

THE REPUBLIC OF YEMEN

COMPREHENSIVE DEVELOPMENT  
REVIEW

ENVIRONMENT

RURAL DEVELOPMENT, WATER AND ENVIRONMENT  
DEPARTMENT

MIDDLE EAST AND NORTH AFRICA REGION

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## ABBREVIATIONS

|        |   |
|--------|---|
| CITES  | Convention on International Trade in Endangered Species           |
| CZM    | Coastal Zone Management   |
| DESD   | Department of Economic and Social Development                     |
| DH     | Department of Hydrology   |
| EEC    | European Economic Community                                       |
| EIA    | Environmental Impact Statement                                    |
| EPC    | Environment Protection Council                                    |
| ESMAP  | Energy Sector Management Assistance Program                       |
| FAO    | Food and Agriculture Organization                                 |
| GDP    | Gross Domestic Product  |
| GDFCD  | General Department of Forestry and Combating Desertification      |
| GEF    | Global Environmental Fund   |
| GIS    | Geographic Information System                                     |
| GTA    | General Tourism Authority   |
| HWC    | High Water Council  |
| IDA    | International Development Association                             |
| IFAD   | International Fund for Agricultural Development                   |
| LPG    | Liquid Petroleum Gas  |
| MARPOL | International Convention for the Prevention of Pollution of Ships |
| MAWR   | Ministry of Agriculture and Water Resources                       |
| MCHUP  | Ministry of Construction, Housing and Urban Planning              |
| MOMR   | Ministry of Oil and Mineral Resources                             |
| NAPED  | National Action Plan for Environment and Development              |
| NEAP   | National Environmental Action Plan                                |
| NGO    | Non Government Organization                                       |
| NPDC   | National Program for Desertification Control                      |
| NWASA  | National Water and Sanitation Authority                           |
| UNCLOS | United Nations Convention on the Law of the Sea                   |
| UNDP   | United Nations Development Program                                |
| USAID  | United States Agency for International Development                |
| WHO    | World Health Organization   |
| YAR    | Yemen Arab Republic   |
| YR     | Yemeni Rial   |

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# **THE REPUBLIC OF YEMEN**

## **COMPREHENSIVE DEVELOPMENT REVIEW**

### **ENVIRONMENT**

#### **ACKNOWLEDGMENTS**

This working paper on environment takes stock of the current status of our knowledge regarding the environment in Yemen and is based on the National Environmental Action Plan (NEAP) of Yemen, which has been updated with more recent information, specially with regard to water scarcity problems. The NEAP was prepared as a joint collaborative effort between the Government of Yemen (GOY) and the World Bank. The work benefited from the support and interest shown by His Excellency Eng. Mohsen Ali Hamdani, Chairman of EPC, H.E. the Minister of Agriculture, and H.E. the Minister of Electricity and Water.

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# THE REPUBLIC OF YEMEN

## COMPREHENSIVE DEVELOPMENT REVIEW

### ENVIRONMENT

#### I. ENVIRONMENT AND DEVELOPMENT

##### A. The Environment Resource Base

The Republic of Yemen is located on the southern coast of the Arabian Peninsula. Its land boundaries are with Saudi Arabia in the north and Oman in the east. The coastline extends to more than 2,000 km. The country is characterized by five major land systems: (i) a hot and humid coastal Tihama plain, 30-60 km wide, along the Red Sea and the Gulf of Aden, (ii) the Yemen Highlands, a volcanic region with elevations between 1,000 and 3,600 m. parallel to the Red Sea coast, and with temperate climate and monsoon rains, (iii) the dissected region of the Yemen High Plateaux and the Hadramawt-Mahra Uplands, with altitudes up to 1,000 m, (iv) the Al-Rub Al-Khali desert interior, with a hot and dry climate, and (v) the islands, including Socotra in the Arabian Sea and more than 112 islands in the Red Sea. Yemen's coastal and marine eco-system which include extensive mangroves, coral reefs, and seagrass areas, are of major economic importance for fisheries and tourism.

Yemen covers a total land area of 55.5 million hectares. About 3 percent of the land can be used for agriculture, or about 1.6 million hectares, but only about 1.2 million hectares are actually cultivated. The main crops are cereals (0.7 million ha.), followed by fruits & vegetables (0.14 m ha.). Fodder and qat areas are smaller but significant at about 90,000 ha each. Mainly rangelands and some forest area cover 40 percent of the land area. Other land, mostly desert, constitutes the remaining 57 percent of the total land area.

Renewable fresh water is very scarce. Fresh water available to the country is 2,100 million cubic meters (cu. m.) per year, and with a population of about 16 million (1997), the availability per capita is only 130 cu. m. per year. This compares with an average annual availability of 7,500 cu. m. for World and 1,250 cu. m for MENA. The resource is mainly ground water and its over exploitation is one of Yemen's major environmental problem.

Fisheries resources are also important and the combined surface and deep water fish catch is about 80,000 metric tons per year. Oil and gas resources are also significant contributing about 85% to Yemen's export revenues. Environmental problems in Yemen are caused by three fundamental factors: (i) population growth, (ii) poverty and (iii) institutional weaknesses. These factors are discussed below.

##### B. Population Growth and Environment

A total of 16 million Yemeni inhabitants make use of Yemen's resource base, over half of them are younger than 14 years. At the current growth rate of about 3.5 percent, the population is expected to double every 20 years. The factors that account for this high rate of growth include improved health standards and a high fertility rate, the latter possibly linked to low female education and employment.

Between 1970 and 1997, the percentage of urban population rose from 13 to 25 percent. In the capital city Sanaa (1 million) the population growth rate is more than 10 percent per year, reflecting an in migration rate of about 7 percent per year and an annual natural increase of over 3 percent. The other cities in Yemen with populations over 100,000 are Aden, Al-Hodeidah, and Taiz, all of which are

growing by about 7 to 8 percent. The failure of the centrally planned system in South Yemen during the late 1980s caused migration to the cities of the north. Urbanization was further accelerated by the return of about 900,000 Yemeni workers and their families after the Gulf War which caused a proliferation of unplanned settlements and accompanying environmental degradation in cities such as Sana'a, AI-Hodeidah, and AI-Mukalla. The inability of Yemen's municipalities to provide the necessary land, services, and facilities to accommodate urban growth poses significant threats to health, natural resources, and urban productivity.

The fertility rate in Yemen (7.5) compares unfavorably to that in other countries: 5 (Algeria), 4.3 (Morocco), 3.5 (Tunisia), 4.2 (Egypt), 6.2 (Iran), and 5.3 (Jordan). The factors which contribute to this high rate are: (i) 74 percent of the female population is illiterate (compared to 47 percent for men), and (ii) only 13 percent of the women are in the labor force. In Morocco and Lebanon, 20 and 27 percent of the women, respectively, are in the labor force.

### **C. Poverty and Environment**

A key issue confronting Yemen is poverty, and the linkage with environmental degradation, and resource depletion - occurring in both rural and urban areas. In rural areas, high levels of poverty often have led to environmental degradation. Households are living at levels well below subsistence levels and use soils, forest, and other resources at rates that exceed sustainable limits for recovery or renewal. The poor have no other option than to adopt short-term survival strategies which do not incorporate longer term resource management considerations. If the poor have no alternatives, they will continue to use land and water resources in ways that will threaten their future productivity. The conditions that exacerbate these trends include: unclear land and water rights, the use of modern technology (e.g., water pumps) without adequate knowledge of its impact on natural resources, and population pressure.

