogs, swine, and cattle. It is an important occupational hazard for scavengers or “pickers” at sanitary landfills and other solid waste disposal sites.

Waste stabilization ponds and conventional treatment. Task managers and governments frequently confront a confusing array of sewage treatment technologies. Waste stabilization ponds (sewage lagoons or oxidation ponds) and conventional sewage treatment (activated sludge, trickling filters, and so on) represent two ends of the operational spectrum with different emphases and measurement criteria, but are seldom compared as alternate options. Conventional treatment (with the exception of chemical processes) merely speeds up natural processes. Nearby human settlements complicate the issue by imposing time and space constraints on waste treatment. Eco-
logical standards include biological oxygen demand (BOD) and chemical oxygen demand (COD) (see glossary), and public health standards include pathogen reduction. Conventional treatment plants can deliver high levels of BOD reduction, but organic matter remaining in the effluent is technically pathogenic (although not necessarily posing a public health threat, because it is diluted and dispersed in receiving waters). In comparison, waste stabilization ponds can render effluent up to 99 percent pathogen free. As a rule of thumb for a city of 100,000, a waste stabilization pond system would need about 15 hectares and take about one month (more sun and a higher temperature reduce time, but not necessarily space), but other alternatives are available that reduce space requirements. In comparison, a conventional treatment plant occupies 1–2 hectares and requires only a few hours for treatment. (Table 13-11 summarizes this discussion.)

Table 13-11: Highlights of Waste Stabilization Ponds and Conventional Treatment

<table>
<thead>
<tr>
<th>Type of Treatment</th>
<th>Objective</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional treatment</td>
<td>High removal of organic matter (low BOD) for direct release to receiving waters</td>
<td>Smaller overall processing area and shorter treatment time</td>
<td>High capital cost and high operation and maintenance and skilled labor requirements. Poor pathogen removal and needs tertiary treatment. Produces large volumes of sludge</td>
</tr>
<tr>
<td>Waste stabilization ponds</td>
<td>High removal of pathogens and prepares for land disposal or to receiving waters</td>
<td>Low capital costs and flexibility in operation. Reasonably pathogen-free effluent. Low operation and maintenance. Can reuse effluent</td>
<td>Land requirement high for holding ponds</td>
</tr>
</tbody>
</table>

Source: Authors’ data.

Undefined technology in sewage treatment. In many new projects, technologies for sewage treatment are often not yet determined before the project appraisal or negotiations stage, especially in those with privatization. Bidding documents or other contractual arrangements should, therefore, consider environment and health in specific clauses. Because sewage treatment technology is so varied, sections on technology choice should clearly describe pathogen removal or equivalent health analysis in setting effluent standards. This is important, because health criteria are often neglected or presumed covered under ecological criteria such as BOD. Engineers do not confuse biochemical water quality with pathogenicity, as do many others involved in managing water quality. Even when public health is the objective of sewage treatment, the engineer running the plant will be more concerned about the toxic chemicals being used (because they can compromise biochemical processes, corrode machinery, or even force a shutdown of the plant) and less because untreated water could poison people or cause an epidemic. It may be necessary to include a special covenant in the loan or credit to ensure public health criteria are met.

It is most important to ensure that excreta disposal is considered a dimension of water supply projects. The precise components might be straightforward excreta removal and safe disposal, with explicit mention of health criteria and technology choice adapted to local conditions and consumer demand. In periurban areas, a component might deal with the often neglected special requirements of animal excreta. Any of the above should consider including community education and worker protection elements. Because technology choice is so important, technical assistance may be appropriate as a separate component to match local conditions with feasible options or as a workshop during project preparation.

Solid Waste Management

Solid waste management can be a significant part of any project, even if not formally identified as a component, for example, deposition of construction materials in any sector. Solid waste management is broken into municipal and domestic, hospital, and industrial waste management, be-
cause their technical requirements for safe handling and disposal will vary, especially if they contain toxic, hazardous, or radioactive components. In addition, recycling, scavenging, accidents and safety are important factors.

Solid waste disposal also plays a key role in controlling diarrheas and intestinal worms, but often emphasizes smell and unsightliness more than sound epidemiology. The waste disposal process consists of:

- Collection from the household to local consolidation points
- Sometimes transfer to a station, which further consolidates the waste for bulk transport in trucks or other means
- Transport to the disposal site
- Operation of the disposal site itself.

From a health perspective, the first and last stages are most important; each stage, however, has public and occupational health and safety concerns. An important but often overlooked institutional aspect of these concerns is that different municipal or regional agencies as well as private contractors may be responsible for each of the four steps, including the three collection stages; thus, even though health and safety concerns might be clear from the household to the disposal site, they can easily fall through institutional cracks because terms of reference, budgets, and legal jurisdictions do not spell out details on monitoring or responsibilities for enacting corrective measures.

The household and neighborhood stage is important, because diarrheas are most prevalent in children and infants, who spend most of their time there and are exposed to a wide range of contaminants. The neighborhood level is also problematic in management of the whole waste disposal system because of the enormous role socioeconomic and behavioral factors play in organizing and paying for waste disposal. Poor solid waste collection at the neighborhood level can lead to clogged drains, which can spread filariasis, and an accumulation of small containers, which provides breeding habitat for mosquitoes that spread dengue fever. These are particular problems in poor neighborhoods.

At the disposal stage, the greatest hazards are contamination of groundwater and overflow from the site during rains. Children are also at risk, because they are often the ones charged with disposing of household waste and go to disposal sites to play.\textsuperscript{157}

\textit{Municipal and domestic waste.} Water and sanitation subsector projects will probably always address domestic and municipal waste issues and might also include hospital, industrial, and other specialized wastes. The main problem normal domestic and municipal waste present in waste disposal projects is groundwater and surface water pollution from leachate (an accumulation of liquid seeping through the waste) and runoff. Leachate should always be considered potentially toxic and treated accordingly. Its toxicity, however, will have destroyed most pathogens.

Those responsible for transporting waste from households to collection points and scavengers are at high risk, because they require appropriate protective gear to prevent direct contact with the waste, which could contain fecal and toxic material. These are consistent weak links in the chain of personal hygiene and public health. Projects can make a difference through community participation components that study and design activities to be implemented outside the project, for example, access paths where trucks cannot pass to ensure the safety of those carrying waste from within the neighborhood to the collection site. Another example is encouraging wheelbarrows and other transport containers that are more hygienic than open baskets.

Equal managerial attention should be given to \textit{transfer stations}. Although the volume of waste transferred and vehicle traffic varies, lack of supervision can lead to enough waste strewn about to contribute to water pollution, noxious odors, and vector breeding.
During construction or rehabilitation of landfill sites, traffic and dust can pose a major problem to nearby populations. Standard best practices for occupational health and safety procedures already exist and should be implemented. After construction, traffic and dust may continue to be problematic along access roads. Dust can be a major irritant, causing or predisposing individuals to a full range of infectious and noninfectious respiratory disease; scheduling truck deliveries to off-peak traffic hours can sometimes help. Design of remedial measures outside the project area’s access roads is difficult. If the access route happens to be near or through a poor residential area with already high levels of respiratory disease, it might be advisable to work with the ministry of health or community groups to design a road upgrading program, such as tree planting, to help filter the dust. In general, the project could deal with access roads as an extension of the landfill site, even though, they may not technically be part of the project.

Often overlooked as a health hazard is air pollution from the waste itself. Dust is frequently only considered a nuisance, but can be considered a health hazard if it contains residues from industrial waste. Covering the waste with tarps or soil at the disposal site for transport can help curtail the problem. In addition, fires are often intentionally set to reduce waste volumes, and spontaneous fires are a regular problem; both contribute to air pollution.

Throughout operation of a landfill site, new areas must be dug to accommodate additional waste until the site completely fills up and is definitively closed. Site development and extension can pose recurrent health hazards. Two factors are extremely important. First, the soil removed from within the site might already be saturated with potentially hazardous waste from underground water movement, surface saturation, or leachate and should be treated as potentially contaminated. Second, digging holes and depositing soils can contribute to spreading mosquito habitat.

Project components could address (a) water and air pollution, (b) neglect of health considerations at and around transfer stations and disposal sites, (c) traffic and access roads to waste disposal sites, and (d) long-term site management as new sections are opened and old ones closed and sometimes returned to public use. In all the above, worker protection as well as access of children to work sites should be considered. Community participation components can help with basic logistical support to community organizations, religious groups, and NGOs. A technical assistance component might be necessary in selecting technology most suitable to local conditions.

**Industrial waste.** The chief sources of hazardous and toxic industrial waste were reviewed above under “Proximity to Large-Scale or Hazardous Waste” and “Tinkering, Cottage Industries, and Artisanal Markets” under “Housing and Urban Development.”

Epidemiologically, the most important factors concerning industrial waste entail (a) acute intoxication, from which the body may recover, (b) acute poisonings, which can kill or permanently harm, (c) chronic low-dose exposures, which may accumulate to toxic doses, (d) retention of fat-soluble toxins in the body, and (e) low-dose chronic exposures possibly leading to more serious effects, such as cancers or birth defects.

Tackling the full gamut of these waste sources may be too ambitious as a component for any project, except a full-scale waste management project that implements an appropriate, modest technical assistance component. This component could undertake a waste inventory, determine potential health risks, and make recommendations on how the different sources can be most effectively managed.

**Medical waste.** Waste from hospitals and other health care facilities is often not managed separately; adverse consequences may range from polluting water to exposing scavengers at waste facilities. Hospital waste contains human tissue, blood, and other infectious waste (e.g., from operating rooms); sharp objects (e.g., needles and glass); disposable medical equipment (e.g., gloves, aprons, and urine or blood containers); pharmaceutical wastes; solid and liquid radioac-
tive wastes; and domestic garbage. With the probable exception of radioactive material, hospital wastes are either flushed into toilets or mixed with domestic waste, even though they could be collected and stored separately. Sometimes they are burned on site; the residue of unburned material is then mixed with municipal waste. Incineration poses a high risk of spreading disease, because of the potential for incomplete combustion of toxic or contaminated waste settling in the immediate area. Hospital waste, such as leachate, should always be considered extremely toxic, but may be overstated in the popular press as a public hazard and lead to hysteria rather than concern. Pathogens in hospital waste, such as the Ebola virus, however, are fragile outside the human body, readily die off, and require interpersonal contact for transmission. A cholera epidemic may be far more significant as a public health hazard.

**Box 13-4: Medical Waste Management in Ghana**

The Shama-Ahanta East Metropolitan Area (SAEMA), one of Ghana’s five largest cities, is at the forefront of major and secondary SSA cities that are responsible for a combination of urban, peri-urban, and rural conditions and are confronting challenging multisectoral issues involving risks to human health and the natural environment. Many cities address these problems lacking adequate tools. They need assistance to meet these local challenges locally, where they are the key actors, as well as nationally, where they can contribute to policy. Such was the case in SAEMA, where, for example, decentralization policies of the central government have transferred responsibility for safe disposal of medical waste to the city level. The challenge facing such cities is daunting, especially because they need to develop bylaws and other statutory measures to regulate the safe collection and disposal of waste from health care facilities, ranging from laboratories to hospitals. The task is even more daunting, considering the open sale of used syringes (with needles removed) in markets as hair curlers (see chapters 16 and 17).

*Source: Authors’ data.*

If a specific hospital waste component is not affordable or technically feasible within a project, a reasonable objective might be technical assistance to design a waste management program with two foci:

- **In-house.** A system of collection, destruction (of infectious waste), and storage, while educating hospital staff
- **At the disposal site.** A system of segregation, collection, disposal, and destruction (of infectious waste) in a separate, inaccessible area of the sanitary landfill with provisions for its immediate cover. Other measures include educating scavengers and local residents on the dangers of hospital waste and its incineration and the importance of (especially kids) avoiding contact with or proximity to it. The disposal site might require some construction to prevent scavengers or children from access to the landfill and could be incorporated into the project. A local NGO or development agency could assist with implementation of the program.

*Scavenging.* The main environmental health risks come from accidents and exposing scavengers—whether organized workers with protective gear, individual pickers, or children playing—to toxic and other hazardous materials that have not been separated from waste before delivery to the site. Scavengers also risk contracting a full range of excreta-related diseases, of which leptospirosis (Weil’s disease) is a particular occupational hazard.

Reuse and resale of contaminated materials that are not removed from the waste stream but treated as recyclables pose an additional public health risk. They include *(a)* cast-off food, bottles, and tin drums that once contained poisons, *(b)* newspaper and cardboard saturated with toxic runoff and residues, and *(c)* in some instances, discarded hospital waste, such as syringes and reusable containers (although hospitals in developing countries do tend to sterilize and reuse items a
great deal). If food processing waste or food storage wastes (e.g., grains wasted during packaging, storage, or shipping) are delivered to the waste site, special care is needed to determine if the food has been exposed to pesticides or fumigants used in preventing mold or spoilage. In addition, large or industrial producers sometimes throw out food on the verge of spoiling or approaching its sale expiration date.

Several realistic measures can be undertaken in projects, based on government policy on scavengers. All these would depend on how scavengers currently handle waste. An appropriate study would be on the risks scavengers face and remedial measures that are practical under local conditions. Provisions should be made to segregate toxic and hospital waste, if possible. A first-aid station could help scavengers deal with routine wounds, or transportation could be provided to a clinic or hospital for more serious accidents. Upgrading sorting conditions in terms of equipment (conveyor belts, sorting screens, and tools), protective clothing (gloves, boots, glasses, and aprons), washing facilities, and shelter from the sun and rain would help increase productivity and reduce accidents.

Recycling. The most common health hazards stem from routine accidents in handling glass and sharp metal, which could lead to serious infections in unsanitary working conditions. Two other factors present potentially serious problems. First, recycling would spread the hazard of toxic materials contained in glass and metal containers, which may have saturated paper and cardboard. Second, the literature review indicated that, in places, toxic material has intentionally been “disguised” as recyclables. Design of a component could follow the same norms as those for scavenging by providing for first-aid and upgraded sorting facilities.

Drainage

A wide range of drains or various forms of water diverters, from stone-lined ditches to buried storm drains, can accommodate storm water. Water from houses or industries cover an equally wide range of technologies—from simple soakage pits outside a house to elaborate plumbing systems connected to sewers. Storm drains, however, need to accommodate large surges of water that can lead to flooding and soil erosion, which lead to accidents and contamination of people’s living areas. Storm drains in residential areas are often cement-lined ditches covered by cement slabs or metal grates. In short order, however, the covers disappear and the drains become open sewers in which people dump garbage of various kinds. In these cases, the drains themselves become the hazard. Otherwise, the major health problems stem from areawide flooding from clogged or undersized drains, which can cause fecal contamination of living areas, particularly in urban areas where roadways and haphazard residential development cut off natural drainage patterns. Injuries and drowning are also common. In addition, standing water can allow for mosquitoes to breed, which can take less than a week. A component can address this problem by relying on community involvement to keep the drains flowing. Such components, however, are only practical in areas with well-organized or active community groups, NGOs, small enterprises (AGETIP-type activities), or business associations that perceive a benefit.

Possible health repercussions of inadequate drainage range from nuisances, especially odors, to more serious problems, such as filariasis. All forms of wastewater and storm water can transmit excreta-related diseases. In addition, inappropriate drainage allows for accumulation of water that is not necessarily contaminated, but can spread vector habitats for malaria (see box 13-5) and schistosomiasis (in low-density or periurban areas), so the emphasis should be on free-flowing drains. Dirty water actually repels malaria mosquitoes and snails that spread schistosomiasis, but can attract other mosquito species that spread other diseases, such as filariasis. Projects can help resolve the problem through a range of straightforward measures, such as cement slabs to cover

* Agences d’Exécution des Travaux d’Intérêt Public.
storm drains and sturdy metal grates to block solid waste, which can later block drains when wa-
ter flow is low. These physical measures cannot, however, be effective if local populations do not
keep drains clean. Some kind of community participation managed by user groups or local NGOs
is necessary.

Box 13-5: Urban Malaria: The Need for Data from Sectors besides Health

Although it may be relatively easy and inexpensive to establish the presence of malaria in a given
population and treat individual patients, it is far more difficult and costly to reduce breeding and
feeding sources through a mosquito reduction strategy, due to the need for extensive information.
Malarial mosquitoes can fly up to 5 kilometers away and breed in the same areas as other mosqui-
toes that are mainly nuisances. A control plan, therefore, needs detailed information on species,
habitats, potential exposure to humans, and so on; this information may not be available in health
reports. Environmental assessments, in comparison, may contain significant background informa-
tion, describing climate, rainfall, land use, and more and providing maps. Similarly, infrastructure
or education projects could provide information on population distribution. This readily available
material could collectively obviate extensive new research.

Source: Authors’ data.

Water Supply

A variety of components are possible under straightforward water supply projects, for example,
water pollution control, vector control, rainwater catchment, and hygiene education. The greatest
contribution that task managers can make is to ensure that provisions for sanitation and drainage
included at project preparation are not cut later for budgetary reasons.

Surface water. Surface water is susceptible to a wide range of urban and rural pollution. In some
cities, air pollution is a major source of water pollution (not generally in Africa, however). Be-
sides key industrial sources, mining runoff and processing wastes can contain highly toxic mate-
rials such as lead, mercury, and solvents. Water heated and emitted by power plants can some-
times indirectly affect health by increasing the reproduction rate of pathogens to unsafe concen-
trations. In addition, chlorination by-products, which remain in drinking water, have been proven
carcinogenic; the relative risks of cancer, even in industrialized countries, however, are insignifi-
cant compared with the risks of no chlorination. Dams, barrages, weirs, storage reservoirs, and
other water impoundments can spread habitats for mosquitoes that can spread malaria, yellow
fever, and filariasis and for aquatic snails that spread schistosomiasis.* In addition, certain flies
that breed in fast-running, oxygen-rich water spread onchocerciasis (river blindness).

Groundwater. Groundwater tends to be free of pathogens, but might contain toxic levels of natu-
aturally occurring chemicals, such as arsenic, manganese, and iron, and salt, intruding from nearby
saltwater bodies. In general, these chemicals do not pose major widespread public health prob-
lems and can be handled through water treatment, although increasing its costs. Nitrates either
occurring naturally or from fertilizers or animal wastes may contaminate groundwater in areas
with heavy agricultural activity. Nitrates can cause blue baby syndrome (methemoglobinemia),
which also affects animals. In high-density or industrial areas with poor sanitation, fecal and in-
dustrial waste and leachate from landfills and dumps can also, of course, contaminate groundwa-
ter.

* A “dam” generally means a structure holding back water. High dams are higher than 10 meters. “Barrages” allow
water to spill over. “Weirs” divert water flow. A “reservoir” is a water body that holds water to irrigate or generate
power.
Rainwater. Rainwater in itself is pure, but can easily become contaminated by particulate matter in air pollution and dust,* both of which can be concentrated to hazardous levels in runoff of the rooftop or community collection system. (Ambient air pollution is generally not a problem for the SSA Region as a whole, but it can be in large areas.) Agricultural dust can contain pesticide and fertilizer residues. Air sheds can contain a wide array of toxic pollutants from local industries, power activities, and solid waste facilities as well as motor vehicle emissions, containing lead. Power plants and industries are the main culprits in producing acid rain.

Water delivery and storage. Water delivery and storage typically open the door to several health problems. Standpipes generally deliver potable water. Contamination leading to excreta-related diseases frequently occurs when water pressure falls, drawing in surrounding liquid in holes, cracks, and loose connections; this is particularly severe in areas with illegal connections or pipes running through storm drains and even open sewers. Similarly, water storage in drinking pots or rainwater catchment systems can become contaminated with pathogens from people’s hands. At distribution points, such as communal standpipes or catchment systems, lack of drainage can contribute to breeding mosquitoes, spreading yellow fever, dengue, and filariasis. These problems can be reduced through construction of concrete platforms with adequate drainage or soakage pits, plus hygiene education.

Women and children can daily spend hours and walk miles fetching water, leading to physical stress that can impair health, a situation exacerbated in rural areas by the search for fuel and fodder. Often, women and children wait a long time for the water truck to arrive, for adequate water pressure, or simply in long lines. Some of this stress can be alleviated by a small component to build shelter from the sun and rain. Its size and sturdiness (e.g., just a foundation with a simple roof of palm fronds) would depend on local needs and maintenance ability of the community, for example, to replace the fronds. If traffic injuries are a problem for children fetching water, a component could include such protective measures as crosswalks, fences, and so on.

Piped water can contain lead, emanating from old systems that commonly used lead pipes or from new systems using lead in their solder. Lead also factors in air pollution in areas with heavy traffic and vehicles still using leaded gas. Many other sources of lead exist that may actually be more significant in health impact than either air or water pollutants; hence, dealing with lead requires some idea of its relative importance locally in order not to overestimate the role of water and air pollution abatement in projects (see table 7-3). (In Africa, lead pollution is probably not significant; therefore, it may be appropriate to seek additional information on lead sources, because lead reduction is regularly included in pollution management proposals. Money spent on lead may be better directed to other investments or, conversely, to efforts on other significant local sources, in the process, anchoring the benefits of reduced lead.)

The question often arises on the risk of using asbestos cement pipes for drinking water. Asbestos is a known carcinogen; however, no clearly established health hazard links asbestos to drinking water, even though asbestos may appear in small amounts. Asbestos does pose an occupational hazard in pipe installation, but cutting pipe while it is wet can reduce the risk.

Other issues. Fine water spray or vapor from flush toilet use and irrigation can cause some enteric infections, for example, polio and hepatitis, by spreading viruses contained in feces. This accounts for an insignificant amount of disease, except as an occupational hazard. In addition, air pollution from automobile exhaust and industrial waste can cause lung cancer and other respira-

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* Particulate matter is referred to as either total suspended particulates (TSP), suspended particulate matter (SPM), or PM10 (particulate matter smaller than 10 [or sometimes 5] microns in diameter, that is, small enough to penetrate deeply into the lungs).
tory diseases. Unfortunately, these are difficult to trace systematically, because, cancers often do not develop until twenty years after exposure.

*Industrial Wastewater*

Industrial wastewater should always be considered at least potentially dangerous to human health, although often it is not. Potential diseases transmitted in industrial wastewater are too numerous to mention in a checklist; they would largely be a compendium of toxic compounds and heavy metals that result in poisonings. Where industrial wastewater treatment facilities are not part of the project, but industries exist in the project area, it may be appropriate to determine the biochemical composition of the wastewater through a modest technical assistance component and assess potential risk. If treatment is unaffordable, other options include provisions for communal treatment facilities in industrial areas or safe transport to a suitable treatment facility or disposal site. If industrial wastewater contains domestic waste, it can also spread excreta-related diseases. A modest technical assistance component could inventory waste sources, determine their potential risks, and evaluate potential solutions. If the wastewater is deemed hazardous, provisions could be made for treatment.

*Accidents and Safety*

The risk of accidents is enormous in the water and sanitation subsector, because so many activities are still labor intensive and potential exposures in waste management are exceptionally high. People at risk include:

- **Workers in waste disposal.** They are probably at highest risk because of the types of materials they handle. Recycling exposes workers to contaminated materials and to cuts that may develop into more serious infections.

- **Scavengers, where they exist.** They are at an even greater risk, because they may not have access to protective gear or be aware of the toxic content of materials once they are mixed together in trucks. After-hours access of scavengers to waste disposal areas exacerbates the situation.

- **Children at play.** They play after hours at unprotected construction sites, waste disposal sites, and around uncovered storm drains. Moreover, they are exposed to a myriad of pathogens around the household from deficient sanitation and waste disposal.

Fires are a constant hazard at waste disposal sites, whether they ignite spontaneously or are set intentionally. Gas (methane) is naturally formed in the process of anaerobic (i.e., without oxygen) decomposition of wastes. Unless the gas is vented or the waste is aerated, the accumulation of gas can migrate under the waste to surrounding areas, where it can dissipate naturally or accumulate in structures along its path. This high concentration of methane, which is combustible, may also contain other toxic gases from other materials.

Accident and safety components dealing with any of these issues can be included in any water, sanitation, or drainage project.

*High Risk and Vulnerable Groups*

The Water Supply and Sanitation Sector Environmental Health Checklist (table 13-13) shows the range of sector projects by subsector, identifies the main potential environmental health problems, and suggests remedial measures.
Table 13-12: Main Occupational and Vulnerable Groups for Water Supply and Sanitation

<table>
<thead>
<tr>
<th>Activity</th>
<th>Potential Health Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women and children fetching water</td>
<td>Physical and mental stress from hours spent a day; risk of accidents (e.g., falls) if water source is not readily accessible in rural and periurban areas; and risk of traffic injuries when children fetch water in urban areas</td>
</tr>
<tr>
<td>Unprotected cutting of asbestos pipes</td>
<td>Asbestosis</td>
</tr>
<tr>
<td>Work crews on infrastructure projects</td>
<td>Risk of exposure to vector-borne diseases (mainly in rural areas), occupational hazards, potential for high risk of exposure to or spreading HIV/AIDS in temporary work camps, and exposure to diarrheal diseases related to inadequate sanitation in poorly maintained work camps.</td>
</tr>
<tr>
<td>Scavengers and waste pickers</td>
<td>Accidents and exposure of workers, scavengers, and children playing after hours to excreta and toxic material at solid waste sites</td>
</tr>
<tr>
<td>Truck delivery of waste to sanitary landfills</td>
<td>Heavy dust affecting residents along site access roads</td>
</tr>
</tbody>
</table>

Source: Authors’ data.

Table 13-13: Water Supply and Sanitation Environmental Health Checklist*

<table>
<thead>
<tr>
<th>Typical Water Supply Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction and works: general comment</td>
<td>General hazards in excavations, deposition, and temporary storage of construction and excavation debris, among others, due to the construction stage of water and waste management components:</td>
<td>(a) Preparation TORs should ensure that proper measures are taken during construction and afterward to eliminate breeding and feeding grounds and to accommodate proper drainage in flood-prone areas, especially in rainy seasons. May also be appropriate to include technical assistance for residents in community education–type component.</td>
</tr>
<tr>
<td></td>
<td>(a) Pools of standing water and flooding can increase malaria and other mosquito-borne diseases, especially during rainy season; workers and local residents are at risk.</td>
<td>(b) Preparation TORs should ensure that proper occupational health and safety measures are provided for workers and to limit access of children after hours. The latter might be pertinent in a community education–type component.</td>
</tr>
<tr>
<td></td>
<td>(b) Accidents are important: (a) during construction, when workers and nearby residents are at risk of flooding, erosion, and mudslides and children are at risk when playing at sites after hours and (b) after construction, in housing near or over water, infants and children are also at risk of drowning.</td>
<td>(c) Preparation TORs should arrange with health agencies, as appropriate, to address worker camps.</td>
</tr>
<tr>
<td></td>
<td>(c) Work crews can be at risk of AIDS.</td>
<td></td>
</tr>
<tr>
<td>Low-cost sanitation and on-site sanitation: construction and disposal of latrines and septic tanks</td>
<td>(a) Poor maintenance of latrines can lead to full range of excreta-related diseases and also create odors, which discourage their use</td>
<td>(a) Implementation TORs should include procedures for hygiene education; community participation component might be appropriate for maintenance and cost recovery, as appropriate.</td>
</tr>
<tr>
<td></td>
<td>(b) When latrines or septic tanks are emptied, ground and surface water can become polluted and create vector-breeding habitats, leading to full range of excreta- and vector-related diseases.</td>
<td>(b) Preparation TORs should include provisions for proper treatment and disposal of septage sludge; community participation and education; design of appropriate treatment facilities.</td>
</tr>
</tbody>
</table>

* This and other sectoral checklists can be found at <http://www.worldbank.org/afr/environmentalhealth/>.  

211
<table>
<thead>
<tr>
<th>Typical Water Supply Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>If no proper treatment of solids (night soil, septage, and nonstabilized sludge), can lead to same health risks. <em>(Note: some latrines are designed to treat waste.)</em></td>
<td><em>(c) See also “Public Facilities: Washing and Bathing and Toilets”</em></td>
</tr>
<tr>
<td></td>
<td><em>(c) See also “Public Facilities: Washing and Bathing and Toilets”</em></td>
<td></td>
</tr>
<tr>
<td>Public facilities: washing and bathing and toilets</td>
<td>Public facilities require adequate maintenance to prevent clogging of toilets and drains for drinking and gray water runoff, which can pollute ground and surface water and create vector breeding habitats, leading to full range of excreta- and vector-related diseases.</td>
<td>Implementation TORs should include procedures for adequate maintenance, including cost recovery scheme. Public education component might also be appropriate.</td>
</tr>
<tr>
<td>Waste stabilization ponds</td>
<td><em>(a) Periods of low sunshine or temperature can lengthen holding time needed for good pathogen removal.</em></td>
<td>*(a) Design should account for effects of weather in retention time. Depending on population at risk of poor quality effluent, operation might require emergency disinfection back-up. <em>(b) Improperly managed facilities can attract flies and mosquitoes that spread disease.</em></td>
</tr>
<tr>
<td>Conventional treatment plants: activated sludge and trickling filters</td>
<td>Skilled labor required to control flow of influent through various steps, especially to prevent “shock loading” (surge in influent), which otherwise results in high pathogen content in effluent.</td>
<td>Preparation TORs and designs need to assure proper operation and maintenance (or discourage use of conventional treatment). TORs need also to determine if receiving waters of effluent is destined for drinking or domestic uses and consider tertiary treatment or other alternatives.</td>
</tr>
<tr>
<td>Rural water supply</td>
<td><em>(a) Final stages of guinea worm eradication feasible in next decade.</em></td>
<td>*(a) Preparation TORs for rural water supply and sanitation projects should determine if disease is or has been endemic; if so, project could contain monitoring. If still endemic, project should include provisions for protecting water source and education as appropriate. <em>(b) Water supply and sanitation are often the responsibility of MOH or ministry of agriculture, which might not have engineering competence necessary for installation, operation and maintenance, and so on.</em></td>
</tr>
<tr>
<td>Periurban water supply</td>
<td>Periurban areas are often similar to rural areas with different needs for water and waste management to accommodate water, waste, and drainage. Range of diseases might include malaria.</td>
<td>Preparation TORs should reflect low-density living conditions and accommodate agricultural and animal waste. Anti-malaria considerations might need special attention.</td>
</tr>
<tr>
<td>Urban water supply</td>
<td><em>(a) Lack of drainage, especially in areas of communal water supply, breeds mosquitoes and flies, which can be a nuisance and spread disease.</em></td>
<td>*(a) Designs should account for proper drainage, soakage pits, and runoff. Community participation component may be necessary for proper maintenance. <em>(b) Water lines flow next to storm drains, which become open sewers (with time, water lines can sag directly into storm drains from neighborhood activity and</em></td>
</tr>
<tr>
<td></td>
<td><em>(b) Designs should take into account risk of illegal connections, poor operation and maintenance. It may require community participation component.</em></td>
<td></td>
</tr>
<tr>
<td>Typical Water Supply Projects and Components</td>
<td>Major Health-Related Issues</td>
<td>Main Remedial Measures and Comments</td>
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<tr>
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<tr>
<td>illegal connections). Low water pressure causes intake of pathogens into water lines. This is especially problematic in areas with illegal connections.</td>
<td>(a) Preparation TORs should include waste generation inventory and type of scavenging or recycling. Designs should reflect special waste collection and disposal needs and, if appropriate, provisions for scavengers and recycling.</td>
<td></td>
</tr>
<tr>
<td>(b) Clogged drains can help spread vector-related diseases. (c) Poor community organization can lead to (a) and (b) above. (d) Lack of water and excreta disposal facilities can spread diarrheal diseases through food and poor personal hygiene.</td>
<td>(b) Preparation TORs should include description of market business and user groups. Community participation component might be appropriate to help with operation and maintenance and cost recovery. (c) Preparation TORs should examine appropriate use of user charges. (d) Preparation TORs should design for sanitation and drainage in new markets and appropriate renovations in upgraded markets. Implementation TORs should address sound management practices with cost recovery. (e) See also “Public Facilities: Markets” and “Housing and Urban Development.”</td>
<td></td>
</tr>
<tr>
<td>See also “Public Facilities: Markets,” in “Housing and Urban Development.”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public facilities: markets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solid waste management: municipal and domestic</td>
<td>(a) See also “Construction and Works: General Comment”</td>
<td>(a) See also “Construction and Works: General Comment”</td>
</tr>
<tr>
<td>(b) See also “Solid Waste Management: Sanitary Landfills”</td>
<td>(b) See also “Solid Waste Management: Sanitary Landfills”</td>
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</tr>
<tr>
<td>(c) See also “Public Facilities: Markets” in “Housing and Urban Development”</td>
<td>(c) See also “Public Facilities: Markets” in “Housing and Urban Development”</td>
<td></td>
</tr>
<tr>
<td>Hazardous and commercial waste can cause a wide range of public health problems, which might require separate treatment.</td>
<td>Preparation TORs should include provisions, as appropriate, for inventory of sources and volumes of waste and recommend appropriate special handling or treatment. Designs should reflect these accordingly. Monitoring program and user charges may be appropriate.</td>
<td></td>
</tr>
<tr>
<td>Solid waste management: hazardous commercial and industrial</td>
<td>(a) Nonsegregated waste can expose hospital and waste disposal staff (and scavengers) to hazardous waste.</td>
<td>(a) Designs should provide for separate collection and storage of nondomestic waste within hospitals and separate disposal under cover preventing access to scavengers. It may require physical barriers.</td>
</tr>
<tr>
<td>(b) Incineration can expose local workers and residents to unburned hazardous waste.</td>
<td>(b) Preparation TORs should determine if incineration is appropriate. If so, designs should provide for safe incineration and disposal.</td>
<td></td>
</tr>
<tr>
<td>(c) Radioactive waste is a special hazard to workers and local residents and needs special, longterm, and highly technical attention.</td>
<td>(c) Preparation TORs should determine use of radioactive wastes and design handling measures, as appropriate.</td>
<td></td>
</tr>
<tr>
<td>Solid waste management: medical wastes</td>
<td>(a) Improperly designed landfills can lead to water and air pollution.</td>
<td>(a) Designs should provide for appropriate disposal of leachate and air pollution from dried waste and soil cover.</td>
</tr>
<tr>
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<tr>
<td>Typical Water Supply Projects and Components</td>
<td>Major Health-Related Issues</td>
<td>Main Remedial Measures and Comments</td>
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<tr>
<td>sanitary landfills</td>
<td><em>(b)</em> Controlled and spontaneous fires can lead to air pollution and burns. <em>(c)</em> Traffic during construction and operation can cause road dust and accidents. Dried waste can cause dust.</td>
<td><em>(b)</em> Designs should provide for control of fires and accidents from burns. <em>(c)</em> Preparation TORs should include a description of possible road accidents and inventory of schools and workplaces along the traffic routes, assess health data that indicate high-risk areas for respiratory disease along the access roads and site itself, and make appropriate recommendations for design modifications.</td>
</tr>
<tr>
<td>Solid waste management: scavengers</td>
<td><em>(a)</em> Scavengers are exposed to excreta- and vector-related diseases, accidents, and hazardous waste. <em>(b)</em> Scavengers sometimes consume or resell food that is contaminated, spoiled, or near its expiration date. Waste from periurban food processing and storage can be contaminated with fumigants and pesticides.</td>
<td>a) Implementation TORs should plan for safe handling of wastes, and, as appropriate, protective clothing and first aid. Designs should provide for sorting areas with appropriate construction or barriers and so on and, if appropriate, areas protected from sun and rain, benches, screening for sorting or sifting (on conveyor belts). b) Implementation TORs should determine if reuse or resale of food is common. If so, describe basic sources and make appropriate provisions to reduce risk. Community participation component may be useful to educate scavengers and solicit help of food producers.</td>
</tr>
<tr>
<td>Solid waste management: recycling</td>
<td><em>(a)</em> Recycling can cause accidents, in particular, cuts that can lead to serious illness given unhygienic conditions. Paper and cardboard taken from disposal sites can be saturated with toxic materials. Recycled bottles and containers from pesticides and industrial chemicals can lead to acute and chronic poisoning. <em>(b)</em> Hazardous materials can be intentionally disguised as recyclables to reduce disposal costs, e.g., of manufacturers, and sent illicitly to developing countries. <em>(c)</em> Collections of tires, bottles, and cans and other containers that hold water can spread mosquito habitat and vector-related diseases.</td>
<td><em>(a)</em> Preparation TORs should inventory main types of recyclables locally, identify potential health hazards, and provide for first aid as appropriate. TORs should determine potential sources of hazardous and caustic materials and make provisions excluding or processing them from the waste stream. It may require a community participation component for to educate workers or solicit assistance from industries. <em>(b)</em> Implementation TORs should determine if recyclables include imported materials and, if so, contain provisions to ascertain that exporters are legitimate companies and, if necessary, examine waste to ensure it contains no hazardous materials. <em>(c)</em> Preparation TORs should determine basic health risks from mosquito-related diseases and provide appropriate education to reduce risks.</td>
</tr>
<tr>
<td>Hygiene education</td>
<td>Health education is appropriate at almost every level. Frequently encountered problems are training materials and translations into local languages.</td>
<td>Preparation TORs should include, as appropriate, a multidisciplinary team and design programs, at least in personal hygiene, food preparation, and waste disposal.</td>
</tr>
<tr>
<td>Pollution control: general comment</td>
<td>Pollution control covers a broad spectrum and could be part of any project. Health aspects to humans might be relatively neglected or subsumed by standards to meet engineering or ecological criteria, which might also omit role of community partici</td>
<td>Preparation TORs and design standards should include explicit references to pathogen removal, vector control, and, as appropriate, identification of the population at risk or pollution inventory. It might be appropriate to include pollution monitoring and community</td>
</tr>
<tr>
<td>Typical Water Supply Projects and Components</td>
<td>Major Health-Related Issues</td>
<td>Main Remedial Measures and Comments</td>
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<tr>
<td>---------------------------------------------</td>
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<tr>
<td></td>
<td>pation in resolving or monitoring the pollution.</td>
<td>involvement.</td>
</tr>
</tbody>
</table>

**Drainage**

- (a) Blockage of storm drains and inadequate drainage of general area can cause flooding, which can contaminate water supply and cause accidents.
- (b) Blockage of storm drains around markets and public facilities can spread vector habitat for filariasis.
- (c) General inadequate drainage can spread habitat of vectors that spread malaria.
- (d) “Solving” drainage problem of one area may merely shift it to another.

**Sewage treatment plants**

- (a) Poor quality effluent can promote excreta-related diseases.
- (b) Improper sludge disposal can lead to water pollution, which can promote excreta-related diseases and provide habitat for mosquitoes and flies.
- (c) It is not always possible to know in advance the technology to be used and, therefore, design in advance for potential health or occupational risks.

**Emergency cholera response**

- Contaminated water and interpersonal contact are considered the main transmission route in epidemics. Epidemic spread can be rapid, necessitating quick response, e.g., diarrheas cause dehydration and shock within hours and up to 60 percent fatality, if untreated (medication and rehydration). MOHs are not well equipped to provide clean water or chlorinate local water supply and need help from water agency or company.

- Preparation TORs could address (a) chlorination, (b) water delivery (trucks), (c) logistical support, e.g., labs and staff, (d) loan of vehicles and equipment to MOH, e.g., water testing, chlorination, and so on, (e) public education campaigns, (f) as a preventive measure, reordering geographic distribution of future project water and sanitation works.

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**Source:** Authors’ data.
CHAPTER 14: GLOBAL ISSUES

This chapter provides a brief overview of linkages between environmental health and global issues. Coverage will be expanded in future versions of these guidelines, which, for the moment, concentrate on infrastructure sector linkages.

Key Environmental Health Issues

Global issues relevant to environmental health span many topics, including international travel, instantaneous communications, multinational companies, the flow of goods and resources, the changing face of disease, global warming, and ozone depletion. Each has some form of health repercussion. This chapter deals particularly with those environmental health issues that affect the planet as a whole, that is, they have the potential to affect everyone, in contrast to issues happening in many places simultaneously. Of this narrower set of issues, climate change, global warming, and ozone depletion are recognized as key issues.

Table 14-1 shows the range of health dimensions for climate change and ozone depletion and demonstrates the need to take a broad perspective, that is, find remedial measures both inside and outside the health sector. Linking changes in climate with those in disease patterns, in particular, raises appreciation for the complexity of interrelationships in a rapidly changing world. The potential for overall adverse health consequences is indeed staggering.\textsuperscript{159} Indirect effects have substantial and often neglected spin-offs, such as mental stress from loss of home or job after a disaster.

\begin{table}[h]
\centering
\begin{tabular}{|l|l|}
\hline
\textbf{Possible Main Direct Health Effects} & \textbf{Possible Main Indirect Health Effects} \\
\hline
\textbf{Ozone Depletion} & \textbf{Impairment of photosynthesis: compromised food production (may exacerbate illnesses in groups with already weakened immune systems)} \\
\textit{UV radiation:} skin cancer and cataracts (perhaps depression of immune system) & \\
\textbf{Climate Change} & \textbf{Extreme cold:} transport-related injuries and death \\
\textit{Extreme temperature variations:} death, illness, and injury from thermal stress\textsuperscript{*} & \textit{Storms:} loss of housing, mental and physical stress of displaced persons, and increase in water-related infectious diseases \\
\textit{Storms:} drowning and injury & \textit{Floods:} (same as storms) \\
\textit{Floods:} drowning and injury & \textit{Brush and forest fires:} injury and death \\
\textit{Brush and forest fires:} (same as indirect effects of storms, but to a lesser extent) & \textit{Habitat alteration:} infectious diseases, plus epidemics \\
\textit{Food production:} malnutrition & \textit{Water quantity and quality:} diarrheal diseases \\
\textit{Aggravation of air pollution:} aggravation of existing illnesses & \\
\hline
\end{tabular}
\caption{Health Effects of Climate Change and Ozone Depletion}
\end{table}

* Thermal stress refers to the body’s inability to respond to rapid changes of extremes in heat or cold, such as heat waves or cold spells. Cold spells are relevant, because global warming, that is, increase in the average temperature of the earth’s atmosphere, entails greater climate variability and a wide range of weather extremes.
Possible Main Direct Health Effects | Possible Main Indirect Health Effects
--- | ---
Desertification and droughts: malnutrition, plus mental and physical stress of displaced persons |
Rising sea level: water pollution, saltwater intrusion, susceptibility to storms, vector diseases, and malnutrition |
Social and demographic dislocations: mental and physical stress in displaced persons and loss of infrastructure

*Source: Adapted from figure 1-1 in McMichael and others (1996), p. 12.*

An example of how climate change may influence disease is cholera. This disease was once regarded as one of deficient sanitation and poverty, passed on by drinking water and poor hygiene. It is now clear that cholera bacteria live in small crustaceans (copepods), are transported farther, and live longer than formerly assumed. Global warming plays a role in the growth and distribution of algal blooms that harbor these copepods, which are spread over larger areas, indeed, as far north as Norway!\(^{160}\)

A number of key linkages with global issues demand more detailed discussion. They include new and re-emerging diseases, food production, and vector-related diseases.

**“New” and Re-Emerging Diseases**

Besides a resurgence of old scourges, such as TB and malaria, twenty-nine new infectious diseases were discovered in the past 20 years. New and re-emerging diseases are not confined to remote areas, as *Ebola* is in the forests of former Zaire. AIDS, for example, has gone well beyond African forests to become a modern pandemic, although its impacts are still severest in Africa (see section on AIDS in chapters 1 and 8.) In 1990, in Milwaukee, Wisconsin (United States, pop. 850,000), *Cryptosporidium* in drinking water caused 100 deaths and 400,000 cases of sickness, 4,000 of which required hospitalization. The disease, previously associated with poverty and poor sanitation, was linked to farm runoff and agroindustrial pollution that had contaminated Milwaukee’s drinking water supply. *Cryptosporidium* is not killed by most disinfectants and was once filtered out naturally by wetlands, many of which have now been developed. In other words, the same economic growth that contributes to improving the standard of living of the world’s poor may also play a role in new and re-emerging diseases.

Continued economic growth (in developing countries, much of it urban) is outstripping the capabilities of governments and the private sector to provide reliable infrastructure services—the same infrastructure that was responsible a century ago for reducing a wide range of respiratory and diarrheal diseases that took a high toll.

**Box 14-1: Key, Confusing, and Misused Terms on Climate and Ozone Depletion**

*Climate change.* Refers to a complex set of disturbances to intricate ecological systems, not to a single event. Heat waves and storms, for example, are both manifestations of increased climatic variation, a related but different aspect of climate, as are the frequency of extreme variations in climate.

*Global warming.* Refers to increases in mean global temperature, which may entail not only the extreme case of heat waves, but also subtle increases in temperature that occur during cooler seasons.*Source: Authors’ data.*
Food Production

The actual effects of climate change and ozone depletion on the productivity of animal, fish, and agricultural food sources are still uncertain. But many positive and negative factors are postulated. For example, a 2°C–3°C warming in mean global temperature could affect crop production with enormous economic consequences. Changes in temperature and rainfall would directly impact productivity in animals and food crops, as well as growth rates of their pests, predators, and diseases. Lower yields would presumably involve major areas in the middle-to-lower latitudes, which include global breadbaskets, for example, the U.S. Great Plains, parts of southern Europe, the Ukraine, parts of south and southeast Asia, and western Australia, plus arid areas, such as the Sahel. In comparison, higher yields would be expected at higher, temperate latitudes, such as Canada, Siberia, and Patagonia. At present, models indicate that the world would still be able to produce enough food to feed future populations.

The main direct health consequences of climate change entail nutrition, particularly in areas, such as the Sahel, where malnutrition is already common; more than 800 million in the world are now chronically malnourished. The consequences of malnutrition, however, go well beyond issues of food adequacy, that is, providing enough energy to perform bodily functions; they also include, for example, maintaining resistance to infection. It is well known that malnutrition predisposes the body to infectious diseases, but new evidence is helping to clarify the relationship between malnutrition and the immune system. The most worrisome aspect of the re-establishment of infectious diseases is that malnutrition might facilitate transformation of otherwise benign viruses into pathogens. Moreover, application of fertilizers and pesticides to address decreases in food production, possibly compromised by climate change, as well as attain normal growth in agricultural output would increase exposures to pesticide residues; this might bring some of the most worrisome indirect health consequences, including the potential for hormone disruption and reproductive disorders (see chapter 8’s section on “Use of Pesticides and Fertilizers”).

Crops. Increased ultraviolet light (UV-B) on photosynthesis on land- and water-based flora could also reduce food production. The International Panel on Climate Change has estimated that the overall effects of climate change on crop production would be negative, but on a modest scale and the negative aspects would be concentrated in the tropical regions. These are precisely the areas where malnutrition is common, that is, parts of Sub-Saharan Africa, south and east Asia, southeast Asia, and some Pacific Islands. Most of these studies, however, do not account for changes in distribution of weeds and plant diseases. Possible resulting changes in fertilizer and pesticide use have some of the most troublesome health repercussions. These include the potential for hormone disruption and reproductive disorders.

Drought. Drought is also a determinant of food production, but is discussed in chapter 8 on the agriculture sector in box 8-3 and related text.

Table 14-2: Main Environmental Health Linkages with Global Issues

<table>
<thead>
<tr>
<th>Sector</th>
<th>Main Linkages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture and rural development</td>
<td>Agricultural expansion, including slash-and-burn agriculture, and commercial logging can contribute to deforestation (depletion of carbon sinks) and land erosion and, consequently, increases global warming and frequency of extreme weather events; drought and desertification, hence, flooding (causing drowning, migration, and mental stress); water pollution and food contamination (causing diarrhea and intestinal disease, among others); and changes in vector habitats (causing vector-related diseases). It can also cause loss of biodiversity (loss of environmental life support systems and potential curative medicinal plants).</td>
</tr>
<tr>
<td>Infrastructure and urban development</td>
<td>Air shed pollution from vehicular transportation (which could exacerbate watershed and land pollution) contributes to ozone depletion (causing skin cancer and cataracts), global warming and frequency of extreme weather events, drought and desertification, hence, causing the same health effects as listed under agriculture. Deforestation (depletion of carbon</td>
</tr>
</tbody>
</table>
sinks) caused by human settlements and extension of roads and railways can increase global warming (can cause same health effects as listed under agriculture).

Energy

Deforestation (depletion of carbon sinks) due to increased use of biofuels and oil and gas exploration and exploitation; fuels used in vehicular transportation and industry, home heating, and so on and pollutant emissions; and hydroelectric schemes (e.g., organic matter washed into reservoir and plant growth on reservoir can increase greenhouse gases) all contribute to ozone depletion (causing skin cancer and cataracts), global warming and frequency of extreme weather events, drought and desertification, hence, causing the same health effects as listed under agriculture.

Industry

Deforestation (depletion of carbon sinks) from wood meant for industrial purposes (land erosion) and pollutant emissions contribute to ozone depletion (causing skin cancer and cataracts) and global warming and frequency of extreme weather events, drought and desertification, hence, causing the same health effects as listed under agriculture.

Health

Need to increase provision of health services for indirect and direct effects, especially in remote areas.

Environment and natural resources

Deforestation (depletion of carbon sink) can cause loss of biodiversity (loss of environmental life support systems and potential curative medicinal plants) and can contribute to global warming and frequency of extreme weather events, drought, and desertification, hence, causing the same health effects as listed under agriculture.

Source: Authors’ data.

Intestinal worms. The literature deals little with changes in soil moisture that affect the habitats of ground worms (nematodes), which cause intestinal worms, still a major problem in developing countries, A 2°C increase in mean soil temperature would probably cause nematodes to increase. Intestinal worms do not kill, but result in high costs in lost labor. In 1990 intestinal worms accounted for 17,059,000 years lived with disability globally, roughly triple those of malaria.

Vector-Related Diseases

Climate change may have specific impacts in spreading vector-related diseases.

In SSA, Rift Valley fever is spread by mosquitoes, but mainly affects livestock. It can be spread to humans, if they eat meat from infected animals or handle sick livestock. An epidemic in 1997–98 in Tanzania, Kenya, Somalia, and Ethiopia was attributed to the unusually moist climate associated with El Niño.

Spread of schistosomiasis and malaria could increase in some parts of the world, if greenhouse gas reduction measures increase energy prices. This is because higher energy costs might spur dam construction that is now considered technically, but not economically feasible. Twenty-nine of the dams under consideration are located in developing countries where these two diseases exist.

