Environmental Assessment Sourcebook UPDATE

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Health Aspects of Environmental Assessment

Many development projects affect human health. In some instances, projects with obvious health benefits may also have unintentional adverse health impacts. Water supply projects, for example, will often reduce the occurrence of diseases such as diarrhea and cholera, but may also create conditions favorable to the proliferation of disease vectors such as mosquitoes or water snails. Road projects may improve access to health services but may also increase the exposure of local communities to sexually transmitted and other diseases, or dramatically increase traffic related injuries and deaths. In many instances, however, the environmental health dimensions of projects are not systematically taken into account.

The objective of this Update *is to provide guidance to task managers and borrowers on systematically integrating public health and safety concerns into environmental assessment (EA). This is best achieved through early screening of proposed developments for risks to health, and taking appropriate measures to adequately address these risks during project preparation, implementation, and beyond.*

Introduction

Some 95 percent of development funds worldwide (and 85–90 percent in the Bank) are spent on projects that fall outside the health sector. These project funds must, by their sheer volume, have significant direct, indirect, and cumulative impacts on the environment, the community, and human health. Some projects affect health positively, others negatively. The health benefits of water supply, sanitation, and pollution reduction projects are well appreciated. Conversely, dam and reservoir projects have been associated with increased risk of contracting water-related disease such as malaria and schistosomiasis, while agricultural pest management has been associated with increased risk of pesticide poisoning. The sociocultural impacts of large construction projects (giving rise, for example, to "boomtowns") have been noted, but their association with increased risk of contracting diseases, for example human immunodeficiency virus (HIV) and other sexually transmitted diseases (STDs), has not been made. However, many of these health costs and benefits are quantifiable.

In some countries, protection of the natural environment is still not a priority and the results of EA may therefore not be given sufficient attention. In such circumstances, placing health prominently within EA can provide the political commitment to environmental protection that may otherwise be lacking. Human health and the health of the environment are mutually interdependent—adverse health impacts on communities resulting from a project undermine the principle of environmentally sustainable development. Such impacts are often transferred as hidden costs to a health sector that does not have sufficient resources to mitigate them.

Health and safety concerns can be integrated into EA by:

- Introducing the relationship between the environment and health hazards, health risks, and health impacts
- Screening development proposals for hazards to human health and safety
- Assessing and quantifying the risks to human health and safety of hazards identified with, or resulting from, projects (taking into consideration the prevailing social, environmental and institutional conditions)
- Developing health risk management proposals as part of the overall environmental management plan (EMP)

- Ensuring the implementation of health risk management measures during project implementation and beyond.

Each of these measures is discussed below, in sufficient detail for task managers or borrowers to decide whether a given project proposal will have any impact on health. If so, the involvement of a health specialist in the project, at least initially, should ensure that health issues are addressed.

A fundamental question for task managers is whether the project may result in health impacts that would adversely affect the project's rate of return. Conversely, could projected health benefits increase the profitability of otherwise marginal projects? These questions can be answered by screening projects for health benefits and hazards, and assessing the economic costs of these potential health impacts.

Health hazards, risks and impacts

Since projects with significant environmental impacts are likely to have an impact on human health as well, health protection is the responsibility of all sectors, not just the health sector. What are the meaning of, and interrelationships between, a health hazard, a health risk, and a health impact? A *health hazard* is a potential harm. A *health risk* is a measure of the probability that a health hazard will cause harm to a particular group of people. A *health impact* is any change in health risk (fall or rise in incidence of disease) that is reasonably attributable to a project, program, or policy.

Some health hazards have an acute and rapid onset, and may result in relatively sudden death. These include malaria, diarrhea, acute poisoning, and traumatic injury. Other health hazards have a latent period or manifest themselves as long periods of chronic ill-health, or require long-term exposure or deprivation before becoming evident. These include dust-induced lung disease, some forms of schistosomiasis, AIDS, cancer, and sensory impairment.

Screening projects for health hazards

The significance of a health hazard is partly determined by its severity and frequency in a population. Health hazards can be grouped into the categories listed in box 1. Early screening should identify the health hazards (if any) that should, in turn, be subjected to a health risk assessment. This assessment should provide sufficient detail to ensure that health impacts can be adequately assessed. As with other components of the EA, it is crucial that screening take place early in the project cycle so that preliminary plans and designs can be modified, if necessary, to safeguard human health. EA should identify the project boundaries in both time and geographical space, within which lie all the human communities and stakeholders whose health may be significantly affected by the project. The key stakeholders should be consulted during this stage. For example, a project with a sanitary landfill should consider the possibility of squatters moving on-site, and of scavenging and recycling.