Yemen's urban areas also illustrate the mutually reinforcing effects of poverty and environmental degradation. Foremost among the environmental concerns of the urban poor are health problems resulting from substandard living conditions that do not shield them from human excreta and other wastes and natural hazards. In most cities, it is not only the impact of urban environmental deterioration on the poor that is a concern. Poverty is itself a major factor in urban environmental degradation as the rural poor migrate to the cities in search of income-producing opportunities. The poor lack the financial resources to compete for serviced land and adequate housing in safe locations. In Sana'a the poor have no access to safe water. As a result, the poor are often forced to occupy illegal settlements on hazard prone or environmentally sensitive land. In many instances, the location of low-income populations on these lands has resulted in health hazards, injuries, property damage and loss of natural resources.

## **II. KEY ENVIRONMENTAL PROBLEMS**

Yemen's natural resources are the basis of the national economy. The depletion or degradation of these resources represents not only a loss of the country's national capital but undermines the sustainability of its economy. Although Yemen is experiencing numerous environmental problems, GOY's NEAP focuses on those issues that are of national importance and that pose immediate threats to health and sustainable economic and social development. The main issues are discussed below.

### **A. Water Depletion, Pollution, and Supply**

Yemen is facing a water crisis, in terms of depletion of water resources, water pollution, and water supply. Although complete data on the nature and magnitude of the water crisis are not available, the basic trends are reason enough for concern. Failure to meet the country's potable water needs will intensify health and environmental problems. The synopsis of main problems and specific concerns with regard to Yemen's water resources, as given in Table 1 is presented in more detail below.

**Table 1: Main Environmental Problems and Specific Concerns in Water Resources**

| MAIN PROBLEM                    | SPECIFIC CONCERN  |
|---------------------------------|---|
| WATER DEPLETION, POLLUTION, AND | <ul style="list-style-type: none"> <li>• OVER-EXTRACTION OF GROUNDWATER</li> <li>• LACK OF WATER ALLOCATION AND CONSERVATION SYSTEMS</li> <li>• WATER POLLUTION INADEQUATE WATER SUPPLY SERVICES</li> </ul> |

### 1. Over extraction of groundwater

Ground water is being mined in many areas. Countrywide, it is estimated that current withdrawals of water for all purposes are over 130 percent of renewable resources. In 1994, water use was estimated at about 2,800 million cubic meters per year; the annual recharge is only 2,100 million cubic meters. Since unification of the country, uncontrolled drilling has spread to the south, which resulted in lower water tables. The most obvious impact of this trend is the increased cost of drilling deeper wells and increased pumping costs in existing wells. In Sanaa the ground water level is dropping by more than 4 meters per year. This is clearly unsustainable and a threat to future prosperity of the country.

Critical aquifers are expected to reach the end of their useful life within twenty years. The depletion and degradation of Yemen's ground-water resources represents a dis-investment of the country's natural resource base. In the short-term, depletion adds to disposable incomes, contributes to rural employment, and postpones the need for more expensive alternatives such as desalinization. In the longer-term, however, these trends are unsustainable.

### 2. Lack of water allocation and conservation systems

National policy and regulatory process for water allocation, conservation, and drilling is weak. Surface water is regulated by customary practice, modified by the impact of Government projects. Ground water, with few exceptions, is currently unregulated although state ownership of land and equipment gave the previous government of the south de facto control. Even where there are regulations, they are rarely enforced.

Qat, which requires large amounts of water to produce, is another constraint to water conservation. Qat production occupies some 25 percent of the irrigated area, provides employment for some 500,000 people, and generates important incomes. Although the official policy towards qat is to restrict cultivation to low potential areas and to levy a sales tax, these measures are not adequately enforced. Due to its profitability and widespread domestic consumption, nothing has been done to restrict production, whereas tax revenues are estimated to be less than ten percent of dues.

In Yemen, land rights are privately held and controlled and the owner of the land believes to have unlimited rights over tubewell water on his land. This has led to the construction of numerous tubewells, resulting in over-irrigation, wasteful energy use, and depletion of ground water. Moreover, the sensitive nature of water rights has posed substantial constraints on water conservation and the regulation of the drilling of new wells.

Numerous management activities in both the north and south have aimed to ensure efficient, equitable, and sustainable use of water resources. Nonetheless, an ineffective institutional framework has undermined these actions. Most agencies have followed their own objectives to expand irrigated areas, meet potable water standards, and satisfy industrial needs. Individuals also have pursued their

own self interest without regard to the surrounding community. Further, the responsibilities for planning, management, regulation, and development are fragmented among several agencies and the private sector. To compound these problems, the government has been unable to secure sufficient technical and enforcement capacity, particularly at the local level, to address the complexities of water resource management which requires management responses tailored to each hydrological system. Not only does this require a greatly improved understanding of specific aquifers and patterns of recharge, but it also calls for measures that discriminate between different areas that are inherently difficult to administer. A more detailed description of the water scarcity problem is included in the working paper on Water Resource Management.

### 3. Water Pollution

Water quality is deteriorating. Shallow aquifers, especially in urban areas, are becoming polluted and coastal aquifers are subject to saline intrusion. The capacity to plan and implement appropriate responses to water resources problems is undermined by insufficient data. Data on water quality and saltwater intrusion are particularly weak. There are no national water quality standards, although WHO guidelines are generally applied to urban water supply monitoring for a restricted range of constituents.

Ground-water contamination is pervasive and poses a serious health threat for those dependent on water from private tankers and neighborhood wells in urban areas. Water resources are contaminated primarily by industrial and residential waste, seepage of wastewater, and low pressure, back siphonage, and cross connections. Consequently, many wells, especially those drawing water from shallow aquifers, are contaminated with viruses and bacteria, leaving large segments of the population vulnerable to waterborne diseases. In addition, ground water used in public water supplies is not filtered. In the poor neighborhoods, inadequate environmental conditions have led to outbreaks of diseases such as cholera, bacterial dysentery, infectious hepatitis, salmonellosis, and typhoid. It is estimated that about 70 percent of infant mortality (or 107 deaths per 1,000 life-births) is due to waterborne diseases.

Surface water is fully exploited and essentially distributed in the upstream parts of watersheds, and only limited flows reach the sea. The immediate impacts include: decline in water quality from diminished dilution of pollutants, seasonal or continuous shortfall in supply of downstream users, and increases in salinity in estuaries and other coastal areas.

### 4. Inadequate water supply services

Although water requirements for domestic and industrial purposes are estimated at less than 10 percent of total water consumption, competition among these water users is increasing due to population growth and increasing urbanization. In a situation where connections to the water network remain unchanged, water availability per capita is decreasing and the percent of the population that has access to piped water supply is decreasing as well. The problem in urban basins is compounded by growing water demand for agriculture and unclear water rights.