Table 14-3: World Hydro Power: Potential Number of Dams for Development

<table>
<thead>
<tr>
<th>Region</th>
<th>Technically Feasible</th>
<th>Economically Feasible</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>39</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td>Asia</td>
<td>33</td>
<td>26</td>
<td>7</td>
</tr>
<tr>
<td>Austral-Asia and Oceania</td>
<td>4</td>
<td>4</td>
<td>–</td>
</tr>
<tr>
<td>Europe</td>
<td>36</td>
<td>32</td>
<td>4</td>
</tr>
<tr>
<td>North and Central America</td>
<td>15</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Region</td>
<td>Technically Feasible</td>
<td>Economically Feasible</td>
<td>Difference</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------------</td>
<td>-----------------------</td>
<td>------------</td>
</tr>
<tr>
<td>South America</td>
<td>12</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>139</td>
<td>100</td>
<td>39</td>
</tr>
<tr>
<td>Gigawatt hours/year</td>
<td>14,000,000</td>
<td>8,905,000</td>
<td>–</td>
</tr>
</tbody>
</table>

Part 3: Putting Theory into Practice: A Case Study in Ghana
CHAPTER 15: GHANA SAMPLE SECTORAL PROFILES

This chapter presents several individual sector “profiles,” using data on Ghana that illustrates information readily available in Bank files, according to Bank sector designations. At this initial stage, such profiles contain considerable extra information to ensure that individual sectors are not summarized out of context. The material supported preparation of an environmental health needs assessment for Ghana and development of a workshop to determine priorities for targeted collaboration in Sekondi-Takoradi, one of Ghana’s five most populous cities. Chapter 16 presents the needs assessment and workshop results. Preparing a profile is a relatively simple exercise in excerpting existing material to compile information useful in obtaining a short list of environmental health issues and priorities. Analysis of this information takes place at a later stage.

This chapter presents sectoral profiles on environment, health, infrastructure, energy, and industry, and multisectoral profiles on demographic, development assistance, institutional, and poverty reduction aspects. The profiles consist of excerpts from the sources indicated in italics.

Environment Sector Profile
(This section contains material from the World Bank’s 1997 Ghana Country Assistance Strategy.)

Protecting the environment and improving it is also an objective. This is to be achieved by encouraging private investors to incorporate environmental impact assessments and adopt mitigation measures up-front during investment calculations and through public investments in urban sanitation and drainage. One major intervention of the environment sector will consist of improving environmental management in rural areas to reduce deforestation and land resource degradation. The National Environment Action Plan (NEAP) and the recent Government report on environment seek to:

- Develop capacity at the center and at the local government level to monitor environmental impact and to enforce EPA standards in respect of mining and manufacturing investments.
- Raise awareness of environmental problems and their solutions
- Increase public investment in urban sanitation, drainage, and solid waste management, given a rapidly growing urban population. To ensure sustained maintenance of such infrastructure in the absence of willingness to pay, efforts must be made to increase local government revenue collection, as well as development of local government capacity to subcontract services (p.10).

(This section contains material from the World Bank’s 1992 Ghana National Environmental Action Plan.)

Environmental Issues

Land Tenure Security: The nonexistence of a coordinated and comprehensive land use/management policy is considered Ghana’s most critical problem in environmental management. A multiplicity of agencies are responsible for various aspects of land management, which further complicates the situation. The traditional system holds land in trust for the community as a whole. On top of this base are the state’s and private developers’ systems of land use. Ownership
boundaries are not clearly marked or mapped, and title is not well documented and registered. A growing population furthermore puts pressure on available land. Certain land use practices, such as use of agrochemicals, shifting cultivation, and bush fires, have degraded soil conditions and reduced crop output.

**Wildlife Depletion:** The forest policy of 1948 neglected to consider the benefits of trees in land use systems beyond reserved forests. The policy permitted the progressive utilization of forest resources in areas outside the permanent forest estates, which has led to uncontrolled deforestation. Wildlife populations are severely depleted as a result of hunting. Animal habitats in unprotected forests and savannas continue to be threatened by hunting, agricultural expansion, fires, mining, and road construction. About 8.22 million hectares of Ghana is comprised of closed forests (34 percent of total land area). But much of the original vegetation has been removed or modified. It is estimated that only about 2 million hectares of the closed forest remain. A deforestation rate of about 22,000 hectares per year was projected by FAO/UNEP for the period 1981–85. Ghana has no adequate system for monitoring the exact rate of deforestation or forest destruction. The forest, coastal savanna, and interior savanna of Ghana have unique wildlife. Bush meat is a source of protein and is the most expensive form of meat in most population centers; thus, wild animal populations are severely depleted.

**Energy Needs:** As an oil-importing country, Ghana spent about 50 percent of foreign exchange earnings on crude oil imports during the oil crisis of the 1980s. Though this figure dropped to 16 percent in 1988 and 24 percent in 1989, crude oil imports still constitute the single largest consumer of the country’s export earnings, but petroleum provides only 13 percent of the energy consumed in Ghana. Over 80 percent of Ghana’s energy is derived from wood fuels. Energy production and utilization constitute the most pervasive source of environmental pollutants in Ghana. The depletion of forests reduces the size of the carbon sink and contributes to carbon emissions, loss of biodiversity, soil erosion, etc. Major problems include the need to meet the increasing energy requirements of a rapidly expanding population, inefficient production and use of charcoal and firewood, failure to regenerate forest resources more quickly than they are used, and the persistence of inefficient and soil-degrading shifting cultivation and swidden methods as the major agricultural and firewood production system.

**Water Supply:** At present, there are no procedures requiring organizations and agencies wishing to abstract water to submit their requires to an authority responsible for the overall management of water resources, so that the right to abstract water without any detrimental effect can be granted. Although laws exist that prohibit the pollution of water bodies, they are not enforced. Water cycle data, including maps, is inadequate, which hampers comprehensive assessment of water resources. Only 30 percent of the population definitely has potable water access. Waterborne, -related, and -associated diseases plague rural dwellers. Domestic and municipal wastes pollute water bodies. Land degradation and soil exposure results in desertification in parts of Ghana such as the Upper East Region, and changes in the relationship between the water balance components are expected to arise.

**Coastal Degradation:** There are important resources for tourism, fishery, industry and mineral development in Ghana. The lagoon, estuary, and delta ecosystems provide suitable environments for oyster and fish culture. The zone also provides feeding, roosting, and nesting sites for thousands of birds and marine turtles. The beaches, cliffs, lagoons, wildlife, cultural and historical sites, and coastal landscape all provide an immense potential for tourism development. Minerals have been identified within the coastal belt; copra production has been an important economic activity. Current development trends and pressures exerted on the coastal zones and the marine environment not only conflict with resource utilization, but also lead to degradation and interference with the various components of the zone. Persistent coastal erosion and net loss of land from waves and waste disposal in the ocean degrades the marine and coastal ecosystems.
Pollution: The presence of hazardous substances affects the quality of air, water, soil, and life. Industry uses a wide variety of chemicals for various purposes, while agricultural productivity has come to depend on agrochemicals. Concern about industrial pollution is growing. The quantity and diversity of industrial wastes have increased over the years, and there are hardly any waste recycling or proper management practices in the country. There are over 4,000 manufacturing industries in Ghana inducing rural to urban migration. The concentration of industries in the Accra-Tema metropolis has aggravated the environmental stresses caused by industrial activities. The textile, food manufacturing, petroleum refining and handling, and mineral exploitation and processing are the most polluting industries.

Urban Decay: There is an explosion in lawlessness and uncontrolled growth in urban areas. In the last decade and a half virtually no new service roads have been built to the sprawling shelters in urban fringes, and existing roads are in disrepair. Sewage drains are broken and choked, refuse collection and street cleaning are unable to cope with mounting refuse and filth, and there is a lack of service personnel. Many uncontrolled private dumps exist, creating high risks of rodent infestation and disease outbreak.

Environmental Recommendations

Land Use Planning: The NEAP recommends the following actions: collect land resource information in a form suitable for planning; elaborate land resource use policy aimed at resolving conflict, achieving multiple uses, projecting major user requirements in the long term; make recommendations to government.

Natural Resource Management: The NEAP recommends the following actions: speed up and broaden the current land registration exercise; sustain and enforce current bushfire legislation and strengthen control organization; implement a soil conservation program with a focus on restoring fertility; continue support of the Interdepartmental Pesticide Control Program; support current agroforestry programs and encourage the development of private and community forests; assure sustainable supplies of fuel wood by requiring industries to meet fuel wood needs from plantations and by licensing charcoal burners and commercial fuel wood producers; improve the collection of water cycle data; expand and update water resources assessment; prepare Water Master Plans for all river basins; implement measures for the rational management of fish stocks; establish protected areas to be managed for multiple use in the coastal zones; control agricultural development in the coastal zone; implement the national Oil Spill Contingency Plan; and conduct additional research.

Energy Program: The energy sector institutions should pursue the following objectives: restore improved productivity and efficiency in the procurement, transformation, distribution, and use of all energy sources; reduce the country’s vulnerability to short-term disruptions in the energy resources and supply bases; ensure the availability and equitable distribution of energy to all socioeconomic sectors and geographical regions; consolidate and accelerate the development and use of the country’s indigenous energy sources, especially wood fuels, hydropower, petroleum, and solar energy; and secure future power supply through thermal complementation of the hydroelectric system.

Education, Training, Public Awareness: The NEAP recommends the following actions: prepare and implement a program of informal environmental education directed at the district and local levels; establish an Environmental Information Center to provide documentation, information, and referral services to the general public; prepare and publish an annual report on the State of the Environment in Ghana; implement the formal environmental education program in schools; implement environmental education in teacher training institutions; introduce agroforestry in the curriculum of all agricultural training institutions; provide training in environmental aspects of
human settlements in polytechnics and technical institutions; and conduct baseline studies on people’s perceptions and knowledge of the environment.

**Environmental Monitoring:** A fair amount of environmental data already exist in Ghana but are scattered and largely uncoordinated. The NEAP recommends the following actions: establish data collection networks for land use; establish a computerized data bank; implement a monitoring program consisting of synoptic monitoring of environmental indicators at the national level and health-related monitoring of water and air quality, emissions, and noise at selected sites; collect baseline data and monitor changes in wildlife populations; monitor the level of chemicals in food; prepare and publish an annual report on National Environmental Data.

*(This section contains material on the ecological zones of Ghana from the 1998 Ghana Natural Resource Management Project.)*

Ghana comprises two broad ecological zones: the high forest and the savanna. The high forest zone covers roughly one-third of the country and supports two-thirds of the population. Most of the country’s economic activity (cocoa, oil palm, rubber, timber, and mining) is concentrated in this zone. At the turn of the century, the area of high forest was 8.2 million hectares, but this has been reduced to about 1.7 million hectares today, of which 1.64 million hectares is within the 216 forest reserves gazetted in the 1930s. Since then, almost all off-reserve forest has been clear-felled under a deliberate policy to open up farm land. It was not until 1994 that this policy was reversed and controls were put in place to extend harvesting of the small remaining off-reserve resource over a longer period. The boundaries of the reserves are still intact today, with very little farming encroachment. Within the reserves, about 0.4 million hectares are degraded (mainly by bush fires) and in need of replanting, 0.35 million hectares are classified as needing permanent protection (hill and swamp sanctuaries, biodiversity, etc.) and the remaining 0.9 million hectares are classified suitable for timber production. Based on recent forest inventories, the estimated sustainable annual allowable cut (AAC) from the high forest is 1.0 million cubic meters of round logs for the wood processing industry—with half coming from reserve forests and half from scattered trees on farmland, off reserve. The actual tree harvest is difficult to quantify accurately because of illegal felling, but it is generally accepted to be at least twice this level.

The savanna zone covers the drier northern two-thirds of the country, where the main economic activities are the production of annual crops (cereals, root crops, and cotton) and livestock. Woodland covers about 9.4 million hectares of the savanna zone, producing mainly wood fuel and a small amount of building poles for local use. An estimated 70 percent of Ghana’s primary energy requirements come from wood fuel, and this comprises about 10.0 million cubic meters of firewood and an additional 4.0 million cubic meters converted into charcoal for use in urban areas. Although current aggregate wood fuel supply exceeds demand, regional deficits occur in the Upper East, Volta, and Brong-Ahafo regions.

*(The following section contains material on climate from the 1996 Ghana Village Infrastructure Project Environmental Assessment.)*

The climate in Ghana is tropical. Southern Ghana is humid, whilst northern Ghana, which falls partly in the Sahelian zone is relatively dry. During the harmattan season, the northern savannah area becomes extremely dry with relative humidity as low as 25 percent or less in January. Average temperatures vary from about 24°C in the south to around 36°C in the north.

In Ghana the mean annual rain varies from 2,250 millimeters in the West Coastal area to about 750 millimeters in the eastern coastal area and 100 millimeters in the North. The rainfall distribution during the year follows four main patterns. These are a single rainy season increasing from March with the peak in August/September (this occurs in the northern savannah areas typified by Tamale and Navrongo), single rainy season of steady rainfall between March and October (this
occurs in the transition zone and is typified by Kete Krachi), two rainy seasons with peaks in May/June and October (this occurs in the forest zone typified by Kumasi), two rainy seasons, the principal one reaching its peak in May/June and subsidiary one in October (this occurs in the whole of the coastal region); however, the western section has the heaviest rainfall in the whole country typified by Axim, whilst the dryer eastern section is typified by Accra.

*Surface water:* The main river basins in Ghana, which constitute the available surface water sources are the White Volta, Black Volta, Oti, Lower Volta, Pra, Arikobra, Tano, Bia, Coastal Drainage (mainly Ayensu and Densu), and Tordzie/Aka Basins. Rainwater harvesting also serves as a source of surface water available to many rural communities. The mean annual rain varies from 2,250 millimeters in the west coastal area, to about 750 millimeters in the eastern coastal area (around the capital, Accra) and 100 millimeters in the North. This indicates that the Southwestern part of the country is well watered, unlike the semiarid savannas to the North and the Central and Eastern coastal plains. The variability and uneven distribution of rainfall results in water deficit in some parts of the country during the year. Investigations reveal that although surface water quality is generally good, local pollution, however, exists particularly in mining localities and areas of intensive agricultural activities.

*Groundwater:* Aquifers underlie almost all areas in the country. Occurrence of groundwater, however, is controlled principally by local geology and other factors, such as topography and climate. In northern Ghana, aquifers have been located at between 10 meters and 60 meters depth with an average of 27 meters. In southern Ghana, due to thicker soil cover, boreholes are deeper, ranging between 25 meters and 90 meters depth with an average of 42 meters (Bannerman 1986).

**Health Sector Profile**

*(This section contains material from the World Bank’s 1997 Ghana Country Assistance Strategy.)*

*Improving the quality of and access to primary health services.* Improving quality of and access to primary health services is also part of the health sector. While district health management and physical access to health services in Ghana is significantly better than the regional average, low public health spending per capita and the high share of such spending being allocated to nonprimary services leaves district facilities poorly equipped with trained staff and medicine. To overcome this, the Government has begun to:

- Establish standards of practice for a priority package of primary services
- Reorient and retrain health workers to provide such a basic package of services
- Rehabilitate clinics, health centers, and regional hospitals
- Provide essential drugs, equipment, and supplies
- Decentralize delivery and strengthen district and subdistrict management and administrative systems
- Reorient secondary and tertiary service delivery to support primary services
- Support local training institutions to ensure the availability of sufficient technical manpower and capacity building.

*(This section contains material from the 1997 Ghana Health Sector Support Program.)*

The Ministry of Health summarized the systemic problems of the health system as *(a)* people cannot access the health care they need because of geographic distances, limited provision of basic services, and financial barriers, *(b)* inadequate service quality and a lack of quality assurance efforts and resource management results in services, which do not respond to what people want, *(c)* inadequate findings of health services, *(d)* inefficient allocations of resources, with insufficient
findings of primary services, misallocation of health personnel, and inadequate benefits reaching the poor, and (e) poor community, intersectoral, and private sector linkages.

Table 15-1: Common Diseases in Ghana 1994

<table>
<thead>
<tr>
<th>Disease</th>
<th>Reported incidence per 10,000 pop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>1,464</td>
</tr>
<tr>
<td>URI</td>
<td>295</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>185</td>
</tr>
<tr>
<td>Skin diseases</td>
<td>184</td>
</tr>
<tr>
<td>Accidents</td>
<td>170</td>
</tr>
<tr>
<td>Intestinal worms</td>
<td>106</td>
</tr>
<tr>
<td>PRC</td>
<td>104</td>
</tr>
</tbody>
</table>


Table 15-2: Ranking of the Top Ten Diseases in Ghana 1991–94

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Diarrhea diseases</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Upper respiratory infection</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Accidents</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Skin diseases</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Pregnancy related complications</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Intestinal worm</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Gynecological disorders</td>
<td>8</td>
<td>8</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Acute eye infection</td>
<td>9</td>
<td>10</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Hypertension</td>
<td>10</td>
<td>9</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>


Infrastructure Sector Profile

(This section contains material from the World Bank’s 1997 Ghana Country Assistance Strategy, p. 13)

Shifts in Bank Group support to infrastructure in the sense of IDA lending moving away from infrastructure investments in telecommunications, power, rails, ports, and large urban water systems, while supporting privatization and/or private participation with enhanced support from IFC and MIGA. Promoting private participation in infrastructure wherever possible is viewed as necessary to reduce cost and improve the quality of infrastructure services, as well as to overcome the fiscal constraint on infrastructure investment. The Government is very conscious that, despite a highly liberal policy framework, inefficient and insufficient infrastructure services—in telecom, power, rails, ports, urban water supply, airports, and roads—make Ghana-based firms and Ghanaian exports less competitive.

Urban

(This section contains material from the 1996 Ghana Urban Environmental Sanitation Project.)

An Urban Strategy Review carried out in 1993–94 with World Bank support produced the following main conclusions: (a) continued improvements in basic urban infrastructure and services are needed to increase the productivity of urban households and firms, but investments must be carefully selected, (b) infrastructure and services for the urban poor can be improved through targeted
upgrading programs, (c) urban service delivery should be made more efficient and sustainable by
greater competition, more reliance on commercial principles, private sector participation, and
attention to demand, (d) further efforts are needed to obtain long-lasting improvements in revenue
mobilization by local governments, (e) sanitation and waste management are the highest priority
urban environmental problems, and (f) impediments to land transfer, land titling and private land
development need to be removed to make urban areas more efficient and productive. These points
are consistent with a 1993 Ghanaian Task Force proposal for a human settlements strategy, which
reflects a broad national consensus on four basic elements: (a) improving the economic perform-
ance of towns and villages, with particular attention to strengthening the economic linkages be-
tween urban and rural productive sectors, (b) increasing access to basic services, (c) improving
the living conditions of the poor and vulnerable groups, and (d) building human capacity for ur-
ban planning and management.

Water Supply

(Information on water supply was from the 1999 Ghana Water Sector Restructuring Project.)

Water supply systems in Ghana deteriorated rapidly during the economic crisis of the late 1970s
and early 1980s when Government’s ability to adequately operate and maintain essential services
was severely constrained. The economic recovery program the Government of Ghana embarked
on during the mid-1980s set about to, among others, reform public enterprises by increasing their
autonomy with the objective to create effectively managed, financially viable institutions. In the
water sector, the focus was on expansion and rehabilitation in the Accra-Tema Metropolitan Area
in addition to technical assistance to the country’s water supply agency, Ghana Water and Sewer-
age Corporation. In 1993, the Government of Ghana (GOG) initiated a restructuring program of
the water sector aimed at segregating responsibilities for urban water, rural water and sanitation,
and sewerage. Late in 1995, the Government took initial steps to consider options for sectoral
reform involving private sector participation, with the objective of improving levels of service
and operational efficiency. Under current proposals, which have evolved from those initial steps,
water supply for small communities will be the responsibility of the Community Water Supply
Agency (CWSA, soon to be devolved from Ghana Water and Sewerage Corporation) and/or the
District Assemblies, and responsibility for operation of urban water supply, comprising about 101
water systems in 10 regions, from source to end user, will be contracted to private operators in
two separate packages under enhanced lease arrangements (meaning that the private operators
will also be responsible for some investment).

Transport

(Key elements of the transport sector system, sector objectives, road administration and institu-
tional achievements are excerpted from the 1991 Ghana National Feeder Roads Rehabilitation
and Maintenance Project.)

Key elements of Ghana’s transport system are (a) a network of about 14,400 kilometers of truck
and urban arterial roads and about 21,300 kilometers of feeder roads, (b) an over-aged road fleet
of some 130,000 vehicles, (c) a 950-kilometer railway system linking Accra, Tema, Kumasi, and
Takoradi, (d) deep water ports at Tema and Takoradi, (e) an inland water transport system on the
Volta Lake, (f) an international airport at Accra and domestic airports at Kumasi and Tamale, and
(g) a national airline providing international and domestic services. Road transport is the domi-
nant mode in the system, and about 90 percent of it is operated by the private sector, with easy
market entry and little government regulation of its operations. Ports, lake transport, railways, and
civil aviation are dominated by the public sector. Though it intervened on a large scale in the
transport sector in the past, GOG now clearly favors strengthening private sector operations, streamlining and reorganizing public transport enterprise, and privatizing many of them.

**Sector objectives.** Government’s primary sector objectives emphasize (a) rehabilitation and maintenance of existing transport infrastructure in a phased program, with a minimal amount of new construction and (b) strengthening institutions in the sector. The network of rural roads is by far the most important part of the transport system. Though recent projects are gradually improving road conditions, particularly for the trunk roads, the overall road network is still in generally poor quality. It, therefore, needs the largest share of resources and the longest period to regain capacity.

**Rural Infrastructure**

(*This section contains material from the 1996 Ghana Village Infrastructure Project.*)

While Ghana has an abundance of water from rainfall, this resource is very unevenly distributed both geographically and seasonally. Even in the high rainfall (over 1,500 millimeters per annum) belt in the south and west of the country, water can be scarce in the dry season, which lasts three to five months. In the northern and the southeast regions, annual rainfall is normally less than 1,500 millimeters, and, in some areas, below 500 millimeters, with the dry season spreading over eight to nine continuous months. In much of the drier regions, a large part of villagers’ time, particularly of women and children, is occupied in collecting water from distant and often unsafe sources. This takes away a substantial amount of time from other gainful activities. Only an estimated 35 percent of rural communities presently have continuous and easy access to safe potable water. Scarcity of potable water increases the risk of water-borne diseases and has a very negative impact on labor availability and productivity. Provision of safe water and good sanitation in the rural areas is high among the rural development priorities of government. Recent client consultations among rural communities also indicate that the most pressing demands in the northern drier half of the country are for safe and reliable supplies of water. Even in the higher rainfall areas, the need for water is high among the priorities of rural communities particularly for intensification of valley bottom cultivation.

The scarcity of water, particularly in the low rainfall areas, is also a major limiting factor to crop and animal production. The rainfall in the drier parts of the country could be more effectively utilized for intensifying the production of crops and livestock. This would involve appropriate water conservation practices, such as storage in accessible aquifers and in simple surface storage facilities such as ponds, tanks, dugouts, and small reservoirs for use in the dry months. In addition, free-flowing seasonal springs and streams could be important sources for supplemental irrigation in the rainfall months or for diverting to storage facilities for later use during the drier months. There are also good prospects for making better use of water in the higher rainfall zones for producing high-value crops and livestock and for fish culture to improve incomes and nutrition of the populations.

**Rural transport infrastructure.** In addition to low coverage, two-thirds of Ghana’s feeder road network are in poor condition due to past neglect. Good rural roads are essential for achieving increases in agricultural production, especially in nonfood export crops, which in turn, can lead to expanded use of agricultural credit, increases in land values, proliferation of traders and small shops, and expansion of rural markets. Improvements in rural transport infrastructure benefit the rural poor in two distinct ways: (a) directly, by generating employment through labor-intensive construction and maintenance programs, and (b) indirectly, by reducing the cost of transport for goods and passengers. Since the rural poor tend to be small farmers or landless laborers, they benefit, along with the rural population at large, from better roads to the extent that roads decrease the cost of agricultural inputs and/or essential consumer goods within the village or expand
the labor market and increase the demand for unskilled labor; however, the extent to which the poor would benefit from rural roads to increase their access to output markets or economic and social services would be enhanced, if they have access to affordable means of transport. The need, therefore, is not only for transport to link larger communities and markets, but also for appropriate and cost-effective means of getting produce from farms to villages, including the use of nonmotorized wheeled vehicles. (pp. 4–5)

(Information on rural development is from the World Bank’s 1997 Ghana Country Assistance Strategy.)

Promoting rural development and faster agricultural growth by diversifying agricultural exports and improving agricultural productivity is critical both for accelerating growth and promoting a pattern of growth more conducive to reducing poverty. Increasing farm income and speeding up growth in food crops and exports will be facilitated by greater small-holder access to better technology and inputs, public investment in rural infrastructure (safe water, roads, post-harvest facilities, electricity), and better access to finance.

Decentralizing the delivery of social services and rural infrastructure maintenance has been initiated; however, many steps remain to be taken before sufficient capacity is generated and adequate revenue is mobilized at the district level to deliver quality primary health and education services and ensure sustainable maintenance of rural infrastructure. Empowerment of local communities through increased participation is the cornerstone of the Government’s decentralization policy.

Promoting agricultural growth and rural development, Bank assistance in this area will be aimed at promoting private investment (including foreign) in agricultural production in general and in nontraditional exports in particular. For this purpose the Bank will support improvements in agricultural services and in investments in rural infrastructure aimed at enhancing access to new technology and profitability of private investments. In addition, the development of Ghanaian capacity to monitor and protect the environment will be critical to sustainable rural development.

(Information on the agricultural sector and irrigation is from the 1994 Ghana Agricultural Sector Investment Project.)

The total land area of Ghana is about 22.4 million hectares, of which 20 percent is cultivated and 7 percent is under perennial tree crops (cocoa, oil palm, and rubber). Ghana’s agriculture is predominantly smallholder, traditional, and rain fed. The mean farm size is less than 1.6 hectares (4 acres). Small- and medium-sized farms of up to 10 hectares account for 95 percent of all cultivated land. Of the total 2.37 million farms operated in Ghana by smallholders, about one-quarter produce mainly for subsistence, about 55 percent sell up to half of their produce, and less than a quarter market more than half of their produce. This signifies the importance of smallholders, for family, regional, and national food security and for achieving sustained growth in agricultural production.

Common factors in Ghanaian agriculture are the use of bush to restore soil fertility, mixed cropping to minimize risks and, in the north of the country, the widespread integration of livestock into farming systems. Women head 30 percent of rural households and are responsible for about 70 percent of the total food production. They often make decisions about the type and area of crop to be planted and have a key role in weeding, harvesting, and processing. Even in male-headed households, women take care of small livestock. There is little use of purchased inputs and land preparation is manual in most areas, though ox-traction is important in the North. Mechanization is used only by a few large enterprises, and irrigated agriculture is poorly developed, covering only 9,000 hectares throughout the country.


Energy Sector Profile

(Energy information is from the 1995 Ghana Thermal Power Project.)

Government policy in the energy sector is designed to (a) reduce the real economic cost of energy supply through rehabilitation and proper maintenance of installations in the petroleum and electricity subsectors, (b) reduce dependence on petroleum imports through promotion of more efficient energy use and proper pricing, (c) improve forestry management to provide an adequate long-term supply of fuel wood, and (d) strengthen sector institutions through a program of public enterprise reform focusing on commercialization, and, in the case of the power sector, regulation and increased private sector participation.

Ghana has substantial energy resources, of which fuel wood and hydropower are the most important. About 18.3 million hectares are under tree cover, equivalent to three-quarters of the country’s land area, of which about 8.8 million hectares is forest. The high forest zone is concentrated in the southwest, where most of the timber industry is located. The northern savanna woodland has less timber potential, but is the most important source of domestic fuel wood. Deforestation is a growing problem in this area and fuel wood scarcities are beginning to develop as a result. This issue is being addressed under the Ghana Environmental Action Plan and the Ghana Forest Resource Management Project.

Ghana’s hydroelectric potential has been the subject of many studies, some dating from the 1920s, but which have mainly covered specific projects or regions. The country’s total technically exploitable hydro potential is estimated at 10,000 Gigawatt hours annually (2,300 megawatts installed capacity), derived mainly from three major river systems (Volta, Tano, and Pra) in the central and western regions. The presently installed hydro plant capacity is 1,072 megawatts, based on two dams on the Volta River. Other sites on the Black Volta, Pra, Tano, and Oti rivers have been studied to prefeasibility stage, and one of these, Bui (300 megawatts and 1,175 Gigawatt hours) has been studied to full feasibility level. There has been a comprehensive, country-wide survey of small hydro potential, and some recently identified sites could possibly provide an economic supply to isolated centers. Offshore deposits of both crude oil and natural gas have been identified, but their size and commercial viability remains to be confirmed. Ghana has no known deposits of coal. Solar energy is plentiful with most regions receiving in excess of 1,900 hours of annual sunshine. This potential has not yet been exploited to any extent. Wind regimes are moderate and insufficient for energy purposes based on existing technology. None of these options are suitable to provide for the large increment of supply needed to meet the existing load and medium-term load growth on the Ghana electricity grid.

Net domestic energy consumption in 1992 is estimated at 4.4 million tons. The bulk of consumption is wood fuel and agricultural residues (59.5 percent) followed by petroleum products (18.8 percent), and electricity (10.1 percent). Households and commerce accounted for 66 percent of domestic energy consumption, industry/mining 17.2 percent, and transportation 11.2 percent. Petroleum products and electricity consumption increased steadily throughout the period of low economic growth in the 1970s and negative growth in the early 1980s despite the deteriorating economy, spurred by subsidized petroleum products and low real prices for electricity; however, consumption declined sharply after 1982 because of shortages of both petroleum and electricity, but have since recovered as supply conditions returned to normal.

Industry Sector Profile

(Information on the industry sector is scattered through enterprise restructuring projects or private sector development projects. It was easier and quicker to retrieve information available from the World Bank’s 1997 Ghana Country Assistance Strategy, which is excerpted here.)
Selected key recommendations included the following: ensure regular dialogue between government and private sector, improve procedures for business transactions, the privatization of state-owned manufacturing and agribusiness enterprises, and strengthen microfinance institutions.

**Demographic Profile**

*(This section contains material from the World Bank’s 1997 Ghana Country Assistance Strategy.)*

Reducing population growth rate to around 2 percent by 2020 is an important objective of the Government’s Vision 2020.

*(This section, including the city profiles, contains material from the 1990 Ghana Urban II Project.)*

Thirty-one percent of Ghana’s 14 million people live in some 189 urban areas. The two large cities Accra (the national capital) and Kumasi (the capital of Ashanti Region) dominate, accounting for 35 percent of the urban population, and together the five largest towns account for 50 percent of the urban population. Urban population growth rates have been declining—from 4.0 percent in 1960–70 to 3.22 in 1970–84. While still higher than rural rates (2.3 percent in 1970–84), they signal a significant shift in favor of the rural area, no doubt as a result of the economic dislocation that occurred in the 1970s, and continued up to the early 1980. As the economy continues to improve under the Economic Recovery Program, urbanization can be expected to accelerate, placing even greater stress on already overburdened urban systems. Signs of this are already evident in the recent traffic jams in Accra. It is estimated that about 1.6 million persons will be added to the urban population between 1995 and the year 2000, an increase of 35 percent.

**Profile of the cities.** The following is a brief profile of Accra and the four secondary cities:

**Accra.** The capital city and main administrative and commercial center, Accra’s population was estimated at 1.0 million in 1984. If the 1970–84 growth rate of 3.2 percent per annum persists, Accra’s population would be about 1.2 million in 1990 and would grow to about 1.6 million by the year 2,000. This represents a 33 percent increase over the next 10 years, a situation that will place great stress on already overburdened infrastructure, services, and housing facilities. Accra’s road network is fairly extensive, covering about 950 kilometers, of which about 550 kilometers are paved; however, due to inadequate maintenance in recent years the paved roads suffer from varying degrees of pavement distress, with much of the trunk and arterial roads showing signs of severe distress. This deterioration of the network plus a number of network gaps has contributed to extensive delays in the movement of people and goods, as well as damage to vehicles and equipment, very high vehicle operating costs, and loss of life in accidents. Other infrastructure and services leave much less than to be desired. For example, only about 400 properties are linked to sewerage. The sewage treatment facilities are in a state of complete disrepair, and raw sewage is being dumped into the ocean. Solid waste management has shown considerable improvement over the last 3–4 years, due largely to West German technical assistance. It is now estimated that about 60–70 percent of the solid waste is now being collected, as compared to about 20 percent just 5 years ago. Although a fairly extensive program of road maintenance has been undertaken, and it has become clear that major road reconstruction is now necessary due to the age of much of the road network and the significant increase in traffic. Modest drainage, sanitation, and urban upgrading improvements are being done. These need to be continued. Key items for the future (beyond Urban II) include sewerage, major drainage plan review, and environmental improvements in the Korle Lagoon area. Also, efforts need to be made to encourage much better use of existing land resources and to curtail urban spread. In particular, densities need to be considerably increased in the inner city, that is, inside the ring road.
Kumasi. Kumasi, with a population of about 400,000 in 1984, is Ghana’s second largest city, the capital of the Ashanti Region, and the center of the most productive agricultural region of the country. The average rate of population growth during the period 1970–84 was 2.2 percent. Assuming that this rate of growth persists, Kumasi’s population would be about 450,000 in 1990 and would grow to about 570,000 by the year 2000, that is, by about 25 percent over the next 10 years. Despite its critical role in the national economy, Kumasi’s infrastructure and services have been severely neglected. In 1986 it was estimated that as little as 20 percent of the road network was in a serviceable condition. GOG, with assistance from the German Democratic Republic has recently embarked upon a program to rehabilitate approximately 100 kilometers (50 percent) of primary and secondary roads. This program has been very successfully implemented, but much remains to be done, particularly improvements to drainage, street lighting, traffic management, and sanitation. There are still 4,000 bucket latrines in the city, and it is estimated that only 40 percent of solid waste is being collected. The 8,000-stall Kumasi Central Market, one of the largest in Africa and the hub of the regional agricultural (food) economy, is overcrowded, subject to flooding, and without adequate sanitary facilities. The city’s thousands of microenterprises occupy marginal, flood-prone land with poor access to infrastructure and services, and many residential areas are very poorly serviced. Modest drainage and sanitation improvements are being done under PWP.

Tema. Ghana’s main port and industrial center, Tema had a population of about 180,000 in 1984. Built as a new town in the 1960s, Tema’s fortunes have ebbed and flowed with Ghana’s changing political and economic circumstances. Despite this, Tema experienced the second highest population growth in the period (4.6 percent per annum) and is fast becoming a suburb of Accra just 27 kilometers away. Assuming that this rate of growth persists, Tema’s population would be about 250,000 in 1990, and would grow to about 390,000 by the year 2,000, that is, by more than 50 percent over the next 10 years. Although infrastructure provision has been generally of a high standard, maintenance has been neglected. Roads are potholed, significant sections of the sewer pipelines have collapsed creating a public health hazard, and the main pumping stations to the sea outfall have long ago ceased to function. In addition to the above problems, significant informal settlements have developed within the city limits without the benefit of some basic services. Repair of sewer lines and modest drainage, sanitation, and urban upgrading improvements are being done under PWP; however, much needs to be done to rehabilitate the sewage pumping stations and treatment plants. There is no shortage of developable land. On the contrary, land is very underutilized.

Sekondi-Takoradi. The capital of the Western Region, Sekondi-Takoradi with an urban population of about 116,000 in 1984 is Ghana’s second largest port. Although the population is growing very slowly (0.32 percent per annum), there is a significant potential for industry, commerce, and possibly tourism; however, poor infrastructure retards development. Only about 23 percent of the primary roads are surfaced, and even these are badly in need of repair. The water system meets only 50 percent of the estimated demand, solid waste collection is inadequate, and sanitation is a serious problem. The port, which is the center of the local economy, is badly deteriorated and is being rehabilitated with Bank assistance (Credit 1674-GH). Modest road, drainage, and sanitation improvements are being done under PWP. Assuming that Sekondi-Takoradi’s slow growth rate persists, its population in 1990 would be about 182,000 and would grow to about 194,000 by the year 2000.

Tamale. The capital of the Northern Region with a population of about 160,000 in 1984, Tamale, was the fastest growing urban area during the period (4.92 percent per annum). Tamale’s infrastructure is in very poor shape. Because of unreliable electricity supply for pumping, water supply is inadequate and irregular. Also, domestic sanitation is very bad, with over 2,400 bucket latrines in operation and open defecation in many areas of the town. Only 27 percent of the roads are paved, though these are in fairly good condition. Like most other cities and towns, refuse collection systems are inadequate. Tamale was excluded from PWP largely because of its far northerly
location and the difficulty that this posed for project management. Assuming that the 1970–84 growth rate continues, Tamale’s population in 1990 would be about 210,000 and would increase to 340,000 by the year 2000, that is, a 60 percent increase over the next 10 years. This growth will severely strain Tamale’s capacities.

**Development Assistance Profile**

*(Information on development assistance is from the World Bank’s 1997 Ghana CAS.)*

The Bank Group is trying to increase its collaboration with donor agencies, the U.N. system, and NGOs and benefit from the complementarities in the activities of these organizations with those of the Bank. On project aid, most donors in Ghana support agriculture and water and sanitation with social sectors and roads coming after that. The recent road and basic education sector investment programs and the planned health sector program have enhanced donor coordination considerably. There has always been a close relationship between the Bank and other donors. Ghana continues to receive support from a broad donor base. The Bank, as chair of the Consultative Group (CG), provides the forum for CG meetings in Paris every alternate year.

**Donor organizations.** There has always been a close relationship between the Bank and other donors. Ghana continues to receive support from a broad donor base. The Bank, as chair of the Consultative Group (CG), provides the forum for CG meetings in Paris every alternate year and regular consultations among official donors. Consultations with individual bilateral and multilateral donors take place in the context of specific projects or programs and also under the Special Program of Assistance (SPA) for Africa. The relationship is strengthened through weekly “heads-of-donor-agency” meetings and sectoral working level meetings in Accra, and through the sector investment programs in roads, education, and health, which require intensive donor coordination.

While sectoral preferences, project vs. program aid emphasis, and comparative advantage differ among donors, the Bank is seeking to make maximum use of the opportunities for complementarities and collaboration. Table 15-3 below shows the sectors where donors are providing aid.

**Table 15-3: Sectoral Participation of Selected Donors**

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<th>Donors</th>
<th>Bilateral</th>
<th>Agriculture</th>
<th>Water and Sanitation</th>
<th>Education</th>
<th>Health and Population</th>
<th>Roads and Transport</th>
<th>Mining, Energy and Environment</th>
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The Bank works closely with the U.N. system in Ghana with respect to both program planning and operations implementation. The Government-U.N. Country Strategy Note, the LTN Joint Consultative Group’s Common Country Assessment, and the UNAIDS Programs are current examples of collaboration. Of particular significance is the U.N. Special Initiative for Africa. The Bank’s role as resource mobilizer, its experience with the Special Program of Assistance for Africa (SPA), and its piloting of sector investment approaches to development cooperation among domestic external partners are contributing to the formulation of ways and means by which these partners—the Government, civil society, NGOs, donors, and investors—can work together more effectively. Emphasis is being placed on value-added cooperative arrangements in all phases of the development cycle—performance criteria, procurement, disbursement, reporting, and monitoring. The emerging priority areas of joint activity with the U.N. system are good governance, food security, health, and education, with the overarching concern being poverty reduction.

**Institutional Profile**

*(Information is from the World Bank’s 1992 Ghana National Environmental Action Plan.)*

**Recommendation.** Built Environment Management

*Description.* The NEAP recommends the following actions: conduct post-audits on industries in the coastal zone that appear to be contributing to environmental damage; enforce standards and regulations on wastewater discharges, emissions, and disposal of solid wastes; support ongoing waste management programs of the Accra Metropolitan Area, District Assemblies, and townships in the coastal zone; improve urban drainage in the coastal zone; improve the siting of industries and enforce zoning regulations in the coastal zone; develop selected sites in urban areas for recreation and tourism; implement an appropriate strategy for coastal protection, taking into account the efforts of other countries; implement a coastal zone management plan; continue support for the National Program on Chemical Safety; review and update the National Physical Development Framework; acquire government lands in advance of anticipated development needs; reinforce selected settlements to act as rural service centers and reduce congestion in Accra area by promoting the development of secondary centers in the coastal zone; implement an urban sanitation program in Accra and other urban areas; require commercial houses to provide public places of convenience for customers; and implement urban landscaping and urban forestry programs (1992 Ghana NEAP).

**Recommendation.** Institutional Reform

*Description.* Ghana’s NEAP makes the following policy recommendations: strengthen and expand the responsibilities of the Economic Planning Council; strengthen the NDPC and establish a Human Settlements Unit within it; create an institutional structure for integrated land use planning; strengthen selected sectoral agencies and interagency coordination; support district assemblies; and involve community groups and NGOs in informal education, tree planting, and agro-forestry initiatives, and the creation of community environment committees.

*(Health information is from the 1995 Ghana Medium-Term Health Strategy: Toward Vision 2020.)*

The health sector will collaborate with the Ghana Water and Sewerage Corporation (GWSC), District Assemblies, and other agencies in the water and sanitation sector. Act 426 allocates the responsibility for sanitation to the Ministry of Local Government. District, Municipal, and Met-
ropolitan Assemblies are, therefore, responsible for providing environmental health services (p. 30).

(Health information is from the 1997 Ghana Health Sector Support Program.)

There are four main types of health care providers in Ghana: public, private not-for-profit (mission), private for-profit, and traditional. Until the establishment of the Ghana Health Service (GHS) and teaching hospital boards during the program period, the Ministry of Health (MOH) will be the main provider of formal modern services. It is a hierarchical organization with a central headquarters in Accra, ten regional administrations responsible for supervision and monitoring, and district health teams in each of the 110 districts. Public facilities include two teaching hospitals, ten regional hospitals, 48 district hospitals, and over 1,600 health centers and clinics based in subdistricts.

The mission sector is estimated to provide coverage to 30 percent of the population covered by health services, predominantly in rural areas. They account for about 30 percent of hospital beds and 35 percent of outpatient care. There is a good working relationship between the public and mission sectors, with the Government providing salaries for many of the health workers at mission hospitals. The private for-profit sector is growing, particularly in urban areas, whose practitioners consist of physicians, midwives, pharmacists, and laboratory technicians. In addition to having their own associations, private practitioners are registered by statutory bodies associated with the MOH. Traditional providers, who range from spiritualists and psychic healers to herbalists, are likely the most popular first line of health care provider, though quantitative information on the levels of use and costs is not known. At present, traditional practice is not well regulated nor understood by the public sector, though stories of both dangerous practices and miraculous cures are common.

Systemic problems of the health sector. Some of the main problems in health service delivery are well recognized by Ghanaians. In its Five-Year Sector Program of Work 1997–2001 (POW), which details the operational framework for the health sector for the medium term, the MOH aptly summarizes the main problems as: (a) people cannot access the health care they need because of geographic distances, limited provision of basic services, and financial barriers, (b) inadequate service quality and a lack of quality assurance efforts and resource management results in services that do not respond to what people want, (c) inadequate findings of health services, (d) inefficient allocations of resources, with insufficient funding of primary services, misallocation of health personnel, and inadequate benefits reaching the poor, and (e) poor community, intersectoral, and private sector linkages. Overall, access and utilization of allopathic services are quite low; 30–40 percent of the population, mostly those in rural areas, do not have easy physical access to health services. Utilization of public curative services was about 0.39 visits per capita in 1996, though this has been increasing steadily, since the late 1980s; however, the use of antenatal care is much higher—over 80 percent coverage in 1995—while 40 percent of births were supervised by trained health personnel. Traditional donor assistance has led to fragmented approaches to dealing with these problems. Rather than build Government systems to tackle these problems, each donor has tended to establish management and reporting systems for their own project, further serving to dissipate Government resources.

Health expenditure patterns. Absolute resources for the health sector have been shrinking over the last decade. Since 1990, the proportion of Government recurrent funds expended in the health sector has also been declining. Although Government has allocated between 8–11 percent of the recurrent budget to health in the 1990s and 2–9 percent of its capital budget, this represents between 1.0 to 1.5 percent of gross domestic product and from US$4 to US$6 per capita. This places Ghana among the lower half of Sub-Saharan countries in terms of Government expenditure on health (Better Health in Africa) and represents a real decline from the late 1970s, when Government spent around US$10 per capita. The poor also receive proportionately less public
expenditures than others. In 1992–93, Ghanaians from the lowest income quintile received 12 percent of public expenditure on health, compared to 33 percent for the top quintile. External support has increased for health sector, amounting to about US$30 million per year in 1995. The resources available for capital expenditures were not well known prior to the preparation of the sector program, and planning for new capital projects often bypassed the MOH. Private funding is poorly captured in official data, but is estimated to be about equal to the Government expenditure.

User fee policy has been a sensitive issue in Ghana. After user fees were initially introduced in 1985, utilization of health services at public clinics fell markedly. It took nearly ten years for utilization rates to recover to the same levels prior to the use of user fees. Many did not associate user fees with improvements in quality, though in the last five years, the availability of drugs may have improved with the use of “cash and carry” payment for drugs. Out-of-pocket expenditures officially recovered at public facilities have been fairly stable in the last ten years, so that nearly 10 percent of Government recurrent expenditures are financed by these internally generated funds, which are used at the point of collection. This level of expenditures recovered is among the highest in Africa; however, current user fee practices are not transparent and create an obstacle for the poor to access health care. Whilst centrally approved official user fees have not changed since they were introduced, in practice, fees have been rising due to unofficial fees and locally sanctioned official fees. Such fees are inequitable; they should subsidize the poor who are particularly vulnerable. Since they do not, the poor often do not seek care or seek care too late. Those conditions that have value as a public good should also be protected (e.g., free treatment of tuberculosis and sexually transmitted diseases), but are not currently exempted. Revising the exemption policies is a significant part of the current reform program. The reforms include making the fees more transparent to the public, building in a system to regularly review and change rates, exempting vulnerable groups, and incorporating incentives for patients to initially use primary services over more expensive services (p. 2–5).

(Urban information is from the 1996 Ghana Urban Environmental Sanitation Project.)

The most important government policy related to urban development is the recent decentralization initiative. Under the 1992 Constitution and the Local Government Act (No. 462) of 1993, Ghana’s Metropolitan, Municipal, and District Assemblies are autonomous local governments with legislative and executive powers within their areas. They are empowered to prepare and approve their annual budgets, to raise revenues from taxes and fees, to borrow funds, to acquire land, and to provide basic services and local infrastructure. A Letter of Local Government Development Policy prepared by the Ministry of Local Government and Rural Development (MLGRD) in conjunction with the latest IDA-financed urban project focuses on two key points. First, local governments should eventually be able to employ their own staff accountable to them. The 1993 Act calls for the creation of a Local Government Service, and proposals for this are being studied. Second, the Assemblies are to have discretion in selecting of projects to be financed with revenues of the District Assemblies Common Fund.

(Transportation information is from the 1996 Ghana Urban Environmental Sanitation Project.)

Road administration. The Ministry of Roads and Highways (MRH) and its three agencies, Ghana Highway Authority (GHA), Department of Feeder Roads, and Department of Urban Roads (DUR), are the organizations that plan and implement road construction, rehabilitation, and maintenance. MRH was set up in 1982, as a separate ministry in charge of roads and highways, with a nucleus of technical staff that reports to the Secretary of Roads and Highways. GHA was established in 1974 as an autonomous body with its own Board of Directors appointed by the Government, but the Board has recently been replaced by an Interim Management Committee. GHA has a staff of some 6,500 spread over the central office in Accra, 10 regional offices and 32 road area offices. It also has a central workshop and a number of small regional workshops. GHA has 70 engineers, 60 technician engineers as well as some 670 technical and supervising staff. DFR and
DUR were established in 1981 and 1983, respectively, and function as civil service agencies under MRH. DFR staff includes 36 engineers, some 40 other professional staff and 330 technical personnel. It maintains small offices in all regions and in 10 road areas. DUR has a staff of about 200, including 10 engineers and offices in the main cities, where it works with the city councils. Annex 2-1 shows the organization chart of MRH.

**Institutional achievements and requirements.** The most important achievements in recent transport and road projects include: (a) implementing a phased 10-year program (1988–1997) to rehabilitate and maintain the trunk road network, and start of work to organize feeder roads planning, rehabilitation, and maintenance, (b) strengthening MRH, GHA, DFR, and DUR through technical assistance in key areas and through training, (c) reducing the share of force account works carried out by direct departmental labor, (d) setting up a Road Fund to ensure the regular flow of funds to the agencies and contractors, (e) starting pilot projects for introducing labor-intensive rural road rehabilitation, and (f) improving contractor capacity through subloans for equipment and spare parts, training, competitive bidding for all works, and ensuring prompt payments to contractors.

The main institutional support needs that remain in MRH, GHA, DFR, and DUR are: (a) technical assistance in specialized areas where local engineers are not available, (b) an enlarged inter-agency training program to improve existing staff skills and to train newly graduated engineers, (c) incentives such as housing for key officials and food aid through the World Food Program (WFP), which has helped to improve productivity, and (d) training and advice to domestic contractors and consultants to further improve their technical and managerial efficiency. The ongoing First and Second Transport Rehabilitation Projects and the Second Urban Project provide such support to MRH, GHA, DFR, and DUR; additional support for DFR will be provided through this project (1991 National Feeder Roads Rehabilitation and Maintenance Project).

(Agriculture information is from the 1994 Ghana Agricultural Sector Investment Project.)

The Ghana Irrigation Development Authority (GIDA) is the main irrigation development institution and operates under MOFA as a semiautonomous body with four regional representatives. Since 1977, GIDA has built and continues to manage most irrigation schemes, although autonomous operating authorities have been set up for some larger schemes. Local authorities operate small water projects. In the North, the Small Irrigation Division of the Upper Region Agricultural Development Project (URADEP), the Irrigation Company of the Upper Region (ICOUR), and some NGOs assist local communities to develop irrigation. Regional MOFA offices are responsible for extension services. Where crop husbandry practices for rainfed and irrigated crops differ, GIDA assists farmers and MOFA staff with technical advice on irrigated crops.