The screening process should produce a list of health hazards to be investigated. Sources of informa-

Box 1. Health hazard categories and examples

Communicable diseases. Acute respiratory infection, diarrhea and malaria remain the major causes of mortality and morbidity in many countries. Malaria, other vector-borne diseases, and various parasitic and microbiological diseases are greatly affected by water engineering.

Noncommunicable diseases. Lung disease, cancers, and chronic poisoning are hazards associated with chemicals and dusts in projects ranging from the application of agricultural chemicals to quarrying and mining. Exposure may occur at places of both occupation and residence through unregulated emissions to various media, or through inappropriate use of machinery. For example, women and children spend hours in poorly ventilated homes exposed to harmful fumes, and farmers frequently misuse agricultural chemicals, or store them in the domestic environment.

Injury. Human injury results from a wide array of mechanical, thermal, radiant, chemical, or electrical factors. Traffic injury is an increasing burden on the health services of many countries. Shanty towns or squatter developments, often located near development projects, are more susceptible to fire, flood and landslides. The absence of occupational health measures such as protective clothing, safety standards, or on-site health services often transforms occupational health problems into broad public health ones.

Malnutrition. One objective of many Bank projects is improved food security or nutrition, either directly or indirectly, through poverty alleviation. However, it is conceivable that other projects might adversely impact nutrition through indirect or unplanned mechanisms, such as changes in land use or a change from subsistence to cash-crop economies.

These four categories also interact with each other. For example, the malnourished child is more susceptible to infection and disease, which in turn may lead to impaired learning and poor economic prospects.

tion on possible hazards include documents relating to similar projects elsewhere, opinions of specialists and community leaders, reference documents, maps, and national health data.

Projects that appear to have benign or positive environmental effects can also cause health hazards, such as increases in mosquito populations resulting from water supply, irrigation, or reforestation projects (see box 2). For example, a project financing communal water supply and washing facilities might not otherwise consider the risks of inadequate drainage resulting in proliferation of vector borne diseases or contamination of the water source, or that of accidents befalling children who fetch water after dark.

Box 2. Malaria risk in forestry and water projects

In many semi-arid areas, water is harvested in small dams to support aforestation, increase water retention, and prevent erosion. Research funded by the Swedish International Development Agency (SIDA) in collaboration with the World Health Organization (WHO) shows that one such program in Tigray (Ethiopia), is associated with a 17-fold increase in childhood malaria in the population living near the dams.

In Thailand, the mosquito which is most important in transmitting malaria (*Anopheles dirus)* is extremely sensitive to light and thrives in closed canopy forests. The reduction of this habitat due to extensive deforestation has resulted in a reduction in the incidence of malaria in these areas. At the same time, however, research indicates that new commercial plantations provide a better habitat for *dirus* than natural forest, and thus lead to an increased incidence of disease in adults. This trend is particularly worrisome, since Southeast Asia has the highest rates of drug-resistant malarial infection in the world.

These experiences provide several lessons, many of which are transferable to other vector-related diseases:

- With malaria, it is not possible to extrapolate from one region to another. Illness and death rates, as well as causative factors, for malaria differ. Therefore the concept of "benefit transfer" used to value non-market products has limitations.
- If a project is likely to increase transmission of malaria, then the differing vulnerabilities of all the communities that will be exposed becomes crucial, with immigrants from non-malarial areas particularly vulnerable.
- The economic evaluation of projects should factor in the cost of measures to mitigate against adverse health impacts, or the value of health benefits. For an otherwise marginal project, this may either have the effect of improving the rate of return or rendering it nonviable.
- Mitigation may involve project design changes supplemented by malaria control measures that include vector reduction and provision of essential health services.

Identification of health hazards needs to be systematic and comprehensive, even if not all the hazards identified are subsequently addressed in a given project. For example, some Bank EAs of reservoir projects undertook limited hazard identification of water-related diseases (notably malaria and schistosomiasis). They did not, however, account for other potential health impacts arising from disposal of construction debris and human waste, or from the influx of a large workforce into the area. The latter could result in the spread of STDs, and communicable diseases like diarrhea, or respiratory ailments associated with environmental degradation. Mitigation measures for some health impacts might not be appropriate for inclusion in a project. Nonetheless, these potential impacts should be identified in an EA in order to provide a framework for mitigation activities outside the project.