Currently, only 50 percent of the estimated 3.5 million urban population have access to public water supply systems. However, supplies are not always available, especially in the north. Sana'a, Taiz, and Mukalla are already running out of water for their existing populations and there are periodic shortages. The National Water and Sanitation Authority (NWSA) is officially responsible for the provision of water supply and sanitation services in urban centers with populations over 10,000 people. This agency, however, has not been able to fulfill its mandate. NWSA provides piped water to serve about 33 percent of the population of Sana'a, 39 percent of the population of Taiz, 25 percent of the population of Ibb, and 78 percent of the population of Dhamar. Pricing policies and incentives have not been used to increase the efficiency of urban services. In urban water supply, prices do not reflect the resource constraint; the prices charged do not even cover the cost for operating and maintaining the system, water is thus provided at a subsidy. Urban residents with no access to public drinking water

(often the urban poor) must obtain water from private networks, private water tank trucks, or their own wells. Bottled water is available too. The cost of all non-public supplied water is high.

Currently, about 40 percent of the estimated 11 million rural population receives piped supply. Here, expansion of public water supply is even more difficult given the high capital cost of new systems due to scattered or remote locations of settlements. At the same time, much of this population is concentrated in the highlands and alternative water supply from seawater desalination is not an economically feasible option.

## **B. Land Degradation**

Yemen covers a total land area of 55.5 million hectares. About 3 percent of the land can be used for agriculture, or about 1.6 million hectares. Rangelands together with forest and woodlands comprise almost 40 percent of the land area. The land is grazed by about 3.5 million sheep, 3.2 million goats, and 1.1 million cattle. Other land, mostly desert with limited use potential, constitutes almost 60 percent of the total land area.

Approximately 3,000 years ago, Yemeni farmers started clearing the hillsides and steep mountain slopes to increase the area of arable land. Terraces were constructed to conserve soil and water, to improve water use efficiency, and to increase crop production. The hillside terraces in Yemen constitute a national heritage and a monument to environmental sustainability and food security in years past. The terrace systems have developed in response to rainfall patterns and rainfall uncertainties and provide optimal soil and water management in dry, mountainous terrain. The farming systems schemes so designed were sustained until recently. Similarly, range management occurred in well-balanced operations. During the last 30 years, social and economic changes have resulted in changing farming and grazing practices and in rapidly expanding urban areas. This in turn, led to widespread soil erosion and sand encroachment, deforestation, agricultural and range land deterioration, and loss of farm land due to urban encroachment. An overview of these land degradation concerns is presented in Table 4 and discussed below.

**Table 2: Main Environmental Problems and Specific Concerns in Land Resources**

| MAIN PROBLEM     | SPECIFIC CONCERN  |
|------------------|---|
| LAND DEGRADATION | <ul style="list-style-type: none"> <li>• SOIL EROSION</li> <li>• DEFORESTATION</li> <li>• AGRICULTURAL AND RANGE LAND DETERIORATION</li> <li>• LOSS OF FARM LAND DUE TO URBAN ENCROACHMENT</li> </ul> |

### 1. Erosion

Although soil erosion occurs naturally and has been a major problem in Yemen since the dawn of civilization, the rate of erosion is increasing as a result of the removal of vegetation and unsustainable land-use and farming practices, particularly the development of large-scale irrigation schemes and deterioration of terraces due to inadequate maintenance. Sedimentation also is affecting reservoirs and diversion channels downstream. The areas most seriously affected by soil erosion are Anas, Bani Matter, Wadi Serbah, Hamman Ali, Wadi Afk, Raymah, Wadi Shiras, Wesab, and Wadi Bani.

The erosion of arable land undermines agricultural production and therefore leads to substantial economic losses. Although there are no quantitative data on the magnitude of soil erosion and the possible increase in erosion as a result of unsustainable land use practices, terrace erosion has emerged as a priority resource management issue in Yemen. Without the proper maintenance of the terraces, and related farming systems and water management practices, productive land reverts to a barren landscape of upper catchments with no soils and a gravel-strewn wadi-beds with no water flow. The collapse of the terrace system also forces rural population off the land and into the cities, which are already suffering from overcrowding.

Generally, efforts aimed at halting erosion are sporadic, inconsistent and have been undertaken by various actors with little or no coordination. There is limited awareness among development addition to the random physical expansion of urban areas, damage to lands occurs as a result of indiscriminate construction of roads and other infrastructure and disposal of waste.

Another aspect of uncontrolled urban growth is the occupation of hazard-prone areas by Yemen's urban population, particularly the urban poor. In several cities (e.g., Sana'a, Aden), unauthorized settlements are spreading rapidly on wadi beds and unstable slopes where periodic floods and landslides are often caused by urban infrastructure and result in the loss of lives and extensive damage to buildings and infrastructure. Flooding causes widespread property damage, traffic disruption, and erosion which often leaves underground water, sewerage, power and telephone lines exposed. Apart from the loss of valuable land, those most affected are the households living below the poverty threshold. Based on a survey of 5,134 households and small businesses in one area in Taiz, the annual direct loss from floods is about YR 29.24 million (or US \$2.7 million, using the official exchange rate) mostly in property damage and missing stock from households and shops. In the city of Sana'a and peri-urban areas, low-income groups also occupy abandoned quarries and land adjacent to municipal landfills.

Inadequate regulation is a key factor accounting for the occupation of hazard-prone areas. In some cases, there are no clear rules governing the settlement of urban areas or guiding urban expansion away from areas poorly suited to urban development. In some southern governorates hazard-prone areas were actually designated for residential development. In other situations, excessive regulation artificially reduced the supply of land and raised the price by requiring large lot sizes or excessive amount of land for traffic or recreation. By reducing the amount of land in the formal land market,

excessive land restrictions have increased costs and thus constrained access by low-income populations to safe lands in suitable locations.

### C. Habitat Degradation

Located at the cross-roads of the African, Asian, and Palearctic ecological zones, and with a wide range of terrestrial, coastal, and marine landforms, Yemen is characterized by a rich variety of natural habitats, species and genetic diversity, including many endemic species. These resources are of major economic importance because of their potential for tourism, and the wildlife and fisheries they support. Also, numerous plants are used in traditional medicine, in local industries, and for grazing and fuelwood. However, in recent decennia human activity has transformed the landscape and over-exploited available biological resources, which resulted in the deterioration of many habitats, in major reduction in plant and animal species.

**Table 3: Main Environmental Problems and Specific Concerns in Habitat Degradation**

| MAIN PROBLEM        | SPECIFIC CONCERN  |
|---------------------|---|
| HABITAT DEGRADATION | <ul style="list-style-type: none"> <li>• DEGRADATION OF NATURAL HABITATS (FORESTS, WETLANDS, COASTAL HABITATS)</li> <li>• LOSS OF BIODIVERSITY (EXTINCTION OF ENDEMIC, RARE AND ENDANGERED SPECIES)</li> <li>• LACK OF MANAGEMENT OF ECO-TOURISM</li> </ul> |

#### 1. Degradation of Natural Habitats

Many factors contribute to the degradation of critical habitats such as forests, wetlands, and coastal areas. Among these are inadequate management of municipal and industrial waste, haphazard urban land development, tourism, fuel wood collection, overgrazing, overfishing, and intensive agriculture. For example, the conversion of traditional agricultural systems to large-scale farming with greater dependency on fossil fuels, fertilizer, and pesticides is proceeding rapidly in the Tihama lowlands. Although this activity is largely isolated from the coast by the band of saline soil and halophytic shrubs, runoff and contamination by pesticides and sediments from soil loss in the upper watersheds have a negative effect on wadi's downstream. Similarly, the large-scale extraction of ground water by tubewells and the diversion of wadi runoff with barrages to support agriculture reduce the fresh water flows downstream. The effects of these activities are likely to be reduction in nutrient input from flooding and changes in groundwater salinity that affect salt sensitive plant communities.