Most of the irrigation in Ghana, totaling about 7000 hectares, has been developed and is managed by GIDA. GIDA’s schemes vary in size from 100 to 2,500 hectares and most of them are beset with problems. Poor site selection, inappropriate design and unsuitable contracting arrangements have led to unacceptably high costs. Poor extension services have resulted in low yields, while land tenure problems, high maintenance costs and a dependence on GIDA for land preparation have resulted in a lack of farmer interest. This has been exacerbated by a lack of farmer participation in irrigation design and management.

Private irrigation is very limited in scope. Small dams and dugouts for drinking water have been constructed in the northern regions, and these sometimes allow small-scale irrigation for traditional vegetable production on small plots. Some private irrigation schemes for commercial crops have also been constructed along river banks, using low-lift pumps, and a number of community-owned valley bottoms in the South have shown potential for rice under increased water control. Additional studies to identify valley-bottom schemes need to be carried out, however.

(Note: Industry information was not available.)
The Ministry of Mines and Energy (MOME) has principal responsibility for petroleum and electricity; it establishes and implements sector policy. MOME supervises the state-owned Ghana National Petroleum Corporation (GNPC), Ghana Oil Corporation (GOEL), and the refining company Tema OH Refinery (TOR), as well as the two power sector entities—the Volta River Authority (VRA) and the Electricity Corporation of Ghana (ECG). VRA supplies electricity in bulk to ECG, the Volta Aluminum Company (VALCO), several mines, the Akosombo Textile Company, and Akosombo Township. VRA also exports electricity to Communauté Électrique du Bénin (CEB) and, until 1994 Énergie Électrique de la Côte d’Ivoire (EECI). Under the IDA-assisted Northern Grid Extension Project (Credit 1759-GH) of February 1987, the responsibility for generating and distributing electricity in Northern Ghana was transferred to VRA from ECG. These responsibilities are handled by VRA’s Northern Electricity Department (NED). ECG distributes the electricity it receives from VRA throughout the rest of Ghana.

Since its foundation in 1961, VRA has operated as a quasi-enclave within Ghana, enjoying a high degree of autonomy. VRA is a relatively well-run public utility with few institutional and financial problems. ECG, which is a much larger organization, was set up in 1967 to succeed the Electricity Division of the Ministry of Works and Housing. It is now beginning to make the transition from a Government department to a commercially viable enterprise, the objective being to establish itself as an autonomous and effective public utility. Attention has been focused upon sector reforms and other measures needed to strengthen ECG. With the Electricity Supply Board of Ireland’s (ESB) assistance, progress has been made in technical operations under the Power System Rehabilitation Project (Credit 1628-GH) and ECG Fifth Power Project (Credit 2061-GH); however, ECG’s commercial operations need substantial improvement, in respect of which a performance-based management contract with a private firm is being financed under the recently approved National Electrification Project.

Prices of petroleum products and electricity fell sharply in real terms from the mid-1970s until 1983, as a result of Governmental energy pricing management, which failed to fully reflect in petroleum product and electricity prices the extent of high domestic inflation to adjust for overvalued exchange rates during that period. After the major devaluation of the cedi in 1983, domestic energy prices were increased very sharply to bring them back into line with their international equivalents. Subsequent increases in petroleum prices have kept up with the successive devaluations. Petroleum product prices are now within the range of international levels and are unsubsidized.

Ghana’s total installed public generating capacity is about 1,102 megawatts, of which 1,072 megawatts (95 percent) is hydroelectric from two stations on the Volta River at Akosombo (912 megawatts), and Kpong (160 megawatts). Both stations are owned by VRA and are capable of providing firm energy of about 4,343 Gigawatt hours/year and can deliver 6,100 Gigawatt hours/year on average. The Akosombo power station is being retrofitted under the ongoing VRA Sixth Power Project (Credit 2109-GH). Total diesel capacity is less than 50 megawatts of which Tema (30 megawatts) is the largest and has been rehabilitated with U.K. financing. The remainder comprises a number of small isolated stations, which are being retired under the ECG Fifth Power project.

**Poverty Reduction Profile**

(Poverty reduction information is from the 1999 Ghana Community Development Project.)

Recent poverty assessments estimated that some 32 percent of the total population lived in poverty. This is overwhelmingly a rural phenomenon, with over 72 percent of the poor living in rural
areas; however, urban poverty is becoming more pronounced. For a large segment of the Ghanaian population, the quality of life is poor, with high levels of malnutrition and infant and child mortality, low life expectancies, low levels of education and literacy and limited access to employment and economic services.

Objectives. The project proposes to (a) test approaches and mechanisms for delivering, coordinating, monitoring and evaluating poverty reduction programs, (b) build capacity for TCOP/NDPC to coordinate and monitor cross-sectoral poverty reduction programs carried out by different line ministries and at decentralized district and community levels, (c) strengthen collaboration between government and NGOs in targeted service delivery, with NGOs providing the actual services and government providing supervision and support, and (d) strengthen collaboration between the Bank and the UNDP and other development partners in supporting the government’s poverty reduction programs.

The project has identified three areas of specific focus—community-based nutrition and food security, street children, and poverty measurement and monitoring. It will test, in selected districts and urban centers, strategies and operational modalities to:

- Strengthen the capacity of communities and districts to take action against the local causes of malnutrition and to improve nutrition and food security especially for children under five and pregnant and lactating mothers
- Meet the needs of various groups of street children and deepen public awareness and understanding of the street children phenomenon
- Build the capacity of the districts to measure and monitor changes in welfare at household and community levels.

Experience from past operations supported by the Bank and other development partners (e.g., the UNICEF Iringa model for nutrition activities) indicate the following lessons. First, communities should actively participate in the design and implementation of project interventions. This gives them a greater sense of ownership and leads to more sustainable results. Project preparation and implementation should be based on strong coordination and consensus-building mechanisms, allowing for flexibility based on community readiness. Second, there are plenty of resources available for infrastructure development from ongoing Bank operations and from other external sources; however, these resources are generally poorly coordinated and not effectively used. Also, the “software” aspects—how to do what needs to be done—have been underfunded. These are the aspects that need to be strengthened, if investments in infrastructure are to be effectively used and sustained.
References

World Bank Documents Cited

- Community Development Project (1999)
- Water Sector Restructuring Project (1999)
- Ghana Country Assistance Strategy (1997)
- Health Sector Support Program (1997)
- Urban Environmental Sanitation Project (1996)
- Village Infrastructure Project and EA (1996)
- Thermal Power Project (1995)
- Agricultural Sector Investment Project (1994)
- National Feeder Roads Rehabilitation and Maintenance Project (1991)
- Urban II (1990)

Additional Useful World Bank Documents on Ghana

- Private Sector Adjustment (1997)
- Public Finance Management (1997)
- Public Enterprises (1996)
- Highway Sector Investment (1996)
- Non-Bank Financial Institutions (1996)
- Private Sector Adjustment (1995)
- Fisheries (1995)
- Private Sector Development (1995)
- Local Government Development (1994)
- Agricultural Sector Investment (1994)
- Enterprise Development (1993)
- Urban Transport (1993)
- National Electrification (1993)
- Livestock (1993)
- Agricultural Extension (1992)
- Agricultural Research (1991)
- Economic Management Support (1991)
- Transport Rehabilitation II (1991)
- Agricultural Diversification (1991)
- Power VI (1990)
- Water Sector Rehabilitation (1990)
This chapter is based on a pilot study in Ghana, “Targeted Collaboration Among Line Agencies, Local Communities, and the Ministry of Health.” The pilot sought to address the following issues: how can health, environment, and infrastructure agencies collaborate on a daily basis and with what benefits and costs? As a background for the pilot, the needs assessment was discussed at a workshop in October 1999, which is discussed in chapter 17. The needs assessment took place from July to October 1999 in Sekondi-Takoradi, one of the five largest cities in Ghana and also referred to as the Shama Ahanta East Metropolitan Assembly (SAEMA).

Environmental Health Needs Assessment from Ghana

**Introduction and Objectives**

The objective of the pilot study was to develop a methodology to define a parallel set of health priorities based on cost-effective interventions through infrastructure and environmental projects, rather than on typical morbidity and mortality data. An additional objective of the pilot would be to replicate analysis of the needs assessment and recommendations of the workshop for other cities in Ghana. The work was initially based on common “entry points” through which health, infrastructure, and environment agencies can agree on objectives. The three main entry points were selected after preparation of an “environmental health profile,” discussed chapter 15 (see chapter 5 for general methodology). The entry points for the pilot study included:

- Management of wastes from health care facilities
- Urban malaria and other vector-borne diseases
- Water, sanitation, and drainage.

The pilot was intended to build on a research report undertaken between April and August 1998 on development of collaborative linkages between sanitation infrastructure and public and environmental health in the context of the World Bank Urban Environmental Sanitation Project (UESP) in Ghana (Stephens and others 1998).

The pilot was divided into three parts:

*Part one institutional needs assessment.* This would consist of consultations and needs assessment on the Metropolitan District Assembly (MDA), private sector, and civil society to ascertain the opportunities and constraints of intersectoral collaboration and build on the “Consultative Assignment on Urban Public and Environmental Health in Ghana” report. (See “terms of Reference,” below.)

*Part two, workshop.* Plan and organize a workshop to present findings, propose next steps, and engage government officials and agencies and stakeholders in a dialogue.

*Part three, summary report and recommendations.* Produce a final report on the pilot workshop for replication of its findings to other cities in Ghana and possible Bank projects.
Methods and Institutions Consulted

A questionnaire was prepared to solicit response from approximately thirty institutions, including government agencies, the private sector, and civil society, for the needs assessment during two-and-a-half weeks in Sekondi-Takoradi. More than one person was contacted in some institutions (see table 16-1 for a list).

Table 16-1: Institutions Consulted

<table>
<thead>
<tr>
<th>Health Care Facilities</th>
<th>Public Departments</th>
<th>Private Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Effia Nkwanta Regional Hospital</td>
<td>• SAEMA Administration</td>
<td>• SNV</td>
</tr>
<tr>
<td>• Kwesimintim Polyclinic</td>
<td>• Works Department</td>
<td>• Friends of the Nation</td>
</tr>
<tr>
<td>• SAEMA Health Administration</td>
<td>• Public Relations Unit</td>
<td>• African Centre for Human Development</td>
</tr>
<tr>
<td>• Western Regional Health Administration</td>
<td>• Physical Planning Department</td>
<td>• Community Development and Environmental Protection Association</td>
</tr>
<tr>
<td>• Aunty Lily’s Maternity Home</td>
<td>• Legal Department</td>
<td>• Takoradi Market Association</td>
</tr>
<tr>
<td>• Qui-Wal Private Hospital</td>
<td>• Department of Community Development</td>
<td>• An assemblyman for New Takoradi</td>
</tr>
<tr>
<td></td>
<td>• Development Planning Unit</td>
<td>• Unit committee chairman, Effia Electoral Area</td>
</tr>
<tr>
<td></td>
<td>• Environmental Health Unit</td>
<td>• A private water vendor at New Takoradi</td>
</tr>
<tr>
<td></td>
<td>• Waste Management Department</td>
<td>• A public toilet operator at Sekondi</td>
</tr>
<tr>
<td></td>
<td>School Health Education Programme</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Urban Environmental Sanitation Project</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Department of Urban Roads</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Environmental Protection Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Community Water and Sanitation Agency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Ghana Water Company</td>
<td></td>
</tr>
</tbody>
</table>

Source: Authors’ data.

SAEMA was chosen instead of the cities of Accra, Tema, and Tamale, because:

(a) SAEMA has started a nucleus of collaboration and coordination under the leadership of the metro chief executive and the metro coordinating director. Assembly department heads meet every Monday morning to take stock of the previous week’s achievements and plan activities for the coming week. This approach appears to increase awareness among all the departments of the assembly and provides a good example of intersectoral collaboration, which could be developed along the entry points.

(b) Accra is already benefiting from a similar initiative sponsored by the Department for International Development of the United Kingdom (DFID-UK). This initiative, the Accra Metro Environmental Health Initiative (AMEHI), are intended to build meaningful partnerships among the Accra Metropolitan Assembly (AMA), organizations, and community to bring about improved protection and promotion of environmental health in the Accra Metropolitan Area. The key principles include:

- Intersectoral collaboration to improve the environment and health of communities
- Institutional capacity building in terms of required skills, personnel, policies, and systems
- Community participation in the design, planning, and implementation of initiatives
- Information for good management.

246
SAEMA is one of the four district assemblies in the Western Region and one of three metropolitan assemblies in the country. SAEMA is located about 210 kilometers along the coast, west of Accra. SAEMA covers a land area of 334 square kilometers and is divided into three sub-metropolitan district councils: Shama, Sekondi, and Takoradi. The twin city of Sekondi/Takoradi is both the regional and district capital.

The topography of the metropolis varies from sandy coastline in the south to low-lying areas interspersed with ridges and hills (with altitudes ranging from 30–60 feet) in the north. The coastline has many bays with serious erosion problems around Shama, Essaman, Sekondi, Nkontompo, and New Takoradi. Low-lying areas (with altitudes of around 4.5 meters) can be found in the central area of Takoradi. Consequently, Takoradi’s central market is in a flood-prone area. Due to the undulating nature of the topography, a number of muddy lagoons and swampy marshlands are common features of the landscape (SAEMA 5-Year-Development Plan).

Natural drainage channels. The metropolis is drained by a number of rivers. On the western border lies the Whim River with its main tributary, the Ayire, flowing through the Whim Lagoon on its way to the sea. On the east lies the Pra River. These two rivers flow throughout the year. The Kansawurado River flows into the Butua Lagoon past the Takoradi Polytechnic, creating coastal marshlands. The Essie Lagoon is another important lagoon. These lagoons and drainage channels create breeding places for mosquitoes and other vectors of diseases.

Climate. Like other parts of southern Ghana, the metropolis experiences an equatorial type of climate with high temperatures ranging from 22°C to 33°C. Precipitation occurs mainly from March to July (70 percent) and between late September and November (30 percent). The dry seasons are short, occurring from August to early September and December to February.

Population and settlement patterns. The population of SAEMA in the last census (1984) was 249,371 and reached an estimated 357,431 in 1996, representing a growth rate of 3.5 percent a year. The population density also grew from 746 persons per square kilometer in 1984 to 1,069 in 1996. The largest communities are concentrated in Sekondi and Takoradi, which continue to grow due to the high levels of services available. Other large communities with major increases are Shama, Effia-Kuma, Kvesimintim, Adiembra, and Nkotompo. The Shama subdistrict has dispersed communities exhibiting rural characteristics. Much inequity exists in the service delivery system: curative facilities are available in urban areas, whereas rural poor lack access to health care. Areas that lack basic infrastructure have more environment-related health problems.

Occupation. Current information on occupation and employment are not available. The 1984 census figures indicate that retail trade is the major occupation in SAEMA, employing more females than males. Retail trade is followed by the following primary occupations: agriculture, forestry, and fishing. The manufacturing industry, especially processing of primary products, such as wood and food, is next in line. Many wood-processing industries exist due to the tropical rain forest location and variety of timber species.

Solid waste. The assembly collects only 43 percent of total refuse generated monthly, approximately 4,500 metric tons. Business and industrial establishments must dispose of their own waste, but only a few have the capacity to do so. A huge backlog of refuse exists, therefore, creating spontaneous dumps in the communities. The situation is worsened by uncovered refuse trucks littering the streets. The assembly operates two disposal grounds. Dump sites in other communities have become places for indiscriminate defecation, creating environmental hazards. SAEMA has introduced door-to-door collection of refuse in high-income areas with good roads, using private contractors, and SAEMA continues to collect refuse in the other parts of the city.
Liquid waste. SAEMA produces an estimated 1,750 cubic meters of liquid waste a month. SAEMA is responsible for dislodging all liquid waste, except for that of the Ghana Ports and Harbours Authority and Ghana Armed Forces. With the limited holding capacity of its equipment, SAEMA can only handle 50 percent of the total volume generated. Many septic tanks are consequently left unattended when they are full, creating environmental hazards and nuisances.

Toilet facilities. About 60 percent of the total population use private toilet facilities. The remaining 40 percent either depend on public toilets or do free-range defecation. The metropolis has 101 public toilets, which are flush, aqua privy, or KVIPs (Kumasi ventilated improved pit). The use of pan latrines is also widespread. Night soil and effluent are discharged untreated into the sea.

Health care facilities. Table 16-2 shows health care facilities in SAEMA:

Table 16-2: Health Care Facilities in SAEMA

<table>
<thead>
<tr>
<th>Facility</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government hospital</td>
<td>2</td>
</tr>
<tr>
<td>Private hospital or clinic</td>
<td>31</td>
</tr>
<tr>
<td>Government health center</td>
<td>5</td>
</tr>
<tr>
<td>Community and maternity clinic</td>
<td>5</td>
</tr>
<tr>
<td>Doctors</td>
<td>57</td>
</tr>
<tr>
<td>Nurses</td>
<td>248</td>
</tr>
<tr>
<td>Auxiliary health staff</td>
<td>211</td>
</tr>
<tr>
<td>Hospital beds</td>
<td>457</td>
</tr>
<tr>
<td>Population per doctor</td>
<td>4,012</td>
</tr>
<tr>
<td>Population per nurse</td>
<td>922</td>
</tr>
<tr>
<td>Population per hospital bed</td>
<td>500</td>
</tr>
</tbody>
</table>


Environmental Health Findings from the Need Assessment Survey

Top Ten Diseases in SAEMA

Table 16-3 shows the top ten causes of morbidity reported to health institutions for SAEMA within 1997 and within 1998.

Table 16-3: Top Ten Diseases in SAEMA

<table>
<thead>
<tr>
<th>Rank</th>
<th>Disease</th>
<th>1997</th>
<th>Percent</th>
<th>Disease</th>
<th>1998</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Malaria</td>
<td>62,304</td>
<td>36.1</td>
<td>Malaria</td>
<td>70,030</td>
<td>37.4</td>
</tr>
<tr>
<td>2</td>
<td>Upper respiratory tract infection</td>
<td>10,222</td>
<td>5.9</td>
<td>Upper respiratory tract infection</td>
<td>12,724</td>
<td>6.8</td>
</tr>
<tr>
<td>3</td>
<td>Acute eye infections</td>
<td>7,733</td>
<td>4.5</td>
<td>Acute eye infections</td>
<td>11,212</td>
<td>6.0</td>
</tr>
<tr>
<td>4</td>
<td>Diseases of skin</td>
<td>7,201</td>
<td>4.2</td>
<td>Diseases of skin</td>
<td>8,872</td>
<td>4.7</td>
</tr>
<tr>
<td>5</td>
<td>Diseases of oral cavity</td>
<td>4,813</td>
<td>2.8</td>
<td>Diarrheal diseases</td>
<td>6,797</td>
<td>3.6</td>
</tr>
<tr>
<td>6</td>
<td>Diarrhea diseases</td>
<td>4,203</td>
<td>2.4</td>
<td>Accidents</td>
<td>5,324</td>
<td>2.8</td>
</tr>
<tr>
<td>7</td>
<td>Accidents</td>
<td>3,777</td>
<td>2.2</td>
<td>Diseases of oral cavity</td>
<td>5,237</td>
<td>2.8</td>
</tr>
<tr>
<td>8</td>
<td>Ear infections</td>
<td>3,761</td>
<td>2.2</td>
<td>Ear infections</td>
<td>3,774</td>
<td>2.0</td>
</tr>
<tr>
<td>9</td>
<td>Intestinal worms</td>
<td>2,070</td>
<td>1.2</td>
<td>Pregnancy related diseases</td>
<td>3,513</td>
<td>1.9</td>
</tr>
<tr>
<td>10</td>
<td>Rheumatism, joint pains</td>
<td>1,631</td>
<td>0.9</td>
<td>Rheumatism and joint pains</td>
<td>3,012</td>
<td>1.6</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>107,715</td>
<td>62.4</td>
<td>Total</td>
<td>130,049</td>
<td>69.8</td>
</tr>
<tr>
<td>Total OPD attendance</td>
<td>172,659</td>
<td>100</td>
<td>Total OPD attendance</td>
<td>187,053</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Note: a. Outpatient Department.
Source: SAEMA Metro Health Department (1999).
Total outpatient attendance at health institutions within SAEMA in 1997 and 1998 were 172,659 and 187,053, respectively. Malaria has consistently remained the top reason for seeking medical treatment at outpatient departments of all health institutions from year to year. In 1997 and 1998 malaria accounted for 36.1 percent and 37.4 percent, respectively, of all hospital attendance in SAEMA. Table 16-4 shows some of the statistics.

Table 16-4: Outpatient Attendance Due to Malaria

<table>
<thead>
<tr>
<th>Health Institution</th>
<th>Year</th>
<th>Total OPD Attendance</th>
<th>Percent Due to Malaria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kwesimintim</td>
<td>1997</td>
<td>30,011</td>
<td>32.0</td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>28,307</td>
<td>34.5</td>
</tr>
<tr>
<td>Effia Nkwanta</td>
<td>1997</td>
<td>28,324</td>
<td>33.7</td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>20,997</td>
<td>36.0</td>
</tr>
<tr>
<td>SAEMA</td>
<td>1997</td>
<td>172,659</td>
<td>36.1</td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>187,053</td>
<td>37.4</td>
</tr>
<tr>
<td>Western Region</td>
<td>1998</td>
<td>573,632</td>
<td>42</td>
</tr>
</tbody>
</table>

Source: Kwesimintim Polyclinic, Effia Nkwanta Hospital, SAEMA Health Department, Western Region Health Office 1999.

A word of caution. Health statistics either overestimate or underestimate the disease burden. As Dr. Linda Vanatoo, medical director of health services said, “It is important that reported data be interpreted carefully, because of the difficulties in obtaining accurate and reliable data.” Figures may be overestimated because:

- Almost all diagnosis of malaria is made without laboratory confirmation. In an endemic area, such as SAEMA, the real possibility exists of diagnosing every fever at clinics as malaria.
- Return attendance at the health institutions is usually not recorded. The system is also not designed to deduct previous diagnosis from the statistics, should a change occur in diagnosis on return.

Figures may be underestimated because:

- The reported figures do not include statistics from the private sector, the quasi-government health institutions, and traditional medical practitioners, all of whom treat malaria.
- Most people with a fever take a course of chloroquine by themselves and only report to the health institution if they do not recover.

Relationship between the Top Ten Diseases and Environmental Conditions

Health cannot be achieved by the health sector alone. The Ministry of Health recognizes this and, in its program of work, emphasizes development of broadly based approaches to public health, including collaboration between the other sectors and the public (Ministry of Health 1996). The ministry realizes that other MDAs control most determinants of health, especially environmental health, whereas members of the public play a significant role in causing disease through their actions. Table 16-5 summarizes the ten top diseases and their relationship to environmental conditions.
Table 16-5: Environmental Linkages of Top Ten Causes of Morbidity in SAEMA

<table>
<thead>
<tr>
<th>Disease or Condition</th>
<th>Comments (Linkage to Environmental Conditions, Required Interventions, and Other Factors)</th>
<th>In Last Five Years</th>
</tr>
</thead>
</table>
| Malaria              | • Anopheles mosquitoes breeding in accumulated brackish water, due to inadequate vector control, sanitation, drainage, and public awareness  
                        • All ages affected, but mostly children ages 0–15 years  
                        • Lower socioeconomic areas are most affected | Stable              |
| Upper respiratory tract infection | • Poor housing, indoor and outdoor pollution, crowding, and poor nutritional status  
                                    • Common among children 0–4 years and also workers and populations near quarries, cement works, and mines | Stable              |
| Acute eye infections | • High reported number of eye conditions, believed to be reduced due to support area receives from NGO Eye Savers on eye conditions  
                        • Inadequate supply of safe water and poor personal hygiene | Increasing, due to cases coming from outside SAEMA |
| Diseases of skin     | • Inadequate supply of safe water and poor personal hygiene  
                        • Includes ulcers | Stable              |
| Diarrheal diseases   | • Water and food contamination from poor solid and liquid waste management and poor personal hygiene  
                        • Common among fishing communities, especially during fishing season | Stable              |
| Accidents            | • Household and road traffic accidents and burns  
                        • The 15–45 year age group mainly affected | Stable              |
| Diseases of oral cavity | • Ignorance and poor personal hygiene and poverty  
                            • High numbers due to presence of dentists at some hospitals. Patients come from within and outside SAEMA, seeking health care for this reason | Stable              |
| Ear infections       | • Ignorance and poor personal hygiene and poverty  
                        • The reason for the high number of ear infections not totally clear | Stable              |
| Pregnancy-Related Diseases | • Inadequate antenatal care and inaccessible health care facilities  
                                • Also reflects the high total fertility rate in the area | Fluctuates          |
| Rheumatism and Joint Pains | • Mostly due to sickle cell disease, a common inherited disorder among Africans. Lack of premarital counseling services for sickle cell patients. | Fluctuates          |

Source: Data compiled for the study.

*Perceptions of the Health Problems*

All health institutions generally agree that no policy and operational guidelines exists for managing hospital waste in the city. Both private and public health institutions currently either bury or burn their waste. They concede that this is not hygienic and could lead to health hazards to scavengers, staff, and general public. The institutions observe that the absence of an operational or policy guidelines for managing and disposing of hospital waste is a fundamental issue to tackle and suggest the involvement of SAEMA’s Waste Management Unit.

Nonhealth institutions, particularly waste management, the UESP, and Ghana’s EPA, recognize the risk to both the community and health service staff and have recently begun investigating the issue. These actions are in the conceptual stage and may take some time to effect. The Western Regional Health Administration, which has the institutional responsibility for developing such a policy, should play the lead role in addressing the problem.

The health institutions are unanimous in their perception of the linkages among the ten top diseases and unsanitary environmental conditions in communities, demonstrated by accumulation of solid waste, indiscriminate defecation on beaches and in open spaces, choked gutters, and poor toilet management. Drainage in the metropolis is grossly inadequate, making the area susceptible
to flooding and stagnant water. The rainy season consequently records the highest frequency of environmentally related diseases, such as malaria and diarrheal diseases.

Nonhealth agencies attribute health problems to inadequate provision of basic facilities in both homes and communities. The head of the Physical Planning Department notes that topographic characteristics of the area combine with absence of proper land-use guidelines to contribute to flooding and formation of vector-breeding sites.

**Box 16-1: Mr. Ampadu Adjei (Head of Physical Planning Department)**

“The topographic characteristics of the SAEMA area make environmental management a critical issue. There are a number of lagoons and water courses that need to be managed properly. The absence of proper land use guidelines in developing the areas around the lagoons has led to a fundamental problem and has adverse effects on health, for example, flooding and malaria control.”

*Source: Authors’ data.*

Housing development characterized by multiple-unit dwellings and overdevelopment has also had an impact on health and hygiene (ventilation, crowding, and lack of amenities and circulation spaces and inadequate provision of sanitation services within homes).

Another dimension of the problem has to do with apathy, attitudes, behavior, and ignorance of the people toward sanitation issues. The public believes that because they pay property rates and levies, SAEMA should alone be responsible for handling waste in the metropolis and the public carries no further obligation. Regulations and bylaws of the General Assembly are flouted and the courts are not able to prosecute offenders.

**Box 16-2: Market Women Association**

“We are aware of the poor sanitation that is in the markets, but we have no control or management role. It is the responsibility of SAEMA, because we pay market tolls.”

*Source: Authors’ data.*

In the rural area, poor health is the outcome of an inadequate supply of potable water and poor sanitation facilities, coupled with poor personal hygiene, which is directly related to poverty and ignorance.

Perception of the linkage between environmental factors and diseases exists at all levels. This perception, however, is not translated into action at the intersectoral level.

**Institutional Roles Regarding Entry Points**

*Health institutions.* Malaria and other vector-borne diseases are major causes of morbidity and mortality in SAEMA. Both private and public health institutions are responsible for providing curative care for patients. In the design of the health care delivery system, these health care facilities currently emphasize their curative more than preventive role, which is relegated to the public health sector. The public health institutions or units of health care facilities are responsible for the following:

- Health education for the public at health institutions and in communities
- Curative and preventive outreach services to the communities
• Monitoring the disease trends in the region and feeding information to lower structures
• Carrying out surveys on prescribing habits and training of prescribers in properly managing malaria and other vector-borne diseases
• Training others, for example, community-based health care workers, day care teachers, chemical dealers, and so on as primary care providers for malaria
• Liaison with other sectors at the SAEMA and Regional Coordination Committee levels for improved management of the environment to control vectors and sources of infections
• Organizing the Regional Malaria Awareness Program for the public
• Promoting screening of houses and use of insecticide-treated materials (ITM), for example, pyrethroid-impregnated bed nets for vector control.

In its supervisory and monitoring role, the District Health Administration collects and collates data on all diseases from public health institutions and sub-metro health management teams. These data are used in planning health service delivery, including public health education. The District Health Administration also assists in drafting the assembly’s bylaws on sanitation.

The District Health Administration serves as the link between the public and private health institutions and the nonhealth departments of SAEMA. It liaises with the Environmental Health Division, the Waste Management Department, and other stakeholders in maintaining sanitation and vector control. The administration, thus, plays an advocacy role at intersectoral levels to ensure incorporation of health considerations in planning and managing assembly projects. This is achieved by the Metropolitan Director of Health Services serving on a number of subcommittees of the assembly.

**Box 16-3: Dr. Lynda Vanatoo (Metro Director of Health Services)**

“In the current year, the department has actively worked with the Environmental Health Unit on the following:

• Weeding, spraying around houses and water bodies to control the breeding of mosquitoes
• House-to-house inspection to detect and enforce the control of breeding sites of the disease vectors
• Public education on personal hygiene and sanitation practices
• Routine cleansing of public and community drains.”

*Source: Authors’ data.*

The private sector health institutions, private medical and dental practitioners, quasi-government hospitals, traditional herbal practitioners, and private maternity homes play important roles in the curative management of diseases in the metropolis.

**Nonhealth Departments**

The nonhealth institutions are responsible for providing and maintaining urban infrastructure and putting in place regulatory measures for using and managing these facilities. All departments perceive public health to be a problem and link disease causation to poor environmental conditions, low infrastructure provision, and lack of community participation and involvement in project planning and implementation. In managing urban malaria and other vector-borne diseases, the roles of the MDAs outside the health sector focus on controlling vectors of diseases by preventing formation and removal of vector-breeding sites and public education on environmental health. The following areas are particularly highlighted:
The Physical Planning Department is involved in land use planning that considers environmental constraints and health needs. These enhance living conditions and improve personal hygiene and public health.

The Works Department of the assembly is involved in approving building plans, development control and enforcement of building regulations, thus ensuring that environmental health is taken care of in physical developments. The Department also undertakes the design, construction, and supervision of assembly projects including toilets, drains and health institutions.

The Public Relations Department conducts public education on issues of health, hygiene, and disease prevention. It undertakes community and stakeholder mobilization and acts as a mediator between the public and the departments of the assembly.

The Legal Department is responsible for the formulation and implementation of policies, preparation of the bylaws, prosecution of sanitary offenders, regulation of demolitions that do not conform to building regulations, defending the assembly and education of legal implications of actions of Departments and how they relate to the community. The Department admits that the assembly has been very apathetic to its legal responsibilities and sanctions, which should help improve hygienic practices and public health. By its activities, the Legal Department contributes to both the removal of obstacles to proper drainage as well as public education to remove the breeding sites of vectors.

The Environmental Protection Agency provides technical assistance to the assembly to enable it meet its responsibility for managing the environment. EPA works in partnership with all stakeholders to ensure implementation of environmental policy and planning to achieve long-term maintenance of environmental quality. The agency also carries out research and public education and awareness on environmental issues and enforces legal provisions on the environment, where necessary. One of the priorities of EPA is to minimize flooding and mosquito breeding. EPA is involved in assessing the impact of environmental nuisance that affect people, particularly waste management of industrial concerns in the city and proposed mitigating measures.

The Metro Development Planning Unit coordinates and monitors implementation of all development projects of the assembly, including physical infrastructure. It also coordinates with other development agencies to improve infrastructure.

The Waste Management Department is responsible for collection, transportation, and disposal of solid and liquid wastes; supervision of solid waste contractors for door to door services; and management of disposal sites.

The Environmental Health Division plays a pivotal role in preventive measures for vector and disease control in SAEMA. The division carries out the following responsibilities:

- Inspecting houses to ensure that basic household sanitation facilities are available to discourage disease vectors
- Monitoring collection of garbage at communal sites by private waste collectors and the Waste Management Department
- Undertaking water usage education and reporting burst pipes to the Ghana Water Company Limited (GWCL), which is responsible for producing and distributing safe water in adequate quantities for all purposes and rehabilitation and expanding the water supply system
- Spraying and weeding around houses and water bodies
- Educating the public through announcement vans on personal hygiene and sanitation practices
- Routine cleansing of public and community drains
- Assisting the Bank’s UESP program in promoting household toilets
- Educating on food hygiene
- Prosecuting sanitary offenders.
The Community Water and Sanitation Agency (CWSA) is involved in training and mobilizing CBOs and community education on hygiene, water, and vector-borne diseases. CWSA also conducts school and institutional hygiene programs in collaboration with the Ministry of Education hygiene education program. It educates on water usage, food and personal hygiene, and management of facilities; promotes development of household latrines; and encourages households to develop and manage soakage pits for domestic wastewater management.

The School Health Education Programme (SHEP) under the Ghana Education Service handles production of education materials in schools and lectures to pupils and teachers on personal environmental hygiene, nutrition, social public health issues, and community involvement in school affairs.

UESP was set up as a unit under SAEMA. Besides providing hardware for sanitation, this Bank project is assisting SAEMA by:

- Improving internal management of the Waste Management Department
- Building human resource capacity of the department in supervising and monitoring the private waste contractors
- Developing modalities and strategies for improving waste management service delivery, including handling of hospital waste and support for logistics
- Developing basic infrastructure, including water supply, toilets, solid waste disposal points, and an upgrading package in two low-income communities in SAEMA
- Planning, designing, and developing a landfill site for proper disposal of solid waste (provisions are being made for handling hospital waste)
- Initiating action to collect data to design a program that would address absence of a policy guide in managing hospital waste.

All the nonhealth departments are aware of the link between disease causation and poor hygiene and liquid waste management, inadequate supply of safe water, lack of sanitation facilities, and ignorance. They all would like to do more to prevent the situations and conditions responsible for creating an environment for mosquito and vector breeding in the city.

**Civil Society**

The general public, particularly in poor areas, contribute significantly to disease causation and prevention. Most of the environmentally related diseases seen in SAEMA can be directly attributed to public attitudes and practices, which can be behavioral, cultural, or traditional. They include:

- Open defecation along beaches, even where toilets exist
- Poor personal hygiene, leading to outbreaks of cholera and yaws in Shama
- General apathy to sanitation and the environment
- Lack of community initiative, due to lack of leadership initiatives, often complicated by chieftaincy disputes, for example, in the New Takoradi Area
- Direction of untreated effluent from soakage pits and liquid waste into drains
- Superstition and belief in spiritual causes of diseases
- Preferences for traditional sources of water, such as streams and rivers, compared with piped water.

To reverse the trend and bring about improved management of the environment and personal hygiene, a number of NGOs and CBOs have sprung up. These organizations play an important role in making people aware of the consequences of poor personal hygiene and environmental practices. They are involved in education on the need for a high level of personal hygiene and intensive public education intended to bring about attitudinal change.
The thrust of their programs is to remove barriers to changing attitudes and behavior. Some NGOs are involved in information dissemination on urban malaria, that is, creating awareness of the health situation and prevention. Some of their activities to maintain a clean environment include cleanup campaigns, desilting of drains to maintain free flow and avoid stagnation of wastewater. Examples of such NGOs are SNV, CODEPA, and a CBO in New Takoradi.

**The Weak or Missing Link in the Management of Urban Malaria**

The management of urban malaria and other vector-borne diseases is a continuum of activities that begins with preventing formation of breeding sites for vectors and continues through treatment of patients affected by these diseases. These roles actually fall under different MDAs, each of which may perform to the best of its ability, but have weak linkages with the rest of the chain of measures to control malaria.

The role of the various MDAs in managing urban malaria and other vector-borne diseases is not always clear to all stakeholders. Although it is usually obvious to the health sector that the causative factors of the diseases presented to health institutions are the responsibility of other MDAs, those MDAs are most of the time not aware of their roles in disease prevention. Rather, they see the service they render as an end in itself and not a means to an end. For example, although the city administration may see clearance of refuse to clean up the city as an end in itself, the health sector sees it as a way to decrease factors causing diseases. In effect, each MDA may render its services to the best of its ability, but leave undone “gray areas,” because of the absence of effective collaboration in bridging gaps between curative and preventive services.

**Institutional Priorities and Objectives**

**Decentralized departments under SAEMA.** Priorities and objectives of the assembly are generated through the assembly mechanism, that is, subcommittees with full participation of the department heads. These are forwarded through the Accra Metropolitan Authority (AMA), which is the executive arm to the General Assembly. The subcommittees, which are comprised of assemblymen, heads of departments, and co-opted members, are responsible for collating and deliberating on issues to assist and guide policy formulation of the Executive Committee and the General Assembly. The outcome of General Assembly deliberations are compiled into annual and five-year development programs.

The various departments under the assembly adhere to the assembly’s policy guidelines. Before year end, departments are requested to present action plans and budgets to the authority for the following year that are in line with the assembly’s policy. These are then compiled into annual development plans. For all departments under SAEMA. Decisionmaking is limited to day-to-day administration, done in consultation with the coordinating director.

Other environmental priorities for SAEMA are contained in the district environmental management plan for district assemblies of Ghana, Report on Training Workshop 1996, prepared by the Environmental Protection Agency.

In the case of UESP, the priorities and objectives are predetermined in the project documents. Management actions and daily decisions are taken by the project manager in consultation with the coordinating director. Other issues, requiring further consideration are referred to the project coordinator and chief director at the Ministry of Local Government and Rural Development.

**Nonassembly departments.** For agencies not directly under the assembly, the objectives and priorities are based on the agency’s mandate. The main priorities are national and regional in character. These decisions are taken at the management level and passed down to the regions and district offices. The local level priorities are intended to achieve improvement in service delivery.
and efficient management. The decisionmaking and financial autonomy of these agencies are limited either by financial sealing on projects that can be initiated by them, purchasing, contracts and recruitment limits, or day-to-day management decisions.

Health institutions derive their priorities from Ministry of Health policy guidelines, which are further developed into localized priorities to suit prevailing conditions of the district or clinic. These are determined by the local health management teams of the various institutions.

CBOs and NGOs. The priorities of CBOs and NGOs are determined through community needs or by the mandate of the head offices of these agencies. Some CBOs and NGOs carry out needs assessments in communities to determine what actions to take to fulfill their mandate.

**Reporting**

Reporting by the agencies under the assembly is clearly outlined. All correspondence (letters, memos, and monthly reports) to the department are routed from the metro chief executive through the coordinating director and vice versa. Reporting and discussions on roles and assignments are also undertaken at the various meetings, that is, the management team meeting, subcommittee meetings, and planning and technical subcommittee meetings. Reports are also made at the weekly management meetings. All these meetings are covered by minutes. The heads of departments also have verbal discussions with the director and metro chief executive when necessary.

In cases where ties with the regional and national offices are close, some decision and reporting are also forwarded to higher levels of government with or without recourse to the assembly.

The non-SAEMA agencies report monthly, quarterly, and annually through their regional offices to the head office. Because the head offices sign performance contracts with the State Enterprise Commission, the reports form the basis for measuring departmental performance.

NGOs report to their headquarters and donors, with whom they design a program of action by sending quarterly and annual reports and end-of-program reports. Quarterly reports are also submitted to the metro assemblies and other NGOs. The level and regularity of reporting by CBOs is not clear. Reporting across sectors is not common.

Legal framework. The basic legal framework for the decentralized departments under the assembly is the Local Government Law, 1993, Act 462, and the legislative instrument that established SAEMA. The act defines the functions and operational modalities for district assemblies. It also defines creation of the assemblies and subdistrict councils, election of members of the assemblies, and other issues connected with running the assemblies. One of the strong points of the law is that it provides arrangements to avoid duplication, rivalry, empire building, and waste of resources. The intention is also to promote and sustain coordinated and integrated planning and implementation and ensure complementarity of activities.

In practical terms, achievement of these ideals is thwarted, because professionals are not trained on how to achieve collaboration, mechanisms and processes are not created for collaboration, and provisions are not made in sector budgets for intersectoral collaboration.

In addition to Act 462, many of the decentralized departments are governed by laws and ordinances under which they were operating before promulgation of Act 462, particularly where these laws were not repealed by Act 462. Other laws that support Act 462 are National Development Planning Commission Law (Act 479), National Planning Systems Law (Act 480), National Building Regulations LI 1630, Criminal code Act 29 of 1960, and Sekondi/Takoradi City Council By-law of 1948.
The Town and Country Planning Ordinance Cap 84, EPA Act 490, and LI1652 are a few of the legal provisions for some of the other agencies.

Limited liability companies, such as GWCL, operate under provisions of the Companies Code (1963) and GWCL Law Act 179 of 1999. Until last year, the company used to be a government department operating under Act 310 of 1965 as the Ghana Water and Sewerage Corporation. The change occurred in part due to privatization of the department.

For the public health institutions, the legal provisions of the Ministry of Health, which establishes hospitals for the delivery of curative services, provides the legal framework for delivery of services.

Legal provisions for establishing private clinics and maternity homes provide the legal framework for delivery of curative services by the private sector.

Financial. The sources of funding for the General Assembly are mainly from the Common Fund, local revenue generated from property rates, levies, and services. The assembly can also get bilateral assistance or any other donor assistance funds under projects, such as UESP and the Urban Infrastructure Improvement Programs of the road sector.

All departments under SAEMA receive financing through the assembly budgeting and auditing mechanism, that is, the Treasury and Audit Departments. Department budgets are presented through the Finance and Administration Subcommittee to the General Assembly, and, when approved, these become the basis for disbursing the assembly’s funds for the year. Projects and programs that have gone through the subcommittee system and been approved are more likely to be financed and implemented than those developed by central government departments for the assembly.

Implementation capabilities of many of the departments are limited, as they all depend on the assembly to enforce and implement decisions. Due to financial constraints, many of the action plans are not undertaken.

Some central government departments, such as EPA, have their own funding sources; however, their projects must also be approved by the head office of the agency.

All the departments, especially decentralized ones, cited the problem of low financial support. The community development officer noted that, as a decentralized department, financial support is expected from the assembly but has not been forthcoming. This year, the department has received only ₵30,000 from the regional office and is, therefore, financially handicapped. The department also receives some assistance, usually in the form of transport allowances and leftover stationery and other logistics, from NGOs who work with the department.

Departments within the assembly that generate revenue pay these monies into the General Assembly Treasury and do not retain any percentage for their own use. All requisition for logistics must be approved by the coordinating director before the Treasury can release monies for purchase. A well-structured purchasing system is available under the assembly system.

Collaboration. As noted above, the Local Government Act provides for intersectoral collaboration for the decentralized departments in theory but, in practice, collaboration among most departments is weak. Some district assemblies are trying to secure collaboration. SAEMA is one such district assembly.

The degree of collaboration among departments under SAEMA is appreciable. Agencies visited under the General Assembly were all happy with their involvement in the functioning of other
agencies. The following avenues for collaboration have been noted: development office, through organization of the radio talk show and public education programs, Environmental Health Unit and their linkage with the Metro Health Management Team, core group meeting under UESP, statutory planning and technical committees, and project monitoring teams.

The assembly decisionmaking mechanism presents a platform for the necessary collaboration at the project formulation stage. It ensures that the contribution of all relevant agencies and decisions are based on consensus.

The central role of SAEMA’s coordinating director, through whom all correspondence passes, is a role that should be developed for collaboration and coordination. By coordinating all activities and reporting on them, the administration is aware of areas of duplication or gaps in activity and able to redirect activity accordingly. It puts the director on top of issues emanating from every department.

The greatest benefit of the weekly management meetings is to resolve conflicts and harmonize programs and plans before implementation. This is laudable, because officers whose actions and inability to deliver and draw back the assembly are made to sit up. These meetings have made every head of department aware of progress on all assembly projects and programs. The meetings can be used to link activities of nonhealth departments to disease causation and help find ways to bridge gaps. Although the meetings are meaningful, the fact that they sometimes take more than half a day is of concern.

**Box 16-4: Robert Austin, Coordinator UESP**

“These meeting are not just talking shop. Every Monday morning, members check on their schedules and make sure that they fulfill commitments and have some progress to report on.”

*Source: Authors’ data.*

**Box 16-5: Deputy Coordinating Director, SAEMA**

“You cannot joke with the Monday morning meetings. Heads of Departments are eager to attend every Monday. It is like a ritual. There is effective contribution from all heads.”

*Source: Authors’ data.*

**Obstacles to effective routine collaboration between the health sector and other MDAs.** In spite of the avenues for collaboration within SAEMA, attempts at collaboration for health have been ad hoc, that is, most active during epidemics or disease outbreaks and poor on a routine basis. A number of factors account for this:

- The Health Information System is not designed to link environmental conditions to health. Health data from health institutions are collated and passed on to regional and national levels and not routinely used to inform decisions on activities by other MDAs.
- Routine reporting among departments has no format. Infrastructure agencies do not routinely monitor the effect of infrastructure development on health; even though other MDAs may be aware of the linkage between their responsibilities and public health, they are not aware of the magnitude of the problem nor their potential contribution in disease prevention.
- Information flow from management to general staff levels is poor, because heads of departments do not have a platform through which they can explain issues discussed in
these meetings to their staff. This information gap should be closed to enable staff to understand their actions and get them involved in the day-to-day running of the departments.

- No system effectively supervises private sector health institutions, and monitoring of activities at these institutions is inadequate. General health statistics of SAEMA, therefore, do not incorporate data from the private sector, and health data are incomplete. The rate of returns on cases these institutions treat and send to the district health administration is also low, as is collaboration between private health and other sectors.

- A limitation noted by Ghana’s EPA is that some projects that are technically objectionable have been implemented, because they meet with the aspirations of the assembly, for example, developing KVIPs in the waterlogged areas of Effia Song.

- The interface between the public and private sectors is weak. The general public is seen as consisting of clients and not partners. In the few instances in which the traditional chiefs were used for identifying and acquiring sites for UESP projects, they were found quite helpful. These partnerships must be extended to other areas of development.

Although the health sector is conscious of the need to link closely with the nonhealth sector in preventive health care, the health sector is more immediately concerned with extending and expanding physical and curative health services. The health sector has identified promotional health roles and the need for collaboration as priorities, but collaboration between the health and nonhealth sectors is not given much importance. Health data are collected but not disseminated to nonhealth departments for use. Similarly, the format of data collection needs to be reviewed to make it usable to these institutions.

The main objective of the nonhealth sector is to provide physical infrastructure and services. Even though the sector perceives related health promotional benefits, they take them for granted and incorporate little activity into their programs and projects to achieve these benefits. Many cite recent experience with collaboration in the core group meeting on the School Health Education Programme and improving the health benefits of infrastructure as a great benefit that has improved health in communities.

The health sector has a role to play in supporting the decisionmaking process with the necessary health statistics. Health information is currently collected for use by health institutions alone, but must be structured to be relevant to the Environmental Health Unit and other nonhealth departments.

Table 16-6 is a matrix for linking the three entry points to the various MDAs; it shows the departments that can support and collaborate with each other on disease prevention.
<table>
<thead>
<tr>
<th>MDA</th>
<th>Role</th>
<th>Linkage</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Works</td>
<td>Supports all urban infrastructure develop-ment within SAEMA</td>
<td>Identification, implementation, supervision, and enforcement</td>
<td>Development office role widely accepted by other MDAs; direct contact with private sector; representatives at the submetro levels; reporting format for project monitoring and supervision</td>
<td>Staffing, financing, and logistics; no general reporting format, especially from the subdistrict level; low motivation</td>
</tr>
<tr>
<td>PRO</td>
<td>Focal point for information dissemination; views and complaints and forwards them to relevant MDA for resolution</td>
<td>Collaboration with all agencies for public education</td>
<td>Good rapport with all agencies and the press</td>
<td>Staffing, training, and logistics; staff with double allegiance to parent department and SAEMA</td>
</tr>
<tr>
<td>Physical planning</td>
<td>Land use planning and development control</td>
<td>Research, policy development and implementation, and regulation</td>
<td>Ability to collaborate under the statutory planning and technical committees; good community development skills; and a supporting legal instrument for action</td>
<td>Finance, logistics, training, and skill improvement; lack of technical and policy directive on technical issues</td>
</tr>
<tr>
<td>Legal section</td>
<td>Policy in terms of formulation of by-laws and procedures; enforcement through prosecution; implementation, e.g., performance contract design; education of the public on legal obligations</td>
<td>Providing legal assistance to MDA enforcement</td>
<td>Appropriate legal backing and capacity would enhance the work of all other sections, i.e., PRO, security, city guards, and so on come under one umbrella</td>
<td>Staffing and logistics, low development of local legal instruments, poor record keeping, poor support from the judiciary/courts system for prosecution.</td>
</tr>
<tr>
<td>UESP</td>
<td>Provision of community infrastructure</td>
<td>Policy implementation, strengthening the capacity of other MDAs, education, and community involvement</td>
<td>Financial support for project; technical support always available through additional consultancies; technical resources available; experience with stakeholders; and support of core group through allowance payments</td>
<td>Lack of bylaws under which to prosecute, lack of education materials, and lack of logistics</td>
</tr>
<tr>
<td>EPA</td>
<td>Education and enforcement of EPA laws on the environment</td>
<td>Policy, enforcement, regulation, and education</td>
<td>Legal backing for activities</td>
<td>Lack of staff; logistics and no enforcement powers and funding for activities</td>
</tr>
<tr>
<td>PHD</td>
<td>Education on environmental issues; enforcement and prosecution</td>
<td>Policy implementation; education</td>
<td>Enough staff at metro and submetro levels; ability to work with others</td>
<td>Lack of bylaws under which to prosecute, lack of education materials, and lack of logistics</td>
</tr>
<tr>
<td>WMD</td>
<td>Management of solid and liquid waste</td>
<td>Strong linkage with UESP</td>
<td>Support from UESP</td>
<td>Inadequate equipment, funding, and vehicles</td>
</tr>
<tr>
<td>CWSA</td>
<td>Support for communities obtaining water</td>
<td>Strong links with communities and donors</td>
<td>Staff, and donor support</td>
<td>Incentives for staff</td>
</tr>
<tr>
<td>GWCL</td>
<td>Provision of potable water</td>
<td>Policy implementation</td>
<td>City-wide coverage</td>
<td>Old reticulation system, staff, equipment, and seasonal variations in reservoirs</td>
</tr>
<tr>
<td>Civil society</td>
<td>Community education on environmental</td>
<td>Policy, education, and implementation</td>
<td>Autonomy to operate and access to donor</td>
<td>Not hindered by bureaucracy</td>
</tr>
<tr>
<td>MDA</td>
<td>Role</td>
<td>Linkage</td>
<td>Strengths</td>
<td>Weaknesses</td>
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<td>-----------------------------------------</td>
</tr>
<tr>
<td>Health institutions</td>
<td>Preventive and cure of diseases</td>
<td>No strong linkage with MDAs</td>
<td>Organized management system and good teamwork</td>
<td>Financial constraints and lack of policy on management of hospital waste</td>
</tr>
</tbody>
</table>

*Source: Authors’ data.*

**Conclusions**

The following conclusions can be drawn at this stage in fulfilling the objectives of the study:

- Environmental conditions in SAEMA have contributed greatly to causing disease in the metropolis. Five out of the ten top diseases are related to environmental conditions. Hospital waste is a potential danger, but no current evidence links any particular diseases to poor disposal of hospital wastes.