Matrix 1 gives an overview of sample health hazards associated with sectoral activities. The matrix should help the task manager decide whether: (1) a project may result in health hazards; (2) the risks are sufficient to warrant a detailed health impact assessment; and (3) the impact assessment would require public health or disease-specific expertise. Matrix 2 gives the best available information on deaths attributable to different categories of disease, and disability adjusted life years (DALYs) by lending regions. However, the death figures should be treated as illustrative only, as the causes of many deaths go unrecorded or are inaccurate.

Health hazard screening should address the project cycle from construction, through operation, to post-closure. The health hazards associated with each of these stages may be different. For example, construction activities may give rise to problems relating to occupational health, safety, sanitation, and the regulation of camp followers. Operational attributes could involve the health and safety of the populations in the immediate areas, or in the airshed and watershed. For example, EAs of projects involving pest management should consider the effects of pesticide spraying on downwind communities, or of handling, storing and using pesticides (see the Bank's *Operational Policy 4.09: Pest Management*).

Matrix 1. Indication of some potentially positive or negative health impacts by sector

	SECTOR	Agriculture and rural development	Irrigation schemes	Integrated pest management	Forestry & agro-forestry	Industry and Energy	Oil and gas	Hydropower construction	Mining/smelting	Manufacturing & processing	Infrastructure	Water dam construction	Roads or rail construction/rehabilitation	Ports and harbors	Airports	Water treatment/supply	Wastewater treatment and disposal	Solid waste management	Housing construction or rehabilitation	Air pollution controls:indoor & outdoor	Temporary construction (all sectors)	Construction camps, townsite	Temporary facilities & over-crowding
Communicable diseases																							
Associated with human behavior																							
STDs and HIV								✚	✚			✚	✚	✚								✚	✚
Hepatitis B & C												✚	✚	✚								✚	✚
Associated with unsanitary conditions																							
Diarrhoeal Diseases			✚					✚		✸						●	●	●	●			✚	✚
Intestinal nematode infections									✚	✸						●	●	●	●			✚	✚
Tuberculosis									✚										●	●		✚	✚
Other respiratory infections									✚										●	●			
Vector borne diseases																							
Malaria			✚		✚							✚				✸			●				
Schistosomiasis					✚							✚				●							
Leishmaniasis			✸		✚											●		●	●			✚	✚
Dengue fever					●											●	●	●	●			✚	✚
Filariasis														✚		●		●	●			✚	✚
Japanese encephalitis			✚					✚				✚											
Childhood diseases*																				●		✚	✚
Non-communicable conditions																							
Exposure to chemicals (pesticides, acids, etc.)			✚	✚	✚		✚		✚	✚						●	✸	✸					
Respiratory diseases									✚	✚										●		✚	✚
Injury: Unintentional																							
Traffic related injuries									✚				✚	✚	✚							✚	
Occupational (falls,fires, other)					✚		✚	✚	✚	✚			✚	✚	✚				✚			✚	✚
Communal violence																			✚			✚	✚

KEY

✚ Project may potentially increase risks of disease or condition

● Project may potentially decrease risks of disease or condition

✸ Potential health impacts of project may be positive or negative

**Note:* Childhood diseases within this category include pertussis, poliomyelitis, diphtheria, measles, and tetanus.

Health risk assessment

Following initial screening, and as part of EA, a rapid health risk assessment may be carried out by a health specialist using secondary sources, key informant interviews, and reconnaissance missions. This will often be sufficient to eliminate many health hazards from further consideration, or to identify appropriate health risk management or mitigation measures that should be included in the project. It may, however, highlight the need for a more detailed health impact assessment of *specific* hazards. In such circumstances, a rapid health risk assessment can be used to develop terms of references (TORs) for more detailed assessments of residual health hazards (see box 3). For example, if lead from vehicular emissions is a problem it would also be important to determine the significance of other sources of lead, such as from water pipes or pottery glazes; otherwise the EA might promote a single-sector remedy to a multi-sectoral problem.