In the coastal areas the principal threats are as follows:

- urban development – critical habitats such as mangroves are being threatened by the disposal of raw sewage and untreated industrial;
- over-exploitation of coastal resources - continued fishing activity during the spawning season despite recommendations made by fishery experts; development of industrial scale fisheries has a potential for disrupting ecosystems upon which fish, shrimps, and another marine fauna depend.
- pollution from oil spills - oil spills occur frequently in the Gulf of Aden (ten spills were recorded in 1985); and
- physical destruction – bottom-trawling in shallow coastal waters destroys the egg deposits of the cuttlefish and damages seagrass vegetation which provides an important habitat for shrimp, extensive wood cutting destroys mangrove vegetation.

Effective management of natural habitats is hampered by (i) ineffective regulatory and economic policies, (ii) a rudimentary information base - there is a lack of comprehensive surveys on the fauna and flora of Yemen, and (iii) a lack of awareness regarding the importance of biological resources at the individual, communal, and national levels. Most important, however, are institutional weaknesses. The three main institutions that deal most directly with the county's habitat resources are the Environmental Protection Council (EPC), Ministry of Agriculture and Water Resources (MAWR), and Sana'a University. In addition, the Marine Science and Resources Research Center in Aden conducts research and training in various coastal and marine issues. All of these institutions, however, are unable to carry out or coordinate conservation initiatives without technical assistance and/or external funding. Shortcomings in the country's institutional capacity to address conservation problems are: a shortage of trained personnel, lack of coordination between ministries, and lack of enforcement capacity.

Effective management of coastal resources requires an understanding of the functioning of the marine and coastal system and their inter-relationships. Based on an analysis of available data on Yemen's coastal resources, however, many gaps can be identified. For example, little is known about changes in water quality and the composition and abundance of marine flora and fauna as a result of human activities. With respect to fisheries, data is needed on spatial and seasonal changes in the composition and size of the catches in relation to changes in the physical environment and the number and types of fishing units operating in the Red Sea and Gulf of Aden areas.

There is a need for coastal zone management (CZM). Coastal zone management is important to guide human development activities in the coastal zone, but is in particular vital to minimize or eliminate pressure imposed on the coastal ecosystems as a result of activities, such as urban development, port and industrial activities, fisheries, tourism, and road building. CZM should be based on information gathering and mapping of current and potential critical habitats, reflecting the impact of environmental degradation on various coastal and marine living organisms and their habitats. The Yemeni coastal zone, because of its diverse habitats, has great significance in the life cycles of many marine animals such as sea turtles, sea cucumber, cuttlefish, shrimp, and larval and juvenile stages of many fishes. The marine and coastal habitats of Yemen are comprised of:

- sandy shores, important as nesting grounds for sea turtles
- rocky coasts
- saline mud flats, "Shabka"
- mangrove swamps, important as detritus producers for shrimp,
- palm groves, with doum palm (*Hyphaene thebaica*) and *Phoenix dactylifera*,
- coral reefs, important as feeding grounds for many fish and Hawksbill turtles (*Eretmochelys imbricata*), and
- seagrass beds, important nutrition for marine mammals, Dugongs (*Dugong dugon*), and green turtles (*Chelonia mydas*).

## 2. Loss of Biodiversity

The "Biological Diversity Assessment of Yemen prepared by the International Council for Bird Preservation summarized the main concerns in the conservation of biodiversity in Yemen as follows:

- Lack of adequate legislation to protect flora and fauna
- Lack of Institutional Capacities at EPC, MAWR, and Sana'a University
- Criteria for defining critical habitats or biotypes are missing
- Critical or endangered species of international or national interest occur, but insufficient information is currently available
- Genetic diversity is a major feature of a variety of species in Yemen, in particular for sorghum species.

Threats exist to an estimated 200 to 300 endemic bird species known in Yemen, including three globally threatened, an unknown number of endemic coral reef fish species, and wildlife such as ibex and gazelles. Threat occur as a result of indiscriminate hunting of birds and mammals. Collection of shells, corals, and coral reef fishes likewise leads to reduction in their number. There is a clear need for establishing protected areas.

Even with is a lack of precise information on the number of fauna and flora species present in Yemen, or on rare, threatened endemic species and their habitats, or inadequate legislation, proposals exist for the development of a network of protected areas. Specifically, the following high-priority sites have been identified: Socotra Island, Jebel Bura, Hugaria (Qubayta and Jebel Iraf), Mahra (Hawf), and the Tihama Mangroves.

### **3. Lack of Management of Eco-Tourism**

There is considerable potential benefit for Yemeni nationals to develop eco-tourism in Yemen. However, as a national undertaking this sector is yet to be developed. Some international initiatives taken do not necessarily benefit local interest. National plans to organize the sector are needed as well as a modest unit in the Ministry of Tourism to guide sustained eco-tourism and to ensure that tourist developments are environmentally acceptable. Eco-tourism possibilities should be explored in conjunction with protected area establishment.

**Table 4: Main Environmental Problems and Specific Concerns in Waste Management**

| <b><u>MAIN PROBLEM</u></b> | <b><u>SPECIFIC CONCERN</u></b>  |
|----------------------------|---|
| WASTE MANAGEMENT           | <ul style="list-style-type: none"> <li>• WASTE WATER MANAGEMENT</li> <li>• SOIID WASTE MANAGEMENT</li> <li>• HAZARDOUS WASTE MANAGEMENT</li> <li>• PESTICIDE. MANAGEMENT</li> </ul> |

In principle, several options are available to better organize waste management - through a department of municipal government, local or regional sanitary district, or a private operating company or companies under contract to the government. To the extent possible, the institutions need to be empowered to generate revenues adequate to cover costs. Permitting and inspection of installations and enforcing standards should be Government functions but could be delegated to local authorities. Actual implementation tasks can best be carried out by the private sector under contract to or licensed by the Government.

#### **1. Waste water management**

Access to sewerage services is provided only to a limited percentage of the urban population. NWASA's waste water collection system only serves about 8 percent of Sana'a, 25 percent of Taiz, 25 percent of Hodeidah, 15 percent of Ibb, and 15 percent Dhamar. The infrastructure which was build in the seventies is no longer capable of handling the demand. Most residences and businesses dispose of wastewater in on-site septic tanks, leaching pits, or through clandestine connections to sewerage systems. Over 90 percent of the urban population depend on individual septic tanks, some of which are emptied by trucks owned by the municipality or private companies. In wet years, shallow groundwater rises and waste water and storm drainage flows in the open.