- Developing intersectoral collaboration between health and environmental initiatives remains difficult and underresourced. Many agencies have roles that can help overcome these problems, but financial and logistic restrictions have led departments to pay more attention to their primary role, leaving “linkage” roles in the background. Local institutions have the advantage of seeing the linkages clearly and how their involvement in total can help improve the conditions they seek to solve. Improving agency perception of the linkages will encourage them to collaborate and share tasks, facilitating their achievement.

- As noted by Stephens and others (1998), “The process of decentralization in Ghana has the greatest potential to facilitate collaboration of professionals of all disciplines that work at the level of local government. The merging of different vertical agencies with complementary themes has the potential to straighten intersectoral collaboration.”

- Some limitations have been experienced in achieving linkages and collaboration. Current approaches consist of basic reporting, mostly verbal and at meetings. Technical directives or procedures for further action have been blurred. No routine reporting format links all departments.

- Few legislative and administrative controls exist to ensure those involved will play their roles and their follow-up actions have not been well defined.

- Monitoring responsibilities are also unclear. Although SAEMA has recorded a number of instances of collaboration, these have not been fully structured and have coordinated sectors that are not of immediate concern.

- The interest of the assembly is to offer efficient delivery of services to prime areas. Prioritization and balancing of concerns between health and efficient urban services must be taken up as a main policy issue at the assembly and followed up through the various agencies of the assembly.

- Logistic and staffing requirements have limited the ability and capacity of agencies to perform complementary roles effectively. Except for UESP, which has external funding, many of the departments are financially constrained in performing and delivering on their mandates of incorporation.

- Decentralization and the state of the decentralized departments regarding budgeting, allegiance, and others is reinforcing separation and discontentment. Resources must be shared collaboratively to enable all departments to play their roles effectively.

- The linkages and the roles played by NGO, CBO, and the private sector have not been fully utilized. All indications are that they have not been getting needed assistance and support from the assembly and no supervision of their activities and impact.

**Terms of Reference for an Institutional Needs Assessment**

**Outline of the Needs Assessment**

The consultant(s) will conduct an institutional needs assessment to assess the opportunities and constraints of intersectoral collaboration and build on the “Consultative Assignment on Urban...
Public and Environmental Health in Ghana” report. The needs assessment for Sekondi-Takoradi will be conducted for:

(a) National, regional, and district and subdistrict levels of government, which will target key government officials, agencies, and ministries in environment, health, infrastructure (roads, housing, water supply, sanitation, and drainage); local governments; government agencies in rural development; line agencies (Ghana’s Environmental Protection Agency [EPA] and others); and district assemblies that are involved with (or should be involved with) the pilot’s three “entry points”—that is, urban malaria, management of waste from health care facilities, and environmental health linkages among water, sanitation, and drainage—to learn their views on what they would need to improve service delivery.

(b) Selected private sector providers and stakeholders (NGOs, community-based organizations [CBOs], and professional associations, among others) that are involved with (or should be involved with) the pilot’s three “entry points” to learn what they provide as a (private sector) service and expect in terms of improved service (to stakeholders).

(c) All of the groups above to learn what they might be able to contribute in exchange for improved service.

The completed needs assessment will be analyzed to update the “Ghana Health Assessment” (a quantitative method of assessing the health impact of different diseases) and produce a preliminary issues paper and an action plan (of no more than forty pages) on public health, institutional and legal, decentralization, financial/incentive, capacity-building aspects, all of which will also be tackled at the workshop.

The consultant(s) will also gather data that will feed into developing a social map for Sekondi-Takoradi to help to ascertain data sources and contacts, relevant “hot spots,” both topically and geographically, and the perceived social causes that underlie and perpetuate observed patterns.

**Content of the Needs Assessment**

The needs assessment has two main sections:

- Public health
- Institutional and legal aspects, financing mechanism, capacity, and recommendations.

**Public Health**

Use *Bridging Environmental Health Gaps* checklists [1996 volumes] for integrating environmental health considerations into projects as background material:

- Define the main health problems in Sekondi-Takoradi.
- Describe in detail linkages to the three “entry points” (management of wastes from health care facilities, urban malaria and other vector-borne diseases, and water, sanitation, and drainage)
- Describe the full range of possible remedial measures in health, environment, and infrastructure sectors.

**Institutional and Legal Aspects, Financing Mechanism, Capacity, and Recommendations**

*Background*
• Definition of institutions\(^\text{168}\): sets of rules by which a ministry, agency, group, association, and so on functions to coordinate activities within (vertical) and between (horizontal) organizations (see chapter 3).

Institutions have three layers:

• Operational (laws and regulations)
• Governance (who makes and applies the rules and how this is done)
• Constitutional (rules that constrain rule making) (*Not to be covered in this assignment*)

The coordination mechanism, which is determined by the nature of the good and service (in our case, a public, toll, or common pool good for water, sanitation, and drainage and private or public good for hospital wastes) will allow for provision of goods and services by the public sector (hierarchy), the private sector (market), and/or stakeholders (collective action).

**Assignment**

*Institutional and Legal Aspects and Financing Mechanism.* Assess, clarify, or identify the set of rules that will help determine sectoral linkages at the national, regional, district, and subdistrict levels as well as the interface between the public, private sector, and stakeholders (PPS).

**Operational aspects include:**

• Institutional set up (provide an organization chart for line ministries and agencies and identify private sector participation and stakeholder involvement) and legal framework
• Levels of responsibilities for identification, planning, design, implementation, operations and maintenance, monitoring, evaluation, and reporting (to whom, how often, when, adherence, penalties, and rewards)
• Financial set up, that is, levels of financial mobilization for each ministry or agency
• Institutional collaboration (with whom to interface PPS, formal and informal relationships, and incentives and disincentives)
• Willingness to collaborate (examples of past collaboration and so on)
• Information management in a decentralized setting (horizontal, that is, national to subdistrict and vice versa, and vertical, that is, across): data flow, in general, and for monitoring, in particular.
• Portfolio (ongoing activities in each sector in Sekondi-Takoradi that are related to the three entry points)
• Environmental, health, and environmental health linkages, as identified by ministries and agencies
• Public, private, stakeholder interface, that is, who does what and the terms of these relationships.

**Governance aspects (ownership of the decentralization process):**

• Level of determination of objectives, priorities, and policies
• Level of the decisionmaking process: What are the “limits” and constraints? To what degree are they achieved locally without hierarchical or outside pressure? What are the incentives and disincentives?
• Level of appropriation of funds
• Accountability and transparency (financial, managerial, and result based as well as incentives and disincentives)
• Recent changes created by the decentralization process in institutional lines of responsibility, reflecting newly identified responsibilities and collaboration across/among different line ministries.

**Capacity**

• Technical resources (instruments, intervention policies, monitoring indicators, and others)
• Technical and managerial staff composition and capacity
• Staff needs, including training and recruitment
• Human health–related resources (capacity to identify, evaluate, and prioritize health problems outside the health sector, managerial skills, and so on).

Recommendations

• Recommendations to foster collaboration among PPS
• Action plan in terms of institutional, legal, and financing set up and training needs
• Expected outcomes from the collaboration in terms of equity, efficiency, sustainability, and accountability.

References

AMA (1998), Accra Metro Health Initiative (AMEHI) Briefing Paper, UK Department For International Development (DFID) in partnership with the Accra Metropolitan Assembly (AMA).
Ministry of Health (1996), 5 Year Programme of Work.
Ministry of Local Government and Rural Development (1999), National Sanitation Policy.
CHAPTER 17: SAMPLE WORKSHOP ON TARGETED COLLABORATION IN GHANA

Chapter 17 puts into practice the lessons and recommendations of parts 1 and 2 in a pilot study in Ghana. The pilot, conducted in four phases, shows how targeted collaboration can lead to positive results without conducting expensive and time consuming studies:

- a desk review to identify key problems and priorities from all sectors and select entry points accordingly (Chapter 15),
- an institutional needs assessment to identify the stakeholders that needed to be involved and understand their perspectives (Chapter 16),
- the first workshop held in a “trial” city with stakeholders to get their views in proposing solutions, and
- the second workshop with participants from four other cities to see how the entry points and proposals could be replicated elsewhere, and eventually integrated into an ongoing project.

Background

The “Targeted Collaboration among Line Agencies, Local Communities, and the Ministry of Health in Ghana” workshop for Sekondi-Takoradi and its subsequent meeting (October 12–14, 1999) were organized by the Ministry of Local Government and Rural Development (MLGRD) and the Shama-Ahanta East Metropolitan Area (SAEMA) in collaboration with the World Bank and funded by a grant from the Swedish government. The workshop was executed under the World Bank Ghana Urban Environmental Sanitation Project (UESP). A follow up workshop was organized in February 2000, with the four other cities of the UESP (Accra, Tema, Tamale, and Kumasi) and representatives from Sekondi-Takoradi. The objective of the follow up workshop was to replicate the approach of the first workshop to the other cities, identify a new set of priorities common to the five cities and include the summary and recommendations of the five cities into the mid-term review of the USEP. These undertakings were part of the World Bank’s program “Environment and Health: Bridging the Gaps,” which is intended to mainstream environmental health into World Bank operations as well as developmental operations and to look systematically for health benefits outside the health care system. The program has also been funded by the Swiss and Norwegian governments under the Africa Regional Initiative on the Urban Environment.

The process, from preparing an environmental health profile (determine entry points, and establish intersectoral problems and priorities) to making recommendations to an ongoing project, took about 6 months, beginning with a desk study in Washington to cull information from existing Bank and Ghanaian reports and followed by the preparation of an institutional needs assessment. Two workshops were organized in Ghana to: (i) identify the range of solutions needed to solve the problems in one city; (ii) prioritize the solutions and formulate them into practicable recommendations in one city; and (iii) replicate the process to four other cities and expand the initial entry points to a set of ten priorities and agree on the top three that were piggybacked onto an ongoing project (see box 5-4).

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265
Both workshops were based on two key documents: (a) “Consultative Assignment on Urban and Environmental Health in Ghana.” (Stephens and others 1999) supported by Managing the Environment Locally in Sub-Saharan Africa (MELISSA) and prepared for the Government of Ghana. Ministry of Local Government and the UESP, and (b) an institutional needs assessment prepared for the first workshop (Chapter 16).

The five USEP cities are at the forefront of major and secondary cities in Sub-Saharan Africa (SSA), which are confronting complicated, multisectoral issues that involve risks to human health and the natural environment, and has responsibility for a combination of urban, periurban, and rural conditions. Many cities must address these problems without adequate tools and need assistance to meet these challenges locally, where they are the key actors, as well as nationally, where they can contribute to policy. It is expected that the results of this workshop will make a modest contribution to help resolve some of these pressing issues.

The five USEP cities are making strides in intersectoral collaboration in both disease prevention and development and growth in their metropolitan areas. These activities need to be formalized by introducing an administrative mechanism that can require all departments to collaborate and coordinate their activities. This should include opportunities for routine sharing, disseminating information, and monitoring and evaluating the results of collaboration and coordination, all of which could be outcomes of the workshops.

This report is organized in three parts:

- USEP Mid-Term Review Workshop: Prioritization and Selection of the Top Three Environmental Health Problems for the Five Cities; and (ii) Proposed Solutions for Each of the Top Three Identified Problems.
- Sekondi-Takoradi Workshop: (i) Background; (ii) Summary of Discussions on Entry Points and Proposed Solutions; (iii) Summary of Participants Comments; and (iv) Summary and Recommendations.
- Sample Terms of Reference for the Sekondi-Takoradi Workshop.

**USEP Mid-Term Review for the Five Cities Workshop**

During the USEP mid-term review of February 2000, a workshop was held to: (i) summarize and discuss the recommendations of an Environmental Health Workshop, held as a pilot exercise in Sekondi-Takoradi in October 1999, with the other four cities of the UESP (Accra, Tema, Tamale, and Kumasi), and (ii) to make recommendations to the UESP concerning environmental health problems as prioritized by representatives from the five cities collectively. The mid-term review workshop was attended by nine members of local government, mainly environmental health officers, one representative from DfID, and three World Bank staff (one from the Ghana office and two from Washington).

The group listed 10 environmental health priorities for consideration in future development projects, including the UESP. The first three of the ten priorities were developed into draft proposals for consideration in the short term. The remaining seven priorities could be developed into proposal as needed. The ten priorities include:

1. Urban malaria and other vector-borne diseases, drainage and sanitation
2. AIDS
3. Health facility waste management
4. Overcrowding, indoor air pollution and poor housing
5. Noise
6. Outdoor air pollution
7. Traffic injuries
8. Central business district congestion
9. Urban and residential heat stress due to deforestation
10. Poor accessibility to slums

Each of the three proposals is divided into three sections:

- Statement of the environmental health problem
- Points of intervention that need to be addressed
- Proposed solutions for inclusion in the UESP

Proposal 1: Urban Malaria and other Vector-Borne Diseases, Sanitation and Drainage

Statement of the Problem. Malaria continues to be one of Ghana’s top health problems. The UESP could be instrumental in helping reduce malaria by strengthening the sanitation and drainage activities within the project by targeting and eliminating breeding sites.

Points of Intervention. The focal point listed below would have to be addressed in any strategy dealing with a comprehensive approach to reducing urban malaria and other vector-borne diseases.

The focal points for intervention in urban malaria are:

- Blocked/clogged man-made drains
- Burrow pits
- Bushy and marshy areas
- Construction quarry sites
- Containers and household water storage
- Unused, abandoned land
- Low lying areas
- Natural watercourses
- Urban agricultural areas
- Waste disposal system/sites
- Used tires

Main Stakeholders for Implementation:

- Assembly officials
- Community, CBOs, NGOs
- Environmental Protection Agency
- Fish industry
- Hydro Division of Ministry of Works & Housing
- Media (press/radio)
- Traditional authorities
- Suppliers/vendors of pest control methods and equipment, esp. malaria sprayers
- Ministry of Roads and Transport
- Ministry of Environment, Science & Technology
- Ministries of Health, Industry & Education
- Religious groups
- Statistical Service
- Town and Country Planning
- Unit Committees
- Associations of small scale industry
- Ministry of Local Government and Rural Development (MLGRD)

Solutions. Novel multisectoral approaches, proposed at the workshop to address issues which have not been dealt with before multisectorally, include 1) land use management, 2) proper drainage, 3) consideration of filling in burrow pits with solid waste as a land fill, and 4) awareness of alternatives to spraying at all levels of government and society. The most important recommendation entails the earmarking of drain maintenance budgets as unfungible (see Urban Malaria under the Sekondi-Takoradi Workshop for details).
Proposal 2: AIDS Outreach

Statement of the Problem. AIDS is increasing in importance throughout SSA. Within the UESP, staff of the Environmental Health Units will be expected to be involved with AIDS prevention and outreach. Regrettably, there currently exists no policies to implement this activity within the MLGRD for EHUs, nor do there exist strategies for AIDS outreach within other government offices for the benefit of their own staff. Development of an AIDS strategy for environmental health workers would focus on three points:

1) procedures for government agencies to mainstream AIDS awareness and protective measures for the government employees themselves;
2) avoidance of overlap with health ministry programs, and collaboration with other agencies on AIDS outreach
3) adequate training for environmental health staff who are expected to do AIDS outreach because of their presence in neighborhoods for their other jobs.

Points of Intervention.

The focal points for intervention in AIDS are:

- policies and training of Ministry of Health
- policies of training of MLGRD
- UESP project sites,
- Communities
- policies of training of Metropolitan District Assemblies (MDAs) --- EHU and especially Public Relations Unit

Main Stakeholders for Implementation:

- Ministry of Health
- MLGRD
- MDAs
- UESP work crews and contractors,
- NGOs/CBOs/Community

Solutions

1) Develop policies, in conjunction with NGO/CBOs, for dealing with AIDS among: a) ministry and MDA staff, b) UESP-related activities, c) general public, d) forthcoming Bank and other donor development activities;
2) Develop policies, programs, and training materials for MOH and EHU staff who will be doing community outreach and training to ministries, MDA and communities: a) initially, for training trainers, and b) for actual training;
3) Prepare budget for: a) preparation of policy formulation and training materials, b) execution of training programs and outreach, and c) materials necessary for implementation of training and community outreach.

Proposal 3: Management of Health Facility Waste

Statement of the Problem

Many cities in Ghana are now responsible for safe disposal of medical and other hazardous waste, but do not have adequate by-laws to manage or enforce the process. The medical waste entry point looked at the weak links in the multisectoral environmental health chain but did not address hazardous waste. Currently in Ghana, the private sector is increasingly involved in waste management. However, incentives and capacity need to be developed to involve the private sector in medical waste management, and to ensure that adequate monitoring and enforcement procedures exist. Accra has old by-laws for dealing with hospital waste that are being revised. Kumasi has
recently privatized handling of medical waste. SAEMA, Tema, and Tamale, however, have by-laws governing sanitation but not medical waste.

**Points of Intervention**
The focal points for intervention in the management of medical wastes:

- Generation at source
- In house segregation and storage
- Treatment (as appropriate)
- On site disposal
- Collection
- Transfer (as appropriate)
- Transport
- Disposal

**Main Stakeholders for Implementation:**

- Ministry of Health
- Waste Management Department
- Environmental Health Division
- Media
- EPA
- Health training institutions
- Market groups
- Pharmaceutical Operators
- Medical Manufacturers
- NGOs and CBOs
- Traditional healers
- Private health institutions and practitioners
- Scavengers

**Solutions**

Novel multisectoral approaches, proposed at the workshop that can address issues which have not been dealt with before multisectorally, include particularly 1) develop bylaws, 2) build capacity to monitor, 3) add economic value to waste, 4) increase awareness of proper disposal of medical waste at all levels of government and society; 5) develop a strategy for prioritization of medical waste, and 6) conduct a needs assessment of the medical waste stream (see Waste Management under the Sekondi-Takoradi Workshop for details).

**Sekondi-Takoradi Workshop**

**Background**

**Objective and Participants**
The objective of the workshop was to enhance health improvement outside the health care system by fostering multisectoral collaboration among line agencies and civil society to improve service delivery to the people. The workshop was based on three “entry points,” where the likelihood for interagency and stakeholder collaboration was expected to be high due to common interests in solving these common problems:

- Management of health facility waste
- Urban malaria and other vector-related diseases
- Water, sanitation, and drainage.

The workshop participants, drawn from SAEMA departments, the Ministry of Health, MLGRD, UESP, civil society, and the World Bank, were asked to:

- Identify risks and stakeholders, especially vulnerable groups, at risk.
- Determine institutional and financial strengths and weaknesses, relying on the information provided in the institutional needs assessment prepared for the workshop.*

* See chapter 16.
• Suggest areas of mutual collaboration and partnership among infrastructure, environment, and health agencies and civil society at large.
• Propose recommendations that could constitute the elements of an action plan for improving service delivery.

Summary of Discussions on Entry Points and Proposed Solutions

Management of Health Facility Waste
The medical waste entry point looked at the weak links in the multisectoral environmental health chain, but did not address hazardous waste. The private sector in Ghana is increasingly involved in waste management; however, incentives and capacity to involve the private sector in medical waste management need to be developed. SAEMA is particularly advanced in the level of multisectoral activity in managing medical wastes.

Health care waste embraced not only that from hospitals, but all health facilities, including pharmacies, traditional birth attendants (TBAs), and other producers of health waste not now properly managed. No policy guidelines or effective monitoring exist for waste disposal. The current disposal methods of private and public health care facilities depend on the type of waste, that is, dry, wet, or liquid.

Points of Intervention
The focal points for intervention in the management of medical wastes include generation, in-house segregation and storage, treatment, on-site collection for disposal, transfer, transport, and disposal.

Solutions
Novel multisectoral approaches were proposed at the workshop that can address issues that have not yet been handled multisectorally. These include the following:

• Develop medical waste management bylaws. The management of medical wastes was recently delegated to local assemblies, but bylaws do not currently exist to implement the policy. There is a need for overall guidelines to monitor and enforce the bylaws to manage medical waste from generation to disposal. Development of these bylaws needs to be based on a multisectoral approach.
• Build capacity to monitor. Improve capacity of assembly to monitor proper disposal of medical waste.
• Add value to waste. Examine the medical waste stream to determine the economic value and remove materials that are hazardous from inexperienced recycling to supervised disposal. Apply the scavenger notion to the medical waste. Items that are now being re-used or sold with risk should be removed from the “informal market.”
• Increase awareness of proper disposal of medical waste. Although needed at all levels of government and society, communities and medical staff should especially be targeted.

Stakeholders at Risk. Stakeholders at risk of improper healthcare waste disposal are children, community, health workers, patients, scavengers, and waste management operators. Exposure to medical waste is primarily through contact with infectious articles, for example, needles and syringes (sometimes sold in the informal sector as hair curlers), blood, gloves, among others, as well as contact with chemicals.
**Solutions.** Formulate bylaws and/or guidelines within the framework of the National Sanitation Policy of 1999 on managing health care facility waste. The bylaws should include information on the composition and volume of waste generated, method of collection, and mode of disposal.

**Partnerships.** Formulation of bylaws and/or guidelines in health care waste management should involve the following institutions: Environmental Protection Agency, Environmental Health Unit, Ghana Medical Association, medical drug vendors, pharmaceutical manufacturers, Pharmacy Board, and Waste Management Department.

**Financing.** Public health care facilities should finance management of medical waste through the internally generated fund of the hospital. Central government could subsidize this, because an element of subsidy exists in the fees charged by these facilities. Private health facilities, including pharmacies, should wholly finance management of medical waste from their own resources.

Recycling hospital wastes should be studied, because syringes, for instance, are sold by medical facility workers and often used as hair curlers by women. Safe recycling of certain wastes could generate some resources for the cash-strapped medical facilities. A preliminary feasibility study should be performed, and a deposit-refund system envisaged for all recyclable items identified. For instance, a fee charged on top of the selling price of syringes would (a) create an incentive to consumers to return infected syringes, provided part of the fees is returned to them, (b) finance the syringe-disinfecting process, before the syringes are sold on the market as hair curlers, and (c) generate or recoup a profit or costs for any private or public entity that manages this operation.

**Monitoring.** Medical waste should be separated from domestic waste and its management contracted to private entities with the skills to perform the role efficiently. Both internal and external monitoring should take place, that is, by staff within the health administration and by the assembly’s monitoring system, respectively. For the system to be effective, the assembly should build its capacity to monitor medical waste management.

**Recommendations**
- Raise awareness on dangers associated with improper disposal of wastes from health care facilities. Hospitals, assembly, NGOs, CBOs, and the media can work together on this.
- Provide technical assistance to formulate bylaws and/or guidelines to implement national environmental policy.
- Build the assembly’s capacity to monitor medical waste management effectively.
- Encourage on-site treatment of liquid waste from health care institutions.
- Consider recycling of certain types of wastes.

**Urban Malaria**
Urban malaria is not only the number one disease in SAEMA, it is also on the rise. It is a multisectoral problem that requires multisectoral collaboration to:
- Identify the cause and location of malaria and other vector-borne diseases in the greater Sekondi-Takoradi.*
- Determine the stakeholders at risk, that is, low-income groups in dense settlements near marshes and quarries, among others.
- Delineate institutional responsibilities and propose multisectoral solutions.

**Area Mapping and Assessment**
Participants assessed the presence of urban malaria and other vector-borne diseases, their entomology, and transmission factors. On a map they plotted (see figure 10-3 “Health Needs Assess-

* See map 5-1 for boundaries.
ment for Ghana”) the high prevalence of malaria together with other vector-borne diseases. Ae-des, anopheles and culex are the three main identified species. Natural and man-made stagnant water was identified as the primary breeding site for mosquitoes that spread urban malaria and constitute the main transmission factor. The following are sources of natural and man-made stagnant water:

<table>
<thead>
<tr>
<th>Natural</th>
<th>Man-Made</th>
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<tbody>
<tr>
<td>Wetlands (including bushy and marshy areas)</td>
<td>Blocked and clogged drains</td>
</tr>
<tr>
<td>Water courses</td>
<td>Construction quarry sites and burrows pits</td>
</tr>
<tr>
<td>Low-lying areas</td>
<td>Containers and household water storage</td>
</tr>
<tr>
<td></td>
<td>Urban agricultural areas</td>
</tr>
<tr>
<td></td>
<td>Waste disposal systems and sites</td>
</tr>
</tbody>
</table>

Points of Intervention. The focal points for intervention in urban malaria are blocked and clogged man-made drains, burrows pits, bushy and marshy areas, construction quarry sites, containers and household water storage, low-lying areas, natural water courses, urban agricultural areas, and waste disposal systems and sites.

Solutions. Novel multisectoral approaches were proposed at the workshop to address issues that have not yet been dealt with multisectorally, including:

- Land use management
  1. Land reclamation. Think through the approach of reclaiming marshy areas in and around the city to eliminate major breeding grounds for mosquitoes. The reclaimed lands could be used for agricultural or settlement purposes or any other compatible use.
  2. Burrow pits in construction and mining sites. Involve construction, mining, and other industries in the process of malaria prevention. For example, work out the social, economic, and technical details of introducing tilapia and/or other appropriate fish species into any similarly unfilled areas and determine fishing rights.

- Proper drainage. Clarify the roles and responsibilities for drain management and monitoring by:
  1. Developing clear maps of primary, secondary, and tertiary drains
  2. Linking maps (GIS) to existing roles and responsibilities
  3. Working out the concept of allocating earmarked budget for desilting
  4. Involving communities in drain clearing, drawing lessons from UESP.

- Awareness creation. Build awareness of alternatives to malaria spraying at all levels of government and society through, for example, use of tilapia, seal water tanks, and storage of containers in households.

Stakeholders at Risk. The entire population is at risk of contracting malaria, but the most vulnerable high-risk groups are children under 5 and other vulnerable groups (women, elderly, sick, and so on); communities around bushy and marshy areas; densely populated areas; and low-income groups that cannot afford preventive or curative treatments (i.e., screens, bednets or drugs).

Many of the high-risk groups do not understand the link between breeding areas for mosquitoes and malaria or live in impoverished areas where exposure rates can be high.
Solutions. The following solutions were suggested for:

- **Blocked and clogged drains**: desilting, maintenance, and education for behavioral changes.
- **Construction quarry sites and burrow pits**: introduction of larvivorous (larva-eating) fish (if it is appropriate to reduce mosquito larvae) and clarify fishing rights
- **Bushy and marshy areas**: spraying, land reclamation, and salinization (experimented with in the Solomon Islands)
- **Containers and household water storage**: behavioral change
- **Urban agricultural areas**: changes in irrigation practices
- **Waste disposal systems and sites**: better waste management and spraying.

No solutions were suggested for low-lying areas and natural water courses.

Novel multisectoral approaches were proposed at the workshop that can address issues that have not previously been handled multisectorally. Three broad areas are land use management, proper drainage, and awareness of alternatives to spraying at all levels of government and society.

- **Land use management**
  1. Explore the option for land reclamation near highly populated and vulnerable community areas. Land has been reclaimed in the past in the Sekondi-Takoradi area. Reclaimed land could be sold or leased for either agricultural purposes or settlements. A cost benefit analysis and environmental assessment need to be performed to determine the feasibility of this solution
  2. Involve construction, mining and industry into the process of malaria prevention and workout the social, economic and technical analysis for the introduction of larvivorous fish (e.g., tilapia) as a feasible means to control mosquito breeding, into burrow pits in construction and mining sites or any similar unfilled areas. Introduce fishing rights or ownership rights to generate resources.

- **Proper drainage**
  5. Clarify the roles and responsibilities for the three-tier drainage network. Each type of drain is the responsibility of a different department within SAEMA: (a) main, Ministry of Works and Housing (Hydro Division), (b) secondary, SAEMA’s Urban Roads Department, and (c) tertiary, SAEMA’s Environmental Health Unit) with the overall monitoring being the responsibility of the Environmental Health Unit with community monitoring assistance and in-kind contribution to unclog the tertiary drains
  6. Develop clear drainage network maps delineating primary, secondary and tertiary drains and linking the maps (GIS) to existing roles, responsibilities and monitoring
  7. Workout the concept of allocating earmarked budget for desilting because this operation was not performed on a regular basis due to cash flow problems
  8. Introduce community participation in drain clearing by following the examples drawn from ongoing the UESP project.

- **Awareness of alternatives to malaria spraying**
  1. Increased awareness at all levels of government and the civil society at large.
  2. Workout the social, economic and technical analysis for the introduction of larvivorous fish, for example, tilapia.
  3. Work with communities to increase participation and effect behavioral change.
  4. Properly seal water tanks and containers in households.
Partnerships. Table 17-1 shows the institutions that can work together to reduce the incidence of urban malaria.
Table 17-1: Institutional Partnerships to Reduce Urban Malaria

<table>
<thead>
<tr>
<th>Institutions</th>
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<tbody>
<tr>
<td>• Assemblymen</td>
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<tr>
<td>• CBOs</td>
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<td>• Community</td>
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<td>• EPA</td>
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<td>• Fishing industry</td>
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<td>• Industry</td>
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<td>• Media (press and radio)</td>
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<td>• Ministry of Education</td>
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<td>• Ministry of Environment</td>
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<td>• Ministry of Health</td>
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<tr>
<td>• Ministry of Local Government and Rural Development</td>
</tr>
<tr>
<td>• Ministry of Roads and Transport Ministry of Works and Housing (Hydro Division)</td>
</tr>
<tr>
<td>• NGOs</td>
</tr>
<tr>
<td>• Private sector</td>
</tr>
<tr>
<td>• Religious Groups</td>
</tr>
<tr>
<td>• SAEMA’s Assembly</td>
</tr>
<tr>
<td>• SAEMA’s Environmental Health Unit</td>
</tr>
<tr>
<td>• SAEMA’s Public Relations Unit</td>
</tr>
<tr>
<td>• SAEMA’s Urban Roads Department</td>
</tr>
<tr>
<td>• SAEMA’s Waste Management Department</td>
</tr>
<tr>
<td>• Town and Country Planning</td>
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<tr>
<td>• Various Unit Committees within SAEMA</td>
</tr>
</tbody>
</table>

Source: Authors’ data

Recommendations

- **Communities** should be involved to improve planning and decisionmaking.
- **The Department of Health** should provide information on the scope and scale of diseases.
- SAEMA’s **General Assembly and Waste Management Department** should provide regular waste pick up and adequate waste management facilities.
- SAEMA’s **Environmental Health Unit** should:
  - Work with communities, NGOs, and CBOs to raise awareness and improve education on the need to maintain clean tertiary drains
  - Effectively monitor and reinforce compliance to environmental policies and bylaws, including maintenance schedules.
- SAEMA’s **Environmental Health Unit and Public Relations Unit** should:
  - Provide a forum for complaints and conflict resolution
  - Create conflict resolution mechanisms.
- SAEMA’s **Waste Management Department** should be equipped to supervise and monitor the cleaning and unclogging of main drains.
- SAEMA’s **Unit Committee structures** should share experiences and ideas among assembly staff.
- SAEMA’s **Urban Roads Department** should:
  - Have clearly defined institutional responsibilities for cleaning secondary drains and desilting secondary and tertiary drains
  - Provide adequate and proper drainage.
- **The private sector** should be subcontracted by the Hydro Division of the Ministry of Works and Housing to unclog main drains (see also water, sanitation, and drainage recommendations).
- SAEMA’s **Department of Planning** should develop an effective system to improve information flow (GIS and MIS and so on).
- **Environmental specialists** should assess the environmental impact of land reclamation of marshes.

Water, Sanitation, and Drainage

Considerable work has been done to integrate health concerns into the water sector; therefore, the most promising from an environmental health perspective are interventions in drainage and sanitation. Two areas that stand out are drainage and information exchange, including mapping. Both of these are cross-cutting and included in all three entry points.
Water
Problems and risks are associated with the quality and quantity of water available, accessibility to water, affordability of water, knowledge and attitude on use of good water, and the spread of diseases through water. Causative factors in providing good quality water are inadequate human, financial, and material resources and inadequate planning and infrastructure (system network) provision.

Stakeholders at risk. Beneficiaries of water services, particularly those in high-density areas that depend on vendors for their water, are at risk.

Partnerships. The following groups are expected to come together to design ways to improve water service to beneficiaries: media, religious groups, SAEMA’s Environmental Health Unit, schools, service providers, traditional leaders, and various Unit Committees within SAEMA.

Recommendations
The group suggested the community assist in sensitizing the public to put available water to good use and to report faults promptly to service providers who are in turn expected to train selected community leaders on water issues.

Sanitation
Inadequate facilities, knowledge, and attitudes in communities largely contribute to sanitation problems.

Stakeholders at risk. The community, industries, and private sector are at risk for diseases of poor sanitation and are expected to come together and collaborate with MDAs and other service providers to find effective solutions.

Recommendations
• Financial and educational institutions, as well as industries should be involved in an awareness campaign.
• Law enforcement agencies should enforce sanitation bylaws in accordance with national sanitation policy.
• The media and NGOs should improve public education.
• Watchdog committees should be formed to work in collaboration with the unit committees, religious groups, and MDAs.
• Current roles of service providers should be reviewed.

Drainage
Poor drainage due to improper planning and implementation, which can stem from inadequate financial and human resources. Unclear institutional responsibility and flooding lead to loss of life and property, spread of diseases, and erosion resulting in silt clogging drains.

Stakeholders at risk. Community, property owners, industries, and the transport sector are at risk.

Recommendations
• Involve the private sector in desilting drains.
• Educate community on maintaining good drainage through unit committees, NGOs, the Ghana Private Road Transport Union (GPRTU), and Private Road Transport Operators Association (PROTOA) (see urban malaria recommendations).
Cross-Cutting Issues

The following three multisectoral cross-cutting issues have been identified: (a) information exchange, (b) institutional responsibilities assigned to the Environmental Health Unit, and (c) application of sanitation bylaws.

Solutions.

- Improve information exchange among departments and communities. This includes an inventory of existing data, assessment of needed multisectoral data, and analysis of the role of GIS. SAEMA and the Development Planning Unit within SAEMA will play a lead role.
- Relieve institutional responsibility that seems to overburden the Environmental Health Unit.
- Ensure multisectoral environmental health issues are taken into consideration in sanitation bylaws that are being revised locally.

Summary of Participants’ Comments

UESP Project Coordinator Mr. Robert Austin presented an overview of the concept and projects being undertaken by UESP. He emphasized two examples of intersectoral collaboration in planning and implementation projects: (a) provision of toilets in household and schools and (b) community upgrading in the city’s low-income areas. In each, project planning and implementation involved the community, households, departments, relevant subcommittees, and assemblymen. This involvement increased project ownership and implementation effectiveness.

The Director of the Policy Planning, Monitoring and Evaluation Unit of the Ministry of Health wanted further clarification on the use of the expression “health benefits outside of the health sector,” because the agencies are already supposed to work together.

The Regional Director of Health Services expressed his appreciation for the “needs assessment.” He stated that collaboration between the health sector and the other ministries, departments, and agencies (MDAs) in the Western Region can be seen in a current effort to set up an intersectoral Emergency and Ambulance Service for SAEMA. The regional director called for development of indicators for sectors outside the health sector. He also called for bridging of gaps between social services (such as health) and the developmental (or infrastructure) sectors. This would recognize health as a developmental effort and not just as a social issue.

The UESP Technical Adviser of the Ministry of Local Government and Rural Development (MLGRD) drew attention to the Physical Decentralization Unit being set up within MLGRD to oversee all aspects of decentralization under the Local Government Service Act.

The Representative of the Department for International Development (DFID-UK) emphasized the importance of involving communities in the planning stages of projects and not introducing already conceived projects. This will ensure community participation and project sustainability.

NGOs and CBOs lamented the absence of clear links and feedback mechanisms with SAEMA, because they can be an important link between the public and SAEMA.

Regarding horizontal collaboration, the Sekondi submetro Chairman observed that attention should be paid to how information or education is passed to the area or unit committees and household level.

In her concluding remarks to SAEMA, the DFID Representative called on SAEMA to examine collaboration needs carefully. No city exists in the world that does not have a collaboration prob-
SAEMA should, therefore, have a shared vision, work to build capacities, and establish linkages for environment and health. In this way, it will come to realize that the benefits outweigh the costs.

The Director of the Policy Planning Monitoring and Evaluation Unit of the Ministry of Health concluded the proceedings by stating that to achieve what was discussed calls for good leadership and governance.

Summary and Recommendations

Four innovative multisectoral sets of recommendations were identified during the workshop and presented to a meeting of the Ghana donor community on the final day of the workshop. It was emphasized again that the objective was not to present a shopping list, but to present innovative multisectoral solutions for health prevention. These recommendations include:

- **Management of health facility waste.** The medical waste group examined weak links in the multisectoral environmental health chain. Incentives and capacity need to be developed to involve the private sector in medical waste management. Novel multisectoral approaches include (a) develop bylaws for medical waste management that do not exist at the municipal level, (b) build capacity to monitor and enforce proper medical waste management at all types of facilities, from laboratories to hospitals, (c) add economic value to recycled waste, so that it can be pulled out of the informal sector and disposed of safely, and (d) increase awareness of proper disposal of medical waste at all levels of government and society.

- **Urban malaria and other vector-borne diseases.** Urban malaria, the primary disease in SAEMA, is on the rise. It is a multisectoral problem that requires multisectoral collaboration but for which no multisectoral tools exist. Novel multisectoral approaches include (a) land use management, for example, land reclamation (bearing in mind that wetlands are not wastelands) and aquaculture, (b) coordination of proper drainage at various levels of municipal government and communities, and (c) awareness of alternatives to spraying at all levels of government and civil society, such as interrupting breeding cycles around households.

- **Water, sanitation, and drainage.** Considerable work has been done to integrate health concerns into the water sector; therefore, the most promising from an environmental health perspective are interventions in drainage and sanitation.

- **Cross-cutting issues.** Three multisectoral, cross-cutting issues have been identified in each of the entry points: (a) information exchange, including geographic information system (GIS) mapping, (b) institutional responsibilities assigned to the recently created Environmental Health Unit, and (c) application of sanitation bylaws.

The following three next steps were proposed in analyzing workshop findings:

- Present and discuss the workshop findings and recommendations at the mid-term review of UESP for inclusion in UESP, and a proposal reflecting these issues should be submitted to the donors.

- Replicate the process of selecting environmental health priorities in Sekondi-Takoradi in the four other UESP cities (Accra, Kumasi, Tamale, and Tema), using the workshop documents. In general, the ten issues from Sekondi-Takoradi are sufficiently similar to those in the rest of Ghana to justify formulation of a draft strategy through a desk review that could be adapted to local circumstances without conducting a separate needs assessment and workshop.
Table 17-2: Opportunities for Intersectoral Collaboration within the SAEMA

<table>
<thead>
<tr>
<th>Ministries, Departments, and Agencies</th>
<th>Health Facility Wastes</th>
<th>Urban Malaria and Other Vector-Borne Diseases</th>
<th>Water</th>
<th>Sanitation</th>
<th>Drainage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regional hospital</td>
<td></td>
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<tr>
<td>Regional Health Administration</td>
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<tr>
<td>Waste Management Department</td>
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<td>Private waste contractors</td>
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<tr>
<td>Selected hospitals in SAEMA</td>
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<tr>
<td>Metropolitan Health Management Team</td>
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<tr>
<td>Environmental Health Unit</td>
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<td>Environmental Protection Agency</td>
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<tr>
<td>Ghana Water and Sewerage Corporation</td>
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<tr>
<td>Community Water and Sanitation Agency</td>
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<tr>
<td>Water vendors</td>
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<tr>
<td>NGOs and CBOs</td>
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<td>Public toilet operators</td>
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<td>Communities (assembly members)</td>
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<td>Community development</td>
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<td>T&amp;CP and Works Departments</td>
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<td>Legal Department of SAEMA</td>
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<td>Traditional authorities</td>
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<tr>
<td>Ministry of Local Government and Rural Development</td>
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<td>SAEMA Roads Unit/Department of Urban Roads</td>
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<td>UESP</td>
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<td>Development Planning Unit</td>
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<td>Public Relations Department</td>
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<td>Ministry of Works and Housing</td>
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<td>Ghana Medical Association</td>
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<td>Pharmacy Board</td>
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<td>Chemical sellers</td>
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<td>Ghana Education Service</td>
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</tbody>
</table>

*Source: Authors’ data.*

Based on the workshop outcome, consider replication of this process to help other cities in SSA prioritize their needs, which could also be presented to government officials and stakeholders for
inclusion in ongoing or future projects. One of the objectives of the workshop was to address how departments can collaborate with each other and at what cost. Collaboration requires sharing information in a format that can be used by others (see table 17-2). As a first step in implementing study conclusions, the results should be disseminated to other cities in Ghana and SAEMA should design an appropriate methodology for data collection and dissemination as well as monitoring and evaluation mechanisms.

Sample Terms of Reference for the Sekondi-Takoradi Workshop

Background and General Assignment

The World Bank’s program “Environment and Health: Bridging the Gaps” is part of an effort to mainstream environmental health into World Bank operations, particularly into environmental assessments. The rationale behind the work is simple: most causes of disease, injury, and death in developing countries— inadequate infrastructure (especially, sanitation, water, waste removal, and housing), poor personal hygiene, and traffic injuries—lie outside the purview of the health sector; yet, policies of the sectors that exert these negative health impacts are not set by health criteria, and the health sector itself tends to focus interventions on the health care delivery system, not necessarily on the sectors that are the sources of the problems. Bridging Environmental Health Gaps (1996) helps redress this situation by identifying opportunities for interventions outside the health sector in three complementary activities:

- Describing environment-health linkages and their impacts, and proposing solutions (rapid environmental health assessment guidelines are being prepared)
- Exploring the cost-effectiveness of interventions outside the health sector to complement health sector interventions
- Fostering intersectoral collaboration among health and other agencies that are not used to working together.

A pilot study, “Targeted Collaboration among Line Agencies, Local Communities, and the Ministry of Health,” will be conducted in Ghana, from July to October 1999. The pilot will be piggy-backed onto the Urban Environmental Sanitation Project (Credit #2836) to address the following issues: how can health, environmental, and infrastructure agencies collaborate on a daily basis and with what benefits and costs? The pilot is intended to develop a methodology to define a parallel set of health priorities based on cost-effective interventions through infrastructure and environmental interventions, rather than on typical morbidity and mortality data. The work will initially be based on common “entry points,” for which health, infrastructure, and environment agencies can build agreed objectives. The three main entry points for the pilot study include:

- Management of wastes from health care facilities
- Urban malaria and other vector-borne diseases
- Water, sanitation, and drainage.

Final products of the pilot study will include:

- Lessons learned on intersectoral collaboration and identification of subsequent institutional set up and responsibilities of such collaboration
- Guidelines to identify, evaluate, and prioritize health problems outside the health sector based on “burden of disease” assessments
- Identification of a panoply of instruments, interventions, and monitoring indicators.

The overriding theme for the assignment—and indeed, a basic premise of the pilot itself—will be to promote sustainable collaboration, based on the notion of mutual benefit rather than additional funding for cross-sectoral collaboration. The “targeted collaboration” promoted by the pilot, thus,
revolves around an exchange of “contributions in kind,” from which each agency benefits. In the long run, mutually beneficial collaboration may be worth far more than additional budget allocations, largely because budget levels can be uncertain. Accordingly, to help promote collaboration, the consultants must conduct a needs assessment \((a)\) for each of the government or commercial groups to learn what they need to improve service delivery, \((b)\) for each of the community groups to learn what they expect in improved service, and \((c)\) most important, for all of the groups to learn what they can contribute in exchange for improved service.

**Selection of City**

One city will be selected for the pilot, and, so far, four cities have been suggested: Sekondi-Takoradi, Tamale, Tema, and Accra.

**Consultant Assignments**

The pilot will require the input of a urban planning consultant. His or her qualifications should include development planning, socioeconomic surveys and analysis, and urban health and environmental issues. The consultant will be in charge of implementing the pilot study locally and may hire appropriate consultants for specific tasks within the overall agreed budget. The consultant may recruit additional consultants, such as a public administrator or a public health specialist, to assist him or her in carrying out this assignment.

The consultant is responsible for four major tasks: \((a)\) consultations and assessment, \((b)\) workshop preparation, \((c)\) workshop management, and \((d)\) workshop report, including methodology of the pilot, its pros, cons, and replicability.

**Consultations and Assessment**

Assess the opportunities and constraints of intersectoral collaboration and build on the “Consultative Assignment on Urban Public and Environmental Health in Ghana” report (see chapter 15) to:

- List all government, business, and community agencies that are involved with (or should be involved with) the pilot’s three “entry points.”
- Contact key government officials and agencies (ministries in the areas of environment, health, infrastructure [roads, housing, water supply, and sanitation]; local governments; rural development; line agencies [EPA and so on]; and district assemblies) and stakeholders (NGOs, CBOs, professional associations, the private sector, communities, and so on), as approved by the Resident Mission, to solicit their views on how the services they provide can be improved.
- Submit a needs assessment prepared by the team at headquarters to all key government officials and stakeholders (see chapter 15 for its content, which will be finalized by July 1\((e)\)).
- Analyze the information or data from the needs assessment and update the “Ghana Assessment” to produce a preliminary issues paper on institutional, legal, decentralization, financial and incentive, capacity-building aspects that will be tackled at the workshop.
- Collect data requested by the team at headquarters for the cost-effectiveness analysis of interventions.

**Workshop Preparation Management and Report**

Workshop preparation will entail the following steps:

- Plan the workshop in coordination with the Ministry of Local Government and Rural Development (MLGRD) and resident mission.
• Select participants in coordination with MLGRD, the resident mission, and team at headquarters.
• Prepare an agenda in coordination with MLGRD, the resident mission, and team at headquarters.
• Be responsible for all logistic and administrative matters (i.e., facility hire, supplies, audio recording for two days; travel and lodging for some participants; meals and coffee; and so on).
• Organize the workshop according to the budget that was prepared by the resident mission.

Workshop Management. The consultant will serve as workshop codirector together with the team leader from headquarters. His or her task will consist of facilitating the two-day pilot workshop, which will provide an opportunity to present findings, propose next steps, and engage government officials and agencies and stakeholders in a dialogue.

Workshop Report Including the Methodology of the Pilot, Its Pros, Cons, and Replicability. Produce a final report on all of the pilot workshop. The report will include the proceedings, methodology that was devised for the pilot that would underpin the pros and cons of the process, and its replicability to other cities at the national and regional levels. The report will also include sections on reclassifying the national burden of disease, the cost-effectiveness methodology, and the multicriteria analysis. These sections will request timely input from the consultant and will be the responsibility of the team at headquarters.

Needs Assessment Main Points. The needs assessment outline will be prepared by the team at headquarters. The main points will include update of the assessment of (a) institutional responsibilities, (b) portfolio, including operations and maintenance policies and practices, (c) priorities and objectives, (d) reporting responsibilities, (e) environmental, health, and environmental health linkages, (f) staff needs, including training and recruitment, (g) willingness to collaborate including spirit, understanding, resources, time, personnel, and examples of past collaboration, (h) costs of collaboration both internally and externally, and (i) restrictions for collaboration with each government official or agency and stakeholder.

Supervision. The consultant will:

• Be supervised by the coordinators based at the World Bank resident mission in Accra
• Liaise with two focal points at the Ministry of Local Government and Rural Development
• Report to the Ghana Pilot Team based in headquarters and designated reviewers
• Communicate with the team at headquarters weekly preferably on Thursday from the resident mission through the telephone-based Tie-Line between Bank headquarters and regional offices. Also, to facilitate communication, an E-mail link would be established at the resident mission.
• Attachment: Consultant CVs.
ANNEX A: ENVIRONMENTAL HEALTH ASSESSMENTS:
RAPID CHECKLISTS

The “Rapid Environmental Health Assessment Checklists” are excerpted for easy reference from part 2, “Environmental Health Assessment Guidelines,” in *Environmental Health: Bridging the Gaps*. The checklists provide basic tools to identify and propose remedial measures for multisectoral health problems, many of which could and do otherwise fall between the cracks in single sector projects. The guidelines have been prepared for the benefit of World Bank staff and other development practitioners, who may be part of a team to perform an environmental health assessment or an equivalent exercise. Although the guidelines focus on SSA, they are pertinent for other Regions. An important aim of the guidelines is to stress the multisectoral links of environmental health problems and possible remedial measures. These links are reflected in the checklists.

The checklists consist of ten tables:

- Table A-1 consolidates selected multisectoral links showing (a) sector issues, (b) possible health linkages per sector, (c) their cross-sectoral dimension, and (d) suggested remedial measures.
- Tables A-2 to A-10 present the material for each sector, showing (a) a typical project or component, (b) possible environmental health repercussions, and (c) suggestions for remedial actions.