Matrix 2. Deaths and DALYs by region and cause

	DEATHS 1990	Established Market Economies	Former Socialist European Economies	China	India	Other Asia & Islands	Sub-Saharan Africa	Latin America & Caribbean	Middle Eastern Crescent	DALYS 1990	Established Market Economies	Former Socialist European Economies	China	India	Other Asia & Islands	Sub-Saharan Africa	Latin America & Caribbean	Middle Eastern Crescent
Diseases		% of Deaths per Region/Country									% of DALYs per Region/Country							
Communicable diseases	**17,241**	**3**	**1**	**8**	**28**	**13**	**31**	**5**	**11**	**605,959**	**1**	**1**	**8**	**27**	**13**	**32**	**6**	**12**
Associated with human behaviour	**650**	**7**	**<1**	**5**	**13**	**10**	**53**	**7**	**4**	**31,992**	**5**	**1**	**2**	**19**	**14**	**47**	**8**	**4**
STDs and HIV	**542**	**8**	**<1**	**<1**	**13**	**8**	**61**	**8**	**3**	**29,857**	**6**	**1**	**<1**	**19**	**14**	**49**	**8**	**3**
Hepatitis B & C	**108**	**4**	**2**	**32**	**16**	**18**	**14**	**4**	**12**	**2,135**	**3**	**2**	**29**	**17**	**18**	**15**	**6**	**12**
Associated with unsanitary conditions	**11,249**	**3**	**2**	**10**	**33**	**14**	**24**	**4**	**11**	**293,180**	**<1**	**<1**	**8**	**31**	**14**	**29**	**5**	**12**
Diarrhoeal Diseases	**2,946**	**<1**	**<1**	**3**	**31**	**14**	**32**	**5**	**14**	**99,633**	**<1**	**<1**	**4**	**30**	**14**	**32**	**5**	**15**
Intestinal nematode infections	**21**			**29**	**15**	**33**	**10**	**10**	**5**	**5,019**			**28**	**16**	**30**	**10**	**13**	**4**
Tuberculosis	**1,961**	**1**	**1**	**14**	**38**	**16**	**20**	**4**	**6**	**38,426**	**<1**	**1**	**11**	**36**	**14**	**27**	**5**	**7**
Other respiratory infections	**4,381**	**6**	**3**	**11**	**28**	**13**	**23**	**4**	**12**	**116,695**	**1**	**1**	**11**	**29**	**13**	**27**	**4**	**14**
Vector borne diseases	**942**			**1**	**8**	**9**	**79**	**2**	**1**	**40,068**			**1**	**12**	**8**	**76**	**2**	**2**
Malaria	**856**				**3**	**9**	**86**	**2**	**1**	**31,708**			**<1**	**4**	**8**	**85**	**1**	**1**
Schistosomiasis	**9**			**11**		**11**	**44**	**11**	**22**	**1,519**			**2**		**1**	**83**	**5**	**10**
Leishmaniasis	**51**				**69**	**4**	**22**	**2**	**4**	**2,091**				**66**	**4**	**22**	**2**	**6**
Dengue fever	**21**			**5**	**57**	**33**	**5**			**750**			**4**	**59**	**34**	**3**	**<1**	
Filariasis	**0**									**4,000**			**5**	**44**	**13**	**37**	**<1**	**<1**
*Childhood diseases**	**1,938**			**3**	**25**	**12**	**44**	**5**	**11**	**74,174**	**<1**	**<1**	**3**	**26**	**11**	**41**	**5**	**12**
Non-communicable conditions	**?**									**?**								
Exposure to chemicals	**?**									**?**								
Respiratory diseases	**2,935**	**12**	**5**	**52**	**9**	**5**	**7**	**4**	**6**	**60,370**	**8**	**5**	**37**	**13**	**8**	**13**	**7**	**11**
Injury: Unintentional	**2,318**	**11**	**8**	**15**	**20**	**12**	**18**	**10**	**6**	**93,494**	**8**	**6**	**14**	**22**	**14**	**19**	**10**	**7**
Traffic related injuries	**998**	**13**	**9**	**14**	**17**	**13**	**16**	**11**	**7**	**34,317**	**13**	**8**	**13**	**18**	**14**	**17**	**12**	**7**
Occupational (falls,fires, other)	**1,023**	**11**	**6**	**18**	**26**	**11**	**16**	**6**	**6**	**50,442**	**5**	**5**	**17**	**28**	**15**	**17**	**7**	**6**
Communal violence	**297**	**5**	**10**	**9**	**9**	**9**	**35**	**17**	**7**	**8,736**	**6**	**5**	**9**	**9**	**9**	**38**	**18**	**7**