The most common type of wastewater treatment in Yemen is stabilization ponds, found in Taiz, Hodeidah, Dhamar, and Aden. Stabilization ponds are under construction in Rada' and are planned for ten secondary towns. In Sana'a, sewage has been receiving partial treatment in temporary stabilization

ponds since 1988, but no acceptable site for a long-term stabilization pond has yet been identified. In 1991, a new site was chosen to construct an extended aeration treatment plant. The only other activated sludge extended aeration treatment plant is in Ibb. Although the major cities have wastewater treatment facilities, a portion of the wastewater collected by trucks is disposed of untreated in nearby wadis, which eventually seep into aquifers or the sea.

Some wastewater is reused in irrigation on an ad hoc basis and without quality controls. In Sana'a, 2.5 times more sewage is discharged into groundwater recharge areas and into freshwater aquifers than into the sewerage system. Private providers of municipal disposal of wastewater are not subject to insufficient regulation.

One of the most visible and serious impacts of inadequate waste water disposal is on historic inner-city buildings where dampness is rising to unprecedented levels. Yemen is one of the oldest civilizations in the world. Its architectural resources are perhaps the most spectacular and best known aspect of the country's heritage and tourism potential. The deterioration and loss of these resources in Yemen's cities, such as Sana'a and Shibam, is due in large part to insufficient maintenance of both buildings and infrastructure. In Shibam, for example, inadequate drainage systems and leaking water pipes have brought increasing amounts of sewage, and other pollutants straight into the ground around some of the highest mud buildings in the world. This has produced structural problems as evidenced by large cracks appearing on the buildings and eventual collapse. Islamic monuments such as the city wall of Shibam and the mosque at Bor are not receiving the care and maintenance that their antiquity demands.

Although the conservation of cultural properties is not viewed as a priority problem in light of other pressing pollution and resource management issues, the destruction of Yemen's cultural patrimony is irreversible. When important historic sites are degraded or destroyed, their value and the information they contain is lost forever. For many, the destruction of Yemen's cultural resources represents a loss of national identity and spiritual values. In some cases, the integrity of internationally significant resources is threatened.

## **2. Solid waste management**

Inadequate municipal solid waste management is a serious problem in the cities as well as in small towns and villages.

Waste collection is especially poor in the low-income neighborhoods, where most of the waste is dumped into wadis, streets, and open dumps. In many cases, accumulated refuse and the stagnant water resulting from the clogging of drainage systems, serve as breeding grounds for rats and insects, contributing to both disease and nuisance. The influx of migrants to the cities has compounded the problem.

Municipal solid waste disposal is a major concern, in particular in Sana'a. The capacity of the existing landfill has long been exceeded; waste presently reaches an elevation of five to ten meters above design level. Spontaneous combustion results in constant fires, widespread smoke, and odors. Moreover, the top of the landfill is dangerously close to high voltage power lines. The fence also has been destroyed allowing access to the landfill by scavengers and animals. The critical conditions of the landfill provoked residents living nearby to block access of disposal trucks to the field. Refuse is now disposed of on public land that had been previously zoned for recreational use.

The regulatory framework leaves many gaps. For example, there are no provisions for national or local regulation of solid waste collection and disposal. In some cases, municipalities have established informal arrangements to enforce appropriate refuse disposal. In the case of the municipality of Taiz, for example, NWASA can interrupt water supply to those residents that do not comply with minimum

requirements for safe disposal. The effectiveness of this mechanism, however, is limited to the extent that NWSA only supplies water for domestic purposes and to a very small portion of the urban population.

### **3. Hazardous waste management**

Although there are no definitive data, the total volume of hazardous waste produced in Yemen is estimated to be approximately 36,000 tons per year. Although this is a relatively small amount when compared to the amounts produced in industrialized countries, local impacts are considerable, particularly on ground water.

The types of hazardous wastes in Yemen include hospital waste, waste oil, industrial waste, pesticides, photographic waste, and pharmaceutical waste. The main sources of hazardous waste are textiles, food processing, cement, plastics, chemicals and petrochemicals, paper and printing industries, and tanneries. Among these, the cement industry, energy sector (refinery and power plants), textile industry, and the plastic industry are producing 85 percent of the hazardous wastes, most of which is oil or oily sludge. Due to expanding oil, chemical, pharmaceutical, plastic, and paint industries, the amounts of hazardous waste is expected to increase in the near future.

Some industries incinerate their solid hazardous waste in open pits. Other hazardous waste is dumped on open dump sites, or on private and municipal landfills, where supervision is inadequate. It is difficult to monitor dumping and ensure that disposal workers are protected or to control the hazards that toxic waste poses to the environment, in particular to fresh water.

Liquid hazardous waste is disposed of into the sewerage system or, as is the case in some industries, disposed of with the wastewater which is discharged into the surroundings without any treatment. There is no regular separation of medical, toxic, and domestic waste. Often, chemical from laboratories, blood banks, and x-ray departments as well as used oil and oily sludge are discharged directly into sewerage systems or disposed locally in the soil.

Hazardous waste is a growing environmental threat due to inadequate disposal of industrial discharges and the lack of separate collection and disposal arrangements in municipal waste management. The responsibility for managing hazardous and toxic waste is not clearly delineated and falls under eight ministries. The resulting duplication and inconsistencies lead to chaotic waste management.

### **4. Pesticide Management**

A special hazardous waste issue is the existing stock of outdated pesticides (about 300 tons) requiring safe disposal. Obsolete pesticide stocks are stored at the Desert Locust Center in Hodeidah and at Lahej in the south. These stocks consist of chlorinated hydrocarbon insecticides used in locust control, which are no longer approved for application, and so can not simply be used up. They can pose serious environmental problems and require immediate appropriate disposal.

## **D Summary Table of Key Environmental Problems**

To focus initial NEAP activities on the most urgent national issues, the eleven problem areas were further narrowed down to four main problems. Consensus was reached that the four main environmental problems presented in Table 7 below constitute the current national priority issues. Plans for dealing with these environmental problems and specific concerns, over the long term and in an immediate priority program, are discussed in Chapter V.

**Table 5: Main Environmental Problems and Specific Concerns in Yemen**

| MAIN PROBLEM                          | SPECIFIC CONCERN  |
|---------------------------------------|---|
| WATER DEPLETION, POLLUTION AND SUPPLY | <ul style="list-style-type: none"> <li>• OVER-EXTRACTION OF GROUNDWATER</li> <li>• LACK OF WATER ALLOCATION AND CONSERVATION SYSTEMS</li> <li>• WATER POLLUTION</li> <li>• INADEQUATE WATER SUPPLY SERVICES</li> </ul>                                      |
| LAND DEGRADATION                      | <ul style="list-style-type: none"> <li>• SOIL EROSION</li> <li>• DEFORESTATION</li> <li>• AGRICULTURAL AND P-RANGE LAND DETERIORATION</li> <li>• LOSS OF FARM LAND DUE TO URBAN ENCROACHMENT</li> </ul>   |
| HABITAT DEGRADATION                   | <ul style="list-style-type: none"> <li>• DEGRADATION OF NATURAL HABITATS (FORESTS, WETLANDS, COASTAL HABITATS)</li> <li>• LOSS OF BIODIVERSITY (EXTINCTION OF ENDEMIC, RARE AND ENDANGERED SPECIES)</li> <li>• LACK OF MANAGEMENT OF ECO-TOURISM</li> </ul> |
| WASTE MANAGEMENT                      | <ul style="list-style-type: none"> <li>• WASTE WATER MANAGEMENT</li> <li>• SOLID WASTE MANAGEMENT</li> <li>• HAZARDOUS WASTE MANAGEMENT</li> <li>• PESTICIDE MANAGEMENT</li> </ul>  |

### III. ENVIRONMENTAL MANAGEMENT FRAMEWORK

This chapter examines the existing framework for environmental management in Yemen. First, consideration is given to the national environmental organization, the national environmental fund, and to national environmental legislation. It will become clear that despite important efforts in environmental management made in recent years, Yemen still lacks adequate institutional and regulatory frameworks to manage its natural resources, disseminate information concerning environmental issues, and to fully promote public awareness and participation.