A broader presentation of these issues is available in part 2 of this volume. These and other sectoral checklists are available at <http://www.worldbank.org/afr/environmentalhealth/>.
<table>
<thead>
<tr>
<th>Environmental Issues by Sector</th>
<th>Possible Links and Health Effects</th>
<th>Cross-Sectoral Dimensions</th>
<th>Remedial Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agriculture and Rural Development:</strong> Deforestation, agricultural chemicals, water resource management, e.g., irrigation and drainage, dams and reservoirs, and fisheries</td>
<td>Contamination of water and the food chain with pesticides and fertilizers, spread of disease vectors, increased resistance to pesticides, loss of medicinal plants, and injury or death from flooding.</td>
<td>Waste management, land use, soil and chemical runoff, depletion of carbon sink, loss of habitat, erosion, resettlement, and so on.</td>
<td>Land use management and integrated pest management, watershed management, comprehensive water resource management, and affordable protective gear and equipment for pesticide application.</td>
</tr>
<tr>
<td><strong>Infrastructure:</strong> Water supply and sanitation, housing and urban development, transport, and telecommunications</td>
<td>Diarrheal, respiratory, and vector-related diseases; traffic injuries; and decreased IQ from lead poisoning in transport fuels.</td>
<td>Sexually transmitted diseases, including AIDS, spread by truckers or construction crews; waste disposal; vector breeding sites; and resettlement</td>
<td>Outreach to truckers, build awareness of work crews as part of contracts, land use management, waste management, and traffic law enforcement.</td>
</tr>
<tr>
<td><strong>Energy:</strong> Deforestation, indoor air pollution, outdoor air and water pollution, global warming, and dams</td>
<td>Respiratory disease, physical stress from getting firewood, vector-related diseases, and contamination of the food chain from lead in fuels or other sources of lead.</td>
<td>Depletion of carbon sink, deforestation, and vector breeding sites.</td>
<td>Economic instruments, regulatory measures, moral suasion, stove and vehicle efficiency, alternative energy sources, and land use and water resource management.</td>
</tr>
<tr>
<td><strong>Industry:</strong> Air, water, and land pollution; climate change and global warming; and occupational exposures</td>
<td>Air, land, water, coastal, and marine pollution leading to diarrheal, respiratory, and vector-related diseases, and contamination of the food chain.</td>
<td>Waste disposal, vector breeding sites, and chemical contamination.</td>
<td>Occupational health and safety measures, economic instruments, regulatory measures, moral suasion, and land use management.</td>
</tr>
<tr>
<td><strong>Health:</strong> Respiratory and diarrheal diseases, AIDS, malaria, and injuries</td>
<td>Medical waste from health facilities leading to various diseases, e.g., AIDS, cancers, diarrheas, and respiratory illnesses.</td>
<td>Sexually transmitted diseases, including AIDS spread by truckers or construction crews; waste disposal; and vector breeding sites.</td>
<td>Improved waste collection, trucker outreach, building awareness of work crews as part of contracts, and affordable protective gear and equipment.</td>
</tr>
<tr>
<td><strong>Environment and Natural Resources:</strong> Forestry, biodiversity, and marine management</td>
<td>Potential for new medications, and contamination of food chain.</td>
<td>Climate change, global warming, and ozone depletion.</td>
<td>Management of land use, watershed, and marine and coastal zones; and pollution control.</td>
</tr>
<tr>
<td><strong>Multisectoral:</strong> Privatization of public services</td>
<td>Absence of health considerations from the business agenda.</td>
<td>Increased exposure of workers and general public to health risks.</td>
<td>Lending instruments and management procedures.</td>
</tr>
<tr>
<td><strong>Global:</strong> Climate change and global warming</td>
<td>Resistance to drugs, spread of vector-borne diseases, skin cancer and cataracts from ozone depletion, death and injury from climate extremes, e.g., storms and heat waves.</td>
<td>Individual sector contributions aggravate overall problem.</td>
<td>Lending instruments, training, and grants to help address the issue; and awareness campaigns.</td>
</tr>
</tbody>
</table>

*Source: Authors’ data*

* See table 6-7.
### Table A-2: Agriculture Sector Environmental Health Checklist

<table>
<thead>
<tr>
<th>Typical Agriculture Projects and Components</th>
<th>Probable Environmental Health Issues</th>
<th>Remediable Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency Reform</td>
<td>Rural water supply, watershed management, or irrigation projects could entail diarrheal diseases, skin diseases, eye infections, vector-related diseases, especially malaria, schistosomiasis, and onchocerciasis.</td>
<td>Besides water provision (quantity and quality), preparation of terms of reference (TORs) for rural water supply and sanitation projects should determine if disease is or has been endemic. If so, the project could assign responsibilities for monitoring stagnant water and drainage to stakeholders. If disease is still endemic, the project should provide for protecting the water source and appropriate education. TOR implementation should provide for proper O&amp;M outside the ministry of health or agriculture (MOH/MOA), if appropriate. A community participation component may be needed for O&amp;M and cost recovery.</td>
</tr>
<tr>
<td>Agricultural Credit</td>
<td>Only relevant if funds are “on-lent” to buy inputs, for example, fertilizers and pesticides and to other subsectors, but without EAs or EHA reviews.</td>
<td>See “Agroindustries”</td>
</tr>
<tr>
<td>Agricultural Extension</td>
<td>Same as for “Agency Reform” subsector</td>
<td>Same as for “Agency Reform” subsector</td>
</tr>
<tr>
<td>Agricultural Adjustment</td>
<td>As part of studies and training, environmental health issues, such as vector-related diseases, should be included in preparation of TORs, when appropriate.</td>
<td></td>
</tr>
<tr>
<td>Agroindustry and Marketing</td>
<td>Pesticide and fertilizer use: Acute poisoning to farmers and family members due to storage problems in houses. Fertility and reproductive problems, for example, spontaneous abortions. Weakened immune system Other possible long-term effects, such as cancer and birth defects.</td>
<td>For (a)–(d), implementation TORs should include procedures for health hazard awareness campaign and provide for affordable protective gear and equipment.</td>
</tr>
</tbody>
</table>

* See table 8-13.
<table>
<thead>
<tr>
<th>Typical Agriculture Projects and Components</th>
<th>Probable Environmental Health Issues</th>
<th>Remediable Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rehabilitation and construction:</td>
<td><strong>Accidents during construction.</strong></td>
<td>Implementation TORs should include:</td>
</tr>
<tr>
<td></td>
<td><strong>Increased vehicle use can cause traffic injuries.</strong></td>
<td>Provision for affordable protective gear and equipment.</td>
</tr>
<tr>
<td></td>
<td><strong>Increased exposure to vehicle fumes can cause respiratory diseases in populations along roadsides.</strong></td>
<td>Appropriate road design and better law enforcement (drunk driving, seat belts, and so on).</td>
</tr>
<tr>
<td></td>
<td><strong>Lead-related conditions such as anemia and neurological effects, especially in children.</strong></td>
<td>Better law enforcement (emission control) and awareness campaign for population at risk.</td>
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<tr>
<td></td>
<td><strong>AIDS spread by construction workers and truckers.</strong></td>
<td>In the short term (preparation TOR should identify population at risk), Vitamin A supplement for population at risk, and, in the long term, introduction of nonleaded fuel.</td>
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<tr>
<td></td>
<td><strong>Food processing and storage:</strong></td>
<td>AIDS and STD awareness in conjunction with MOH campaign targeting workers (labor unions and associations) and truckers (associations), a clause on AIDS and STDs (and possibly hygiene) in the subcontractor contract, and distribution of condoms as appropriate.</td>
</tr>
<tr>
<td>Food processing and storage:</td>
<td><strong>Contamination with pesticides or other chemicals and/or microorganisms may occur during handling, transport, or storage of foodstuffs resulting in:</strong></td>
<td>For (a) and (b), implementation TORs should include a health hazard awareness campaign.</td>
</tr>
<tr>
<td></td>
<td><strong>Acute poisoning and Diarrhoeal diseases.</strong></td>
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<td></td>
<td><strong>Small-scale water systems:</strong></td>
<td>See “Irrigation and Drainage”</td>
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<td></td>
<td><strong>See “Irrigation and Drainage”</strong></td>
<td></td>
</tr>
<tr>
<td>Annual Crops</td>
<td>Similar to “Agroindustry and Marketing”</td>
<td>Similar to “Agroindustry and Marketing”</td>
</tr>
<tr>
<td>Fisheries and Aquaculture</td>
<td>Fishing and processing:</td>
<td>For (a)–(b), implementation TORs should include and awareness campaign and affordable protective gear and equipment and for (c) counseling and (d) affordable protective gear and equipment, including insect repellant.</td>
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<td></td>
<td><strong>Drowning and accidents from falls</strong></td>
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<td><strong>Skin diseases due to constant moisture, especially the extremities.</strong></td>
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<td></td>
<td><strong>Occupational injuries and physical stress, e.g., overexertion and back pains.</strong></td>
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<tr>
<td></td>
<td><strong>Vector-borne diseases, e.g., schistosomiasis, onchocerciasis, and malaria.</strong></td>
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</tr>
<tr>
<td>Typical Agriculture Projects and Components</td>
<td>Probable Environmental Health Issues</td>
<td>Remediable Measures</td>
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</tr>
<tr>
<td>Road rehabilitation:</td>
<td>Still included TORs</td>
<td></td>
</tr>
<tr>
<td>Forestry</td>
<td>See “Agroindustry and Marketing”</td>
<td>For (a), implementation TORs should include affordable protective gear and equipment including insect repellent and for (b)–(d) awareness campaigns.</td>
</tr>
<tr>
<td>Vector-related diseases, especially malaria.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accidents, e.g., falls, cuts, and abrasions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snake and animal bites.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupational injuries and physical stress, e.g., overexertion, back pains.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation and Drainage</td>
<td>Vector-related diseases</td>
<td>For (a)–(c), implementation TORs should include vector control targeting drainage, sanitation, and stagnant water (stakeholder involvement in monitoring and introduction of larvivorous [larva-eating] fish as appropriate) as well as an awareness campaign including hygiene behavior.</td>
</tr>
<tr>
<td>Diarrheal diseases from improper drainage and sanitation; Long-term, low-level exposure to pesticides due to reuse and exposure of irrigation waters.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Livestock</td>
<td>Health issues mostly related to exposure of workers to animal waste: Brucellosis and anthrax from contact with infected cattle, swine, goats, and sheep. Other infectious diseases from occupational exposures to livestock, poultry, and abattoirs, for example, Q fever, asthma, psittacosis, fungal and parasitic diseases, and leptospirosis (Weil’s disease) (the latter of which can be spread to communities during heavy rains in areas of poor drainage). Diarrheal diseases in workers and village due to contamination of drinking water. Other effects may include the nuisance of smells and aesthetics.</td>
<td>For (a)–(c), implementation TORs should include awareness campaigns and affordable protective gear and equipment.</td>
</tr>
<tr>
<td></td>
<td>Food processing: See “Agroindustry and Marketing”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water resources: See “Irrigation and Drainage”</td>
<td></td>
</tr>
<tr>
<td>Other Agriculture</td>
<td>As covered above</td>
<td>As covered above</td>
</tr>
<tr>
<td>Typical Agriculture Projects and Components</td>
<td>Probable Environmental Health Issues</td>
<td>Remediable Measures</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-------------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Perennial Crops</td>
<td>As covered above in other subsectors, especially agroindustry.</td>
<td>As covered above in other subsectors, especially agroindustry.</td>
</tr>
<tr>
<td>Research</td>
<td>Varies</td>
<td>Varies</td>
</tr>
</tbody>
</table>

*Source: Authors’ data.*
<table>
<thead>
<tr>
<th>Typical Energy Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distribution and transmission</strong></td>
<td>(a) Occupational health and safety issues such as exposures to chemicals, excessive heat, dust,</td>
<td>Implementation TORs should include:</td>
</tr>
<tr>
<td>Aside from installation and</td>
<td>noise, biological agents such as mosquitoes (malaria) and the like, and ergonomic hazards</td>
<td>(a) Awareness campaign and affordable protective gear and equipment.</td>
</tr>
<tr>
<td>improvement of transmission lines</td>
<td>for workers during construction, maintenance, rehabilitation, and/or upgrading of power</td>
<td>(b) Gradual reduction of emissions to reach WHO standards through (as appropriate) regulatory</td>
</tr>
<tr>
<td>or distribution system, also includes</td>
<td>facilities, including installation or improvement of transmission or distribution system.</td>
<td>measures, economic instruments and moral suasion; demand management programs; improvement of</td>
</tr>
<tr>
<td>upgrading, maintenance, and</td>
<td>(b) Ambient air pollution is an issue especially for populations living within a certain</td>
<td>production processes; alternative energy sources; and so on.</td>
</tr>
<tr>
<td>rehabilitation of power facilities;</td>
<td>distance from power plants. Most common pollutants are SO₂, PM₁₀, CO, and other chemicals.</td>
<td></td>
</tr>
<tr>
<td>provision of workshop equipment and</td>
<td>NOₓ may also be present, especially in areas in which vehicular traffic may increase due to</td>
<td></td>
</tr>
<tr>
<td>maintenance vehicles; management</td>
<td>activities related to the installation or upgrading of power plants and/or transmission</td>
<td></td>
</tr>
<tr>
<td>information system; technical</td>
<td>systems. Respiratory diseases in the exposed population may increase due to such activities.</td>
<td></td>
</tr>
<tr>
<td>assistance; and institutional</td>
<td>(c) Some studies show childhood cancers due to exposure to electromagnetic fields (EMFs) in</td>
<td></td>
</tr>
<tr>
<td>strengthening</td>
<td>people living around high-voltage installations or equipment.</td>
<td></td>
</tr>
<tr>
<td>(d) Physical and mental stress due</td>
<td>(d) Safety concerns for the surrounding communities due to the danger of fire and explosions</td>
<td></td>
</tr>
<tr>
<td>to displacement of populations</td>
<td>from accidents in the power plants and transmission system.</td>
<td></td>
</tr>
<tr>
<td>from construction of power plants</td>
<td>(e) Safety concerns for the surrounding communities due to the danger of fire and explosions</td>
<td></td>
</tr>
<tr>
<td>and transmission lines.</td>
<td>from accidents in the power plants and transmission system.</td>
<td></td>
</tr>
<tr>
<td>(f) Herbicide exposures from</td>
<td>(f) Herbicide exposures from intensive use of herbicides underneath and around electricity</td>
<td></td>
</tr>
<tr>
<td>intensive use of herbicides</td>
<td>power lines and oil pipelines.</td>
<td></td>
</tr>
<tr>
<td>**Electric power and other energy</td>
<td>Refer to above</td>
<td>Refer to above</td>
</tr>
<tr>
<td>adjustment**</td>
<td>Refer to above</td>
<td>Refer to above</td>
</tr>
</tbody>
</table>

* See table 9-3.
<table>
<thead>
<tr>
<th>Typical Energy Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hydro</strong></td>
<td>Refer to above. In addition, water and vector-related diseases, such as schistosomiasis and malaria, must be considered. Safety concerns from accidental drowning may also be considered.</td>
<td>Refer to above. Implementation TORs should include possible alteration of habitats of snails (schistosomiasis) and mosquitoes (malaria) and awareness campaign.</td>
</tr>
<tr>
<td>Similar to former, but more focused on hydroelectric generation</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other power and energy conversion:</strong></td>
<td>Refer to above. However, coal-fired power plants and bagasse have been shown to be especially polluting in terms of SO₂ and dust particulate, thus, emphasis must be given to respiratory diseases.</td>
<td>Implementation TORs should include gradual reduction of emissions to reach WHO standards through (as appropriate) regulatory measures; economic instruments and moral suasion; demand management programs; improvement of production processes; alternative energy sources, and so on.</td>
</tr>
<tr>
<td>Similar to hydro. In addition, includes development and adaptation of other types of power generation, e.g., bagasse-coal plants, environmental projects, e.g. tree planting, forest protection, and so on</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Thermal</strong></td>
<td>Refer to above. In addition, drillings for geothermal may unearth certain heavy metals that may pollute surface and groundwater, thus, giving rise to certain diseases depending on the chemical or heavy metal.</td>
<td>Implementation TORs should include proper disposal of unearthed soil.</td>
</tr>
<tr>
<td>Similar to former but focused on gas and steam turbine generator sets and exploring geothermal sources</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Source: Authors’ data.*
Table A-4: Environment Sector Environmental Health Checklist

<table>
<thead>
<tr>
<th>Typical Environment Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environmental Adjustment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Projects include soil, water, and forest ecosystem management; national parks and ecotourism; marine and coastal management; general environmental management and public works, namely maintenance of roads; rehabilitation of drainage systems; urban infrastructure; and public services. Training and technical support and study components also occur.</td>
<td>Vector-related diseases, such as malaria, schistosomiasis, filariasis, and others, for communities living near or within the management areas and areas where public works are being done. Occupational health issues for workers both for the environmental management projects and public services construction and rehabilitation, e.g., prolonged exposure to the sun and heatstroke, exhaustion, and, in the long term, skin cancer. Accidents, such as drowning, falls, and animal bites, especially for those engaged in forestry and marine conservation activities as well as in the community near the activities.</td>
<td>Implementation TORs should include: Vector control, especially drainage, targeting stagnant water, and introducing larvivorous (larva-eating) fish (tilapia) as appropriate. Awareness campaigns and affordable protective gear and equipment.</td>
</tr>
<tr>
<td><strong>Environmental Institutions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concerned with developing institutional and technical capabilities for environmental monitoring, policy formulation and coordination, and dealing with management issues in environmental action plans. Also, conducts program, pilot, or otherwise on preventing soil degradation and erosion and further degradation of fragile ecosystems.</td>
<td>Similar to above</td>
<td>Similar to above. and preparation TORs should attempt to harmonize environmental and environmental health strategies and other sectoral strategies as appropriate, and foster multisectoral collaboration through entry points.</td>
</tr>
<tr>
<td><strong>Natural Resource Management</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Similar to environmental adjustments. In addition, village, regional, and local level investments to set up natural resource management plans and environmental information systems. Other projects may include fisheries management, research and studies, policies and laws, water quality monitoring, industrial and municipal waste management, land use and wetland management, soil conservation, and reforestation.</td>
<td>Similar to the above. In addition, due to the waste management component, skin diseases, parasitic and other infectious diseases could be prevalent among those living near waste disposal areas and, especially, the scavengers. Exposure to chemical pollutants in the water and air from the waste may also be prominent.</td>
<td>Similar to the above, and implementation TORs should include adequate landfill management and restriction of waste disposal areas to workers; awareness campaign; and creation of an interface that allows for using the environmental information system to map and prevent environmental health risks.</td>
</tr>
<tr>
<td><strong>Pollution Control and Waste Management</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mostly pollution management projects on water, air, and land</td>
<td>Monitoring of respiratory diseases for air pollution and heavy metal</td>
<td>Implementation TORs should include an awareness campaign and</td>
</tr>
</tbody>
</table>

* See table 10-2.
<table>
<thead>
<tr>
<th>Typical Environment Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>poisoning for both air and water pollution must be considered.</td>
<td>emission reduction targeting population at high risk of exposure first.</td>
</tr>
<tr>
<td></td>
<td>For other relevant diseases, refer to the natural resource management subsector.</td>
<td>For other relevant diseases, refer to the natural resource management subsector and table 9-3 for energy.</td>
</tr>
<tr>
<td>Resettlement</td>
<td>Mental and physical stress due to displacement.</td>
<td>Counseling</td>
</tr>
<tr>
<td>Issues of resettling populations, e.g., tribal groups from ancestral homes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Environment</td>
<td>Similar to the above. In addition, focus on urban infrastructure brings in road accidents as a safety risk.</td>
<td>Similar to the above, and implementation TORs should include law enforcement (drunk driving, seat belts, insurance liabilities, and so on).</td>
</tr>
<tr>
<td>Similar to the above with more focus on urban infrastructure and services, including studies on sanitary landfills, industrial parks, marine conservation, and so on</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Authors’ data.
<table>
<thead>
<tr>
<th>Typical Health Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Proposed Remedial Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Targeted health</strong></td>
<td>Same as above. In addition, emphasis must be made for occupational health issues for health caregivers dealing with hepatitis B and HIV. Also in the Africa region, transmission of STDs via the truckers and work crews must be given importance.</td>
<td>Implementation TORs should include AIDS and STD awareness in conjunction with MOH campaign targeting worker (labor unions and associations) and truckers (associations), a clause on AIDS and STDs (and possibly hygiene) in the subcontractor contract, and distribution of condoms as appropriate.</td>
</tr>
<tr>
<td><strong>Medical waste</strong></td>
<td>Health hazard from contaminated medical wastes.</td>
<td>Preparation TORs should include identification of the type of medical waste and ways they are segregated. Implementation TORs should include adequate incineration and proper transportation and disposal.</td>
</tr>
<tr>
<td><strong>Other population, health, and nutrition</strong></td>
<td>Similar to the above</td>
<td>Similar to the above</td>
</tr>
</tbody>
</table>

*Source: Authors’ data.*

* See table 11-2.
<table>
<thead>
<tr>
<th>Typical Industry Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fertilizer and other chemicals</strong></td>
<td>Methemoglobinemia and some cancers, such as gastric, esophageal, and bladder, have been associated with exposure to fertilizers. Acute poisoning must also be considered with exposures to any chemical as well as malignancies due to low-level long-term exposure. Due to exposure to night soil or manure as fertilizer, parasitism and diarrhea may also occur among farmers and other farm workers.</td>
<td>Implementation TORs should include awareness campaign through research and extension and affordable protective gear and equipment.</td>
</tr>
<tr>
<td><strong>Industrial adjustments</strong></td>
<td>Occupational health and safety issues for workers in industrial estates. Toxic waste may also be a problem, thus, poisonings, malignancies, and fertility problems may be of concern.</td>
<td>Same as above</td>
</tr>
<tr>
<td><strong>Industrial restructuring</strong></td>
<td>Same as above</td>
<td>Same as above</td>
</tr>
<tr>
<td><strong>Small-scale enterprises</strong></td>
<td>Same as above. In addition, due to improper waste disposal—a typical problem among small scale enterprises—diarrhea and other infectious diseases and exposure to toxic waste may be prevalent in the surrounding community.</td>
<td>Same as above. Implementation TORs should include, in the short term, the identification of populations at risk and determination of mitigative measures and, in the long term, introduction, as appropriate, of regulatory enforcement (polluter pays principle), economic instruments, and moral suasion.</td>
</tr>
<tr>
<td><strong>Mining</strong></td>
<td>Occupational health and safety issues for the miners and other workers in the mines including silicosis and other diseases of the lung (pneumoconiosis). Malaria for mine workers in endemic areas, especially when opening new mines. Also, other vector-related diseases. For small-scale miners of gold, use of mercury is rampant. This may result in acute poisoning and/or neurological problems. Respiratory</td>
<td>Implementation TORs should include awareness campaigns and affordable protective gear and equipment, including insect repellent; vector control targeting stagnant water; burrow pits; and introduction of larvivorous (larva-eating) fish as appropriate.</td>
</tr>
</tbody>
</table>

* See table 12-2.
<table>
<thead>
<tr>
<th>Typical Industry Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>diseases have also been shown to increase among those exposed to mercury. If mercury is used within the household, imminent risk also exists to other members of the household and to the community at large due to air pollution and toxic waste disposal.</td>
<td>Implementation TORs should include awareness campaigns and affordable protective gear and equipment; law enforcement (drunk driving, seat belts, insurance liabilities, and so on); counseling; and gradual reduction of emissions to reach WHO standards (see table 9-3).</td>
</tr>
</tbody>
</table>

**Oil and gas**

Exploration and development, adjustment, transportation, refining, storage, and distribution

Occupational health and safety issues; much concern for problems of workers in off-shore drilling operations; road traffic accidents; fatal accidents from fires, explosions, and chemical disasters; long-term exposure to toxic waste (refer to industrial adjustment subsector); physical and mental stress for displaced populations; and respiratory diseases for populations surrounding refineries that may not have air pollution control.

**Source:** Authors’ data
<table>
<thead>
<tr>
<th>Typical Housing and Urban Development Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Housing construction</strong>&lt;br&gt;(including temporary worker housing)</td>
<td><em>(a)</em> Pools of standing water and flooding can lead to increased incidence of malaria and other mosquito-borne diseases, especially during the rainy season; workers and local residents are at risk.</td>
<td><em>(a)</em> Preparation TORs should ensure proper measures are taken during construction and afterward to eliminate breeding and feeding grounds and accommodate proper drainage in flood-prone areas, especially in rainy seasons. May also be appropriate to include community education component.</td>
</tr>
<tr>
<td></td>
<td><em>(b)</em> Poor ventilation associated with cooking, heating, and lighting sources (other than electricity or gas) can lead to respiratory diseases, especially important to women when cooking and children who spend time indoors.</td>
<td><em>(b)</em> If housing designs are to be specified, preparation TORs should include provisions to maximize ventilation and, as appropriate, exhaust cooking area. If designs are completed, it may be appropriate during implementation to include technical assistance in a community participation or other type of component. If malaria is endemic, housing design should include option of window screens.</td>
</tr>
<tr>
<td></td>
<td><em>(c)</em> Accidents can occur during construction, when workers and nearby residents are at risk from flooding, erosion, and mudslides and children are at risk playing after hours at construction sites; during or after implementation, when children risk burns from unprotected cooking, heating, and lighting sources; and in housing near or over water, where infants and children risk drowning.</td>
<td><em>(c)</em> Implementation TORs should ensure that proper occupational health and safety measures are provided for workers and access of children is limited after hours. If housing designs are not complete, preparation TORs should accommodate ventilation and safety features (the latter may be pertinent in a community education component.</td>
</tr>
<tr>
<td></td>
<td><em>(d)</em> Work crews can be at high risk for AIDS.</td>
<td><em>(d)</em> Preparation TORs should arrange for health agencies to reach out to work crews.</td>
</tr>
<tr>
<td><strong>Sites and services</strong></td>
<td><em>(a)</em> See “Housing Construction.”</td>
<td><em>(a)</em> See “Housing Construction.”</td>
</tr>
<tr>
<td></td>
<td><em>(b)</em> Poor maintenance of neighborhood services can lead to a full range of excreta- and vector-related diseases; main weak points include clogged storm drains, poor drainage at water distribution points, inadequate trash collection, and special needs of markets for proper</td>
<td><em>(b)</em> Preparation or implementation TORs should provide for community education and, as appropriate, cost recovery schemes to cover maintenance costs; might be appropriate to involve local community (informal and formal leaders) and NGOs, religious groups, and</td>
</tr>
</tbody>
</table>

* See table 13-3.
<table>
<thead>
<tr>
<th>Typical Housing and Urban Development Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste management.</td>
<td></td>
<td>others. Preparation TORs should ensure that adequate water, sanitation, and drainage services are included as a component.</td>
</tr>
<tr>
<td><strong>Drainage</strong></td>
<td>Poor drainage, quite common after storms, can lead to leptospirosis (Weil’s disease), which is spread through rodent urine and poor drainage in construction (see “Water and Sanitation”).</td>
<td>TORs should provide for adequate drainage.</td>
</tr>
<tr>
<td><strong>Dredging</strong></td>
<td>See “Ports” in table 13-9</td>
<td>(a) Preparation or implementation TORs should ensure that proper measures are taken to identify groups at risk of pedestrian injury or regular exposure to vehicle exhausts and propose remedial measures as appropriate. As feasible, include measures to lessen existing and prevent new congestion around public markets, build wider access roads and sidewalks, install sidewalks and barriers across roads to prevent pedestrian crossing, and explore public safety campaigns.</td>
</tr>
<tr>
<td><strong>Public facilities: markets</strong></td>
<td>(a) Vehicular congestion contributes to air pollution and injuries (see also table 13-9).</td>
<td>(a) Preparation designs and implementation TORs should allow for customer and merchant needs in new markets and, as appropriate, for upgrading.</td>
</tr>
<tr>
<td></td>
<td>(b) Frequently lack toilets, trash receptacles, as well as drainage from uses of drinking water, market cleaning, and rainfall.</td>
<td>(b) Preparation designs should ensure that proper measures are taken during construction and afterward through implementation.</td>
</tr>
<tr>
<td></td>
<td>(c) Improperly managed solid waste can clog storm drains, cause flooding, create garbage heaps in surrounding areas, and provide breeding and feeding grounds for mosquitoes, flies, and rodents. Collectively, these can cause diarrheas, parasitic infections, and injuries. Separate attention is needed to accommodate waste of specialized markets, such as live animals or automobile repairs, e.g., animal excreta and motor oils.</td>
<td>(c) Market designs should include space for waste receptacles, protected storm drains, and a plan for general waste removal. Assuring proper operation and maintenance and cost recovery could be adequately addressed through a community participation component.</td>
</tr>
<tr>
<td></td>
<td>(d) See also “Water and Sanitation,” table 13-13, for waste management by the markets themselves.</td>
<td>(d) Items (a)–(c) above should involve local government, community leaders (formal and informal), and NGOs.</td>
</tr>
<tr>
<td><strong>Public facilities: washing and bathing and toilets</strong></td>
<td>See table 13-13</td>
<td>See table 13-13</td>
</tr>
<tr>
<td><strong>Public facilities: public buildings</strong></td>
<td>(a) Pools of standing water and flooding can lead to increased incidence of malaria and other mosquito-borne diseases, espe-</td>
<td>(a) Preparation designs should ensure that proper measures are taken during construction and afterward through implementa-</td>
</tr>
</tbody>
</table>
### Typical Housing and Urban Development Projects and Components

<table>
<thead>
<tr>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>cially during the rainy season, placing workers and local residents at risk.</td>
<td>tion TORs to eliminate breeding and feeding grounds and accommodate proper drainage in flood-prone areas, especially in rainy seasons. It may also be appropriate to include technical assistance for residents in community education–type component.</td>
</tr>
<tr>
<td>(b) Public facilities often fall into disrepair for lack of maintenance, setting the stage for accidents and poor waste management.</td>
<td>(b) Preparation TORs should include maintenance programs (including, if feasible, provisions for health safety and aesthetics).</td>
</tr>
<tr>
<td>(c) Hospitals should always be considered a special case (see “Water Supply and Sanitation Subsector”).</td>
<td>(c) Implementation TORs should include provisions for proper waste management, citing special conditions for industrial and other hazardous materials (see also “solid waste management” in table 13-13).</td>
</tr>
</tbody>
</table>

| |  
| Water supply | See table 13-13  
| Sanitation | See table 13-13  
| Waste management | See table 13-13  
| Urban transport | See table 13-9  
| Traffic management and road rehabilitation | See table 13-9  
| Motor parks | Covered motor parks can lead to buildup of air pollution from vehicle fumes inside and exhaust streams to areas and buildings nearby. Gasoline and oil leaks from vehicles can pose safety hazards. Implementation TORs should incorporate appropriate ventilation procedures and monitoring, where appropriate, and, if feasible, cleaning up gasoline and oil leaks. |
| Capacity and institution building | Community involvement is an important aspect in devising curative and preventative measures for health. Local talent is often not tapped, because of poor community organization, rather than lack of technical knowledge. Design component to reflect the level of organization of local community groups and problems being addressed. It may be useful during preparation to solicit help of NGOs for topics difficult to deal with during works or after project cycle, e.g., accident prevention; collection of contributions for operation and maintenance of communal facilities; appropriate methods to eliminate improper water storage, standing pools of water, or clogged drains where mosquitoes can breed; household methods to reduce injuries (especially burns and drowning); and efficient waste management of markets and other community facilities. |

*Source: Authors’ data*
### Table A-8: Telecommunications Sector Environmental Health Checklist*

<table>
<thead>
<tr>
<th>Typical Telecommunications Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
</table>
| Installation of telephone lines                   | *(a)* Can spread vector-borne diseases, especially for malaria and dengue.  
* *(b)* Can expose work crews to AIDS.            | *(a)* Preparation TORs should include provisions for vector control and procedure for health agency to reach workers.  
* *(b)* Implementation TORs should monitor malaria and AIDS and respond accordingly with remedial measures. |

*Source: Authors’ data*

* See table 13-5.
### Table A-9: Transport Sector Environmental Health Checklist

<table>
<thead>
<tr>
<th>Typical Transport Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Roads: rehabilitation and maintenance</strong></td>
<td><em>(a)</em> Mosquito-related diseases, especially malaria and dengue, can be spread by extending breeding areas in water that has accumulated in disposed construction materials and holes dug for sand and gravel. <em>(b)</em> Pollution of local water from improper disposal of excreta and domestic waste at work camps, leading to vector-related diseases, particularly malaria, filariasis, and, sometimes, schistosomiasis. <em>(c)</em> Road erosion due to digging for sand and gravel, leading to pedestrian and vehicle accidents. <em>(d)</em> Flooding and extension of vector habitats from improperly disposed mining debris. <em>(e)</em> Asphalt production and work dust can cause local air pollution, aggravating respiratory disease. <em>(f)</em> Communal and rural road projects may require special assistance to educate community on hazards described above. <em>(g)</em> See also “Roads: Drainage”</td>
<td><em>(a)</em> Preparation TORs should determine the importance of malaria locally and risks of its spreading and include provisions for appropriate mosquito control in work sites. <em>(b)</em> Preparation TORs should determine importance of vector-related diseases locally and risks of their spread. Should include provisions for proper waste disposal and vector control as appropriate. <em>(c)</em> Preparation TORs should contain provisions for safety, with appropriate instructions for subcontractors providing the materials and conditions for disposal of debris. <em>(d)</em> Preparation TORs should contain provision for safe disposal of mining debris. <em>(e)</em> Preparation TORs should include provisions for worker health and safety. Implementation TORs should contain provisions for reducing air pollution as appropriate. Designs should incorporate provisions accordingly. <em>(f)</em> TORs should contain provisions for community education awareness with help from local NGOs as appropriate. <em>(g)</em> See also “Roads: Drainage”</td>
</tr>
<tr>
<td><strong>Roads: construction</strong></td>
<td><em>(a)</em> Conditions and risks are similar to those of “Rehabilitation and Maintenance,” except on a large scale. <em>(b)</em> On a large scale, greater probability of established work camps and expatriate personnel contributing to the spread of vector-related diseases and AIDS.</td>
<td><em>(a)</em> See “Rehabilitation and Maintenance” <em>(b)</em> Implementation TORs should cover worker protection and education (as appropriate) and basic on-site health facilities (as appropriate).</td>
</tr>
<tr>
<td><strong>Roads: drainage</strong></td>
<td><em>(a)</em> Blockage of storm drains plus inadequate drainage of general area can cause flooding, contaminating water supply and causing injuries. This can cause vehicle and pedestrian accidents and spread mosquito-related diseases. <em>(b)</em> In rural and periurban areas near dams and irrigation schemes, blocked drains can extend snail habitat and spread schistosomiasis. <em>(c)</em> See “Drainage” in Water and Sanitation subsector below.</td>
<td><em>(a)</em> Implementation TORs should provide for regular maintenance of storm drains, possibly requiring a component for community education and participation. Designs should include appropriate provisions for proper drainage of project zone and contiguous areas. <em>(b)</em> If schistosomiasis is endemic in the general region, implementation TORs should provide for appropriate preventive measures to keep drains from spreading habitat. A health component might also be appropriate to curtail further spread. <em>(c)</em> See “Drainage” in table 13-13.</td>
</tr>
</tbody>
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* See table 13-9.
<table>
<thead>
<tr>
<th>Typical Transport Projects and Components</th>
<th>Major Health-Related Issues</th>
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<tr>
<td>Roads: workshops</td>
<td>Liquid and solid waste from workshops can contaminate local ground and surface water supply and spread vector habitat by creating breeding grounds. (notably, motor oil can be reused for mosquito control.)</td>
<td>Designs should include proper waste disposal facilities.</td>
</tr>
<tr>
<td>Roads: safety</td>
<td>Safety components can be useful in addressing a wider range of issues than traffic accidents: (a) accident prevention in construction activities, (b) safe handling of hazardous chemicals and wastes, and (c) AIDS and sexually transmitted diseases (STDs), including immunizations for vector-related diseases and STDs.</td>
<td>Implementation TORs should incorporate, as appropriate, these wider health and safety concerns.</td>
</tr>
<tr>
<td>Roads: private sector development (labor intensive)</td>
<td>(a) Improper disposal of excreta and domestic waste at work camps can pollute local water leading to vector-related diseases, particularly malaria (and sometimes schistosomiasis). (b) Work crews, particularly not local, can introduce vector-related diseases and can spread AIDS and sexually transmitted diseases.</td>
<td>(a) Preparation TORs should determine the importance of vector-related diseases locally and risks of their spread. Implementation TORs should include provisions for proper waste disposal and vector control as appropriate. (b) Preparation TORs should provide for appropriate immunizations and education.</td>
</tr>
<tr>
<td>Roads: conservation management</td>
<td>Ecological issues could be enhanced to include preventive measures for workers spreading disease vectors.</td>
<td>Preparation TORs could also address reduction of disease vectors in consultation with the MOH as appropriate.</td>
</tr>
<tr>
<td>Traffic management</td>
<td>Air pollution can be an important direct or predisposing factor for respiratory disease and increased lead level in the blood of the population at risk (resulting in lowered IQs for children and cardiovascular diseases for elders). High-risk groups are traffic police and concentrations of people at congested areas (especially bus and taxi stations) and markets, schools, and workplaces near heavily traveled roadways.</td>
<td>Preparation TORs should define appropriate high-risk groups and current air pollution monitoring efforts, assess relative hazard with the MOH, and propose designs as appropriate, e.g., protective kiosks and masks and barriers, Vitamin A supplements for children with lead in the blood in the short term and introduction of unleaded fuel in the long term.</td>
</tr>
<tr>
<td>Pollution management</td>
<td>(a) For air pollution see “Traffic Management.” (b) For water pollution, see “Ports” below.</td>
<td>(a) For air pollution see “Traffic Management.” (b) For water pollution, see “Ports” below.</td>
</tr>
<tr>
<td>Railways: rehabilitation</td>
<td>(a) Passenger trains can contribute to excreta- and vector-related diseases in congested areas where toilets empty directly onto tracks. (b) Combustion engine smoke can be major contributor to respiratory disease to residents in railway air shed. (c) Rehabilitation of railroad cars can ex-</td>
<td>(a) Preparation TORs should determine if excreta removal is a problem. If so, implementation TORs should recommend locally acceptable methods for collection, removal, or disinfection. Community education component might be advisable. (b) Preparation TORs should determine if smoke is a problem. If so, recommend locally acceptable methods. Might require design modifications or other protective measures, including using trees as barriers for pollution. Community education component might be advisable during implementation. (c) Implementation TORs should include</td>
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<tr>
<td>Typical Transport Projects and Components</td>
<td>Major Health-Related Issues</td>
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<td>pose workers to asbestos (used in insulation).</td>
<td>worker protection measures.</td>
</tr>
<tr>
<td>Ports</td>
<td>(a) Storage and transport of hazardous chemicals can cause serious damage to workers and any local population exposed to regular transport or accidents.</td>
<td>(a) Preparation TORs should determine types and volume of hazardous chemicals passing through, and, as appropriate, implementation TORs should design safety component.</td>
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<td></td>
<td>(b) Traffic congestion can lead to air pollution and accidents.</td>
<td>(b) Preparation TORs should include provisions for assessing traffic management data on congestion, pollution, and port accidents, and implementation TORs should include recommendations for improvements.</td>
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<td></td>
<td>(c) Vessels can cause pollution from domestic and hazardous waste (see “Ports: Marine Pollution”).</td>
<td>(c) See “Ports: Marine Pollution.”</td>
</tr>
<tr>
<td>Ports: dredging</td>
<td>Improper disposal of sludge can (a) pollute surface water and groundwater and lead to diarrheas and poisoning (from chemical content) and (b) create mosquito breeding grounds causing malaria and filariasis and other vector-borne disease.</td>
<td>Preparation TORs should contain provisions for appropriate disposal of sludge in terms of pathogen removal, chemical content, and vector breeding.</td>
</tr>
<tr>
<td>Ports: petroleum and cement terminal</td>
<td>(a) Petroleum refinement and shipping can cause air and water pollution. Uncontained fires and accidents at refineries can become world-class disasters.</td>
<td>(a) Preparation TORs should make provisions for appropriate treatment of waste, controls for air pollution, emergency procedures, and first aid. May require formal loan and credit covenant.</td>
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<td></td>
<td>(b) Cement dust is primarily a nuisance, but an important irritant to workers and residents in the air shed, causing skin and eye disease and predisposition to respiratory disease.</td>
<td>(b) Preparation TORs should ensure that assessment of dust is considered. Implementation TORs should make appropriate recommendations for dust reduction from manufacture and local transport.</td>
</tr>
<tr>
<td>Ports: marine pollution</td>
<td>(a) Discharge of domestic wastes from pleasure craft, commercial boats, and passenger transport, worsened by absence of convenient onshore waste discharge points, can lead to excreta-related diseases and skin and eye infections.</td>
<td>(a) Preparation TORs should recommend provisions for pleasure, commercial, and passenger boats. Solid waste component might be advisable. Implementation TORs should include consumer education and might also require special consideration for signs, translations, and so on.</td>
</tr>
<tr>
<td></td>
<td>(b) Discharge of maintenance and bilge cleaning can contaminate food supply, if seafood and shellfish are harvested locally.</td>
<td>(b) Implementation TORs should include provisions for pollution monitoring in ports and make appropriate recommendations.</td>
</tr>
<tr>
<td>Rivers</td>
<td>See “Ports”</td>
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<tr>
<td>Typical Transport Projects and Components</td>
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<td>(a) Inadequate attention to road and driver safety can cause accidents from a myriad of factors: poor maintenance of vehicles, drunk driving, and no driver education or seat-belt campaigns, among others.</td>
<td>(a) Preparation TORs should contain provisions for maintenance, enforcement, and public awareness campaigns as appropriate. Involving NGOs in community participation might be advisable.</td>
</tr>
<tr>
<td></td>
<td>(b) Truck drivers are at high risk of spreading or getting sexually transmitted diseases. See below for AIDS.</td>
<td>(b) See “Capacity and institution building: AIDS awareness and prevention” below.</td>
</tr>
<tr>
<td>Airports and aviation workshops</td>
<td>See “Roads: Workshops”</td>
<td>See “Roads: Workshops”</td>
</tr>
<tr>
<td>Capacity and institution building: public health and safety</td>
<td>Truckers can be major factor in spreading AIDS and other sexually transmitted diseases. In small towns, depots, and places where flooding has forced travelers to congregate local circumstances might allow for a tailored response not possible in cities.</td>
<td>An education component is appropriate for truckers. It may also be appropriate to consult with the MOH, religious groups, or NGOs to “tailor” a response and, if appropriate, incorporate it into the project.</td>
</tr>
<tr>
<td></td>
<td>(c) Hazardous chemicals (including temporary storage and transits).</td>
<td>(c) Preparation TORs should contain provisions for handling, storing, and transporting hazardous waste, including first-aid and washing facilities for workers.</td>
</tr>
<tr>
<td></td>
<td>(d) Possibility of air accidents.</td>
<td>(d) Implementation TORs should contain provisions for formulating and implementing emergency airport procedures.</td>
</tr>
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<td></td>
<td>(e) Basic health precautions for international travelers.</td>
<td>(e) Implementation TORs should contain provisions for collaboration with MOH on appropriate inspection, inoculation, and quarantine procedures as appropriate.</td>
</tr>
</tbody>
</table>

*Source: Authors’ data*
Table A-10: Water Supply and Sanitation Environmental Health Checklist

<table>
<thead>
<tr>
<th>Typical Water Supply and Sanitation Projects and Components</th>
<th>Major Health-Related Issues</th>
<th>Main Remedial Measures and Comments</th>
</tr>
</thead>
</table>
| Construction and works: general comment                     | General hazards in excavations, deposition, and temporary storage of construction and excavation debris, among others, due to the construction stage of water and waste management components:  
  
  (a) Pools of standing water and flooding can increase malaria and other mosquito-borne diseases, especially during rainy season; workers and local residents are at risk.  
  
  (b) Accidents are important: (i) during construction, when workers and nearby residents are at risk of flooding, erosion, and mudslides and children are at risk when playing at sites after hours and (ii) after construction, in housing near or over water, infants and children are also at risk of drowning.  
  
  (c) Work crews can be at risk of AIDS.  

  (a) Preparation TORs should ensure that proper measures are taken during construction and afterward to eliminate breeding and feeding grounds and to accommodate proper drainage in flood-prone areas, especially in rainy seasons. May also be appropriate to include technical assistance for residents in community education–type component.  
  
  (b) Preparation TORs should ensure that proper occupational health and safety measures are provided for workers and to limit access of children after hours. The latter might be pertinent in a community education–type component.  
  
  (c) Preparation TORs should arrange with health agencies, as appropriate, to address worker camps. |

| Low-cost sanitation and on-site sanitation: construction and disposal of latrines and septic tanks | (a) Poor maintenance of latrines can lead to full range of excreta-related diseases and also create odors, which discourage their use.  

  (b) When latrines or septic tanks are emptied, ground and surface water can become polluted and create vector-breeding habitats, leading to full range of excreta- and vector-related diseases. If no proper treatment of solids (night soil, septage, and nonstabilized sludge), can lead to same health risks. (Note: some latrines are designed to treat waste.)  
  
  (c) See also “Public Facilities: Washing and Bathing and Toilets”  

  (a) Implementation TORs should include procedures for hygiene education; community participation component might be appropriate for maintenance and cost recovery, as appropriate.  
  
  (b) Preparation TORs should include provisions for proper treatment and disposal of septage sludge; community participation and education; design of appropriate treatment facilities.  
  
  (c) See also “Public Facilities: Washing and Bathing and Toilets” |

| Public facilities: | Public facilities require adequate | Implementation TORs should in- |

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<tbody>
<tr>
<td>washing and bathing and toilets</td>
<td>maintenance to prevent clogging of toilets and drains for drinking and gray water runoff, which can pollute ground and surface water and create vector breeding habitats, leading to full range of excreta- and vector-related diseases.</td>
<td>include procedures for adequate maintenance, including cost recovery scheme. Public education component might also be appropriate.</td>
</tr>
<tr>
<td>Waste stabilization ponds</td>
<td>(a) Periods of low sunshine or temperature can lengthen holding time needed for good pathogen removal.</td>
<td>(a) Design should account for effects of weather in retention time. Depending on population at risk of poor quality effluent, operation might require emergency disinfection back-up. (b) Improperly managed facilities can attract flies and mosquitoes that spread disease.</td>
</tr>
<tr>
<td>Conventional treatment plants: activated sludge and trickling filters</td>
<td>Skilled labor required to control flow of influent through various steps, especially to prevent “shock loading” (surge in influent), which otherwise results in high pathogen content in effluent.</td>
<td>Preparation TORs and designs need to assure proper operation and maintenance (or discourage use of conventional treatment). TORs need also to determine if receiving waters of effluent is destined for drinking or domestic uses and consider tertiary treatment or other alternatives.</td>
</tr>
<tr>
<td>Rural water supply</td>
<td>(a) Final stages of guinea worm eradication feasible in next decade.</td>
<td>(a) Preparation TORs for rural water supply and sanitation projects should determine if disease is or has been endemic; if so, project could contain monitoring. If still endemic, project should include provisions for protecting water source and education as appropriate. (b) Water supply and sanitation are often the responsibility of MOH or ministry of agriculture, which might not have engineering competence necessary for installation, operation and maintenance, and so on.</td>
</tr>
<tr>
<td>Periurban water supply</td>
<td>Periurban areas are often similar to rural areas with different needs for water and waste management to accommodate water, waste, and drainage. Range of diseases might include malaria.</td>
<td>Preparation TORs should reflect low-density living conditions and accommodate agricultural and animal waste. Anti-malaria considerations might need special attention.</td>
</tr>
<tr>
<td>Urban water supply</td>
<td>(a) Lack of drainage, especially in areas of communal water supply, breeds mosquitoes and flies, which can be a nuisance and spread disease. (b) Water lines flow next to storm drains, which become open sew-</td>
<td>(a) Designs should account for proper drainage, soakage pits, and runoff. Community participation component may be necessary for proper maintenance. (b) Designs should take into account risk of illegal connections, poor</td>
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<td>ers (with time, water lines can sag directly into storm drains from neighborhood activity and illegal connections). Low water pressure causes intake of pathogens into water lines. This is especially problematic in areas with illegal connections.</td>
<td>Operation and maintenance. It may require community participation component.</td>
<td></td>
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</table>

**Public facilities: markets**

(a) Markets can generate special waste needs, e.g., slaughterhouse and vehicle maintenance (battery acid and oils).

(b) Clogged drains can help spread vector-related diseases.

(c) Poor community organization can lead to (a) and (b) above.

(d) Lack of water and excreta disposal facilities can spread diarrheal diseases through food and poor personal hygiene.

(e) See also “Public Facilities: Markets,” in “Housing and Urban Development”

**Solid waste management: municipal and domestic**

(a) See also “Construction and Works: General Comment”

(b) See also “Solid Waste Management: Sanitary Landfills”

(c) See also “Public Facilities: Markets” in “Housing and Urban Development”

**Solid waste management: hazardous commercial and industrial**

Hazardous and commercial waste can cause a wide range of public health problems, which might require separate treatment.

Preparation TORs should include provisions, as appropriate, for inventory of sources and volumes of waste and recommend appropriate special handling or treatment. Designs should reflect these accordingly. Monitoring program and user charges may be appropriate.

**Solid waste management: medical wastes**

(a) Nonsegregated waste can expose hospital and waste disposal staff (and scavengers) to hazardous waste.