**Note:* Childhood diseases within this category include pertussis, poliomyelitis, diphtheria, measles, and tetanus.

The detailed assessment of risks should be confined to potentially significant but unproven health hazards for which the need for mitigation measures is uncertain. For example, inadequate collection and treatment of human waste presents a significant health hazard. However, it is not necessary to spend time justifying or conducting a health assessment because remedial measures are clearly needed. In such circumstances, it is more important that there be clear commitment to, and funding for, waste collection and disposal in an environmentally, socially, and economically acceptable manner (taking account of cost and the need for ongoing management and maintenance).

Box 3. Health risk assessment in EA TORs

To ensure adequate consideration of health risks that may require more detailed assessment, it is essential to develop good TORs. The health risk assessment should be properly integrated with other components of the EA, and all specialists involved should have an opportunity to interact and discuss their findings. The outcome of a health assessment may recommend a change in project design, and this needs to be discussed before detailed plans have been prepared. A timely input can save lives, reduce disease and disability, and promote more efficient use of limited funds.

There is no universally accepted methodology for assessing health risks, although the basic steps should consist of:

- Identifying the population at risk from health hazards and disaggregating that population into vulnerable community groups, for example by age, gender, or social status
- Assessing the expected health impacts on each vulnerable community group
- Evaluating the reversibility or irreversibility of the effects—does a disease respond to drug therapy, or are the effects of exposure to toxic pollutants reversible if the source of pollution is removed
- Determining the time lag (if any) for health conditions to manifest themselves
- Developing risk management measures for inclusion in the project.

Note: Not all of these aspects are addressed in this *Update*. More detailed WHO/Bank guidance on developing TORs for health risk assessment is available from the editors on request.

Essential considerations in health risk assessment include the population at risk from health hazards and related issues such as immunity of the population, the influence of environmental factors, and the extent to which health risks may be quantified. It is also important to consider the institutional capacity within health protection agencies and other agencies indirectly involved with health protection.

The health specialist should address the components of the health risk assessment using secondary sources, key informant interviews, focus group discussions and other community participation methods, direct observation, random sampling, and project documents. Consultation is essential since the priorities of the project beneficiaries may differ from those of the project proponents. Primary data collection should be employed only where necessary. When evaluating data, it is important to remember that routinely collected health statistics are rarely accurate and under-reporting is the norm. Many health risks vary seasonally, so that in some cases primary data collection may be required over a whole year. The health specialist should be able to establish the relative importance of all health hazards.

Population at risk

The health assessment component of EA should put the human community first. This community is composed of groups who differ in their vulnerability to health hazards. For example, children are less likely to be immune to malaria than adults, while adult smokers are often more vulnerable than nonsmokers to inhaled dusts and chemicals. The affected communities need to be identified and their vulnerabilities described. The poor, the elderly, women, and children are often designated as high risk groups, although this will vary from one locale to another. Low-income groups are often found living in or near high-risk areas such as floodplains, erosion-prone hill sides, polluting industries or busy roadways. The composition of the community may also change during the life of the project. For example, during construction, the community may comprise mainly single adult males and camp followers, whereas, once the project is completed, a more "normal" community structure may be expected.

The risks associated with a given health hazard (which may or may not be a disease) will depend on the vulnerability of the community group (such as their age, gender, immunity and poverty); the effectiveness and availability of medicines (which may be influenced by drug resistance of pathogens); and the level of exposure to the hazard. Very often young children are at greatest risk from communicable diseases because of their lack of immunity, and because of their greater susceptibility to rapid deterioration as compared to adults with the same illnesses.

Influence of environmental factors on health impacts

Both natural and man-made environments influence the exposure of vulnerable people to health hazards. Rural development projects may take place in conditions favorable to proliferation of disease vectors (such as mosquitoes and snails), carriers of disease (such as rodents and pigs), and agricultural pests and weeds. Indoor air pollution from cooking, heating, lighting, and tobacco smoke can both predispose inhabitants to respiratory infections, and cause emphysema and lung cancer.