Subsequently in this chapter, environmental management is considered in an international context. Yemen's international obligations are discussed in terms of the international treaties and agreements on the environment that were ratified by the Government. Also, an overview is presented of ongoing and upcoming environmental projects supported by international donors. Here, the purpose is to demonstrate the commitment of both the Government and of international donors to Yemen's environment and to underline the cost involved for countries, such as Yemen, to adhere to international environmental conventions.

### A. Institutional Capabilities

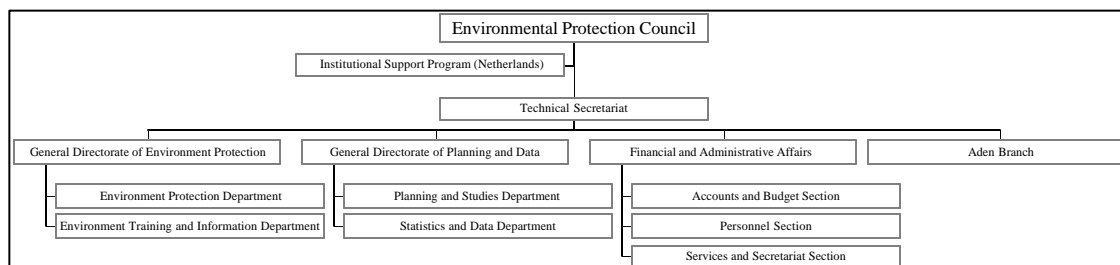
In 1990, immediately after the unification, the Government of Yemen constituted the Environment Protection Council (EPC) by Decree of the Prime Minister 94/1990. The EPC replaced two separate institutions for environmental management that existed in both the former PDRY and the former YAR. A National Council for Environmental Protection of the PDRY was organized in 1984 under the Ministry of Health and a Technical Committee was set up under the Ministry of Fisheries. An Environmental Protection Council was established in YAR in 1987, by decree of the Chairman of the Council of Ministers.

The EPC is an inter-ministerial council with broad responsibilities to manage the nation's environment. The budget of the EPC is part of the Cabinet budget. Its tasks are presented in summary form in Table 8. In 1992, EPC was expanded with a Technical Secretariat. The tasks and functions of the Secretariat were determined by Decree of the Prime Minister 34/1992. Three Directorates were set up to implement the Secretariat's functions, as shown in Table 9. In 1995 a detailed program of activities was developed for EPC in collaboration with the Dutch-funded institutional support program.

As of 1995, the EPC is composed of a Chairman, appointed on a permanent basis, and Council members appointed on an ad hoc basis. The following are Council Members: the Vice-Minister of Planning and Development, the Vice-Minister of Housing and Urban Planning, and the Vice-Minister of Oil and Mineral Resources, the Deputy Secretaries of the Ministry of Agriculture and Water Resources, the Ministry of Fisheries and Water, the Ministry of Transport, the Ministry of Industry, the Ministry of Health, and the Chairman of the National Water and Sanitation Authority (NWASA). The EPC therefore includes representation from the ministries with primary responsibility over natural resources management, or whose activities are potentially damaging to the environment. All ministries, corporations, and authorities are obliged to follow the directives of EPC, each within its own mandate.

**Table 6: Mandate of the Environment Protection Council**

|   |
|---|
| Propose general policies to protect the environment   |
| Coordinate the efforts of national, regional, and international agencies involved in environment protection   |
| Set up standards for control of air and water pollution and land degradation  |
| Formulate national environmental legislation and regulations and develop recommendations for ratification of international environmental agreements |
| Set up effective international cooperation and accommodate international environment funds  |
| Collect information, undertake assessments, and monitor mitigation measures   |
| Promote environment education and public awareness of environmental issues  |
| Monitor the nation's environment and report periodically to the Cabinet   |
| Program national study and education programs to train Yemeni senior staff in environmental affairs   |
| Organize seminars and lectures on environment and represent Yemen at international conferences  |

**Table 7: Organization Chart of the Environment Protection Council**

Numerous other institutions in Yemen play an active role in management of the nation's resources. These include the Ministry of Planning and Development, the different line ministries and their specialized agencies and departments, local administrations, universities, NGOs, and the communications media. The system is characterized by the centralization of the management of natural resources at the national level, under the responsibility of the line ministries. The provision of many environmental services, such as urban water supply, wastewater collection and disposal, and solid waste management is also centralized at the national level. In addition, the Universities of Sana'a and Aden have developed some research and training in the environmental field, although both institutions are under-staffed and under-equipped. A few recently created environmental NGOs (c.g., Yemeni Society for Environmental Conservation, Yemen Omithological Society) contribute to the expansion of public awareness and education on environmental issues.

**Constraints in Environmental Management.** Despite the contributions of EPC, of line ministries, and of other organizations, in the management of Yemen's environment significant institutional problems remain. Below is an overview of the main issues.

**Coordination of national efforts.** Among the many agencies with natural resource management responsibilities at the national level, there is fragmentation and a lack of coordination. For example, at least four ministries and a number of government agencies share responsibility for water management but do not coordinate their operations. This leads to overlap and duplication of functions. In addition, competing sectoral interests undermine the establishment of overall objectives and formulation of policies and strategies for resource management.

**Coordination of international efforts.** Coordination of the efforts of various donors in Yemen also is an important issue in environmental management. Although donors occasionally meet to coordinate their activities, there has been little coordination among donors and the Yemen government on environmental projects. The Ministry of Planning is initiating efforts to improve donor coordination on environmental projects. The Environment Protection Council will take a lead role in such coordination activities

**Management.** There are gaps in management. Some areas of environmental concern are not addressed at all. For example, there is no agency designated to coastal zone management. There is no Department in the Ministry of Tourism to deal with Eco-tourism. There is no central authority to deal with oil spills. Although spills within the confinement of harbors are under responsibility of the port authorities, there is no budget allocated to control oil pollution.

**Local administration.** The increasing demands for environmental services associated with the rapid urban growth have not been met by line ministries, as a result of their limited managerial, institutional and financial capacities. The role of local administrations in the provision of these services

is limited, although the allocation of key natural resources, such as water, is mostly regulated at the local level through customary law. At present, most municipalities do not have the mandate or resources to provide even basic services such as waste collection and disposal. Recognizing the need for decentralization, the Government is creating greater administrative and financial autonomy for local governments. The proposed Municipality Law is the first step toward achieving this objective. According to this law, local authorities will be able to expand their services through central government transfers and increased local taxation. These reforms are expected to have an immediate impact on the management of the urban environment.