(a) Designs should provide for separate collection and storage of nondomestic waste within hospitals and separate disposal under cover preventing access to scavengers. It may require physical barriers.
<table>
<thead>
<tr>
<th>Typical Water Supply and Sanitation Projects and Components</th>
<th>Major Health-Related Issues</th>
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</tr>
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<tbody>
<tr>
<td>(b) Incineration can expose local workers and residents to unburned hazardous waste.</td>
<td>(b) Preparation TORs should determine if incineration is appropriate. If so, designs should provide for safe incineration and disposal.</td>
<td></td>
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<tr>
<td>(c) Radioactive waste is a special hazard to workers and local residents and needs special, long-term, and highly technical attention.</td>
<td>(c) Preparation TORs should determine use of radioactive wastes and design handling measures, as appropriate.</td>
<td></td>
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<tr>
<td><strong>Solid waste management: sanitary landfills</strong></td>
<td><strong>(a)</strong> Improperly designed landfills can lead to water and air pollution.</td>
<td><strong>(a)</strong> Designs should provide for appropriate disposal of leachate and air pollution from dried waste and soil cover.</td>
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<td><strong>(b)</strong> Controlled and spontaneous fires can lead to air pollution and burns.</td>
<td><strong>(b)</strong> Designs should provide for control of fires and accidents from burns.</td>
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<td><strong>(c)</strong> Traffic during construction and operation can cause road dust and accidents. Dried waste can cause dust.</td>
<td><strong>(c)</strong> Preparation TORs should include a description of possible road accidents and inventory of schools and workplaces along the traffic routes, assess health data that indicate high-risk areas for respiratory disease along the access roads and site itself, and make appropriate recommendations for design modifications.</td>
</tr>
<tr>
<td><strong>Solid waste management: scavengers</strong></td>
<td><strong>(a)</strong> Scavengers are exposed to excreta- and vector-related diseases, accidents, and hazardous waste.</td>
<td><strong>(a)</strong> Implementation TORs should plan for safe handling of wastes, and, as appropriate, protective clothing and first aid. Designs should provide for sorting areas with appropriate construction or barriers and so on and, if appropriate, areas protected from sun and rain, benches, screening for sorting or sifting (on conveyor belts).</td>
</tr>
<tr>
<td></td>
<td><strong>(b)</strong> Scavengers sometimes consume or resell food that is contaminated, spoiled, or near its expiration date. Waste from periurban food processing and storage can be contaminated with fumigants and pesticides.</td>
<td><strong>(b)</strong> Implementation TORs should determine if reuse or resale of food is common. If so, describe basic sources and make appropriate provisions to reduce risk. Community participation component may be useful to educate scavengers and solicit help of food producers.</td>
</tr>
<tr>
<td><strong>Solid waste management: recycling</strong></td>
<td><strong>(a)</strong> Recycling can cause accidents, in particular, cuts that can lead to serious illness given unhygienic conditions. Paper and cardboard taken from disposal sites can be saturated with toxic materials. Recycled bottles and containers from pesticides and industrial chemicals can lead to acute and chronic poisoning.</td>
<td><strong>(a)</strong> Preparation TORs should inventory main types of recyclables locally, indicate potential health hazards, and provide for first aid as appropriate. TORs should determine potential sources of hazardous and caustic materials and make provisions excluding or processing them from the waste stream. It may require a community participation component for</td>
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<tr>
<td>(b) Hazardous materials can be intentionally disguised as recyclables to reduce disposal costs, e.g., of manufacturers, and sent illicitly to developing countries.</td>
<td>to educate workers or solicit assistance from industries. (b) Implementation TORs should determine if recyclables include imported materials and, if so, contain provisions to ascertain that exporters are legitimate companies and, if necessary, examine waste to ensure it contains no hazardous materials. (c) Preparation TORs should determine basic health risks from mosquito-related diseases and provide appropriate education to reduce risks.</td>
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<tr>
<td>(c) Collections of tires, bottles, and cans and other containers that hold water can spread mosquito habitat and vector-related diseases.</td>
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<tr>
<td><strong>Hygiene education</strong></td>
<td>Health education is appropriate at almost every level. Frequently encountered problems are training materials and translations into local languages.</td>
<td>Preparation TORs should include, as appropriate, a multidisciplinary team and design programs, at least in personal hygiene, food preparation, and waste disposal.</td>
</tr>
<tr>
<td><strong>Pollution control:</strong> general comment</td>
<td>Pollution control covers a broad spectrum and could be part of any project. Health aspects to humans might be relatively neglected or subsumed by standards to meet engineering or ecological criteria, which might also omit role of community participation in resolving or monitoring the pollution.</td>
<td>Preparation TORs and design standards should include explicit references to pathogen removal, vector control, and, as appropriate, identification of the population at risk or pollution inventory. It might be appropriate to include pollution monitoring and community involvement.</td>
</tr>
<tr>
<td><strong>Drainage</strong></td>
<td>(a) Blockage of storm drains and inadequate drainage of general area can cause flooding, which can contaminate water supply and cause accidents. (b) Blockage of storm drains around markets and public facilities can spread vector habitat for filariasis. (c) General inadequate drainage can spread habitat of vectors that spread malaria. (d) “Solving” drainage problem of one area may merely shift it to another.</td>
<td>(a) Implementation TORs should provide for regular maintenance of storm drains, which may require component for community education and participation. Designs should provide for proper drainage of project zone and contiguous areas as appropriate. (b) Designs should include soakage pits, runoff, spillways, and so on. (c) Preparation TORs should allow for proper geographic planning area (neighborhood and town) and appropriate regulatory needs. (d) Designs should verify if they need to extend drainage provisions beyond the immediate project area.</td>
</tr>
<tr>
<td><strong>Sewage treatment plants</strong></td>
<td>(a) Poor quality effluent can promote excreta-related diseases. (b) Improper sludge disposal can lead to water pollution, which can promote excreta-related diseases and provide habitat for mosquitoes and flies.</td>
<td>(a) Designs should adequately consider BOD and pathogen removal. (b) Designs should provide for proper sludge disposal and incorporate measures to reduce mosquito and fly breeding.</td>
</tr>
<tr>
<td>Typical Water Supply and Sanitation Projects and Components</td>
<td>Major Health-Related Issues</td>
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<td>mosquitoes and flies.</td>
<td>(c) It is not always possible to know in advance the technology to be used and, therefore, design in advance for potential health or occupational risks.</td>
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<td>(c) Preparation TORs should ensure that environmental health considerations are considered in bidding documents or environmental assessments.</td>
</tr>
<tr>
<td>Emergency cholera response</td>
<td>Contaminated water and interpersonal contact are considered the main transmission route in epidemics. Epidemic spread can be rapid, necessitating quick response, e.g., diarrheas cause dehydration and shock within hours and up to 60 percent fatality, if untreated (medication and rehydration). MOHs are not well equipped to provide clean water or chlorinate local water supply and need help from water agency or company.</td>
<td>Preparation TORs could address (a) chlorination, (b) water delivery (trucks), (c) logistical support, e.g., labs and staff, (d) loan of vehicles and equipment to MOH, e.g., water testing, chlorination, and so on, (e) public education campaigns, (f) as a preventive measure, reordering geographic distribution of future project water and sanitation works.</td>
</tr>
</tbody>
</table>

*Source: Authors’ data*
ANNEX B: BASIC INFORMATION ON IMPORTANT DISEASES

This chapter describes about twenty of the most common diseases in developing countries. It is intended as a quick reference for sustainable development project team members who do not have health backgrounds or are not familiar with conditions in developing countries. Each disease is described in three parts:

- Description
- Transmission
- Intervention.

**Box B-1: Caveat on These Disease Descriptions**

*These descriptions of diseases are generalizations and may not be accurate for local conditions.*

Malaria and filariasis, for example, are spread by different species of mosquitoes that exhibit vastly different breeding and feeding habits. Still other diseases, such as measles or sexually transmitted diseases, have not been included, because they rely so heavily on behavioral factors.

Also, the emphasis of these interventions is directed outside the health sector, mainly at such factors as housing, water supply, and sanitation, coupled with health education. The interventions described for each disease generally exclude curative health care interventions. Rehydration, for example, which includes oral rehydration therapy (ORT), is discussed only if it serves as a means to interrupt transmission as a preventive measure for curtailing the spread of cholera, for example.

In addition, please note that much of the information on diseases in general is rapidly changing.

*Source: Authors’ data.*

**Individual Diseases**

**Cholera**

- *Description.* Cholera is a serious acute diarrheal disease, characterized by sudden onset, profuse, painless, and watery stools (rice water stools), followed occasionally by cramps and vomiting. These symptoms result from a poison produced by the cholera bacteria or vibrio in the intestines. Cholera’s most serious effects are rapid dehydration and shock. These, in turn, cause a chemical imbalance in body fluids and eventually circulatory collapse. Two types of cholera exist: classical, which is generally more serious, and El Tor. Fatality in untreated cases is severe—as high as 50 percent depending on its type—and can occur within hours of onset. With proper treatment, fatality can be reduced to less than 1 percent. Most infections, however, are asymptomatic or cause only short bouts of diarrhea. Cholera affects all age groups. In the malnourished, however, who are more susceptible to the disease in lower doses, even short bouts of diarrhea can have far-reaching consequences; hence, cholera is serious primarily as an epidemic predominantly in low socioeconomic groups for which malnutrition is prevalent. Seven pandemics of cholera, that is, global spread for an extended period (15 or more years), have occurred. For most of this century, cholera has been confined largely to Asia, but is now endemic throughout most of Asia, the Middle East, and Africa. Since the 1960s, it has spread throughout Asia and Africa and extended into Europe, the Americas, and South Pacific. Cholera transmission has been understood for more than a century. The cholera threat probably did more to improve environmental conditions in nineteenth century Europe than any other form of persuasion or logic.
• **Transmission.** Humans are the main carriers of cholera. Certain types of seafood and domestic animals are also known to harbor the disease. For every attack are fifty to a hundred asymptomatic carriers, who can carry the disease for up to two months. Ingestion of water contaminated with feces or vomitus of infected individuals is generally considered the main route of transmission. Contamination of clothing, hands, food, and bed linens by carriers or patients is also important. Transmission is also possible by eating raw or undercooked seafood and, to a lesser extent, food contaminated by flies. Because all of these have been implicated to varying degrees, it is difficult to single out a dominant mode of transmission, although sudden outbreaks are usually associated with a contaminated water supply and/or common food source. Vibrios multiply rapidly in foods such as milk or boiled rice, especially if salt fish or meat is added and can survive in absorbent materials, such as cotton, in bed linens, clothing, and bandages saturated with sweat.

• Infection usually occurs about 2 days after exposure, and its communicability is presumed in most cases to last for a few days after recovery, but may persist for several months among carriers. The cholera vibrios can live in water for up to about 2 weeks, prefer brackish water, and can survive for approximately 2 months in sea water. High water temperatures reduce its endurance, whereas low temperatures extend it. Susceptibility of the population varies and is poorly understood, although it is considered to be a function of an individual’s gastric juices, acquired immunity, and nutritional status, hence, its greater severity among children, especially malnourished. In epidemics, however, infection rates rarely exceed 1–2 percent of those exposed.

• **Intervention.** Sanitary disposal of feces, improved housing, proper hygiene, hand washing, protection (chlorination in large doses) and purification of water supplies, and boiling or pasteurizing milk and dairy products are all important general interventions. Tracking and, if necessary, quarantine of known cases is required, but not always possible. Moreover, many governments tend to withhold figures on the incidence of cholera. The many inconsistencies in transmission make it difficult to cite various specific universally applicable steps. Some apparently effective interventions may be due to a natural cyclical fluctuation of epidemics. Immunization is possible, but short-lived (up to 6 months) and only partially effective (about 50 percent). Rehydration of victims, isolation, hospitalization, and medication are necessary curative interventions and also function as means to interrupt the cycle of transmission.

**Dengue Fever**

*Other names:* dengue hemorrhagic fever, arthropod-borne viral fever, and breakbone fever.

• **Description.** Dengue is an acute fever with sudden onset and usually lasts about five days. Its symptoms include intense headache, muscle pains, lack of appetite, and rash. A more serious form of the disease, dengue hemorrhagic fever, also exists. Its symptoms include vomiting, hemorrhaging, and shock; fatality in untreated cases can reach 40–50 percent or be brought down to 1–2 percent with proper hospital care. Recovery may entail prolonged fatigue and depression. Dengue has been spreading steadily on five continents and is now endemic throughout tropical Asia, Northern Australia, and Africa, also occurring in the Eastern Mediterranean, Caribbean, and Central and South America. Asian countries have more of the serious hemorrhagic version than the Americas. Since 1981, however, incidence in the Americas has been steadily rising.

• **Transmission.** Humans and certain mosquitoes are the reservoirs (in jungle and forest areas, monkeys are also a reservoir). Dengue is transmitted by an infectious mosquito (genus Aedes) that bites during the day. The disease usually develops three to fifteen days after the bite. Human blood is infective for about a week; the mosquito remains so for life. The general population is susceptible, however depending on the type of disease, children or adults can be more seriously affected, especially in the case of dengue hemorrhagic fever in children. In tropical Asia, the hemorrhagic type seems to occur exclusively among children under 15 and is usually spread during the rainy season.

• **Intervention.** The major intervention entails eliminating habitat of aedes, which live in a variety of small pools ranging from tree holes to water storage pots (see the note on mosquitoes in chapter 8-6 in “Malaria and Vector-Related Diseases”). Education of the population on mosquito habitat is indispen-
sable. Protective screening and insecticides are also recommended, but not always practicable or afford-

dible. Protective screening and insecticides are also recommended, but not always practicable or afford-

**Diarrheas and Dysentery**

*Diarrheas.* Diarrheas can entail a mild to severe infection. Usual symptoms are loose stools (more than five episodes in 24 hours) and nausea, often accompanied by vomiting and fever. Diarrheas can be due to more than thirty common communicable diseases; they can occur as a side reaction to another disease or its treatment or they may erupt due to a variety of conditions, such as stress, changing environmental conditions, irregular diet, or nutritional imbalances. Diarrheas are described below in two categories: undifferentiated and specific (see also “salmonelloses” below).

Understanding the cause of diarrheas can be helpful to understanding their eventual control, especially when dealing with their four main types of pathogens: bacteria, viruses, protozoans, or helminthes. Viruses tend to be fragile outside their human host and die rapidly under adverse conditions of temperature and moisture. This has led to the assumption that the majority of transmissions occur through interpersonal contact, rather than water or food. In comparison, bacteria can exist for long periods outside their human host and are more tolerant to adverse conditions of temperature and moisture. This leads to the assumption that bacterial infections as a broad class are probably spread more in food and water than by interpersonal contact. Although prior strategies have emphasized water and sanitation—that is, engineering interventions—this revised emphasis clearly points as well to the pivotal role of education. In this vein, personal hygiene emerges as being at least as important.

**Diarrheas: Undifferentiated (Childhood and Traveler’s)**

*Other names:* Undifferentiated diarrhea, acute diarrhea, diarrhea of early childhood, weanling diarrhea, traveler’s diarrhea, la turista, Montezuma’s revenge, and Delhi belly. *See also:* cholera, dysentery (amebic and shigellosis), giardiasis, food poisoning, specific diarrhea, and salmonelloses.

1. **Weanling Childhood Diarrhea**

- **Description.** This is a common infection that recurs for up to three months in bouts of four to five days. It can affect children both before and after weaning, but is most common after. This is when the child loses the nutritional value of breast milk and some of the immunities acquired from its mother and, at the same time, is being exposed to more and more sources of infection from its external environment, all of which is exacerbated by unsanitary living environments and poor hygiene. Protein calorie malnutrition is commonly associated with these acute diarrheal episodes. (A typical example would be about 115 attacks a year for every 100 children under five months receiving breast milk, and 275 attacks for the same 100 children after breast feeding.) Mortality can exceed 50 per 1,000 a year in preschool children or be as high as 40 per 100 in premature or low birth weight children. The highest incidence tends to be in hot dry periods, associated with lack of water. A prime consideration is rapid dehydration, which is an important cause of death. Weanling diarrhea occurs at ages of approximately 4 to 30 months depending on the period of weaning and nutritional status of mother and child.

- **Transmission.** Transmission in most cases occurs as a result of ingestion of pathogens in or on food, toys, pets, clothing, and unclean hands of mothers and other children. The transmission cycle is perpetuated in a vicious cycle in cultures in which children’s feces are considered harmless. Unknowingly, mothers jeopardize their child’s health with lax hygiene habits that actually increase exposure.

- **Intervention.** Education on personal hygiene, especially the benefits of breast feeding and hand washing are key interventions. Except in nurseries, however, it is not clear from contradictory findings how effective personal hygiene measures actually are; that is, certain viruses (e.g., rotavirus) have been transmitted in developed countries, although without producing disease, despite high levels of hygiene, sanitation, water supply, and education. The crucial variable may be nutritional levels.
2. Travelers’ Diarrhea

• **Description.** Common in tropical areas in newly arrived or departing travelers, migrants or refugees, this diarrhea can be triggered by a radical change in environment and food. Normally, bouts last one to three days, accompanied by nausea, vomiting and sometimes fever. Because high doses are necessary to cause infection, transmission is assumed to be through food or water in which the bacteria or virus have had time to multiply to an infective dose.

• **Transmission.** The majority of traveler’s diarrheas are assumed to be transmitted in food and water, including ice, rather than interpersonal contact. Some incidences of diarrhea can be attributed to a radical and abrupt change in intake of food and water, rather than to a pathogen.

• **Intervention.** Precaution should be taken to maintain proper personal hygiene and wash personal items, for example, eating utensils, and less obvious ones, such as soiled clothing and bed linen, because certain bacteria can live in ambient conditions of temperature and moisture. The most important consideration in these cases is the liberal ingestion of safe and nutritious fluids to rehydrate the body and re-establish the various chemicals that have been voided through excessive loss of fluids. Antimicrobials may be used as prophylaxis and have been found effective in up to 90 percent of travelers.

**Diarrheas: Specific**

*Other names: Campylobacter, E. coli, rotavirus, Norwalk; common names: epidemic diarrhea and vomiting, epidemic collapse, epidemic nausea and vomiting, winter vomiting disease, severe gastroenteritis in infants and children, and sporadic gastroenteritis.*

• **Description.** Gastroenteritis or diarrhea is an infection of the intestines, causing nausea, vomiting, diarrhea, fever, and abdominal pain. It can be severe in children and require hospitalization. When not specifically identified, it can also be classified as an “undi differentiated diarrhea.” It usually lasts about 1–6 days, depending on the type. Gastroenteritis or diarrhea occurs worldwide, most frequently in the winter months in temperate climates and year-round in the tropics. This feature suggests a high level of interpersonal contact, including the possibility of air-borne transmission. The viral types are normally referred to as gastroenteritis and the bacterial types as diarrhea. For component interventions, this distinction is not significant, because the general response would be to treat them in the same manner. They each, however, have different characteristics. Three of the four account for high percentages of infant and childhood mortality (E. coli, rotavirus, and campylobacter). Rotavirus, for example, which may account for up to 10 percent of childhood diarrhea, is most common in children 3 months–6 years old, that is, after weaning and until they have been able to acquire immunity from exposure. In developing countries, an estimated 870,000 diarrheal deaths are due to the rotavirus. In comparison, E. coli requires a large dose to cause infection, relative to other diarrheal diseases, for which personal hygiene and interpersonal contact may be more important. In dealing with infants and children, however, it is difficult to determine when they have swallowed an “infective dose,” given the range of ways they are exposed. The high presence of antibodies in the blood (which show that an individual has been exposed to the disease) throughout the industrialized countries indicates that these diseases are being transmitted—although with much lower rates of morbidity and mortality—in spite of the high levels of education, hygiene, and water and sewerage services. Individual resistance, due to higher standards of living and better nutrition, may be a key factor. Unfortunately, a great deal is still not known on this topic.

• **Transmission.** Humans are the major reservoir. The actual mechanism of transmission is still not known due to many complicating factors and multiple routes of transmission. Diarrheas are all clearly transmitted by the fecal-oral route, with both food and water implicated. Respiratory spread is also probable. In the case of children, the variety of means of transmission is infinite. Diarrheas usually occur within 1–5 days after exposure depending on type. Individuals can spread the infection to others for duration of infection, which can last up to several weeks, depending on type. The entire population is susceptible, although children more severely. Some acquired immunity is apparent, but its duration depends on the virus or bacteria and often is unknown, so reinfection is possible.
• **Intervention.** Because of the number of complicating factors in transmission, recommendation of specific interventions is difficult. Proper hygiene and food handling and sanitary disposal of waste remain, of course, of paramount importance. In some cases, transmission is also possible through animals, that is, pets (dogs and birds), poultry, pigs, sheep, and cows. Their actual role is, unfortunately, still unknown. This feature clearly defines a potential strategy: additional care in food preparation and avoidance of nonpasteurized milk. Special care to have children avoid pets and domestic animals is also desirable, although hardly practical. As with all diarrheas, rehydration is important.

**Dysentery: Amebic**

*Other names:* Amebiasis. (See also: salmonelloses or bacillary dysentery.)

• **Description.** Amebiasis is an infection, primarily of the large intestine, with the parasite *Entamoeba histolytica*. Most cases are asymptomatic or cause only mild abdominal discomfort. When a serious infection develops, it causes fulminating (rapid onset and termination) dysentery, that is, fevers, chills, and, in its severe forms, bloody or mucoid diarrhea. (Blood and mucous in the stools are characteristic of dysentery, but not diarrhea.) Long-term infection can cause ulcers or abscesses or lead to secondary infections. The precise factors causing the more serious forms are still unknown. Ameba can absorb nutrients and blood, but feed mostly on bacteria in the intestines and, in most cases, appear not to be a primary contributor to malnutrition. Death from amebic dysentery is rare. Amebic dysentery ranks as a low to moderate problem for society; because most regular infections are asymptomatic, endemic areas tend to be localized, and epidemics tend to be localized. In the already malnourished, however, its social importance increases from “low to moderate” to “moderate to high.”

• **Transmission.** Amebiasis occurs worldwide. It is rare, however, in children below age 5 years old. In areas with poor sanitation, prevalence reaches about 30 percent, but can go as high as 80 percent. Asymptomatic humans or those who are chronically ill with the disease are the main carriers. The parasite exists in two forms that can transmit the infection, a cyst, which is reasonably hardy and can live several days, and a trophozoite, which is extremely fragile and susceptible to gastric acid. It is the latter, which is common during an acute attack or epidemic and, hence, not extremely infectious because of its fragility. Transmission usually occurs by ingestion of cysts expelled in feces. Cysts cling to the surface of raw vegetables or fruit that have been contaminated by flies or the soiled hands of food handlers or that have been washed or freshened by sprinkling contaminated water. Cysts can remain alive on vegetables, bread, cheese, and fruits for up to 48 hours; in fecal matter under fingernails for 45 minutes; or on hands for 10 minutes. They are also relatively resistant to chlorine at concentrations used for water purification. Transmission is also possible through drinking water or improperly prepared local brews. In epidemics, infection is more commonly spread through contaminated drinking water. Infection occurs commonly two to four weeks after exposure, although varying from a few days to several months or even years. A mildly symptomatic or asymptomatic infected person, if untreated, can be communicable for years.” The general population is at risk, although all who are infected do not develop symptoms.

• **Intervention.** Sanitary disposal of feces, protection of water supplies from contamination, screening of food handlers, hand washing, and general hygiene education, especially of mothers, are the primary recommended interventions. Unfortunately, extensive case studies do not show a consistent pattern that clearly implicates any single or collective means of transmission; hence, preventive interventions such as sanitation are most likely to have a sustainable effect only in the long term. For drinking water, sand filtration removes nearly all cysts, whereas filtration with diatomaceous earth removes all. Standard chlorination does not destroy cysts, but iodine tablets are effective for small quantities of water. In areas where sewage effluent is treated, primary treatment is not especially effective because of the small size and low density of cysts. Secondary treatment and tertiary treatment can both achieve 100 percent reduction of cysts, depending on the methods. Disinfectant dips for fruit and vegetables are not proven, although it is certainly recommended that vegetables be prepared using iodine solutions, strong vinegar or boiling. Infected individuals can be treated with amebicidal drugs.
**Dysentery: Shigellosis**

*Other names:* Bacillary dysentery; can also sometimes be considered as food poisoning, gastroenteritis or undifferentiated diarrhea

- **Description.** Shigellosis is an acute bacterial disease primarily of the large intestine, characterized by diarrhea, fever, vomiting, cramps, strained urination and defecation, and blood, mucous, and pus in the stools. (Blood and mucous are characteristic of dysentery, but not diarrhea.) The illness is generally self-limiting and lasts for an average of 4 to 7 days. Symptoms usually develop within 1–3 days of exposure, but may take up to a week. The severity of infection depends on the dose and type of the organism and the age and nutritional state of the infected individual. The mortality rate in some cases can be 25 percent, if untreated, and can exceed 20 percent, even in hospitalized patients. Shigellosis occurs worldwide. Its prevalence and fatality are greatest among children ages 1–4 years; 60 percent occurs in children under 10. (Children under 6 months appear to gained immunity from their mothers). It is common and serious where nutrition and sanitation are poor and is more readily transmissible by an infected individual than many other diarrheal diseases. Shigellosis, therefore, can be readily spread by interpersonal contact and houseflies. The potentially high mortality rate of certain strains and ease of transmission make it an important health problem.

- **Transmission.** Humans are the reservoir. Transmission occurs by direct or indirect transfer of feces from an infected individual or carrier to another. An extremely low dose may suffice to cause infection. (Under laboratory conditions, only 10–100 bacteria were able to cause an infection in 10–40 percent of adult volunteers.) The prime method of transmission seems to be from unwashed hands or fingernails after defecation. Most transmission occurs within the household, except for occupational hazards. A large variety of transmission routes are possible besides direct physical transfer among individuals, for example, clothes, toilet seats, and glasses. Low temperature and lighting and high humidity extend the bacteria’s survival, for example, 3 hours on hands, 17 hours on toilet seats, and 1 week in cotton. Shigella multiply in contaminated food that is not served immediately. Water-, milk-, and fly-borne outbreaks are also possible. The bacteria can survive for up to 3 months under optimum conditions in foods, such as flour, eggs, milk, and some mollusks, and up to 2 weeks in acidic foods, such as citrus juices. Individuals remain infectious as long as shigella is present in feces, usually under one week and not more than four weeks. Because of its requirement for low temperature and light, plus high humidity, transmission on crops is not a major route. Survival on crops is rare beyond one week and probably very low beyond 2 days in hot arid climates. The bacteria can, however, be spread by aerosol droplets in flush toilets and spray irrigation systems; groups working with wastewater are, therefore, at risk in irrigation or treatment. The general population is susceptible, but the disease is more severe in children than adults and in the aged or those suffering from malnutrition. Breast feeding is protective for infants.

- **Intervention.** Most studies show that shigellosis reduction correlates most highly to water availability. Personal hygiene, especially of hands and fingernails; sanitary disposal of feces; fly control; education; and proper cooking and storage of prepared foods are the major preventive interventions. Emphasis on home, schools, or workplaces will vary according to standards of personal and food preparation hygiene. Standard chlorination is effective in reducing shigella in drinking water. As in the case of diarrheas, rehydration is important for those with the disease. Antibiotics appear to shorten the illness, but resistance to them is common.

**Filariasis**

*Other names:* Wuchereriasis, Bancroftian filariasis, elephantiasis, Malayan filariasis, Brugiasis, Timorean filariasis, and lymphatic filariasis.

See also “Malaria and Vector-Related Diseases” in chapter 8 and table 8-6.

- **Description.** This section refers to lymphatic filariasis, which is the most widespread. Filariasis is an infection with a small worm that causes inflammation and blockage of the lymphatic system (a part of the circulatory system). Reaction to this blockage, in turn, can cause headaches, nausea, fever, and painful swelling of the lower extremities, genitalia, and breasts, often with thickened and rough skin.
Although it can result in serious complications to the circulatory system, the disease is more disfiguring than life threatening except in serious cases. Disfigurement and deformity, which may take up to 20 years to manifest themselves, may have a greater social consequence as a handicap than its actual health effects. Filariasis is endemic across the equatorial belt in most warm regions where mosquitoes can live (genus: Aedes, Culex, Anopheles, and Hansonia). Cases currently occur in 73 countries worldwide, more than half in Southeast Asia, especially India. In the Western Hemisphere, filariasis occurs in the West Indies, Republica Bolivariana de Venezuela, Suriname, French Guiana, Haiti, the Dominican Republic, Costa Rica, Panama, parts of the Guyanas, and Brazil. Approximately 1 billion people live in areas where filariasis is endemic. Because mosquitoes spread filariasis, it can be either urban or rural. It has been suggested that the disease is increasing because water development projects have expanded year-round mosquito habitats in rural areas. Similarly, a proportionate lack of development projects to keep pace with urban growth and population migration is potentially expanding the mosquito’s urban habitat; wastewater contaminated with organic matter, storm drains functioning as open sewers, and pit latrines are of particular importance. Stagnant and improperly maintained water sources also play a role. These provide breeding sites for the culex mosquito, which accounts for most of the disease distribution. In Africa, however, anopheles, which breeds in clean water, accounts for most cases. In the South Pacific, the disease is spread by a species of aedes, which is rural.

- **Transmission.** Mosquitoes spread the disease when they pass on the blood of an infected individual. Humans are the major reservoir (although, in some species, mammals can provide an intermediate host). Mosquito biting habits bear on local transmission and intervention. Culex, the major source of filariasis, bites at night. (It is interesting to note that a heavily infected human can kill the mosquito.) Development of the disease in humans takes three months or more after the bite. Humans can infect mosquitoes and continue the chain of infection, as long as humans are infective, up to five years or more. All humans are at risk, although the physical symptoms of the disease are rare among children, because it may take up to 20 years for the disease to cause a blockage in the lymph system. Severity varies considerably according to various geographical differences. Repeated infection can occur.

- **Intervention.** Control of mosquito breeding grounds is of paramount importance. Culex mosquitoes, the principal vector, prefer to breed in water contaminated with sewage or other organic matter. This implicates poor sanitation, especially pit latrines in spread of the disease near homes. Ventilated improved pit (VIP) latrines are effective for control of breeding in latrines; however, in urban areas, filariasis is primarily associated with sewage and sullage in drains and ditches. Where waste stabilization ponds are used for wastewater treatment, overhanging vegetation has been associated with culex breeding. By and large, mosquito control should focus on (a) eliminating mosquito breeding sites through land fill or application of oil or insecticides and (b) altering the physical environment. Local factors will, obviously, determine the efficacy of any measures. High water tables, seasonally or throughout the year, and increased water use compromise many sanitation methods. Detergents in wastewater emulsify oil, limiting its efficiency (oils inhibit respiration of mosquito larvae). Natural predators, for example, guppies, are only possible in canals large enough to contain adequate oxygen. Some mosquitoes readily build up resistance to insecticides. Nonetheless, numerous possibilities exist that are universal: (a) keeping drains as clear as possible to reduce stagnation, (b) fitting and retrofitting septic tanks, latrines, and vent pipes with mosquito netting (more mosquitoes escape through vents than holes in squat plates or toilet seats), (c) covering or repairing soakage pits, septic tanks, and latrines, (d) fitting or retrofitting water seals, (e) avoiding, where possible, open drains for sewage and sullage, and (f) using insect traps. Use of insecticides, however, is compromised by their high cost. Because of the short breeding cycle, that is, approximately 2 weeks, all methods require recurrent attention. This factor, in turn, requires community involvement and education. Protective netting and spraying against mosquitoes in houses are effective only for “domesticated” mosquitoes, but not for sylvan types. Medication and, in extreme cases, surgery are the major curative interventions; no vaccine exists at the moment.

* The worms undergo development in the mosquito in about 2 weeks and then are passed on to another human. When they are deposited on the skin during a bite, the worms later penetrate the skin, probably at the punctured skin area. The mosquito, which takes about 2 weeks to hatch, becomes infective 10 days after the blood seal and remains infective until larvae are discharged from its system.
**Food Poisoning**

*Other names:* Food-borne intoxication, food-borne disease, and botulism.

- **Description.** Food poisoning is a general term referring to illnesses, usually, vomiting, caused by contaminated food or water. It is often, but not necessarily, accompanied by diarrhea, cramps, or fever. Food poisoning can be considered more an intoxication than an infection. Toxicants or poisons can be chemical or bacterial or consist of a variety of naturally occurring organic substances present in such foods as mushrooms or shellfish. Vomiting and diarrheas from gastroenteric infections, for example, salmonellosis or typhoid, can also be classed as food poisoning, whenever their identification is not possible. A characteristic feature of food poisoning is its rapid onset. Food poisoning occurs worldwide and is relatively frequent. Indeed, WHO even considers illness due to contaminated food as perhaps the most widespread health problem in the contemporary world.

- **Transmission.** The most common mode of transmission is through food, especially meats and food prepared with milk products that have been undercooked or kept unrefrigerated, allowing time for the pathogen to reproduce to a toxic dose (in the case of botulism, food that is insufficiently cooked prior to canning). Of particular risk are large quantities prepared for groups where portions of the food cool or are reheated unevenly. Most cases produce symptoms within 1–14 hours depending on the type of food and toxin. Food poisoning is not directly communicable among humans.

- **Intervention.** Proper food handling and storage is essential, although this is not always feasible. Cooking to 60°C or 140°F for at least 15 minutes is recommended to ensure chemical breakdown of the toxins, as is covered storage of food under 4°C or 40°F. In the case of cooked foods, cooling time of 2 or more hours is sufficient time for food to become contaminated. Curative interventions include rehydration and patience, because the best method is often for the body to purge itself of the toxicants.

**Giardiasis**

*Other names:* Giardia enteritis, lambliaisis, and giardia duodenalis.

- **Description.** Giardiasis is an infection of the small intestine. Often only mildly symptomatic or even asymptomatic, the disease can cause diarrhea, bloating, malodorous stools, inflammation of the bile duct, malabsorption of nutrients especially fat and fat-soluble vitamins, fatigue, weight loss, and malaise. The disease usually lasts less than three months and is rarely fatal. Giardiasis is more likely to be severe in prolonged cases and in individuals with protein-calorie malnutrition, low gastric acidity and immunodeficiency, all of which predispose individuals to contract the disease. In severe cases, the disease can persist for years. Giardiasis can be one of the causes of traveler’s diarrhea and is now one of the most commonly found intestinal parasites throughout the world today. Giardiasis occurs worldwide; children are more frequently infected than adults (perhaps three times more). A prevalence rate of 30 percent among children is not uncommon. Current prevalence is estimated at about 2–7 percent of the world’s population. Giardiasis is more prevalent in areas of poor sanitation and poor hygiene and among malnourished children. A direct correlation between poor sanitation and economic development is not clear, because outbreaks regularly occur in economically developed countries with high standards of living and in children in developing countries who are not disadvantaged.

- **Transmission.** Humans are the main carriers, but it can also be spread by animals. Beaver and deer are known and rats possible vectors. Flies are probable vectors in areas of high prevalence. The disease is spread primarily through fecal contamination of water, and also by fecal-oral transmission in food and interpersonal contact. Epidemics tend to be water-borne. Contaminated hands are probably the main sources of transmission in outbreaks where water supply is protected. Development of the disease varies, but usually within 3 weeks of exposure. A high rate of asymptomatic carriers contributes markedly to its continuation. Up to 900 million cysts can be shed by an infected individual, although it is not clear that all are infective; twenty-five to 100 cysts are sufficient to cause an infection. An infected individual remains communicable for the duration of infection, usually under three months.
• **Intervention.** Sanitary disposal of feces to protect water supplies is the main preventive intervention, because the disease is primarily waterborne. Protection of water supplies is clearly more difficult for animal than human feces. Sand filtration is effective in eliminating cysts, when done under high standards of operation. Chlorination is probably not effective at currently practiced standards. Because of the of the many means of transmission, hygiene education may be the most important intervention (as with amebiasis). Cysts are killed by desiccation and freezing, but resistant to wide ranges of acidity (pH) and ambient temperatures. Secondary sewerage treatment is effective in reducing 50–90 percent and waste stabilization ponds in reducing 100 percent of the cysts. Because the normal night soil and sludge treatment process does not produce a hostile environment for cysts, their reduction and elimination is a function of time and temperature. Evidence exists of protective immunity after repeated exposures. Medication is available for infected individuals.

**Guinea Worm Disease**

*Other names:* Dracontiasis, Dracunculiasis

• **Description.** Dracontiasis is an infection of the tissues with a large roundworm. Its most frequent characteristics are blisters or skin ulcers that last up to several months and appear when the female worm is ready to release its larvae. The blisters and ulcers normally occur on the lower extremity, especially the foot (90 percent of cases), but also elsewhere on the body. The threadlike worms measure 30–120 centimeters. Symptoms include burning, itching of skin, nausea, fever, vomiting, and diarrhea. The disease does not kill, but is extremely debilitating. The worm infestation itself, secondary infections, and presence of an open sore can result in abscesses, arthritis, and tetanus. Some worms remain in the body and are calcified. These repercussions determine its social importance—devastating consequences to agricultural productivity—because the disease debilitates during planting and harvest seasons. In endemic areas, affliction of 50 percent of a village with the disease is not uncommon. About 30 percent of cases result in incapacitation, about 0.5 percent with permanent disability, and 0.1 percent with mortality. Disability ranges from 5–10 weeks in untreated cases. In western Nigeria, for example, the average disability lasted 100 days. In essence, the disease means a significant wage loss for those whose livelihood depends on seasonal labor. Prolonged periods of school absenteeism is more difficult to measure, but certainly important. The global incidence of the disease has decreased tremendously in the past decade; by 1996, WHO estimated fewer than 153,000 cases, most of which occurred in Sudan. At present, the disease still thrives in several countries in Sub-Saharan Africa, India, and the Arabian Peninsula, particularly Yemen.

• **Transmission.** The disease is spread by infected humans and the only one spread exclusively in drinking water. Larvae are discharged by the worm periodically for 2–4 months when the infected individual immerses the blister in water when, for example, swimming, fetching water, or doing laundry. These larvae, which can survive in water for up to a week, are then swallowed by a small crustacean (*Cyclops*) about the size of a flea and then develop in about two weeks. Humans who drink water harboring this crustacean can acquire the infection when the worms are released in the stomach and then migrate to muscle tissue. * Individuals with high stomach acidity are less prone to multiple infections. This feature tends to increase susceptibility for those actively engaged in farming. That is, they tend to drink more to replenish water lost in heat and, being away from their houses, probably eat less frequently. These, in turn, dilute or lower stomach acidity. The species of *Cyclops* that spreads the disease favor stagnant water, that is, unprotected wells, ponds, and inlet pools and not flowing rivers or streams. Transmission is seasonal, depending on geography and rainfall. In dryer regions, peaks in the disease occur when a rainy season produces seasonal ponds supportive of *Cyclops*. Transmission in wetter regions, in comparison, decreases where rain overflows ponds or causes turbidity unsuitable for *Cyclops*.

• **Intervention.** Protection of water sources from contamination by infected individuals is a straightforward and effective measure. Simple architectural improvement of water sources, such as sealing wells

*After discharging her eggs, the female is expelled and the open sore can heal. Females live about 12–18 months; it takes about 1 year to produce eggs.*
with covers or adding a platform on which to stand, can prevent immersion of infected parts, usually the lower leg. Boiling or filtering water eliminates the crustacean. Holding tanks are not effective, because it is possible for larvae to be released from a dead *Cyclops* crustacean. Treatment of water with chlorine or copper sulfate is also effective. High-risk groups are those engaged in farming, a sweat-inducing activity; they may drink unfiltered, unboiled water or directly from ponds. Education on the disease’s life cycle is vital, but it is not always possible to change behavior where water sources are not protected from contamination where they are accessed. The most common form of treatment is to remove the worm physically from the sore by wrapping it around a twig, little by little, until the worm is fully removed. Chemical control of *Cyclops* is possible, but of limited utility due to the cost and practical difficulties of application in rural areas. Several medications exist that can control the worm once in the body, but these are too expensive for mass treatment and have toxic side effects. Traditional herbal remedies also exist, but their potential use is often compromised by people who think the disease is not preventable, especially because the disease does not manifest itself for as much as a year after drinking contaminated water.

**Hepatitis**

*Other names:* Type A hepatitis, viral hepatitis, epidemic hepatitis, epidemic jaundice, infectious hepatitis, and catarrhal jaundice.

- **Description.** Hepatitis is actually a general term referring to an infection of the liver. The three main types of hepatitis are type A, type B (or serum), and type C (formerly called non-A and non-B). The description below pertains only to type A. The remaining two types, although serious health problems, do not fall within the purview of this work, because their transmission revolves around contamination of blood (e.g., in transfusions and dirty needles) and, to a certain extent, sexual intimacy.

Hepatitis is a serious infection of the liver with an abrupt onset of fever, malaise, loss of appetite, nausea, abdominal discomfort, followed in a few days by jaundice (yellowing of skin and whites of the eyes). It can be a mild illness of one to two weeks or last several months. A long convalescence is generally necessary, but completely effective. The severity of the disease seems to increase with age. Many children are only mildly symptomatic and escape diagnosis. Most cases are diagnosed in older children and adults. Mortality is usually less than 1 percent. Even in countries with high standards of living, exposure to hepatitis is widespread, but underreported because infections are mild and go undetected. Outbreaks are common in institutions and for lower socioeconomic groups; epidemics are common in school-age children and young adults and in situations of congested housing with poor hygiene. The disease tends to be more prevalent in rural rather than urban areas. Hepatitis is endemic worldwide with a tendency to cyclic recurrences. In temperate countries, incidence is higher in autumn and winter except in cases of epidemics.

- **Transmission.** Humans are the main carriers. The disease is transmitted in feces, urine, and probably also discharges from the throat and nose. Interpersonal contact is the main route of transmission, presumably of fecal-oral. Outbreaks are most frequently related to contaminated water supplies, but can also be due to food, including milk and raw or undercooked mollusks (e.g., clams and oysters), which retain and accumulate the viruses. Transmission via mollusks appears to be dose related, because it is not clear that cooking kills all the virus. Spread of hepatitis in this way, therefore, appears to reflect general levels of contamination of saltwater habitat. Depending on dose, the disease develops normally about 28–30 days after exposure and is most highly communicable while still developing within the infected individual, that is, usually about two weeks before symptoms set in. Infants and preschool children are infected, but frequently do not exhibit symptoms. Hepatitis imparts an immunity, but its strength and longevity are not certain.

- **Intervention.** Personal hygiene, proper human waste sanitation, and thorough cooking of shellfish are the main interventions. Precise interventions concerning water and wastewater treatment still remain speculative because of past difficulties in isolating the virus from actual field outbreaks. The hepatitis virus appears to resist normal chlorination, but water meeting conventional bacteriological standards does not appear to cause the disease. Hepatitis A vaccine is available, but usually lasts under four
months, after which a booster may be necessary for longer term protection. No specific medication for hepatitis exists.

**Intestinal Worms (Ascaris and Hookworm)**

**Intestinal Worms: Ascariasis**

- **Description.** Ascariasis is a worm (nematode or roundworm) infection of the small intestine, which causes digestive and nutritional disturbances, rashes, restlessness, and insomnia. Symptoms in 85 percent of the cases are mild or absent. During its development, the worm larvae migrate through the circulatory system. This can lead to numerous other secondary infections, such as pneumonia. In heavily infected children, ascariasis can cause other serious complications, for example, severe malnutrition or intestinal blockage. Prevalence is worldwide, but mostly in tropical countries where it can infect 50 percent of the population. Young children are more frequently and more heavily infected. Prevalence from 60–90 percent of children and 10–50 percent of the aged are not uncommon. In Africa, an estimated one-third of the population is infected. It has been suggested that mortality due to ascariasis as a contributing factor is much higher than estimated, but generally underreported or attributed to another disease. Its widespread mild occurrence has, unfortunately, led many people to assume it is a harmless part of life. Ascariasis tends to be spread in the immediate vicinity of households. Where night soil or sewage effluent is used as fertilizer, ascariasis can be spread through raw or undercooked vegetables. Distribution of the disease near households, therefore, may be due to cultural and occupational factors, because the very young and very old—the most vulnerable—tend to spend more time near the house, compounding the problem in a vicious cycle. Because it is so widespread and difficult to eliminate, due to the persistence of ascaris eggs, ascariasis is a serious health problem. In view of its proportionately low mortality rate (less than 0.02 percent) and asymptomatic infection, however, it is not considered a priority when compared with other diseases that seem to be more serious.

- **Transmission.** Humans are the reservoir, but pigs, chickens, cats, and dogs can act as vectors by eating human feces and passing on the eggs, aggravating transmission in work and living environments. Ascariasis is spread by ingestion of eggs from soil contaminated with human feces. Salads and raw vegetables are the most frequent vehicles, especially when manured with human feces. Dirty hands and children’s playthings that have fallen on the ground also tend to be major vehicles of transmission. By and large, the bulk of transmission in highly endemic areas appears to focus on household activities, exacerbated by small children’s defecating indiscriminately around living areas. Soil on feet, shoes, and sandals can also transport eggs for long distances. Transmission in dust is also possible. Even bank notes have been implicated in transmission. After eggs are swallowed, they eventually develop passing through the circulatory system and settling in the intestines as mature worms, a process that takes about 2 months. About 2 to several weeks after being shed in feces, eggs develop into an infective stage in soil under ambient conditions (loose, moderately damp soil with ample oxygen and temperature higher than 15°C), although eggs can tolerate adverse conditions. Eggs die within 1 hour at temperatures higher than 50°C and within 15 hours of exposure to direct sunlight. Humans remain infective as long as live female worms inhabit the intestines. A female can produce 200,000 eggs daily, or 26 million eggs in her lifetime, about 6–18 months average. About 60 percent of these can become infective. Average worm lifespan extends 12 to 24 months. Eggs in the soil can remain viable for several months; up to 10 years has been reported. The general population is at risk, although some individuals seem to develop some immunity with age.

- **Intervention.** Because water is not significant in transmission, proper disposal of feces and prevention of contamination in areas adjacent to living quarters, especially play areas, are some of the primary preventive measures. Because children appear to be the main reservoirs of infection, education about hygiene and food handling is indispensable, as is the design of toilets. Given that eggs do not become

* Estimates of nutritional consequences vary. Twenty adult worms, a normal mild infection, consume about 3 grams of carbohydrate and 1 gram of protein daily, hence, the consequences of infection depend on the load. Similarly, this could consume 1 ounce of a child’s protein and cause deficiencies in vitamins A and C. In addition to this consumption, worms also can inhibit nutrient absorption.
infective for about two weeks, regular environmental cleanup of household areas is not unrealistic. A variety of sanitation measures are possible and effective, but depend on three overriding complementary variables: time, temperature, and moisture. Mass deworming with drugs is of questionable value except in severe cases, because of the high probability of reinfection unless effective sanitary measures and hygiene education are also taken. To be effective, deworming campaigns should be repeated at intervals of less than 2 months as long as individuals are shedding eggs. Otherwise, reinfection to pretreatment levels are likely to return within 6–12 months. Effective sanitation measures, however, will only work if accompanied by proper education.

**Intestinal Worms: Hookworm**

*Other names:* Ancylostomiasis, necatoriasis, uncinariasis, and ankylostomiasis

- **Description.** Ancylostomiasis is a chronic and debilitating infection of the small intestine with hookworm (a nematode, *Necator* sp. or *Ancylostoma* sp.) causing anemia of varying severity depending on the worm load. The anemia is caused by the blood-sucking worm, which attaches itself to the intestinal wall. (Its head end is curved like a hook, hence, the name.) It can be asymptomatic with mild or heavy levels of infestation, lead to mental retardation and stunted physical development in children, especially if they are malnourished. Symptoms include abdominal pain, indigestion, diarrhea, constipation, and a desire to eat soil (geophagy). Pregnant and lactating women are especially vulnerable. The consequences of anemia can include lower productivity, poor memory, heart disease, and a variety of adverse effects to the reproductive system, for example, infant and maternal mortality, miscarriages, still births, abortions, and delayed puberty. In tropical Africa, hookworm-related anemia is one of the most common causes of hospitalization. The disease is widely endemic in hot, humid tropical and subtropical countries with poor sanitation, ideal conditions for egg or larva survival. Prevalence of up to 50 percent is common. Distribution is relatively even among all ages, except for the very young and aged, where prevalence appears low. Sanitary measures to control hookworm is not always considered high priority in public health campaigns, because it often goes underdetected and has a relatively low mortality rate, compared with the infection rate; yet, together with malaria and schistosomiasis, it rates as one of the three most important parasitic diseases afflicting humankind. (Bear in mind that diarrheas are not considered parasitic diseases.) It has been suggested that the mortality is much higher than estimated, but generally underreported or attributed to another disease.

- **Transmission.** Humans are the main reservoir, although dogs and cats spread certain varieties in Southeast Asia. Eggs in the feces of an infected individual are deposited in the ground and, where soil density, moisture, and temperature are favorable (loam or sandy soil of about 20 to 30°C), hatch into larvae. The larvae, which become infective about a week after hatching, live in the soil or attach themselves to grass where they can survive for up to 15 weeks. Transmission tends not to be in the immediate vicinity of homes because soil is packed too tightly. High transmission probably occurs at regular defecation sites where the larvae density is high, soil is moist, but not waterlogged, and feet come into prolonged and stationary contact with the soil. (Sunlight and urine, however, are lethal to the larvae.) The larvae penetrate the skin, usually through the feet or legs (sometimes hands and, buttocks), producing dermatitis, “dew itch,” or “ground itch.” Certain types can also be ingested, although this is less common. The larvae pass through the body to the small intestine, where they attach themselves to the intestinal wall. They then develop to maturity and begin producing eggs to complete the cycle, which usually takes between 1 and 2 months. Depending on species, hookworms produce from as few as 9 to 30,000 eggs a day. Symptoms develop after a few weeks, but can take up to several months depending on the worm load and nutritional status of the infected person, specifically iron intake. In the absence of treatment, infected individuals are potential egg spreaders for up to 7 to 15 years depending on the species, although most worms die within 3 years. Hookworm infection and, therefore, transmission varies seasonally, but the particulars are not clear. Generally, anyone can contract the disease, although some immunity is thought to develop with infection.

- **Intervention.** Proper disposal of feces (night soil and sewage effluents are particularly hazardous when used as fertilizer) is of paramount importance, together with proper education. This includes identification of high-risk defecation sites such as cool, shady areas with moist soil. Encouragement on wearing shoes or sandals is extremely important, although not always feasible for economic and cultural reasons. Deworming is of questionable value, except in cases of heavy loads, due to the likelihood of reinfection, unless the entire population is treated and effective hygiene education measures are also taken.
Improved excreta facilities alone have not proved especially effective in areas of high prevalence. Because hookworms continue to produce eggs in an individual for an average of 3 years, programs to eradicate the disease are predictably slow. A variety of sanitation measures are possible, but depend on time, temperature, and moisture.