Quantifying health risks

Quantifying health impacts is often difficult, and is most readily accomplished for specific physical hazards amenable to engineering analysis (see *Update* no.18: *Hazard and Risk Assessment*). Epidemiological evidence can help to assess relative risks, but for many diseases a simple ranking, such as apparent change, increased risk, or decreased risk, may be all that is possible. In many cases the ranking will be sufficient for incorporating appropriate health risk management measures during project design, construction, operation and maintenance, or closure. A summary health assessment table is useful in presenting results (see, for example, the case of schistosomiasis in China, box 4). Information in the table should be accompanied by detailed and reasoned argument found in full in the project document. Since there are bound to be many uncertainties, the assumptions of the analysis should be explicitly stated and, like other components of EA, health assessments must be communicated simply and concisely.

The capacity of health protection agencies

Protection of human health is normally the responsibility of the Ministry of Health (or equivalent), but other agencies also have an interest in and responsibility for human health concerns. For example, responsibilities for drinking water quality, sanitation, traffic movement and safety, occupational health and safety, housing standards, energy policies, pollution monitoring criteria, and environmental protection usually reside in other ministries. Health activities are also undertaken by a range of nongovernmental organizations and the private sector, both nonprofit as well as profit.

Box 4. Schistosomiasis hazard associated with a reservoir project in China

Schistosomiasis has long been known to be endemic in many parts of China, and was therefore flagged as a potential health hazard in the Ertan Reservoir Project in South China. The EA determined that the project would increase the health risk on a number of grounds.

Vulnerable communities. These communities included not only those living in the region, but also migrant laborers, and anyone for that matter who might have contact with natural sources of water.

Environmental factors. Transmission of schistosomiasis in China (in contrast to Africa) depends on a parasite that is widely distributed in many domestic animals. The amphibious snail vector thrives in moist vegetation subject to slow fluctuations in water level, including irrigation channels, but is not associated with floating vegetation. Areas of swampy ground created by the reservoir or irrigation ditches are transmission foci if they are close to human settlements or not intensively cultivated.

Capacity and capability of health protection agencies. There is a wealth of disease control expertise in China, effective veterinary services, and treatment of affected domesticated animals, and the human variant has been well controlled by chemotherapy and snail destruction. As a result, in some areas active surveillance has ceased and the drug preferred for the treatment of schistosomiasis is no longer stocked.

Change in health risk attributable to the project. As the disease has occurred in the project area in the past, an animal reservoir of infection is expected and new snail habitats may be created. This results in an increased health risk associated directly with the project.

Health risk management. Because control has been effective in the past, the risk of resurgence will be addressed by employing staff, stockpiling drugs, and undertaking snail control measures.

Summary Health Assessment

Health hazard	schistosomiasis
Community groups affected	neighboring communities, migrants, construction workers
Vulnerability of community groups	linked to water contact
Environmental factors determining exposure to the hazard	amphibious snail, animal parasite reservoir, moist ground, increased irrigation, shallow margins
Capability of health protection agencies	formerly successful eradication campaign deactivated
Change in health risk attributable to the project	increased risk

A health assessment should seek to determine whether the various agencies have the capacity, skills, and jurisdiction to prevent exposure of the vulnerable community to the identified health hazards or to care for them after they are exposed. *Capacity* refers to nonhuman resources, for example staff, equipment, and transport, as distinct from the *skills* of the staff to use their resources. For example, a rural health center may not have the capacity to cope with an influx of 30,000 immigrants without additional staff, drug supplies, or primary health-care facilities. If the project creates new or unusual health risks, the staff will need training on how to respond. *Jurisdiction* refers to the legal and administrative authority to act on health matters. For example, in some countries, rural water supply is under the ministry of health, not the water agencies, and water or air pollution standards are set by industrial and municipal boards according to ecological, and not necessarily human health, criteria. In addition, the division of responsibility between project proponents and local governments is often not clear, and local governments may lack the capacity to discharge their responsibilities. Health assessments should also describe and assess the linkages between relevant government agencies and NGOs.

Health risk management

The focus of health risk management should be to prevent adverse health impacts and identify opportunities to safeguard and enhance human health. It is not simply about providing extra services such as health care, health education and medicine. In many cases, modification of project plans and operating procedures can both improve the sustainability of a project and safeguard human health.