**Enforcement of existing legislation.** The institutional capacity in Yemen to enforce environmental regulations, and ensure compliance with national and international laws, lags behind what is anticipated by legislators. In particular, the existing capacity to implement international treaty obligations is missing (as in CITES reporting, toxic dumping reporting, port facilities that comply with MARPOL requirements).

**Financial resources.** Despite its initial efforts in institutional strengthening and training, the EPC Secretariat still has insufficient resources to fulfill its present mandate. Critical issues include the shortage of professional and managerial staff, the absence of skills in some environmental fields, and insufficient equipment and information resources. Moreover, its limited budget has forced EPC to rely heavily on external technical assistance.

**Scientific support.** The weakness of scientific capabilities in the domain of environmental sciences is an additional constraint to the work of the environmental administration. Academic research activities have been meager at the Universities of Sana'a and Aden, given the shortage of qualified staff, equipment, and financial support. Some applied research has been developed by specialized departments in sector ministries, but its findings have not been widely disseminated. Insufficient resource data and the capacity to collect, analyze, store, disseminate, and update those data place additional constraints to effective environmental management.

## **B. Yemen Environment Protection Fund**

The Environment Protection Law of 1995 specifically stipulates the establishment of a special Yemen Environment Protection Fund. The text is as follows (unofficial translation of Article 92):

*"By resolution of the Prime Minister, the EPC shall establish a special fund to be named the Yemen Environment Protection Fund. All money allocated by the Government to protect the environment shall be deposited there as well as all moneys, grants, donations, and assistance which are approved and accepted by EPC from national and international agencies or individuals. The EPC shall allocate the funds to achieve protection of the environment in accordance with the resolution of the Prime Minister, stipulating the purposes and regulatory matters of the fund".*

EPC has recently taken steps to establish the Fund, which will give the Council much needed capacity to support environmental activities in Yemen. It is expected that on a day-to-day basis the fund will be managed by the Chairman of the EPC or his delegated authority. The Fund is to be audited by the Government Audit Agency. An overview of the Fund's potential resources, beneficiaries, and projects, as proposed in a preliminary fashion, is presented in Table 10.

**Table 8: The Yemen Environment Protection Fund**

| <b>Fund Features</b>   | <b>Proposed Main Characteristic</b>  |
|------------------------|--|
| Potential Resources    | <ul style="list-style-type: none"> <li>• Government allocations for environment protection</li> <li>• Grants, donations, and assistance from national or international agencies or individuals</li> <li>• Percentage of revenue from penalties ordered by the Courts in cases of non-compliance with environmental standards, regulations, or laws</li> <li>• Fees from licenses issued by EPC</li> <li>• Revenues from nominal charges for environmental protection</li> <li>• Fees for services provided by EPC</li> </ul> |
| Eligible Beneficiaries | <ul style="list-style-type: none"> <li>• EPC - in particular to execute projects as identified in the NEAP</li> <li>• Line Ministries - to support activities in environment protection</li> <li>• Local Administration and NGOs - in particular to execute pilot projects</li> </ul>  |
| Eligible Projects      | <ul style="list-style-type: none"> <li>• Private sector - to support incremental investments necessary to minimize pollution or degradation</li> <li>• to minimize adverse effects of catastrophes on the environment</li> <li>• to implement pilot project in environment</li> <li>• to support transfer of appropriate environmental technologies</li> <li>• to contribute to the establishment or protection of protected areas</li> <li>• to support research in environment</li> </ul>                                  |

### C. Legal and Regulatory Instruments

The Yemeni legal system is based on Islamic law, Turkish law, English common law, and local customary law. Statutory law was introduced by the British in former South Yemen. According to the Unification Declaration, the existing laws and provisions of both the former YAR and PDRY remain valid and applicable to Yemen as a whole, until consolidated or replaced by new legislation.

In 1995, Parliament enacted a comprehensive Environment Protection Law. The law is designed to safeguard sustained use of the national resource base and provides a comprehensive framework for environmental management and the establishment of sectoral legislation. It outlines the basic objectives and the roles of concerned authorities in the protection of air, water, and soil, and establishes controls on pesticide use, environmentally damaging activities, transportation and disposal of hazardous materials and wastes, environmental monitoring, and marine pollution. The law also proposes broadening the role of EPC to include statutory planning, licensing, monitoring and auditing functions. It outlines the procedures for developing, adopting, and monitoring environmental standards, and project licensing. It also establishes the principle of environmental assessments.

There is as yet no comprehensive regulatory framework for environmental management to support the Environment Protection Law. Such regulations and standards should be formulated and implemented in accordance with available technical, financial, and enforcement capacity. Priorities include creating a permit system for polluting activities and establishing environmental assessment procedures. Regulations should be developed in line with existing codes. Islamic legal provisions, for

example, address many aspects of the relationship between society and the environment, and they have a strong role in the definition of land and water rights as well as the management of natural resources at the local level. Other existing legislation deals with the management of specific natural resources (for example, fisheries, water supply) and public health and safety aspects. Some environmental provisions are scattered in legislation primarily concerned with other subjects, such as the penal code, the labor law, municipal laws, and the PDRY Constitution. The protection of the coastal environment is a notable exception. The PDRY government passed comprehensive national maritime legislation that covers activities at sea (transport of goods, navigation, and shipping), and the protection of the marine environment.

In addition to the Environment Protection Law, several new laws related to the environment are in various stages of development. The Law for the Protection of the Marine Environment from Pollution will deal with the pollution of the marine environment by oil and its products, both and marine structures and from shore-based operations. The Civil Aviation Law will deal with and atmospheric pollution. The Land Use Law will address the environmental effects of automobiles and roads, and the Ports Law will deal with the environmental protection within port areas. Finally, the proposed Municipality Law deals with the decentralization of the provision of public services. Also, a new Forest law and new Water and Sewage Law are in preparation.

#### D. International Environmental Conventions

Yemen has international environmental law obligations that are directly related to its national environmental planning activities and concern both the marine and terrestrial habitats. Many of the global treaties and conventions protecting the environment were ratified by either the former YAR and/or the **former PDRY**. According to the Unification Declaration, the international conventions ratified in this manner remain valid and are applicable to the whole nation.

By themselves, international conventions have little direct impact on environmental conditions in any given country. In most cases international law is implemented through domestic legislation and environmental actions. Different scenarios may occur depending on the particular case. Firstly, the international agreement may already be covered by similar national laws, and no particular action is required to comply with the international agreement. Secondly, the implementation of international law may be in line with national legislation but may call for additional monitoring or regular reporting to an international agency. Thirdly, international agreements may require new or substantially changed national laws and new compliance measures.

Yemen has ratified all conventions listed in Table 11 (if the former YAR and the former PDRY signed the convention, then only the earlier date is given). The Yemen Government is concerned about effective implementation and enforcement of international obligations in light of national financial and managerial constraints. Yemen has not ratified the MARPOL agreement due to a lack of funds to purchase the necessary port waste reception facilities. Ratification of other international environmental conventions has been slow for similar reasons; the few conventions not yet ratified by Yemen are listed in Table 12.