**Malaria**

*Other names:* Palladiums, *Palludisme* (in French), Roman fever, Chiggers fever, marsh fever, tropical fever, and ague.

See also “Malaria and Vector-Related Diseases” in chapter 8 and table 8-6.

- **Description.** The term malaria is derived from the Italian for bad air (mala aria). In general, malaria is characterized mostly by general malaise, shaking chills, rapidly rising fever, usually with headache, nausea and profuse sweating. The symptoms, which are produced by the activity of the malarial parasite in the blood, repeat themselves from one to three days depending on type of malaria. (It is this variation which is responsible for their names, tertian and quartan which follow the Roman system of dating.) This initial attack sequence varies from a week to a month if untreated. Relapses are frequent with recurrence of symptoms lasting at irregular intervals from 2–5 years, but usually extending beyond 1.5 years. There are actually four types of human malaria which is essentially a parasitic invasion of the blood. The most serious type (falciparum or malignant tertian) causes periodic bouts of fever, chills, and sweating which can lead eventually to anemia, jaundice, blood coagulation, shock, kidney failure, acute inflammation of the brain (encephalitis), delirium and coma. Prompt treatment is essential as irreversible complications can occur. Case fatality rate in children and nonimmune adults exceeds 10 percent. This more serious type of malaria accounts for approximately 50 percent of all malaria worldwide and is the type more widespread in tropical Africa. In the milder forms of malaria (vivax or benign tertian, quartan, and ovale), the symptoms are similar, but are not life threatening, except in infants or those suffering from other diseases. Of these three milder types of malaria, one type (vivax) is found mostly in Asia and accounts for about 40 percent of global malaria, but has a low prevalence in Africa.

- **Malaria** has been mostly eradicated in temperate climates, occurs primarily in the tropics and subtropics (i.e., 60°N to 40°S latitude) wherever anopheles mosquitoes breed, and is usually absent in dry regions or altitudes above 1,500 meters. Malaria tends, however, to be more of a rural disease that adversely affects agricultural development, although urban malaria has recently been recognized. Malaria remains one of the world’s most severe health problems and one of the most difficult to combat. For Africa, malaria appears to be worsening and accounts for about 20–50 percent of all admissions to health services and one in five childhood deaths. WHO has certified some forty countries as having eradicated malaria, but 103 countries have not achieved this. Malaria is staging a resurgence in the past decade in southern Asia, Latin America, and Turkey. Mosquitoes have unfortunately become increasingly resistant to insecticides, and the parasite in the blood has grown resistant to drugs.

- **Transmission.** Humans are the main reservoir. Malaria is transmitted predominately through the bite of an infected (female) anopheles mosquito. (It can also be transmitted in transfusions of blood from an infected human or the use of contaminated needles.) Anopheles mosquitoes tend to bite from dusk through dawn; many species favor feeding indoors and in areas around human habitations. They have a complicated life cycle. When the mosquito bites a human with active malaria, it ingests parasites that undergo a transformation, which is temperature dependent (i.e., 21–27°C or 70–80°F and does not occur under 16°C or 60°F). These parasites are eventually passed on to a human, in whom they further develop and actually cause the disease. On average, it takes humans 1–4 weeks to develop malaria (a1-
though some strains take up to ten months). In comparison, it takes the mosquito about 8 to 35 days to become infective after the blood meal from an infected human. The human can be infective as long as the parasite is in the blood, which can occur irregularly for up to three years. Once infected, a mosquito remains so for the duration of its life, which lasts from a few days to about a month. The general population is susceptible to malaria, but the degree is lessened by previous infection. Tolerance is evident in adults in some areas where malaria is highly endemic and where exposure has been frequent for several years. High-risk groups are children 6 months to 5 years old and pregnant mothers.

**Intervention.** Mosquito eradication and control, treatment of infective cases to reduce spread, house spraying with repellents, bed nets, protective clothing, proper control of blood for donations and transfusion, and protective medications are the full range of possible interventions, each with varying complexity and possibility of success. Because the young anopheles must pass its early development stages in water, drainage of all possible breeding grounds is important, although certainly not always possible. The same climatic factors that encourage people to wear protective clothing, that is, cold weather, naturally reduce mosquito reproduction. Limited immunity occurs from exposure to the disease. Antimalarial medications are available, but their efficacy has been compromised in recent years by resistance of the parasites.

**Onchocerciasis**

*Other names:* River blindness, onchocerciasis

**Description.** River blindness is a chronic, but nonfatal disease caused by infestation with a roundworm (nematode). The disease is characterized by small lumps (nodules) in the skin, seen mostly in areas where bones are near the surface of the skin. The female worm within an infected individual discharges small threadlike worms (microfilariae), which cause skin itching and dermatitis, rash, pigmentation change, swelling (edema, because of abnormal accumulation of fluids), and wasting (atrophy) of the skin. Progression of its various stages has given the disease its local names (e.g., skin of an orange, lizard, or crocodile). The loss of skin elasticity, the last stage, is responsible for hanging groin and hernia that frequently accompany the disease. In endemic areas, populations sometimes associate the intense itching and change in skin as part of the aging process. Worms reaching the eyes can produce blindness. Severity of individual infection depends on progressive buildup of microfilariae, which can take up to 30 years to cause blindness.

Although not a life-threatening disease, river blindness has enormous socioeconomic consequences. The dermatitis, for example, causes premature aging in appearance and intense itching, which can inhibit sleep and reduce overall work productivity—sometimes of whole communities. In endemic areas, for example, parts of Africa, as many as 50 percent of a local population have the disease, 30 percent have impaired sight, and 10 percent or more have gone blind. The overall effects have caused entire communities to move away from fertile river valleys to less productive land. This in itself can produce adverse effects on the agricultural economy and environment through overpopulation and overcropping. Water resource development projects can have positive effects by reducing breeding areas for the fly in vegetation and rocks near fast-moving water. (The flies need high amounts of oxygen.) Spillways and drainage canals, in contrast, can extend the habitat. Because the severity of infection depends on buildup of the microfilariae for years, the pattern of communitywide blindness leading to abandonment of the village may take up to 60 years. River blindness occurs primarily in Sub-Saharan Africa (in a belt of thirty countries from Senegal to Ethiopia and from Angola to Mozambique) and irregularly in Latin America (Guatemala, southern Mexico, República Bolivariana de Venezuela, and parts of Colombia, Ecuador, and Brazil) and the Middle East (Yemen). In eleven countries in West Africa, the disease is on the verge of being eliminated as a public health threat.

**Transmission.** Humans are the only known reservoir. Transmission occurs through the bite of an infected female black fly (genus *Simulium*). When the fly ingests blood of an infected individual, it becomes infective within 7–14 days depending on the temperature and climate of the area. The flies breed on vegetation and rocks in fast-moving water, which provides sufficient oxygen for the fly eggs to develop. Disease distribution tends to be highest within 5 kilometers of the water habit. (Flight range, however, averages 40 kilometers and reaches a maximum of 150 kilometers.) The flies normally
bite during the day outdoors and do not like bright sun. An infected individual can be communicable up to 15 years, if untreated. The population at large is at risk, and reinfection can occur, because no immunity has been demonstrated.

- **Intervention.** Vector control, protective clothing, and repellents are all possible control measures of varying feasibility for rural populations. For example, according to geographic distribution, certain flies bite above the waist, others below the waist, but this is of little practical value in interventions. Current practical measures include larvicides in infected streams and medication of infected individuals. Of the variety of interventions, alteration of fly-breeding habitat has proved the most effective. Its major drawbacks are the length of time necessary for implementation and follow-up, that is, 15–20 years; expense; and complexity of achieving broad environmental coverage without adverse effects to the environment. DDT, for example, has been used effectively in Africa. (See “Pesticide Use” in chapter 8 and “Use of Pesticides and Fertilizers” in chapter 9 for discussion of DDT and current World Bank policies on use of pesticides.) Efficiency, however, depends on repeated spraying, even of remote areas for 15 years to avoid reinvasion throughout the lifespan of adult worms. An extensive program of onchocerciasis research and control in the Volta River Basin of West Africa was launched in 1974 and has considerably reduced the incidence of the disease in eleven countries in the area.

**Respiratory Diseases (Acute, Flu, and Pneumonia)**

Respiratory diseases are divided into three categories: acute, influenza, and pneumonias. Other respiratory diseases, such as asthma, bronchitis, and cancer, are not covered below.

**Respiratory Disease: Acute Respiratory Illnesses (Short-Term and Mild)**

_Other names:_ laryngitis, bronchitis, earache, and the common cold.

- **Description.** Acute respiratory illnesses are broad categories of diseases characterized by a variety of reactions, such as chills, headache, body aches, malaise, loss of appetite, and localized inflammations of the respiratory tract. (The absence of fever in the common cold, however, distinguishes it from the other upper respiratory tract infections, e.g., laryngitis, bronchitis, tonsillitis, and earache.) Symptoms usually subside within a week, unless complicated by another infection. These infections are generally nonfatal, but constitute a major reason for reduced efficiency and absenteeism from work and school. Irritation of the respiratory tract predisposes individuals to other more serious complications, such as pneumonia. Respiratory infections and their complications are most serious to children under 5 years, who normally have the highest incidence. This set of infections occurs worldwide. In temperate zones, incidences tend to be highest in winter months and, in tropical areas, in wet and cold weather.

- **Transmission.** Humans are the main carriers. Respiratory diseases are spread directly presumably by interpersonal contact and droplet spread and indirectly by contact with soiled articles and eating utensils of an infected individual. The role of hands appears now to be more important in transmission than was considered earlier. The period of symptom development and communicability varies by disease and individual, but is usually under one week. The general population is susceptible. Illness is more frequent and more severe in infants and children. Reinfection is possible, but usually milder if induced by the same strain of pathogen.

- **Intervention.** Immunization is possible for certain illnesses, but not those that induce the common cold. Major interventions include reducing crowded living conditions, improved ventilation, improved stoves for cooling, heating, and lighting (especially irritants such as smoke), and education on personal hygiene (especially concerning sneezing and coughing and disposal and cleaning of soiled articles).

**Respiratory Disease: Influenza**

_Other names:_ Flu.

- **Description.** Influenza is a short-term infection of the respiratory tract characterized by abrupt onset of fever, chills, headache, muscle ache, and cough and often accompanied by a common head cold and
sore throat. It normally lasts 2 to 7 days. Influenza is an important public health problem because of the rapidity of its spread, high attack rate, the seriousness of frequent complications (especially pneumonia), and severity in the malnourished, elderly, and chronically ill. (The name influenza, which derives from Italian for “influence,” is traced to the Medieval Latin belief that epidemics were influenced by the stars.) Distribution of influenza is worldwide and seems to follow a 10- to 11-year serious pandemic (i.e., worldwide epidemic) cycle (i.e., 1889, 1918, 1947, 1957, and 1968). Influenza infections also occur in swine, horses, and other animals, but transmission from these animals to humans has not been demonstrated. In temperate climates, epidemics tend to occur in winter months; in the tropics, no seasonal pattern seems evident. Several distinct strains of the virus exist, which evolve into different substrains at irregular intervals. This development of new strains at irregular intervals is responsible for the pandemics.

**Transmission.** Humans are the source of human infections, although some animals are suspected of providing strains of virus that recombine with human strains. Influenza is spread by direct contact, droplet infection (i.e., airborne through coughing or sneezing), and by indirect contact with freshly soiled articles. The influenza virus can persist for several hours in dried mucous, which increases the potential for spread, especially in children and groups with poor personal hygiene. Most frequent outbreaks occur in crowded living conditions. Infection develops usually within 24 to 72 hours of exposure. Communicability of individuals is probably limited to 3 days after symptoms begin. The general population is susceptible. Infection produces immunity only to a particular strain.

**Intervention.** Personal hygiene (especially washing hands and encouraging individuals to cover their mouths when coughing or sneezing) and immunizations are the major preventive interventions.

**Respiratory Disease: Pneumonias**

*Other names:* pneumonoccal pneumonia, bacterial pneumonia, myocomplasmal pneumonia, pneumocystis pneumonia, infant pneumonia, viral pneumonia.

**Description.** Pneumonias are a category of diseases that affects the lungs, inhibits breathing, and thereby negatively affect oxygen exchange and blood purification. In most cases, pneumonia is actually a secondary infection, which results from preceding infections to the upper respiratory tract (e.g., flu, whooping cough, or measles) that spread to the lungs to become pneumonia. The pneumonias are, therefore, especially significant in malnourished children, the aged, the chronically ill, and others weakened by another disease that has left them susceptible to lung infection. Pneumonia is characterized by fever, pain in the chest, difficult breathing, increase in white blood cells, and a sputum-producing cough; vomiting and convulsions are also possible at disease onset. Pneumonia is an important cause of death, especially in the aged and infants; hospitalized patients have a fatality rate of 20 to 40 percent. Antibiotics have helped reduce this fatality for certain types of pneumonia, which is now down to about 5–10 percent; but early diagnosis and treatment is still important for effective cure. Pneumonia remains common in developing countries, especially in industrial cities and poor economic groups. It occurs in all climates and seasons with the highest incidence in winter and spring months of temperate zones. Incidence also commonly increases with epidemics of respiratory infections, especially influenza. Humans are the carriers of infective bacteria that cause one of the more common types of pneumonia, commonly found in the mouth, nose, and throat of healthy persons.

**Transmission.** Pneumonias are spread, directly, by droplets through sneezing and coughing and by oral contact or, indirectly, by contact with articles freshly soiled with respiratory discharges. Depending on its type, pneumonia can develop up to a month after exposure. Individuals remain highly communicable for probably under 2 weeks, depending on the type of pneumonia. Resistance to pneumonia is generally high, but is lowered by exposure to wet and cold environments, physical fatigue, alcoholism, chronic lung disease, or a preceding respiratory infection. Immunity is imparted for the specific strain for a few months to years.

**Intervention.** Reducing crowded living conditions and potential irritations to the respiratory tract, for example, smoke or dust, through proper ventilation of houses or workplaces is the major recommended intervention.
Salmonelloses (Salmonella and Typhoid)

Salmonelloses: Salmonellosis (see also Dysentery)
Other names: Can sometimes be considered a food poisoning, undifferentiated gastrointestinal infection, gastroenteritis, or enteric fever.

- **Description.** Salmonellosis is an acute gastrointestinal infection characterized by sudden onset of abdominal pain, diarrhea, nausea, and sometimes vomiting, usually with fever. It is often accompanied by a loss of appetite, which can last for a few days. Dehydration is an important concern, especially in infants, who, together with children, have the highest infection rate. Salmonellosis occurs worldwide, and epidemics are frequent. In many developing countries, however, salmonellosis represents only a small portion of the more important diarrheas of infancy and childhood. Mortality is generally low. Salmonellosis is one of the few diarrheal diseases in which humans and animals can infect each other and one of the few fecal-oral types of disease spread predominately by animals rather than humans. Because of this feature, typhoid and paratyphoid, also types of salmonellosis, are considered separately in the literature. Salmonella occurs worldwide, although it tends to be reported more frequently in North America and Europe, where it is classified as a food-borne disease.

- **Transmission.** Primarily domestic animals and, to a lesser extent, wild animals (poultry, swine, cattle, sheep, horses, rodents such as rats and mice, and pets such as turtles, dogs, cats, and baby animals) are the main reservoirs of the disease. Humans also transmit the disease, as well as fleas, ticks, lice, and flies. In short, these are animals and insects that share the habitat of humans. Transmission occurs by ingesting food contaminated with feces of infected animals or persons. Most frequently, contamination occurs at its source, less frequently by contaminated food handlers and finally interpersonal contact. It can also be spread in milk, raw eggs (especially cracked), egg products (including frozen and dried), meat and meat products (e.g., preserved meats and sausages), poultry, some pharmaceuticals of animal origin, and animal feeds and fertilizers prepared from contaminated meat scraps, fish meal, and bones. Individuals or animals can spread the disease throughout the course of infection, which varies from days to weeks. Humans can spread the disease for 2 months, but seldom more than a year. Salmonellosis develops usually within 36 hours of exposure. The entire population is susceptible. Severity of infection depends on the type of organism and dose. Ultimately, the level of production and consumption of meat and dairy products is a determining factor in its spread to the general population. Water-borne epidemics are, of course, also possible, although not the major source of transmission.

- **Intervention.** Major preventive measures are thorough cooking of foodstuffs derived from animal sources, especially poultry and egg dishes (and avoiding use of cracked eggs). Food handlers tend to be a high risk both for acquiring and spreading the disease and should be a focal point of any education program, as should producers of meat and dairy products for public consumption. Careful cooking hygiene and proper storage to prevent contamination of food are the essentials of hygiene education, which should also include the possible dangers of pet animals such as chickens, ducks, and turtles. This latter group, however, is of dubious practicality. No curative measures exist except for rehydration. The existence of such a large animal reservoir, however, makes any intervention strategies extremely complicated. Standard treatment of raw sewage and effluents are practical to inactivate salmonella to acceptable levels. Outbreaks have been tracked, however, to the presence of salmonella on crops, consequently, use of furrow, subsurface, or drip irrigation are preferable to flooding or spraying types. Discontinuance, if possible, of contaminated water, 10 days to 2 weeks prior to harvesting is an added precaution, because heat, sunlight and low humidity will substantially reduce salmonella on crops.

Salmonelloses: Typhoid and Paratyphoid
Other names: enteric fever, typhus abdominal, typhoid fever, and paratyphoid fever.

Typhoid and paratyphoid are salmonella-type infections, but are treated separately, because they are not spread to humans in animal feces. Unless indicated, this section focuses on typhoid, because it is more serious.
Identification. Typhoid is a salmonella-type infection of the intestines characterized by continued fever, headache, malaise, loss of appetite, slow pulse rate, spleen enlargement, and rash. Because the infection spreads beyond the intestines, it causes fever, which is usually the distinguishing feature of salmonellosis from other gastrointestinal infections. Constipation is more common than diarrhea (although diarrhea is a symptom of paratyphoid). Typhoid has had a fatality rate of 10 percent, which has been reduced by antibiotics to less than 1 percent. The spread of typhoid in contaminated water was recognized as early as 1838. Since that time, typhoid has become a benchmark for the spread of waterborne diseases. In both the United States and Europe, improved water supplies have been recognized as the single most important factor in reducing the disease—up to 80 percent within five years of water treatment and filtration. Typhoid occurs worldwide, but its incidence has been greatly reduced—virtually eliminated in the industrialized countries—because of improved water, sanitary facilities, reduction in the number of carriers, and the availability of antibiotics. This is not, unfortunately, the case in developing countries. Typhoid is still considered a major public health problem in many developing countries. Furthermore, strains of salmonella that are resistant to antibiotics have been reported in Asia, Latin America, and the Middle East. Patients who are HIV positive have a significantly increased risk of contracting the disease. In general, the salmonelloses are not a major cause of infant and child diarrhea morbidity and mortality.

Transmission. Humans are the main reservoirs. Asymptomatic carriers play an important role in spreading typhoid. Transmission occurs by ingesting food or water contaminated by feces and, to a lesser extent, urine. Relatively high doses are normally needed to cause infection. Improperly cooked, starchy foods and pastries that allow typhoid to multiply to an infective dose are the most common vehicles. Raw fruits and vegetables, whole milk, and milk products are also frequent vehicles. Transmission can also occur in shellfish from contaminated waters or food stored in, cooled in, or “freshened” with contaminated water. Contamination is most commonly spread by hands of carriers, although flies can also be involved. Depending on the size of dose, typhoid develops within three weeks of exposure. (Most other salmonelloses occur within 36 hours.) Individuals remain communicable as long as 3 months; under 5 percent become permanent carriers, mostly through their feces. A large proportion of asymptomatic carriers spread the disease. Curiously, these individuals frequently acquire illness in middle age, females more than males. The general population is susceptible, but is increased in individuals with low gastric acid levels. In countries where the disease is most prevalent, the disease is most common among individuals ages 4 to 19 years old. Resistance to small doses follows recovery or after immunizations; in endemic areas, attack rates usually decline with age. As with other salmonelloses, typhoid tends to peak in the warmer months, whether dry or wet.

Intervention. Protection and chlorination of water supplies, proper disposal of excreta are the main preventive intervention. Controlling flies through insecticides and eliminating breeding and feeding grounds through proper garbage collection and control are also recommended, but less important, because these are not main routes of transmission. Proper kitchen hygiene, cooking, and storage, especially of milk and dairy products should be at the core of proper education, especially of food handlers. Identification and treatment of carriers, as well as immunization are also recommended. The latter is not always practical, and the majority of carriers, who are asymptomatic, are unknown. Typhoid and polio are the only diseases spread by human excreta, for which vaccination is possible. It requires, however, periodic boosters every three years.

**Schistosomiasis**

Other names: Bilharziasis, bilharzia, snail fever, *Schistosomiasis hematobium*, *S. intercalatum*, *S. japonicum*, *S. mansoni*, and *S. mekongi*.

Description. Schistosomiasis is an infection with a parasitic worm (trematode or blood fluke), which lives in the veins around the bladder, intestines, and liver of the infected individual. The worms deposit large numbers of eggs most commonly in the intestines or urinary tract. The presence of the worms and their eggs and the migration of both are responsible for the symptoms, which, depending on the type of the disease, affect either the liver and intestines or urinary tract. These, in turn, can cause complications for example, obstruction of the intestines, tissue scarring, ulcers, bleeding, organ enlargement, and possibly bladder cancer. Blood in the urine is characteristic of the urinary type and is responsible
for its scientific name. Minor symptoms, such as cough and fever, occur as the worm matures. Major symptoms occur in response to long-term egg laying during 2–5 years. (Similar, but relatively mild infections occur in many parts of the world, typified by “swimmers itch,” “clam diggers itch,” and skin rash, but the invading organism is limited to skin infections.) Schistosomiasis occurs in seventy-four countries of the Middle East, Africa, Asia, some parts of Latin America and the Caribbean. The type that affects the urinary tract (S. hematobium) is restricted primarily to the African continent and Middle East and tends to be somewhat less severe.

- In endemic areas, as much as 80 percent of the population can be infected, most commonly those 5–20 years old. Because of the intermediate snail vector, schistosomiasis tends to be primarily a rural disease; however, it can exist in ponds and streams of periurban and urban areas and be carried by people who acquire the disease in rural areas. Schistosomiasis has existed since pharaonic times and was clinically identified by Dr. Theodore Bilharz in 1851 in Cairo during construction of the Suez Canal. It is ironic that this development project played a role in its identification, because it is now seen also as a development disease. The spread of schistosomiasis has increased, because of extension of snail habitat in water resource development projects: dams, reservoirs, irrigation schemes, hydroelectric power, fisheries, and so on. Schistosomiasis is often considered an occupational disease of fishermen and farmers. Women and children doing domestic chores, however, are at an equal, if not greater risk through their regular contact with water. Even though mortality is low, schistosomiasis is a major health problem, because of its widespread prevalence and the difficulty in eradicating the snail vector.

- Transmission. Humans are the principal reservoir for types common in Africa and the Americas. With the Asian version, dogs, cats, pigs, cattle, water buffalo, horses, rodents, and wild rats also act as animal hosts. In all cases, transmission depends on a snail as an intermediate host. These snails generally live near slow-moving water. Transmission is seasonal, because rainfall affects snail habitat and, therefore, the possibility of exposure. Some snails, however, can withstand dry periods by burrowing into mud. The disease has a complicated life cycle. Eggs of the mature worm, schistosome, are passed in urine or feces, depending on the type of schistosomiasis. The eggs hatch in fresh water as “miracidia” and enter the snail where they develop, usually after several weeks, and are passed on as free swimming “cercariae.” The cercariae then penetrate the skin (within minutes) or, sometimes, are ingested when humans come into contact with infested waters. The worms reach maturity in the human usually within six weeks after infection. The worms then begin to produce eggs, some of which are expelled and must reach water to hatch into “miracidia,” which, in turn, penetrate fresh water snails to continue the cycle. Both the miracidia and cercariae must find a host within 6 and 48 hours respectively or die. The disease, because of the necessary snail intermediary, is not directly communicable among humans. Humans remain infective as long as eggs are discharged in the urine or feces of an infected individual, usually one to two years, but this can last up to 5 years for the type expelled in urine and 30 years for the type excreted in feces. The snail can remain infective for several weeks. The general population is at risk, and resistance from a prior infection has not been conclusively proven.

- Intervention. The overall aim of intervention is to break the cycle of transmission at any of several possible stages: eggs reaching water, humans being exposed to water, and eliminating snails or their habitat. A convenient, close water supply away from snail habitats is one of the most effective means. Essential to any intervention is proper disposal of urine and feces; this is an especially difficult task where animals are a reservoir (occurs only in the type common in Asia). Equally important are improved irrigation, drainage, and agricultural practices, which reduce exposure to contaminated waters or eliminate habitat of snails (i.e., slow-moving water). Provision of water for drinking, bathing, and household use, free from cercariae infestations, is also possible. Retaining pools or storage tanks that hold water for 48 hours are effective as a partial intervention. Coagulation and sedimentation are not effective in eliminating the cercariae. Filtration and chlorination, if properly implemented, can be effective. Biological control of snails through natural predators is also possible, but requires extensive preliminary study and monitoring. Because the miracidia and cercariae can swim 5 meters, building “beaches” to limit human access, where appropriate, to about 10 meters.

- Drugs have been available for about 60 years, but generally have had undesirable side effects; new drugs suitable for wide-scale use, however, show promise.
Even though schistosomiasis is a sanitation deficiency disease, sanitation measures alone have not been effective in curtailing transmission. Because of the large number of eggs produced—hundreds to thousands a day, depending on the species—effective treatment and control require coverage of an entire community. Moreover, urination behavior, especially among 5–20 year olds is difficult to modify. This is complicated by some species of schistosomiasis with maximum egg output in the afternoon when people are most likely to be in contact with water. In general, reduction of snail populations appears to have been the most effective single intervention, coupled with chemotherapy of infected individuals, water supply, sanitation, and hygiene education.

**Tetanus**

*Other names:* Lockjaw, infant tetanus, tetanus neonatorum.

- **Description.** Tetanus is an infection of the musculature, which responds to toxic substances produced by the tetanus bacillus. The disease is characterized by painful muscular contractions primarily of the neck muscles (hence the term lockjaw) and, secondarily, of the trunk. In the absence of immunization or treatment, fatality can range from 10–90 percent, depending on the age of the infected individual and the available medical intensive care. Because the tetanus bacillus can only produce its toxin in the absence of oxygen, it is an important source of infection from puncture wounds or superficial wounds with an accumulation of dead tissue. Tetanus occurs worldwide, most commonly in agricultural regions where contact with animal excreta is frequent. In developing countries, infant tetanus commonly results from application of a poultice to the umbilical cord, which is used to close the wound.

- **Transmission.** The tetanus bacillus can live in soil, intestinal canals of animals (especially horses), and also humans. It usually enters the body through a puncture wound contaminated with soil, street dust, or animal feces, but also through burns or scratches or the unhealed umbilical cord of infants. Tetanus has little to do with water quality, because, even if ingested, the toxin produced is not absorbed by the bowel. The disease usually develops within 14 days of exposure. Tetanus cannot be transmitted directly from human to human. Tetanus spores, however, are resistant to drying and high temperatures and even boiling for short periods, which means that, in principle, soil or street dirt can possibly be dangerous for extended periods. The general population is susceptible. Immunization lasting ten years is available, but recovery from tetanus only imparts short-term immunity.

- **Intervention.** Apart from immunization, the greatest interventions fall in the realm of education about treatment of small wounds, burns, puncture wounds, and hygiene. Special education about the need for thorough cleansing of all wounds because tetanus develops where oxygen is absent (i.e., under anaerobic conditions) should be directed to all high-risk groups. This includes midwives and those involved with birth on proper procedures for severing and healing umbilical cords; farmers; and workers in abattoirs and so on, who have frequent small wounds and exposure to animal feces. Provision of adequate supply of water is important as a first-aid means to clean wounds.

**Trachoma**

- **Description.** Trachoma is one of the leading causes of preventable blindness in the world today. Trachoma is an eye infection causing inflammation of the cornea and conjunctiva, that is, the delicate membrane that lines the inner surface of the eyelids and covers the whites of the eyes. (The name trachoma comes from the Greek for “rough eye.”) If untreated, trachoma can last for years and eventually lead to deformity of the eyelids, impair vision, and eventually cause blindness. Trachoma exists worldwide, generally associated with poor hygiene and crowded living conditions, especially in dry, dusty regions. In endemic areas, up to 3 percent of the population may eventually become blind as a result. The infection tends to increase with a seasonal decrease in water supply.

- **Transmission.** Humans are the reservoir of the disease. Trachoma is spread by direct contact with ocular discharges and possibly with mucous secretions from the nose of infected persons. Indirect transmission also occurs from contact with articles soiled by these discharges, especially by using the same towels, wash basins, and washing water. Flies may contribute to the spread of the disease.
cability is relatively low, but endures as long as the infection is active and repeated infections appear to be an important factor in transmission. The general population is susceptible, although children are infected more frequently than adults. The severity is related to environmental conditions, such as lack of water and exposure to dry winds; dust and sand appear to act as irritants and contribute to the severity of diseases.

- **Intervention.** Personal hygiene, increased supply of water, and hygiene education are the prime interventions. The availability of water plays a crucial role in short-term perceptible decreases in trachoma.

**Trypanosomiases (African Sleeping Sickness and Chagas’ Disease)**

**Trypanosomiases: African Sleeping Sickness**

- **Description.** African sleeping sickness is a disease transmitted by the tsetse fly. Two main types of the disease exist; one causes anemia and the other is potentially far more serious. Depending on the fly species, symptoms are characterized by fever, intense headache, insomnia, lymph node enlargement, anemia, localized swelling, and rash, which are eventually followed in later stages by body wasting (atrophy), sleepiness (in the West African strain, hence, the name), and disorders of the central nervous system, which can lead to lethargy and mental retardation. This frequently fatal disease can last for several years or cause death within a few weeks or months without treatment. In addition, the fly bite leaves a sore for up to two weeks, which can lead to secondary infections. In endemic areas, as much as 40 percent of the population can be infected. Its occurrence is limited in tropical Africa to between 15°N and 25°S of the equator, according to the distribution of the tsetse fly.

- The disease occurs primarily in rural areas. Specific distribution depends on the fly species and their preferred habitats: riverine areas and savanna. In west and central Africa, this tends to be near streams and, in eastern Africa, in savanna. Males aged 20–40 years show the highest incidence and, because the riverine species bites in the day, are at highest risk of the disease as an occupational hazard of farming. The disease can infect the general population, but women and children who fetch water are at the next greatest risk. In general, the riverine type tends to favor west and central Africa, be spread only through a human-fly-human cycle and is less severe and fatal than the eastern African type. By contrast, in the eastern African type, the flies prefer savanna; cattle and wild animals are important reservoirs. Fly populations tend to decrease in dry seasons, but people tend to gravitate closer to streams and water sources also in dry seasons, bringing them into closer contact with the flies. Normally, the disease is not present on flat plains or closely cultivated areas, probably because of disruption of the fly habitat, that is, the flies deposit their larvae in soil underneath shrubs and adults use shrubs as resting points. In general, incidence of human trypanosomiasis appears to have decreased. This may be a result of a shift of population from rural to urban areas and increase in agriculture, which destroys the fly larvae. The disease is not considered a major public health problem in Africa, except in pockets. In contrast, the disease is considered a major hurdle to development of a livestock industry, due to the different species of tsetse fly that share the same habitats. Apart from its economic effects on agricultural development, it affects human health by hampering production of animal protein, milk, and dairy products, which otherwise must be imported.

- **Transmission.** Humans, wild game, domestic animals are the reservoirs. (The importance of animal reservoirs, however, depends on the fly species.) The disease is transmitted in a cycle through the bite of an infective tsetse fly, which is itself infected when it bites an infected human or animal. The flies hunt by sight and are attracted by dark moving objects. High-risk groups are those working with livestock and those fetching water. Once infected, a process that takes about 3 weeks, the fly remains infected for its lifetime, about three months. In an endemic area, the percentage of infected flies is generally less than 5 percent. Transmission can also occur as a direct mechanical transfer of blood by any insect, for example, horse fly, from one infected person directly to another. Depending on the species, the disease develops in humans within 2 to 3 weeks, but may take several months or even years. Individuals and animals with the disease are communicable normally for the duration of the infection, which varies greatly, as long as the parasite is present in the blood. The general population is susceptible. Seasonal migration of animals in search of water and vegetation (transhumance) contributes to the spread.
• Intervention. Destruction of tsetse fly habitat is the major intervention, that is, brush clearing along streams near villages and application of insecticides. Where possible, relocation of population to areas not infested with the flies is a potential intervention, but not always practical. For the riverine species, an approach is to create an area of access to water or passage around water that is free of flies, for example, a stretch of land about 730 meters long and 45–135 meters wide. The savanna species are more difficult to eradicate. In addition, education about transmission and recommended precaution against fly bites would also be included.

Trypanosomiases: Chagas’ Disease (American)

• Description. Chagas disease is an acute infection that generally occurs in children, but can also be a chronic condition manifested later in life. Approximately 75 percent of cases are younger than 21 years old. The acute stages consist of variable fever, malaise, infection of the lymph glands, and enlargement of the liver and spleen; inflammation of the site of initial infection (chagoma) may last up to eight weeks. Symptoms can develop into life-threatening complications, involving the heart and inflammation of the brain. Chronic symptoms cause dilation of the heart and enlargement of the esophagus and colon. Chagas’ disease is confined to the Western Hemisphere, especially in rural Mexico and Central and South America. It is endemic in twenty-one countries. Of these, after several years without symptoms, about 27 percent will probably develop chronic, severe Chagas’ disease with cardiac manifestations that may be fatal. Others may develop a form of the disease involving the digestive or nervous system. In some areas, chronic Chagas’ disease accounts for 10 percent of adult mortality. In endemic areas, around 15 percent of the population may be infected. It tends, however, to be most common in rural areas, poverty groups, and families living in thatched or adobe huts, which provide an excellent habitat for the cone nose bug, which spreads the disease.

• Transmission. The disease is spread by a blood-sucking cone nose bug and has numerous reservoirs: infected humans, domestic and wild animals (dog, cat, pig, guinea pig, bat, house rat, wood rat, fox, opossum, and armadillo). The bugs defecate when feeding; their feces transmit the disease by contaminating the eye, mucous membranes, abrasions, and wounds, including the bite wound itself, the most common point of entry. Cone nose bugs tend to bite at night. The disease develops within two weeks after the bite. The bugs become infective within a month after biting an infected host and remain so for life (about two years). All ages are susceptible, but the young are more severely affected.

• Intervention. Elimination of insects from dwellings through insecticides or physical repair (they like to hide in small crevices), use of bed nets, and education concerning cycle of transmission are all recommended interventions. The cost of physical repair to poor housing, however, makes this potential solution difficult. No drugs have yet proven their value as a curative or preventive measure.

Tuberculosis

Other names: TB, Koch’s disease, Pthisis

• Description. Tuberculosis is a chronic infection with most serious repercussions in the lungs, characterized by cough, fatigue, fever, weight loss, hoarseness, chest pain, and coughing up blood. Symptoms often do not become apparent until TB has already reached a severe stage. (Other forms of tuberculosis can involve meningitis, blood formation, bones, joints, eyes, lymph nodes, kidneys, intestines, larynx, skin, or abdominal membranes, but these forms are much less common.) TB is actually a quite common infection, but most healthy people overcome it without ill effects through natural resistance. TB occurs worldwide and has, until recently, had a downward trend in industrialized countries. Since the 1980s, because of AIDS, cases have again increased among population groups with a high prevalence of HIV infection. Incidence is usually higher in cities than rural areas. Severity of infection and subsequent mortality is higher among the poor and in males more than females, and increases with age. European TB began to decline before the discovery of the TB bacillus and effective drugs to combat it, hence, the disease is related to general improvements in living conditions. TB’s socioeconomic significance stems from the fact that in developing countries, 80 percent of the cases occur in the most productive age groups (15–59 years) and accounts for more than one-fourth of avoidable adult deaths.
Within this group. Because of the AIDS epidemic, the number of TB deaths is increasing rapidly, particularly in Sub-Saharan Africa.

- **Transmission.** Humans are the major reservoir; in some areas, infected cattle and their raw milk can spread TB. Transmission occurs through exposure to tubercle bacilli from droplets of an infected person by coughing, spitting, sneezing, laughing, and talking. Prolonged household exposure among family members may lead to infection. Indirect transfer from soiled personal articles may also occur, but this is of lesser importance. (Bovine tuberculosis in humans usually results from drinking unpasteurized milk from tuberculous cows and, sometimes, is spread through the air to farmers or animal handlers.) TB bacilli are resistant to drying, but susceptible to sunlight, hence, dark, dusty rooms promote their spread. TB usually develops within 3 months of exposure; progressive cases sometimes take years. Infected individuals remain contagious as long as the infection is active, which can last intermittently for years. With treatment, communicability is generally reduced within weeks. The general population is susceptible. Incidence is highest in children younger than three years, is lowest later in childhood, then increases in adolescents and young adults. Undernourished persons or persons suffering from a variety of other chronic illnesses are especially susceptible.

Recently, air transportation has been implicated in TB transmission, because of prolonged close exposure; however, evidence is still inconclusive; a low likelihood of transmission in this way is possible.

- **Intervention.** Reduction of overcrowding and improvements in ventilation, nutrition, and general living conditions are the main preventive intervention. Screening (i.e., lab sputum tests) for active cases and follow up for treatment and immunization of family members are also necessary for effective elimination of the disease. An easy and effective skin test is available that has helped identify carriers. About 75 percent of cases must be treated before disease transmission can be sufficiently interrupted to reduce incidence in a community. Control of cattle industry and processing of dairy products where appropriate is also important. Education includes the importance of personal hygiene and household ventilation.

- If air transport is implicated, provisions are needed to prevent and follow up documented cases.
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GLOSSARY

General Terms on Environmental Health

**African sleeping sickness.** Trypanosomiasis. Spread through the bite of the blood-sucking tsetse fly (*Glossina*), which lives and breeds in woody vegetation along rivers and forests.

**Amebiasis.** Infection by amoebas, spread mainly hand-to-mouth. Parasitic in humans, most commonly known for amoebic dysentery or bloody (rather than watery) diarrhea.

**Bioaccumulation.** Biological accumulation. Concentration of substances in living organisms from breathing, eating, or drinking at a rate greater than the substances can be metabolized or excreted. Can accumulate to toxic doses. (Sometimes used, however, to refer to intake of toxic chemicals from environmental factors other than food and water.) Refers to the process within an organism, as opposed to “biomagnification,” which emphasizes the overall process in the aquatic food chain and bioamplification, which emphasizes given impurities.

**Bioamplification.** Biological amplification. Concentration of a persistent substance by an organism in the food chain, for example, 0.001 parts per million (ppm) in earthworms of a pesticide can be amplified to 1 ppm in birds. Bioamplification emphasizes a given substance as opposed to biomagnification, which emphasizes the overall process in the aquatic food chain and bioaccumulation, which emphasizes given organisms.

**Biocide.** General term for substances toxic to living organisms. Pesticide. Also used as a general term on killing pests. *Herbicides* attack weeds. *Fungicides* attack fungi and molds.

**Biodegradation.** Biological degradation. General term covering the process of breakdown by microorganisms, in which organic matter becomes less toxic or harmful to humans and the natural environment. Sometimes misused in that biodegradation is not necessarily total and materials remain harmful. Should not be confused with disintegration, in which the physical form changes, but not the biochemical content; for example, many “biodegradable” plastics with additives cause the plastic simply to dissolve or fragment, so that it is less unsightly.

**Biomagnification.** Biological magnification. Concentration of impurities in water as they pass through the food chain. Concentrations occur in tissues or organs, which are consumed by larger organisms and humans, as they move up the food chain, for example, 0.001 micrograms of mercury in water can magnify to 50 micrograms in fish. Contrast with bioaccumulation, which emphasizes the overall process in the aquatic food chain and bioamplification, which emphasizes given impurities.

**Biological oxygen demand.** A common water quality standard that measures the amount of dissolved oxygen “demanded” by organic material in biological degradation for 5 days. An indicator of the degree of organic pollution. Does not indicate pathogenicity of organic material. Used primarily as an indicator of the healthiness of water bodies to support flora and fauna or, conversely, the propensity to stagnate or eutrophy due to lack of oxygen. Compare with chemical oxygen demand (COD), which emphasizes inorganic chemical pollution levels.

**BOD.** (a) See biological oxygen demand or (b) burden of disease.

**Burden of disease.** As used in health analyses, a comprehensive, internally consistent, and comparable set of estimates of current patterns of mortality and disability from disease and injury for all regions of the world. See also global burden of disease.

**Carbon monoxide** (CO). Odorless, colorless gas. The product of incomplete combustion. CO reacts with blood in the lungs and reduces overall capacity of blood to carry oxygen. At moderate concentrations, can affect the central nervous system, diminishing perception and performance of fine movements. CO also paralyzes the cilia (tiny hairs) of the respiratory tract, which predisposes people to respiratory infection. Main sources are vehicular traffic and tobacco smoke. Major indoor sources are heating, lighting, and cooking fuels.
Carcinogen. Substances that produce cancer. Related terms include metastasis, cancer spreading to other organs, “mutagen,” a change in DNA, which is passed on to other generations, and “teratogen,” a change in utero or birth defect.

Carrier. An infected individual that can spread a disease without necessarily becoming sick or showing symptoms.

Chagas’ disease. American trypanosomiasis or sleeping sickness that is spread by the bite of a nocturnal, blood-sucking, cone-nosed bug that lives in cracks and crevices of walls and roofing in the day, hence, sometimes called bedbugs. Tends to be associated with poor housing, particularly in rural areas. See also African sleeping sickness.

Chemical oxygen demand (COD). A common water quality standard that measures the amount of dissolved oxygen “demanded” by inorganic material in chemical breakdown for 5 days. An indicator of the degree of inorganic pollution. Does not indicate toxicity of inorganic material. See also biological oxygen demand, which, in comparison, emphasizes the capacity of a water body to support life, rather than pollution, which can jeopardize it.

Cholera. Diarrheal disease that is important, because it frequently occurs in epidemics and can spread rapidly. Due primarily to a combination of deficient sanitation and poor hygiene. Interpersonal contact is a major means of transmission, thus, considerations of crowding, even in rural areas, are important. Also important, because once introduced, it can be difficult to eliminate in areas of poor sanitation; historically, it has taken up to 50 years. Can be fatal if untreated, because it strikes rapidly, that is, major consequences are due to rapid dehydration and subsequent depletion of essential body chemicals from water loss. Can be effectively treated with oral rehydration therapy (ORT), which replaces lost fluids and essential chemicals.

CO. See carbon monoxide.

COD. See chemical oxygen demand.

Coliforms. Groups of bacteria that live in human and animal intestines, commonly used as an indicator of fecal contamination of water supply. “Coliform count” is a common standard of water quality.

DALY. Disability-adjusted life years. A socioeconomic measure of human suffering that weighs morbidity against mortality by combining years lived with a disability, disease, and/or injury with the death rate from the same conditions.

Dengue. Also known as dengue fever, breakbone fever, and dengue hemorrhagic fever. Febrile illness spread by the aedes mosquito, which breeds in clean water. Appears to be increasing. Epidemics noted in Latin America. Causes for epidemic spread not yet fully understood, but might involve habitat change from global warming or urbanization.

Diarrheas and diarrheal diseases. Broad category of diseases symptomatic of many illnesses. Main effect is loss of body fluids, which can include essential chemicals and blood (e.g., in dysentery).

Dose-response. Relationship indicating degree of exposure, for example, of a pathogen, radiation, or pollutant, to evoke a physiological response. Sometimes considered controversial, because it can overstate relationships for which exposure has been measured, but understate potential risks because of inadequate data.

Endocrine disrupters. Group of pesticides and byproducts that, when absorbed by the body, can mimic hormone activity leading to negative consequences, such as birth defects or breast cancer, in humans and animals. Those causing breast cancers are also called “estrogen mimickers.”

Filariasis. Parasitic worm infection spread by culex mosquito, which tends to breed in organically polluted water, thus, a direct risk in dealing with sanitation and drainage.

Giardiasis. Intestinal infection by Giardia, spread mainly hand to mouth. Important in water management, because chlorine concentrations sufficient to kill most pathogens do not kill giardia cysts. Can also be passed on to humans from some animals.

Global burden of disease. Concept developed to convey various socioeconomic factors beyond traditional morbidity and mortality rates. Consists of a combination of years lived with disability and death rates.

Gray water. Wastewater that does not contain fecal material. Also called sullage. See sanitation.
Guinea worm. Primarily rural worm infection of the lower extremities, causing an ulcer, from which the 60–100-centimeter-long female discharges eggs. The eggs develop into tiny “water fleas” that people drink. Eggs are spread when infected individuals immerse their legs or feet, when fetching water from ponds and other sources or to relieve itching from the sore. The only disease spread exclusively by drinking water. On the verge of eradication in Africa.

H$_2$SO$_4$. Sulfuric acid. See sulfur oxides.

Helminthes and helminthic worms. See intestinal worms.

Hepatitis. General term for several forms of live infection that are commonly designated viral hepatitis and differentiated by the main mode of transmission: ingestion of feces for hepatitis A and E, or contaminated blood or exchange of body fluids for hepatitis B, C, and D. Debilitating illness causing severe fatigue and lasting up to several months. Improved sanitation is important for A and E.

Herbicides. See “biocides.”

Host. Human or animal that harbors an infectious agent. The host does not always get the infection or even show symptoms. Sometimes also called reservoir.

Infective dose. Level of infection from a pathogen that causes sickness. See also dose-response.

Insecticides. See biocides.

Intestinal worms. Helminthes are parasitic worms (nematodes or trematodes) that are spread by deficient sanitation. Most commonly known from epidemiologically important intestinal infections, such as hookworm, ascariasis, tapeworm, and liver fluke. Can cause a wide array of problems and infect body organs.

Lead (Pb). Lead poisoning can cause a wide array of problems even in low doses. Most common problems are irreversible neurological damage and stunted mental growth (to which aggressive behavior has also been linked), stomach pain, colic, high blood pressure, kidney problems, and bone loss. Can adversely affect normal functions of other vital organs. Lead can accumulate in the body, causing paralysis, blindness, and death. Major sources are lead smelting and lead in gasoline. Important sources not related to commerce and industry are cosmetics, household remedies for diarrhea and stomach ailments, and poultices for sealing infant umbilical cords. Other sources that could be important hotspots include battery manufacturing, brass foundries, lead-glazed pottery and cloisonné, radiator repair, and art restoration. Exposure standards vary, for example, the U.S. OSHA (Occupational Safety and Health Administration) standard of from 50 micrograms/8 hours permissible exposure for workers to the USEPA standards of 1.5 microns/cubic meter for ambient air, 30 micrograms or more/30 days per year maximum atmospheric exposure, and 0.15 milligrams/cubic meter threshold limit value for fumes and dust. Generally, about 40 percent of the lead deposited in the lungs is absorbed into the bloodstream. Despite the general importance of lead, the role of vehicular emissions is sometimes overstated relative to other issues, because lead in ambient air is commonly measured and, thus, data are available for analysis and discussion, whereas other sources are only irregularly measured.

Malaria. Common parasitic infection spread by the anopheles mosquito, which breeds in pure, slow-moving salt or fresh water. Once on the decline, because of vigorous prevention programs, malaria has been staging a comeback, because of resistance to prophylactic drug measures (spraying and medication), as well as prolongation of its breeding season through year-round cropping and extension of its habitat through water supply and irrigation. In addition to water management, control strategies should also consider drainage, because breeding occurs in natural marshes and backwaters. Four basic forms of malaria exist, characterized by different symptoms and relative seriousness.

Micron (µ). 1/1,000,000th of a meter or about 1/25,000th of an inch.

Night soil. Human (or animal) excreta (feces and urine). Term normally in the context of its collection, for example, in latrines using buckets or its being carted away or reused.

Nitrates. Class of chemicals that are commonly discussed as water pollutants in groundwater and rural surface water, mainly from fertilizers and human and livestock waste. (Nitrates also derive from nitric acid, which is discussed as an air pollutant under nitrogen oxides.) Nitrites and N-nitroso compounds (nitrosamines) are frequently cited derivatives of nitrates transformed in the digestive tract. Nitrates and nitrites contain antimicrobial agents and are, thus, used in food processing; an excess, however, can be toxic to humans. From a health perspective, nitrosamines are important as a group, because they can cause blue baby syndrome (methemoglobinemia) in humans and animals and possibly gastric cancer (drinking water
standards are based on the risk of methemoglobinemia). Methemoglobinemia is normally a temporary condition, occurring in the first six months of life, until the infant’s digestive system develops. Can also come from nitrates used in meat and fish curing and food preservation and storage of certain green vegetables, for example, spinach, which form nitrite and N-nitroso compounds. The latter occur also in tanneries, cosmetics, and rubber and iron foundries. Wells more than 30 meters deep are likely to be safe. USEPA standards for drinking water are 10 ppm.

Nitric acid (HNO₃). Corrosive, colorless acid that is toxic to humans when inhaled and caustic to skin and mucous membranes. Public health importance stems from the possibility of the virtually ubiquitous NOₓ reacting with water vapor and other chemicals in the air to form acid aerosol of nitric acid. Commonly used in industry, for example, in manufacturing fertilizers, herbicides, insecticides, explosives, etching glass and steel, wood pulping, reprocessing nuclear fuel, meat processing, ceramics, pharmaceuticals, chemicals, and dyes. A common laboratory reagent. OSHA limit is 232 ppm in air or 30 milligrams/cubic meter.

Nitrates. See nitrates.

N-nitroso compounds. See nitrates.

Nitrogen dioxide (NO₂). See nitrogen oxides.

NOₓ. See nitrogen oxides.