Risk management measures should be incorporated into environmental management plans (EMPs) and fully costed. The justification for these costs may be based on an economic evaluation of the impacts (see box 5). In order of priority, risk management should seek to:

- Avoid or eliminate risk, for example by prohibiting use of substances or controlling disease vectors

Box 5. Economic costs of disease or injury

Disease and injury impose heavy burdens on their victims, the families and societies in which they live, and the economies in which they operate. There are, broadly, two methods of estimating economic values for disease or injury (or their avoidance). The cost of illness (COI) method analyses the ways in which illness imposes costs on individual sufferers, their families, and on society at large. The main items taken into account are loss of earnings, work output, or time. These costs may be borne wholly by the victim, or shared by his/her family, friends, or employer. A second important cost is treatment (such as drugs, doctor's fees, or hospitalization) which may be borne privately or publicly.

The COI method is straightforward, but does not take account of pain and suffering, and is difficult to apply to people outside the labor force. It is also difficult to represent the costs of a disease where its effects are long-term and diffuse, or where its impact is displaced among the victim's family and friends. For such reasons, the willingness-to-pay (WTP) method is considered a theoretically superior measure, particularly for diseases. The victims of a disease are given carefully-designed surveys to elicit the values they place on health, by asking what they would pay to avoid the disease, or to reduce their risk of contracting it.

The majority of studies of costs of tropical diseases have used the COI method, focusing on loss of income and output, and direct private and social costs of treatment. Although estimates vary, they indicate a heavy (and previously underestimated), burden of diseases such as malaria, schistosomiasis, and lymphatic filariasis. For example, in some African countries in which incomes average US$300 annually, people often spend $65 per year on mosquito nets and coils. WTP-based estimates for tropical diseases are still few, but those that have been developed are proving useful for project appraisal, priority-setting, and health sector financing in developing countries.

Using information such as this in project design and appraisal entails first identifying and quantifying the likely health risks (such as the number of cases of malaria likely to result from a particular land use change) and second, ascribing economic values to them. The relevant data are the incremental effects solely attributable to a project, assuming these can be separated from the baseline situation. In extreme cases, the inclusion of health impacts might nullify the other economic benefits of a project. In other cases, the exercise would enable an informed judgment to be made of the size and cost of mitigation measures that would be justified.

Source: J. Winpenny, Overseas Development Institute.

- Control exposure to risks, for instance by regulating the use of agricultural chemicals or access to landfill sites
- Reduce vulnerability to risk by requiring or advocating the use of personal protective devices such as mosquito nets or workwear
- Develop mitigation and recovery procedures, such as medical or emergency services
- Institute schemes to reimburse and redistribute losses, such as compensatory or insurance payments.

To be effective, health risk management measures must also be socially acceptable to the affected community, affordable, and of proven efficacy. The agencies responsible for implementation of the plans must be specified, and the capacity of these agencies must be sufficient to undertake the task. An example of an EA which attempted to integrate the various elements of health risk assessment and management is given in box 6.

It is important to consider the potential environmental consequences of human health risk management measures. For example, control of disease vectors through the application of insecticides should be carefully managed to ensure that minimal adverse environmental impacts occur. Similarly, where health risk management involves construction or expansion of hospitals or clinics, strict procedures for waste segregation and disposal from these facilities should be developed.

EA review

For EAs that include a health component, a health specialist should determine whether the EA report was consistent with its TORs, and whether or not it was prepared in a timely fashion that enabled the specialist to interact with other members of the EA team and with project planners. One measure of this would be evidence that alternative health measures were considered.

Ensuring implementation of health risk management

Contractual aspects

During project implementation, occupational health and safety at the construction site are important considerations. The Bank provides standard bidding documents for procurement that outline the fairly comprehensive contractual obligations with respect to staff, labor, and subcontracted labor. The obligations of the contractor are less clear with regard to the

Box 6. Health aspects of an EA for the mining sector in Ecuador

Rapid expansion of informal gold mining in Ecuador has created environmental problems associated with land use changes and discharge of pollutants to rivers and estuaries. Crude extraction techniques are used with minimal waste recovery and maximal exposure of workers to mercury. Unregulated mining camps and towns have sprung up with inadequate health services, sanitation, and safety measures. The most vulnerable groups and the principal causes of their vulnerability include:

- *adult male miners*—poor sanitation and contaminated water supplies result in intestinal parasites and other enteric infections, occupational injuries, communal violence, STDs, and alcoholism
- *women, unborn children, and child laborers*—neurological damage from mercury poisoning, occupational injuries, and enteric infections, prostitution-related health hazards including STDs and traumatic injury due to violence
- *indigenous laborers*—due to their relatively poor socioeconomic status, more severely affected by occupational injuries, malnutrition, and communicable diseases.

Weaknesses in the system of human health protection identified by the EA included:

- Inadequate provision of public security
- Shortage of private and public health centers and pharmacies
- Unregulated food production, prostitution, and alcohol consumption
- Absence of municipal water supply and sanitary facilities in villages and mines
- Unregulated working conditions;
- Inadequate monitoring of the use of mercury or other heavy metals in mining activity
- Inadequate enforcement or monitoring of compliance with regulations regarding river pollution
- Weaknesses of land rights of indigenous peoples.

Proposals for reducing or mitigating the environmental, social, or health impacts of mining activity included:

- Development of rational and safe mining and milling systems with control of discharges
- Strengthening of the institutions responsible for implementing national environmental policy, supported by monitoring in mining areas to ensure compliance with environmental regulations
- Establishment of an occupational health center to provide medical care and health monitoring in all major fields of mining-related injuries and disease
- Rehabilitation of health and social services in existing mining communities, and provision of housing and related social infrastructure at new mine sites
- Environmental and public health education to provide accurate information about the dangers of mercury and other mining-related health hazards.

health and safety of neighboring communities. However, further provision could be made for the prevention of sexually transmitted diseases (including acquired immunodeficiency syndrome (AIDS)) by including a contractual clause requiring development and implementation of awareness programs.

Institutional capacity development

The requirement for EA of many development projects has given rise to increasing local capacity in the consulting community in many less-developed countries. Since health assessments require additional skills, further capacity building is needed. Health specialists are not currently well-equipped to undertake this task because of their traditional focus on the delivery of health care and curative medicine. Public health or environmental health officers may have the most appropriate perspective, but are often underfunded and would nevertheless require further training.

The composition of EA teams is often limited by cost, and one individual may have to undertake multiple duties. At the early stages of project preparation, some international technical assistance by health assessment specialists will be required.

Recent experience in Africa suggests that training for middle-level government officers can be conducted successfully in multi-sectoral, task-based courses. Such training is only effective if it is accompanied by an enabling policy environment, in which the participants feel encouraged by their superiors. An important contribution to training can be made by ensuring that at least one model environmental assessment is available that has adequately addressed health issues.

Monitoring and supervision

The objective of health monitoring is to detect early warnings of an increased health risk so that mitigation measures can be implemented. Direct monitoring of human health may be expensive, unreliable, or unethical, and there may be a need for proxy indicators. Routinely collected health data are unlikely to be useful in health monitoring, due to their poor quality and the likelihood of under-reporting (of births, deaths, and disease incidence, among other things).

There are many proxy indicators of human health. For example, fish can be monitored for their bioaccumulation of toxins, and changes in the abundance of certain vector species may indicate an increased (or decreased) risk of disease transmission. Urinary schis-

tosomiasis can be monitored by sampling schoolchildren's urine. Changes in the incidence of fevers that respond to treatment may indicate variance in the levels of malaria infection. Levels of pollutant emission can be monitored, and in cases where the emission is easily detectable, the local community may be an effective and economical source of information (see also *Update* no. 14: *Environmental Performance Monitoring and Supervision*).

Conclusions

There is a need to more systematically integrate health and safety concerns into EAs. One of the most effective means of satisfying this need is to ensure that development projects are screened at an early stage for potential health hazards, and that assessment of these hazards is integral to the project EA. The primary objectives are the prevention of adverse health impacts as a consequence of development, and the maximization of opportunities to safeguard and enhance human health.

For further reading

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This *Update* was prepared by Dr. Martin Birley, Liverpool School of Tropical Medicine, Dr. Melba Gomes, World Health Organization, and Aidan Davy. James Winpenny, Overseas Development Institute, and Jim Listorti provided valuable contributions. The *EA Sourcebook Updates* provide guidance for conducting environmental assessments (EAs) of proposed projects and should be used as a supplement to the *Environmental Assessment Sourcebook.* The Bank is thankful to the Government of Norway for financing the production of the *Updates.* Please address comments and inquiries to Olav Kjørven and Aidan Davy, Managing Editors, *EA Sourcebook Updates*, ENVLW, The World Bank, 1818 H St. NW, Washington, D.C., 20433, Room No. S-5-139, (202) 473-1297, or send E-mail to: eaupdates@worldbank.org.