Nitrogen oxides (NOₓ). A general term for compounds containing nitrogen and oxygen, the most common of which is nitrogen dioxide (NO₂). Principal sources of NO₂ are combustion of coal, oil, natural gas, and motor vehicle fuel from transportation, energy, industry, solid waste disposal, and miscellaneous activities, such as fires. Also used in manufacture of chemicals, fertilizers, paints, and propellants. Because transportation and industrial activity are concentrated in urban areas, NO₂ tends to be more significant as an urban pollutant, but can be important in rural or periurban pockets. NO₂ is also an ingredient of tobacco smoke. NO₂ can compromise the body’s ability to kill bacteria in the respiratory tract and reduce the body’s resistance to disease. It is not very soluble in water and, thus, is not readily filtered out in the upper respiratory tract, causing difficulty in breathing or asphyxiation, and can penetrate into the lungs, causing other problems, including respiratory and cardiovascular diseases. NO₂ is believed to be particularly harmful in the presence of automobile exhaust. When nitrogen in the air reacts with a burning flame in a furnace or combustion engine, it forms nitric oxide (NO), a relatively harmless pollutant. Combustion and cooling temperatures are important. When this involves venting and rapid cooling, it becomes significant to public health, thus, idling cars produce less of a health hazard than rapidly moving ones. Can react with water vapor to form acid rain, acid aerosol (nitric acid), and poor visibility.

NOₓ. See nitrogen oxides.

O₃. See ozone.

Onchocerciasis. “River blindness.” Spread through bite of the black fly (Simulium), which needs highly oxygenated water for breeding, that is, fast-moving streams or other water. Predominantly rural. On the decline from effective programs of Onchocerciasis Control Programme of Western Africa.

Organochlorides. Group of chemicals characterized by their solubility in fat, epidemiologically important because they can be absorbed and accumulate in the body to toxic doses (as opposed to water-soluble chemicals which, generally, are either metabolized or flushed) and because they are common in the food chain, because they are widely used in pesticides. PCBs (see below) are also organochlorides. See also “pesticides.”

Organophosphates. Class of insecticides highly toxic to the nervous system of humans and mammals, but nonpersistent in the environment.

Oxides of nitrogen (NOₓ). See nitrogen oxides.

Oxides of sulfur (SOₓ). See sulfur oxides.

Ozone (O₃). A secondary pollutant, caused by the reaction of oxygen with carbon monoxide or unburned oxygen from vehicle fuels. The main component of smog. Economic activities that generate ozone include high voltage electrical equipment, for example, x-ray machines, electrical insulators, motor brushes, and some ultraviolet lights. Also used to purify water, sugar, and industrial waste and helps extend the shelf life of produce in cold storage by controlling the growth of bacteria and fungi. Irritant to eyes and respiratory tract. Can compromise the body’s ability to kill bacteria in the respiratory tract and reduce the body’s resistance to disease. Like SO₂, O₃ reacts mainly with the respiratory tract itself, thus, generally does not get
absorbed by the blood. Portion of O₃ not destroyed in the upper respiratory tract can cause thickening of the respiratory arteries, leading to chronic lung disease, emphysema, and sometimes heart failure. It can also react with nerve endings, interfering with normal oxygen and carbon dioxide exchange in breathing. OSHA ceiling is 0.1 ppm in air or 0.2 milligrams/cubic meter.

PAH. See polyaromatic hydrocarbons.

Pathogens. Organisms, mostly microscopic in size, that cause disease. In this discussion paper, pathogens collectively refer to bacteria, viruses, and parasites.

Ph. See lead.

PCB. Polychlorinated biphenyl. Class of industrial chemicals once widely used in transformers, vacuum pumps, (liquid) insulators, adhesives, and plastifiers. One of their most important uses was as fire retardants. Now discontinued in many countries because of toxicity, negative effects, and persistence in the environment. See also organochlorides.

Pesticides. Substances that kill or repel pests (i.e., fungicides, rodenticides, herbicides, and insecticides), including defoliants and desiccants. See also biocides.

Phenols. Toxic organic chemicals released from oil-based compounds during chemical breakdown. Significant, because of the predominance of oil-based compounds (e.g., gasoline, motor oil, coal, and others) currently used in the transportation, energy, and infrastructure sectors.

PM₁₀ and PM₅. Particulate matter less than 10 or 5 microns in diameter (less than 1/1,000,000 meter). See suspended particulate matter.

Polyaromatic hydrocarbons (PAH). Polycyclic or polynuclear aromatic hydrocarbons. Class of chemicals that are significant as air pollutants. Produced by incomplete combustion of coal, oil, gas, garbage, and hazardous waste. Common constituents are cigarette smoke and coal tar. Toxic to humans and can cause lung cancer. The OSHA permissible exposure limit is 0.2 milligrams/cubic meter.

Respirable fraction. Refers to that fraction of air pollutants that are not filtered out in the nasal passage and are small enough in particle size (generally less than 10 microns in diameter) to penetrate into the lungs where oxygen exchange occurs.

Quality adjusted life year (QALY). An outcome measure that expresses years life gained (opposite of DALYs) from an intervention, that is, the quantity and quality of the extra life in years provided by an intervention. It is the arithmetic product of the life expectancy and the quality of the remaining years. One QALY is one gained year of healthy life.

Reservoir. Any human, animal, plant, or other substance in which an infectious agent can live and multiply, until it can find a “host” to infect. A human or animal reservoir does not necessarily become infested while serving as a reservoir, in which case they are often referred to as a “carrier.”

Roundworms. See intestinal worms.

Salmonelloses. Common, acute gastrointestinal infections with salmonella, causing sudden onset of diarrhea, headache pain, and nausea. Frequently associated with food poisoning. Spread mainly through animal feces, so food preparation is a major preventive measure. Spread also by deficient sanitation. Typhoid and paratyphoid are classified as salmonelloses, but are not spread through animal feces and are characterized mostly by fever.

Sanitation. General term covering waste management. Used irregularly to refer to sewers and other water conveyance systems, for example, high- and medium-tech sewerage; on-site systems, for example, latrines and other low-tech systems; and solid waste removal.

Septage. Human waste that does not pass through a sewage system. See sanitation.

Sewage. Contents of sewers.

Sewerage. General term referring to the system of conveyance for wastewater containing human and animal excreta. Consists of (a) sewers, that is, a network of pipes, (b) treatment plants, which produce water and sludge, and (c) the means of final disposal, for example, sewage outfalls discharging treated or untreated wastewater into rivers or oceans, or a sanitary landfill that accepts the sludge. Technically speaking, the sewerage system is different from the “drainage system,” which conveys storm water not requiring treatment for pathogen removal. Some systems carry a combination of sewage and storm water. “Sewer-
age” and “sewerage system” are inconsistently used and defined, even in technical dictionaries. The im-
portant point is to distinguish among component parts (collection, transmission, and disposal), drainage sys-
tems, and the institutions that manage the system.

**Sludge.** Residue from sewage treatment plant, consisting of the accumulation of settled solids and other
material that results from different treatment stages. Eventually needs proper disposal. Depending on the
thoroughness of treatment and type of effluent coming into the system, can be biologically pathogenic and
chemically toxic.

**SO₂.** Sulfur dioxide. See *sulfur oxides*.

**SO₃.** See *sulfur oxides*.

**SPM.** See *suspended particulate matter*.

**Sulfur dioxide** (SO₂). A mild respiratory irritant, most of which is absorbed in the upper respiratory tract,
because it is soluble in water. Can be converted to sulfuric acid, a more serious pollutant to the lungs. SO₂
is implicated in chronic bronchitis, asthma, eye, and nasal irritations. See *sulfur oxides*.

**Sulfuric acid** (H₂SO₄). Mainly a secondary pollutant caused by reactions with sulfur dioxide. See *sulfur
oxides*.

**Sulfur oxides** (SOₓ). General term used to refer to compounds containing sulfur and oxygen, the most
common of which are *sulfur dioxide* (SO₂) and *sulfuric acid* (H₂SO₄). Most SO₂ is generated in the combus-
tion of coal, petroleum products and wood and as a byproduct primarily of space heating, cooking, and
production of electricity. SO₃ is also generated in refineries, smelters (e.g., copper, lead, and zinc), manu-
facturing of paper, and incineration of refuse. Most SO₃ consists of particles less than 2 microns, which
makes it a contributor to poor visibility and also small enough to penetrate into the lungs. SO₃ is a major
component of tobacco smoke, which probably constitutes a more serious health problem than respiration of
SO₂ in ambient air.

**Sullage.** Wastewater that does not contain fecal material. Also called *gray water*. See *sanitation*.

**Suspended particulate matter** (SPM). Small particles of solids or liquids suspended in air. When used in
measuring air pollution, figures also include PM₁₀ or PM₂.₅ to refer to particles less than 10 or 5 microns in
diameter, which are significant because they can penetrate deep into the lung cavity where the blood is
oxygenated. Compare with TSP and *respirable fraction*.

**Tetanus.** An infection of the musculature causing painful contractions, hence, the name lockjaw. Tetanus is
commonly spread through puncture wounds contaminated with human or animal feces in soil and street
dust. It is an important occupational disease for agriculture and animal husbandry, because of frequent han-
dling of animal feces.

**Trachoma.** A leading cause of preventable blindness, transmitted through person-to-person contact of dis-
charges from the eye of infected individuals. More common in dry areas, hence, exhibits seasonal variation.
The main preventive measure is adequate water for personal hygiene.

**Trypanosomiasis.** See *African sleeping sickness* and *Chagas’ disease*.

**Total suspended particulate** (TSP). Refers to the aggregate of pollutants, regardless of particle size. Com-
pare with suspended particulate matter and *respirable fraction*.

**TSP.** See total suspended particulate.

**Tuberculosis** (TB). Disease of the lungs (although it can infect other body organs) that is spread mainly by
interpersonal contact through air-borne droplets; hence, crowded living conditions are a factor (may also be
spread through consumption of unpasteurized dairy products). Common complication of HIV infection.
Staging a comeback, even in developed countries, where, at the turn of the century, it was considered a
scourge of humanity. TB bacillus resists drying, but is susceptible to sunlight, hence, dark, dusty housing
aids its spread.

**Typhoid.** See *salmonelloses*.

**Vector.** An intermediate agent, such as a fly, mosquito, or rodent, that is capable of transmitting a disease
from one organism to another or a susceptible *host*. Infections may be transmitted through a bite or skin
penetration (inoculation) (e.g., mosquitoes transmitting malaria or rats carrying plague), mechanical deposi-
tion (e.g., flies carrying bacteria that cause diarrheas), or ingestion (e.g., humans drinking “water fleas” that carry guinea worm disease.

**Intermediate vector.** Indicates a complicated life cycle with more than one stage. For example, in schistosomiasis, humans excrete worm eggs, which develop into larvae. These infect snails, which, in turn, excrete eggs that develop into larvae able to penetrate human skin.

**Virulence.** Degree of severity of an infection capable of withstanding body defenses or medical treatment. Often measured by case fatality rates.

**Volatile organic compounds (VOC).** Organic compounds that readily evaporate and exist as gases in the atmosphere. Commonly used term when referring to air pollutants, for example, benzene.

### Terms on Environmental, Health, and Risk Assessments

This section contains various definitions for:

- Environmental health
- Assessment
- Health impact assessment
- Environmental assessment and environmental impact assessment
- Risk assessment.

Because no internationally accepted definitions, practices, or standards for environmental health exist, several are listed here. Sources are noted for those definitions quoted, excerpted, or adapted from other sources. Each bullet indicates a separate source.

#### Environmental Health

- **Environmental health** is as much a way of thinking as a set of facts or professional discipline. Preventing disease, death, and disability form its core. The field or discipline entails looking at a problem in both its broad and narrow contexts. Broadly speaking, environmental health is intended to reduce exposure to adverse environmental conditions as well as promote behavioral change. More narrowly, it addresses the underlying causes of individual groups of diseases and injuries by looking at the direct and indirect causes and effecting relationships in the short and long term.

  **Environmental health** relates to ecological factors, natural disasters, and human activities (production or consumption) that impact on socioeconomic conditions and environmental life support systems, potentially affecting the well-being of present and future generations,* specifically by increasing human disease, injury, and premature death, especially among vulnerable groups, mainly the poor, women, and children under five.

  **Environmental health** is intended to prevent health risks by controlling human exposure to (a) biological agents, such as bacteria, viruses, and parasites, (b) chemical agents, such as heavy metals, particulate matter, pesticides, and fertilizers, (c) disease vectors, such as mosquitoes and snails, and (d) physical and safety hazards, such as traffic accidents, fire, extremes of heat and cold, noise, and radiation. Human exposure pathways are air, water, land, and food.

  **Environmental health** strives to consider individual problems in as broad a context as possible, within which to set policies and develop reasonably practical and cost-effective preventive and remedial measures. The broad context should include socioeconomic determinants of physical and mental stress, for example, (a) population movements, such as growth, rural-to-urban migration, and resettlement, (b)

* Future generation preferences and possible environment-related human genetic defects cannot be determined or documented beforehand; this chapter will not address this unresolved issue (see also institutional failures).
general lack of access to basic services, such as transport, water, sanitation, and energy, and (c) time spent compensating for this lack, such as fetching water and household fuels, or getting to school, work, and health services. Remedial measures in environmental health complement health care system interventions in order to optimize health benefits. The broad context also allows for more efficient cross-sectoral intervention, such as addressing the risk of STDs/AIDS in infrastructure projects, in which truckers and work crews risk acquiring or spreading the disease. (World Bank, 1996, Bridging Environmental Health Gaps, vol. 1, AFTES Working Paper No. 22, Environmentally Sustainable Development Division, Africa Technical Department, Washington, D.C., p. 2)

“Environmental health is the body of knowledge concerned with the prevention of disease through the control of biological, chemical, or physical agents in the air, water, and food, and the control of environmental factors that may have an impact on the well-being of people.” (Frank S. Lisella, ed., 1994, The VNR Dictionary of Environmental Health and Safety, New York: Van Nostrand Reinhold, pp. 107–108.)

“Environmental health comprises those aspects of human health, including quality of life, that are determined by physical, biological, social, and psychosocial factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling, and preventing those factors in the environment that can potentially affect adversely the health of present and future generations.” (World Health Organization, 1997, Health and Environment in Sustainable Development. Geneva)

• What is environmental health?

The definition of environmental health is still evolving. The conventional list of main health hazards in the household and community environment includes the following:

- Traditional hazards. Lack of safe water, inadequate sanitation, and waste disposal, indoor air pollution, and vector-borne diseases (malaria and others).
- Modern hazards. Urban air pollution and agroindustrial chemicals and waste.
- Other health hazards may be added—at least partially—to the environmental health category, such as food contamination, occupational safety, and natural disasters. Health and environment nexus is broader than environmental health itself. For example, it may include health care waste management, health impact of land degradation and impoverishment, and the impact of biodiversity loss on medicinal plants. These issues, however, are outside the scope of this note. (WHO web site, <www.who.int>)

Assessment

• The critical analysis, evaluation, or judgment of the status or quality of a particular condition, situation, or other subject of appraisal. (Herman Koren, 1996, Illustrated Dictionary of Environmental Health and Occupational Safety, New York: Lewis Publishers, p. 34.)

Environmental Health Impact Assessment

• A statement of the beneficial or adverse health effects or risks due to an environmental exposure or likely to follow an environmental change. Such statements may contain or refer to results of epidemiological and/or toxicological studies of environmental health hazards. (Alan Gilpin, Dictionary of Environment and Sustainable Development, Second Edition, New York: John Wiley and Sons, 1996, p. 53.)

• An assessment of the effects on the environment and people of aspects of a project recognized as having potentially adverse health effects; the health component is often insufficiently addressed in environmental impact assessments (EIAs). In 1982 the World Health Organization recommended that EHIA [environmental health impact assessment] studies should be conducted for all major development projects. Health assessment embraces the following: risks and hazards (direct and indirect), involving explosion, fire, shock, heat, blast, vibration, and destruction of property beyond the boundaries of the plant; biological factors such as parasites, helminthes, protozoa, bacteria, mycobacteria, rickett-
rickettsia, and viruses; toxic, carcinogenic, or mutagenic chemicals, and heavy metals; ionizing and nonionizing radiation; noise; dust and other irritants; and excessive temperature or humidity. The possible implications for human health may be measured in terms of mortality and morbidity. (Alan Gilpin, 1996, *Dictionary of Environment and Sustainable Development*, Second Edition, New York: John Wiley and Sons, p. 53.)

- Environmental health impact assessment offers an appropriate mechanism for maximizing the advantages of such projects, while minimizing possible environmental and health damage. Environmental impact assessment identifies, at an early stage, the impact on both the environment and human health that planned development projects may have. Environmental health impact assessment, thus, puts into action the sound public health principle: prevention is better than cure. In doing so, its overall purpose is to create an environment conducive to achieving physical and social well-being. (Robert G. H. Turnbull, ed. 1992, *Environmental and Health Impact Assessment of Development Projects. A Handbook for Practitioners*. WHO and CEMP, New York, NY: Elsevier Applied Science, p. 1.)


**Health Impact Assessment**

- The main steps in health impact assessment are identification of health hazards, interpretation of health risks, and management of health risks. The operational procedures required by a regulating agency to achieve these steps are initial screening of the project for health hazards, initial health examination or rapid appraisal, health impact assessment, and proposals for health risk management. The initial screening process identifies the health hazards normally associated with the kind of development project. The initial health examination (IHE) or rapid appraisal uses existing information to interpret the health hazard as a health risk. (Dr. M. H. Birley, 1995, *The Health Impact Assessment of Development Projects*, London: HMSO, p. 3.)

- A full health impact assessment (HIA) involves detailed field studies and is a more rigorous, expensive, and specific form of assessment. (Dr. M. H. Birley, 1995, *The Health Impact Assessment of Development Projects*, London: HMSO, p.4.)

- The assessment is concerned with the change in exposure associated with the project: identifying the communities that will be exposed and the nature, magnitude, and likelihood of that exposure. The consultant should also establish the capabilities of existing protection agencies, including the health service, to monitor, inform, safeguard, and mitigate health risk. (Dr. M. H. Birley, 1995, *The Health Impact Assessment of Development Projects*, London: HMSO, p. 29.)

*(Health impact assessment within an environmental impact assessment)*


**Environmental Assessment and Environmental Impact Assessment**

*Environmental Assessment*

- A written environmental analysis that is prepared pursuant to the National Environmental Policy Act (NEPA) by a federal agency in anticipation of proposed legislation or federal action. The analysis
briefly provides significant evidence for determining whether to prepare an environmental impact statement or a finding of no significant impact and aids an agency’s compliance with NEPA, when no environmental impact statement is necessary. It also includes a brief discussion of the need for the proposal of alternatives and of the environmental impacts of the proposed action and alternatives, as well as a listing of agencies and persons consulted. (Ruth A Eblen and William R. Eblen, eds., 1994, The Encyclopedia of the Environment, New York: Houghton Mifflin Company, p. 107.)

Environmental Assessment (Regional)

• An instrument that examines environmental issues and impacts associated with a particular strategy, policy, plan, or program or with a series of projects for a particular region (e.g., an urban area, watershed, or coastal zone), evaluates and compares the impacts with those of alternative options, assesses legal and institutional aspects relevant to the issues and impacts, and recommends broad measures to strengthen environmental management in the region. Regional environmental assessments pay particular attention to potential cumulative impacts of multiple activities. (World Bank OP 4.1 Annex.)

Environmental Assessment (Sectoral)

• An instrument that examines environmental issues and impacts associated with a particular strategy, policy, plan, or program, or with a series of projects for a specific sector (e.g., power, transport, or agriculture), evaluates and compares the impacts against those of alternative options, assesses legal and institutional aspects relevant to the issues and impacts, and recommends broad measures to strengthen environmental management in the sector. Sectoral environmental assessments pay particular attention to potential cumulative impacts of multiple activities. (World Bank OP 4.1 Annex.)

Environmental Impact Assessment

• Insure that environmental amenities and values are given appropriate consideration by preparing detailed statements on the environmental impacts of major federal actions, significantly affecting the quality of the human environment. The detailed statements are called environmental impact statements (EIS). (Ruth A Eblen and William R. Eblen, eds., 1994, The Encyclopedia of the Environment, New York: Houghton Mifflin Company, p. 463.)


• A method of analysis that attempts to predict probable repercussions of a proposed development on the social and physical environment of the surrounding area. (Thomas M. Pankratz, 1996, Concise Dictionary of Environmental Engineering, New York: Lewis Publishers, p. 107.)

• The principal method of ensuring that environmental considerations are taken into account at the planning stage is to conduct an environmental impact assessment or EIA, which is then embodied in an environmental impact statement (EIS), which is now often required by law before a new project can proceed. Typically, an EIS will embody the following information:

  • A description of the development proposed, comprising information about the site and the design and size or scale of the development
  • The data necessary to identify and assess the main effects that development is likely to have on the environment
  • Description of the likely significant effects, direct and indirect, on the environment of the development, explained by reference to its possible impact on human beings, flora, fauna, soil, water, air, climate, the landscape, the interaction between any of the foregoing material assets, the cultural heritage, employment, transport, education resources, housing, etc.
  • Where significant adverse effects are identified with respect to any of the foregoing, a description of the measures envisaged in order to avoid, reduce, or remedy those effects

• An interdisciplinary process by which the environmental consequences of proposed actions and various alternatives are presented and considered as an aid to decisionmaking. The process may involve assessment of ecological, sociological, anthropological, economic, geological, and other environmental impacts. In many countries, industrial organizations planning new projects are required by law to conduct such studies and to produce an environmental impact assessment, which can then be examined critically. (W. John Maunder, 1992, Dictionary of Global Climate Change, Compiled under the auspices of the Stockholm Environment Institute, New York: Chapman and Hall, pp. 85–6.)

• The critical appraisal of the likely effects of a policy, program, project, or activity on the environment. To assist the decisionmaking authority, assessments are carried out independently of the proponent, who may have prepared an environmental impact statement (EIS). The decisionmaking authority may be a level of government (local, state, or federal) or a government agency (at local, state, or federal level). Assessments take account of any adverse environmental effects on the community; any environmental impacts on the ecosystems of the locality; any diminution of the aesthetic, recreational, aesthetic, scientific, or other environmental values of a locality; the endangering of any species of fauna or flora; any adverse effects on any place or building having aesthetic, anthropological, archaeological, cultural, historical, scientific, or social significance; any long-term or cumulative effects on the environment; any curtailing of the range of beneficial uses; any environmental problems associated with the disposal of wastes; any implications for natural resources; and the implications for the concept of sustainable development. EIA extends to the entire process from the inception of a proposal to environmental auditing and post-project analysis. (Alan Gilpin, 1996, Dictionary of Environment and Sustainable Development, Second Edition, New York: John Wiley and Sons, p. 76.)

• The assessment is intended to identify and predict the impact of the project on the biogeographical environment and on people’s health and well-being and to interpret and communicate information about the impacts. This book proposes to incorporate health impact assessment within environmental impact assessment. (Dr. M. H. Birley, 1995, The Health Impact Assessment of Development Projects, London: HMSO, p. 2.)


• There is no general and universally accepted definition of EIA. The great diversity of EIA definitions is illustrated by the following examples:

(a) “... an activity designed to identify and predict the impact on the biogeophysical environment and on man’s health and well-being of legislative proposals, policies, programs, projects, and operational procedures, and to interpret and communicate information about impacts.”

(b) “... to identify, predict, and describe in appropriate terms the pros and cons (penalties and benefits) of a proposed development. To be useful, the assessment needs to be communicated in terms understandable by the community and decisionmakers and the pros and cons should be identified on the basis of criteria relevant to the countries affected.”

(c) “... an assessment of all relevant environmental and resulting social effects that would result from a project.”

(d) “... assessment consists in establishing quantitative values for selected parameters that indicate the quality of the environment before, during, and after the action.”
Main objectives of an EIA: To identify beneficial and adverse environmental impacts. To suggest mitigation actions that might reduce or prevent adverse impacts. To identify and describe the residual adverse impacts that cannot be mitigated. To identify appropriate monitoring strategies to “track” impacts and provide an “early warning” system. To incorporate environmental information into the decisionmaking process relating to development projects. To aid selection of the “optimum” alternative, where alternative sites or project designs are being investigated in an EIA study. (Robert G. H. Turnbull, ed. 1992. *Environmental and Health Impact Assessment of Development Projects. A Handbook for Practitioners.* WHO and CEMP, New York, NY: Elsevier Applied Science, p. 13.)

- A document, prepared by a PROponent, describing: a proposed activity or development and identifying the possible, probable, or certain effects of the proposal on the ENVIRONMENT; examining the possible alternatives; setting out the mitigation measures to be adopted; proposing a program of environmental management; provisions for monitoring, post-project analysis, or auditing; and plans for decommissioning and rehabilitation. An EIS should be prepared following SCOPING exercises to identify the key issues. It should be objective, thorough, and comprehensive, but without superfluous material. EISs are usually prepared by consultants working for the proponent, presenting what has been described as an ethical dilemma; however, the ultimate test is not pleasing the proponent in the short term, but achieving development consent after rigorous examination by a government agency and the public. This has ensured an increasing degree of integrity in the preparation of EISs. An EIS is often a key document in the EIA process. (Alan Gilpin, 1996, *Dictionary of Environment and Sustainable Development*, Second Edition, New York: John Wiley and Sons, pp. 76–78.)

- A report required by major federal action significantly affecting the quality of the human environment, under the terms of the National Environmental Policy Act (NEPA). This report is, in effect, a detailed study of the proposed action and the environmental consequences of that action. Alternatives must be provided in the statement and a “no action” scenario must be presented. Specifically, the study must describe the environmental impact of the proposed action and adverse environmental effects that cannot be avoided should the proposal be implemented, alternatives to the proposed action, the relationship between the short-term uses of the human environment and the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitments of resources that would be involved in the implementation of the proposed action. (Ruth A Eblen and William R. Eblen, eds., 1994, *The Encyclopedia of the Environment*, New York: Houghton Mifflin Company, p. 108.)

- An instrument to identify and assess the potential environmental impacts of a proposed project, evaluate alternatives, and design appropriate mitigation, management, and monitoring measures. Projects and subprojects need EIAs to address important issues not covered by any applicable regional or sectoral EA. (World Bank OP 4.1 Annex.)

**Risk and Hazard Assessment**

**Hazard and Risk Assessment**

- An essential component of many environmental impact statements, embracing the potentially adverse effects of a project involving fire, heat, blast, explosion, or flood, arising from a manufacturing plant or transportation system. An assessment reveals hazards to life and limb and property and is expressed in the form of risk probability. Safety depends both on the location of a plant and the safety precautions and back-up arrangements adopted, together with the degree of training and alertness in the plant. Buffer zones and correct routing of vehicles are also essential. (Alan Gilpin, 1996, *Dictionary of Environment and Sustainable Development*, Second Edition, New York: John Wiley and Sons, p. 107.)
Risk Assessment

- The qualitative and quantitative evaluation performed in an effort to define the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific chemicals. (Ruth A Eblen and William R. Eblen, eds., 1994, *The Encyclopedia of the Environment*, New York: Houghton Mifflin Company, p. 264.)

- The evaluation of short- and long-term risks by hazard identification, dose-response assessment, exposure assessment, and risk characterization; the process of integrating available information in the inherent toxicity of the chemical with information on how much of the chemical may come in contact with the individual. (Herman Koren, 1996, *Illustrated Dictionary of Environmental Health and Occupational Safety*, New York: Lewis Publishers, p. 238.)

- The qualitative and quantitative estimation of the likelihood of adverse effects that may result from exposure to specified health hazards or from the absence of beneficial influences. The process of determining risks to health attributable to environment or other hazards. The process consists of four steps, as follows:
  - *Hazard identification*: Identifying the agent responsible for the health problem, its adverse effects, the target population, and the conditions of exposure.
  - *Risk characterization*: Describing the potential health effects of the hazard, quantifying dose-effect and dose-response relationships.
  - *Exposure assessment*: Quantifying exposure (dose) in a specified population, based on measurement of emissions, environmental levels of toxic substances, biologic monitoring, etc.
  - *Risk estimation*: Combining risk characterization, dose-response relationships, and exposure estimates to quantify the risk level in a specific population. The end result is a qualitative and quantitative statement about the health effects expected and the proportion and number of affected people in a target population, including estimation of the uncertainties involved. The size of the exposed population must be known. (Alan Gilpin, 1996, *Dictionary of Environment and Sustainable Development*, Second Edition, New York: John Wiley and Sons, p. 148.)

- An instrument for estimating the probability of harm occurring from the presence of dangerous conditions or materials at a project site. Risk represents the likelihood and significance of a potential hazard being realized; therefore, a hazard assessment often precedes a risk assessment, or the two are conducted as one exercise. Risk assessment is a flexible method of analysis, a systematic approach to organizing and analyzing scientific information about potentially hazardous activities or about substances that might pose risks under specified conditions. The Bank routinely requires risk assessment for projects involving handling, storage, or disposal of hazardous materials and waste, the construction of dams, and major construction works in locations vulnerable to seismic activity or other potentially damaging natural events. For certain projects, the environmental assessment report may consist of the risk assessment alone; in other cases, the risk assessment is part of the environmental assessment documentation. (World Bank OP 4.1 Annex)

Comparative Risk Assessment

- Comparative risk assessment is a technique developed within the last decade to distinguish actual risk from potential exposure. A strength of this technique is being able to compare and evaluate the effects of two or three pollutants or hazards. A limitation is its reliance on animal studies and focus on limited risks. Because few such epidemiological tools exist, they are often overextended or misapplied. Bearing in mind that many user assessments will probably not have a background in health and environment (and maybe neither), the inherent value of comparative risk assessments, that is, of ranking selected pollutants, can be compromised, if they are inappropriately used as an equal substitute for an environmental health assessment; the difference is one of emphasis and breadth of coverage. (James
Hazard Assessment

• An instrument for identifying, analyzing, and controlling hazards associated with the presence of dangerous materials and conditions at a project site. The Bank requires a hazard assessment for projects involving certain inflammable, explosive, reactive, and toxic materials, when they are present at a site in quantities above a specified threshold level. For certain projects, the environmental assessment report may consist of the hazard assessment alone. In other cases, the hazard assessment is part of the environmental assessment documentation. (World Bank OP 4.1 Annex.)
This bibliography covers four topics:

- Environmental assessment resources
- Environmental and health resources
- Environmental health links on the Internet
- Audiovisuals on all the above topics.

Compiled during research for the guidelines and Ghana Pilot, these lists, by no means comprehensive, provide a starting point.

Environmental Assessment Resources


Giroult, Eric. 1988. “WHO Interest in Environmental Health Impact Assessment.” In Peter Wathern, ed., *Environmental Impact Assessment Theory and Practice*. London: Unwin Hyman Ltd. Abstract: The World Health Organization’s environmental health impacts (EHIs) are intended to strengthen health and safety considerations in impact assessments and encourage these assessments. A lack of epidemiological knowledge and willingness of government officials to release health statistics have hindered health impact assessments (HIAs). WHO is working to overcome these difficulties and develop the interrelationships between environmental factors and human health. Presents a schema and checklist for environmental health impact assessment. Describes the specific case of health considerations in an agricultural irrigation development project.

———. 1992. “Health Impact Assessment.” In *Environmental Assessment and Management 13th International Seminar* (proceedings), vol. 2, Geneva, Switzerland: WHO and others. Paper presented at seminar held June 28–July 11, 1992, University of Aberdeen, Scotland. Abstract: HIAs, as part of the EIA process, involve determining possible health impacts of an economic development project. These include prevalence of target diseases in the project area, risk of disease importation, degree of vulnerability or immunization of exposed population, receptivity of the environment, and vigilance of health services in the community. The three main components of HIAs are community vulnerability, assessment of the specific health hazard, and analysis of human behavior in the affected area. Outlines WHO guidelines on assessing the risk of chronic disease resulting from a development project, including toxic effects and quantitative assessment of carcinogenicity.

Sutcliffe, Jill. 1995. “Environmental Impact Assessment: a Healthy Outcome?” Project Appraisal 10:2 (113–24). United Kingdom: Beech Tree Publishing. Abstract: Health considerations should form an important part of an EIA; this is reflected in the wording of legislation and guidelines adopted by many governments and agencies. Reviews pointing to inadequacies in this area have led to recommendations for incorporating health into EIA guidelines; some administrations have sought to do this. A review of the operation of EIA, as demonstrated by environmental impact statements (EISs) published in the United Kingdom, reveals a lack of systematic evaluation of health impacts. Continued omission or neglect of health is contrary to the legislation’s intention and undermines the legitimacy of decisionmaking through a process that is not fully informed.


lic health impact assessment; data bases and information sources; research needs for future development; and a substantial chapter of case study examples. Case studies cover health aspects of irrigation projects in Africa; EIAs of dams and reservoirs in Thailand; health and environmental impacts of industrial developments in Poland and Brazil; the Seveso accident in Italy; and health impacts of water development in Turkey. Annexes give examples of guidelines and screening criteria for selection of projects for EIAs

Environmental and Health Resources


Ehiri, John and Julia Prowse. 1999. “Child Health Promotion in Developing Countries: The Case for Integration of Environmental and Social Interventions.” Health Policy and Planning 14:1. Abstract: In spite of improving epidemiological knowledge in relation to child health, the challenge of promoting the survival and quality of life of infants and children in most parts of the developing world remains an abiding public health problem, for both the countries and international agencies involved. Current infant and child health care programs largely reflect Western style medical care, which emphasizes mortality reduction, and preventive aspects confined mainly to immunization, improved nutrition, provision of micronutrients, and promotion of breast feeding and birth spacing. In contrast, environmental and social factors underpinning the proliferation of disease agents receive minimal attention. This paper presents a critical review of current strategies for promoting child health. Presenting a specific example of infant and childhood diarrhea, the authors argue that equal weight needs to be given to environmental and social factors. They advocate adoption of the hazard analysis critical control point (HACCP) system.


Pimental, D. M. Tort, and A. Krawic. 1998. “Ecology of Increasing Disease: Population Growth and Environmental Degradation.” *Bioscience* 48:10. *Abstract:* Study of population trends, climate change, increasing pollution levels, and emerging diseases, based on data from a variety of sources, including the World Health Organization and the U.S. Centers of Disease Control. Results indicate that air pollutants harm the health of between 4 and 5 billion people a year; the trend is expected to worsen with the number of vehicles increasing at three times the population growth rate. The study, which also examined the increased spread of disease and the growing use of pesticides, concluded that global warming would further encourage the spread of diseases and fuel development of new illnesses; such problems will intensify without international cooperation. It suggests that policymakers adopt “fair” population-control policies, combined with effective environmental management programs. “Forty percent of deaths result from diverse environmental factors, including chemical pollutants, tobacco, and malnutrition. The growth of diseases is expected to continue. Without international cooperative efforts, disease prevalence will continue its rapid rise throughout the world.”

Postel, Sandra L. 1998. “Water for Food Production: Will There Be Enough in 2025?” *Bioscience* 48:8 (August) (629–37). *Abstract:* “This year marks the 200th anniversary of the publication of Thomas Malthus’s famous essay postulating that human population growth would outstrip the Earth’s food-producing capabilities. Boosting water productivity of world agriculture will be crucial to meeting future food needs.”


Shiva, Vandana. 1998. “Women’s Water Rights.” *Gender and Water Waterlines* 17:1 (9–11). *Abstract:* One of three articles that examine whether women have control over public policy and infrastructure that affect water issues. In Mary Breen’s introduction to the issue, she comments that women “still bear the day-to-day responsibility for whole families’ water supply and sanitation needs.”


Environmental Health Links on the Internet

The Internet provides access to a constantly evolving wealth of knowledge. This list is organized by sector—agriculture, environment, health, industry, infrastructure (urban, water and sanitation, energy, and transport), multisector, nonsector specific, and economic. Many of the web pages may no longer exist or be drastically revised in the time between preparation and publication of this document; this is one of the drawbacks and exciting aspects of the web.

Resources available only within the Bank itself constitute an additional category, “World Bank Intranet” (as opposed to Internet), and is presented first.

World Bank Intranet

Environment

Web page location (URL): <www.worldbank.org/wbi/pubpriv/ni.htm> --- The World Bank Institute (WBI) hosts many worldwide policy dialogues between the public and private sector on topics such as “Collaborating for Cost-Effective Pollution Management.” In the past decade, environmental regulators and policymakers have increasingly discovered that working with industry representatives can be a more cost-effective alternative to pollution control than traditional monitoring and enforcement mechanisms. Industry has also learned that collaborative approaches with regulators can reduce their production costs and improve both the quality of their product and their image to consumers. This dialogue will bring together government and private sector representatives to highlight successful approaches and lessons for managing pollution.

Web page location (URL): <www.worldbank.org/wbi/wbien/environmental.html> --- The Environmental Economics and Policy (EPP) Program focuses on mainstreaming the environment at different levels of policymaking and across sectors in client countries. The program promotes the approaches, methods, and tools of economics, as they relate to the environment. Professionals are trained to do analytical work, on which good policies should rest and to internalize it in the policymaking and implementation process.

Web page location (URL): <www.worldbank.org/wbi/wbien/urban.html> --- The overall focus of the Urban Environment and Pollution Management Program focuses on metropolitan and large urban centers, where pollution from a variety of sources affects public health and the sustainability of natural resources, and on the impact of industrial pollution that—although mostly concentrated in the cities—extends well beyond their boundaries.

Web page location (URL): <www.worldbank.org/wbi/wbien/rural.html> --- The training program of the Rural Development and Sustainable Agriculture Team of WBIEN is designed to meet the need for capacity building in the area of policy and institutional reforms for more sustainable rural development, as well as adoption of sustainable agricultural practices and sound management of countries’ natural resource bases, in partnership with other relevant organizations.

Web page location (URL): <www.worldbank.org/wbi/wbien/water.html> --- In line with the above environmental factors, the Bank’s environmental priorities as they relate to water are to (a) help people access clean water and sanitation services, (b) reduce water quality degradation caused by discharges of municipal and industrial effluents and by contamination from agrochemicals and waste, and (c) improve management of water resources, including water allocation among competing sectors (mainly irrigation, urban water, hydropower, and ecosystems) and between national jurisdictions and countries. Building capacity for water resource management is a major concern of the Bank.

Health


Web page location (URL): <afr.worldbank.org/afthd/hnp/pophlth/poprhlt.htm> --- The Africa Region Population/Reproduction Health Affinity web site has the latest on reproductive health of young people,
intersectoral issues, STI treatment and prevention and HIV, key indicators, and news from our partners, among other topics.

Web page location (URL): <www.worldbank.org/healthreform> --- The World Bank Institute (WBI) developed “Health Reform Online” to provide distance education opportunities for those interested in “health sector reform, health economics, or sustainable financing.” The site will house educational modules based on WBI’s Health Sector Reform and Sustainable Financing training program. The first module, “Introduction to the Concepts and Analytical Tools of Health Sector Reform and Financing” includes lessons, case studies, interactive exercises, suggested readings, an extensive glossary, and a course outline. The site will announce future training opportunities. A document section allows browsing, searching of abstracts or full text of World Bank health documents on health projects.

Infrastructure (Water)

Industry
Web page location (URL): <www.worldbank.org/nipr> --- Site for researchers, government officials, and citizens interested in understanding and improving control of industrial pollution, especially in developing countries. New Ideas in Pollution Research is primary source for materials produced by World Bank’s Economics of Industrial Pollution Control Research Project.

Nonsector Specific


Web page location (URL): <www.worldbank.org/wdr> --- The World Bank’s annual World Development Report (WDR) is an invaluable guide to the economic, social, and environmental state of the world today. Each year the WDR provides in-depth analysis of a specific aspect of development. Past reports have considered such topics as the role of the state, transition economies, labor, infrastructure, health, the environment, and poverty. The reports are the Bank’s best contribution to thinking about development.

On the Internet

Agriculture
Web page location (URL): <www.brown.edu/Departments/World_Hunger_Program> --- Hunger web site.


Web page location (URL): <www.sarep.ucdavis.edu> --- The University of California’s Sustainable Agriculture Research and Education Program (SAREP) supports “scientific research and education to encourage farmers, farm workers, and consumers in California to produce, distribute, process, and consume food and fiber in a manner that is economically viable [and] sustains natural resources and biodiversity.”
Environment

Web page location (URL): <natural-resources.org> --- A framework for international cooperation on minerals, metals, and sustainable development to bring together stakeholders from all sectors of the community, including government, industry, and the general public. An initiative of the United Nations Conference on Trade and Development with the United Nations Environment Programme’s Industry and Environment Centre as a principal partner.


Web page location (URL): <www.ehsn.com> --- The EHSN (Environmental Health and Safety Network) includes more than 25,000 resources organized into six categories: (a) “Who’s Who” of EHSN professionals from industry, government, academia including experts, speakers, authors and trainers, (b) directories of companies and organizations, consultants, educators and trainers, laboratories, legal services, agencies, trade and industrial associations, and public interest organizations, (c) calendar for workshops, seminars, conventions, trade shows, annual meetings, any EHSN-related local, regional, national and international event, with calls for papers and exhibitors, (d) marketplace for materials, software, books, magazines, subscription services, computer-based training, all types of materials for education and training, (e) “Employment Forum,” (f) links to other Internet resource web sites, e-mail groups, newsgroups, and more.

Web page location (URL): <www.enn.com> --- Link to environmental news and awareness network.


Web page location (URL): <www.feem.it/gnee> --- Global Network of Environmental Economists: a virtual network to find information on research programs; conferences, workshops, and seminars; research funds; and links to related web sites and research centers.

Web page location (URL): <www.grida.no> --- United Nations Environment Program Global Resource Information Database. Intended to be an internationally recognized information center, providing decisionmakers and the public with improved access to high-quality environmental information and supporting the United Nations Environment Program in expanding the use of such information for awareness raising, policymaking, and action.

Web page location (URL): <www.grrn.org> --- Network of recycling and community-based activists who advocate policies and practices to achieve zero waste, end corporate welfare for waste, and create sustainable jobs from discards.


Web page location (URL): <www.library.utoronto.ca/www/pcs/database/libintro.htm> --- Environmental Security Database looks at environmental stress and violent conflict in developing countries. Maintained by the Peace and Conflict Studies Program at the University of Toronto, this database has potential as a powerful research tool on the relationships between environmental stress and violent conflict in developing countries.


Web page location (URL): <www.panda.org/livingplanet/lpr/index.htm> --- Living Planet Report 1998 published by the World Wildlife Fund (WWF). This report analyzes environmental data in conjunction with global consumption patterns to calculate the cumulative effect that humankind has on the earth’s ecosystems. The report consists of two major parts: The Consumption Pressure section measures the per capita resource consumption and pollution statistics from 152 countries to determine humanity’s impact on earth.

363
The Living Planet Index presents new data on the health of the forest, freshwater, and marine ecosystems around the world from 1970–95.


**Web page location (URL):** <wbhn0023/env/pollman.nsf> --- This site provides access to information on the Bank’s ongoing work on pollution management, emphasizing integrated environmental management, rather than just pollution control and using a broad mix of incentives and pressures to achieve sustainable environmental improvements.

**Health**

**Web page location (URL):** <igm.nlm.nih.gov> --- Desktop access to POPLINE and TOXLINE. POPLINE includes citations on population, family planning, and related health care, law, and policy issues. TOXLINE includes citations on environmental and occupational health.


**Web page location (URL):** <www.basics.org> --- BASICS (Basic Support for Institutionalizing Child Survival) is the U.S. government’s largest child survival project. BASICS provides technical assistance to countries’ priority health programs.

**Web page location (URL):** <www.cdc.gov> --- U.S. Centers for Disease Control.

**Web page location (URL):** <www.cdc.gov/ogh> --- The Office of Global Health/U.S. Centers for Disease Control.

**Web page location (URL):** <www.crosslink.net/~ehp> --- USAID’s EHP (Environmental Health Project) page.

**Web page location (URL):** <www.epidem.com> --- Website for Epidemiology, a publication of Epidemiology Resources, Inc. and the official journal of the International Society for Environmental Epidemiology. **Web page location (URL):** <hsph.harvard.edu> --- Harvard’s School of Public Health home page.

**Web page location (URL):** <www.hst.org.za> --- Health Systems Trust: rapid situation analysis for health services.

**Web page location (URL):** <www.malaria.org> --- Malaria Foundation International’s mission is to facilitate development and implementation of solutions to the health, economic, and social problems caused by malaria.

**Web page location (URL):** <www.micronutrient.org> --- The Micronutrient Initiative, established in 1992, facilitates elimination of micronutrient malnutrition by supporting effective and sustainable programs for virtual elimination of iodine deficiency disorders; virtual elimination of vitamin A deficiency and its consequences, including blindness; and reduction of iron deficiency anemia in women by one-third of 1990 levels.

**Web page location (URL):** <www.mrc.ac.za> --- Medical Research Council of South Africa intends to improve the nation’s health status and quality of life through relevant and excellent health research aimed at promoting equity and development.

Web page location (URL): <www.paho.org> --- Pan-American Health Organization’s web site. PAHO promotes a primary health care strategy, which reaches people in their communities, as a way to extend health services and increase efficiency in the use of scarce resources.

Web page location (URL): <www.phrproject.com> --- Partnerships for Health Reform (PHR) seeks to improve people’s health by enabling the health sector to provide and ensure equitable access to sustainable, quality health care services. Working in partnership with national and local governments, communities, nongovernmental organizations (NGOs), and donors, PHR technical expertise supports and promotes positive changes in health policies, regulations, financing, and the quality, organization, and management of health services from hospitals to clinics, across urban and rural areas, and among public and private sector providers.

Web page location (URL): <www.reproline.jhu.edu/index.htm> --- ReproLine is designed for use by policymakers with a technical and/or clinical background involved in setting policy for reproductive health service delivery systems. It is also designed for individuals, particularly teachers and trainers, with an interest in maintaining a current knowledge of selected reproductive health information. The site is fully searchable and offers the following sections: integrated reproductive health and family planning, international reference documents, components of quality care, contraceptive advances, contraceptive methods, and related web links.

Web page location (URL): <www.soeh.org> --- The Society of Occupational and Environmental Health (SOEH) mission is to reduce occupational and environmental health hazards through presentation of scientific data and dynamic exchange of information across institutions and disciplines.

Web page location (URL): <www.sph.emory.edu/PHIL> --- The Rollins School of Public Health at Emory University has put together a searchable subject index of more than 2,000 links related to public health intended for public health researchers.


Industry

Web page location (URL): <www.worldbank.org/nipr/> --- For researchers, government officials, and citizens interested in understanding and improving control of industrial pollution, especially in developing countries. New Ideas in Pollution Research is primary source for materials produced by the World Bank’s Economics of Industrial Pollution Control Research Project.

Infrastructure (Water and sanitation)

Web page location (URL): <www.awwa.org> --- The American Water Works Association (AWWA) is an international nonprofit scientific and educational society dedicated to improving drinking water quality and supply and promoting public health and welfare in providing drinking water of unquestionable quality and sufficient quantity.


Web page location (URL): <www.irc.nl> --- News, advice, research, and training on low-cost water supply/sanitation in developing countries.

Web page location (URL): <www.iwmi.org> --- The World Water and Climate Atlas is a growing collection of data products and analytical tools focused on climate and water resources.


Web page location (URL): <www.state.nv.us/cnr/ndwp/dict-1/waterwds.htm> --- An extremely detailed water dictionary by the Nevada Division of Water Planning.


365

Web page location (URL): <www.who.int/peh> --- Links to WHO Programme for Promotion of Environmental Health (PEH) and Programme for Promotion of Chemical Safety (PCS). PEH addresses issues concerning the physical and social environment and assists member states with development and implementation of national health and environment programs.

Audiovisuals


World Bank. 1997. No Place to Run (video recording). Global Links series. Washington, D.C. Abstract: Examines the rise of disease epidemics and their links to environmental degradation. The outbreak of plague in India, cholera in Peru, and Lyme disease in the United States may appear unrelated; yet, scientists say these diseases are all triggered by changes in man’s relationship with the environment. This edition of the Global Links film series explores what can be done to stem the tide of disease.

Waste Not... A City. Video presentation. Abstract: Takes viewers to Accra, Ghana, to look at how this African country is dealing with the challenge of overflowing waste in its cities. Tired of municipal services that left them with trash-laden streets, some enterprising Ghanaians took matters into their own hands—literally. They formed their own trash companies, but met with mixed results. This edition of Global Links introduces viewers to citizens who are trying to improve the quality of life in their city and the obstacles they face.
NOTES

6. Memo from World Bank Africa Regional Vice Presidents, C. Madavo and J. L. Sarbib to Africa Regional staff (June 2, 1999).
10. Memos from the World Bank Africa Regional Vice Presidents, C. Madavo and J. L. Sarbib to Africa Regional Staff (June 2 and November 23, 1999).
19. Goodland, Mercier, and Muntemba (1995). Using the average cost of environmental assessments in SSA as a proxy, it amounts to 0.08 percent of project costs.
27. Ostro (1994).
41. Reed (1996).
45. See earlier footnote in this chapter on the International Development Agency.
68. USEPA (1993).
71. Gwatkin and Guillot (1999), p. 44.
75. WHO (1997).
76. Based on exchanges with Robert Bos, WHO and Martin Birley, Liverpool School of Tropical Medicine.
77. Smith, Kirk, 1999, Indoor Air Pollution, Pollution Management in Focus, Discussion Note No. 4, the World Bank.
78. Esrey and others (1990).
79. EHP web site: <www.ehproject.org/>.
83. Based on work done by Meghan Dunleavy, World Bank Consultant, August, 1999.
85. A scientific study in Sub-Saharan Africa suggests that people with HIV are twice as likely to catch malaria as those who do not have the AIDS virus. BBC web site: <http://news6.thdo.bbc.co.uk/hi/english/health/newsid%5F936000/936776.stm> accessed September 20, 2000).
92. See World Health Organization, “Diseases: Vaccine Preventable Diseases” (<http://www.who.int/home/map_ht.html#Vaccine Preventable Diseases>, accessed September 2000) or visit WHO’s home page at <www.who.int/home> (select “Health Topics,” then “Diseases: Vaccine-Preventable Diseases”).
98. World Bank (1996), p. 22. Data was drawn from Brazil, China, the Gambia, India, Kenya, Nepal, Papua New Guinea, and Zimbabwe.
161 Henriksen and others (1993).
166 Ando (1994).