**Table 9: Global Conventions Protecting the Environment Ratified by Yemen**

|   |                        |
|---|------------------------|
| Framework Convention on Climate Change (New York, 1992)   | 3.12.1995              |
| Convention on Biological Diversity (Rio de Janeiro, 1992)   | 3.12.1995              |
| Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel, 1989) | 1992                   |
| Protocol on Substances that Deplete the Ozone Layer (Montreal, 1987)                                      | Approved by Parliament |
| Convention for the Protection of the Ozone Layer (Vienna, 1985)   | 3.12.1995              |
| Protocol concerning Regional Cooperation of the Red Sea and the Gulf of Aden                              | 20.8.1985              |

|   |            |
|---|------------|
| Environment   |            |
| Regional Convention for the Conservation of the Red Sea and the Gulf of Aden (PERSGA) (Jeddah, 1982)  | 20.8.1985  |
| United Nations Convention on the Law of the Sea (Montego Bay, 1982) UNCLOS)   | 10.12.1982 |
| Agreement on Banning the Use of Technologies that Change the Environment for Military Purposes and for Any Other Aggression (Geneva, 1977)                                    | 5.10.1978  |
| Protocol on Interference on High Seas in case of Marine Pollution with Substances other than Oil (London, 1973)   | 30.3 1983  |
| Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London, etc., 1972)   | 6.3 1979   |
| Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons, and on their destruction (London, etc. 1972) | 1.6.1979   |
| Convention Concerning the Protection of World Cultural and Natural Heritage (Paris, 1972)   | 7.1 1981   |
| Agreement on Civil Responsibility of Marine Transport of Nuclear Materials (Brussels, 1971)   | 4.6.1979   |
| Convention on Intervention on High Seas in case of Catastrophes of Oil Pollution (Brussels, 1969)   | 4.6.1979   |
| Agreement on Civil Responsibility concerning Damage from Oil Pollution (Brussels, 1969). Amended (London 1981)  | 4.6.1979   |
| Agreement for Combating Desert Locust (FAO, Rome, 1965)   | 20.3.1969  |
| Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Underwater (Moscow, 1963)   | 1.6.1979   |
| Convention for the Safety of Life at Sea (1960)   | 1969       |
| Convention for the Prevention of Pollution of the Sea by Oil (1954)   | 6.6.1969   |

**Table 10: Global Conventions Protecting the Environment Not Ratified by Yemen**

|  |
|--|
| <p>Convention on the Conservation of Migratory Species of Wild Animals (Bonn, 1979)</p> <p>Protocol Relating to the International Convention for the Prevention of Pollution from Ships, 1973 (London, 1978). [MARPOLI</p> <p>Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington, DC, 1973) [commonly known as CITES]</p> <p>Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar, 1971)</p> <p>Treaty Banning Nuclear Weapon Tests and Other Weapons of Total Destruction on the bottom or the Sea, Oceans, and Underground (London, Moscow, Washington, 1971)</p> |
|--|

Implementation of international treaty obligations invariably becomes the responsibility of a national agency. It appears that, in Yemen, the capacities of national agencies to deal with the technical complexities and reporting requirements of international agreements are underestimated. For example, Yemen is a party to several international conventions dealing with the marine environment, but does not have sufficient capacity to enforce them. With respect to oil pollution, the International Convention for the Prevention of Pollution of the Sea from Ships (1973) and its Protocol of 1978 prohibits any discharge of oil or oily products into “special areas” of the sea. Although the International Maritime Organization designated the Gulf of Aden as a special area in 1989, there is no capacity to enforce the regulations; tankers continue to discharge dirty ballast water and tank washings into the Gulf of Aden. Although there is oil spill clean-up equipment available in Aden, the existing clean-up capability is insufficient in the event of a major spill.

It is clear that the assignment of new responsibilities to a technical agency or department to implement international treaties should go hand in hand with technical and financial strengthening of the agency concerned.

### **E. Intentional Environmental Project Support**

This section includes information on Yemen's international links in environment, and deals in particular with the support in environmental projects which Yemen is receiving. Donor-supported environmental management projects focus on general environmental concerns, including institution building, on water resources, on land resources, on waste management, and on habitat protection. Examples of important ongoing project efforts are given below. A detailed list of all ongoing and pipeline environmental projects is included in Annex 1.

#### General Environment

The Dutch government supports an institution building project that will strengthen the capacity of the EPC to acquire and analyze environmental data as well as disseminate environmental information to concerned ministries, departments, and the general public.

#### Water Resources

A UNDP/ Netherlands Government funded project to strengthen water resources management capabilities is aimed at national capacity-building in water resources management to establish an independent and neutral water resources authority.

The World Bank is assisting Yemen in the preparation of a national Water Strategy.

#### Land resources

IFAD is assisting the Yemen government in the Tihama Environment Protection Project. The project has an overall goal at the national level of contributing to the ROY's program for improving the standards of living of rural people. Achievement of this goal involves enhancing production and productivity from crops and livestock, and supporting essential household activities.

A World Bank and UNCDF-funded Land and Water Conservation Project aims to strengthen sustainable agriculture through (i) developing irrigation and forestry institutions and technologies; (ii) initiating a program of water resources monitoring and regulation in the agriculture sector, (iii) improving water use efficiency in irrigated agriculture; (iv) conserving key indigenous forest areas, accelerating tree planting and extending soil and water conservation; and (v) establishing approaches for watershed management and terrace stabilization.

#### Waste Management

The World Bank is assisting Yemen in supporting the Taiz Flood Disaster Prevention and Municipal Development Project. The objectives are (i) to provide most needed flood control structures to protect private and public buildings and infrastructures; (ii) to implement a project cost recovery mechanism at a municipal level, and to promote implementation of a national municipal resource mobilization policy; (iii) to strengthen the urban management capabilities; and (iv) to strengthen the institutional capacity to address urban problems more effectively.

### Habitat Protection

The World Bank, IFAD, and the EEC supported Fourth Fisheries Development project is concerned with achieving sustainable use of marine resources. The objectives of the project are (i) to increase fish catch and improve processing for both local consumption and export; (ii) to improve the efficiency of domestic and export marketing of fish; (iii) improve the assessment and management of the fisheries resources in Yemini waters, and (iv) to help improve the position of fishing communities.

The Global Environment Fund (GEF) supports the Government of Yemen to protect marine ecosystems of the Yemen Red Sea coast including coral reefs and other critical habitats, by assisting in the development of the sustainable use of its marine resources. Project support takes place in the Protection of Marine Ecosystems of the Red Sea Coast (YEM/92/G31) project.

Switzerland provides support in Phase 111 of the Forestry Development project in an effort to increase tree and forest cover in Yemen in order to maintain the ecological stability upon which food production and producers depend.. The project provides institutional and organizational support, coordination of forestry activities, training, forest management, and information support.

## **IV. ENVIRONMENTAL ACTIONS**

The purpose of this chapter is to present a program of actions that responds to the environmental problems and issues identified in the previous Chapters III and IV, and thus ensure some measure of sustainable development.

The program of actions was developed in a participatory manner. It involved (i) preparatory analyses made by resource persons, (ii) active involvement during a special seminar of a wide range of persons from the private sector, NGOS, universities, and government agencies, and (iii) discussions and verifications carried out by resource persons and environmental specialists. The program was developed in the course of a four-step process. The following two chapters reflect this process; they consists of two sections each. This chapter contains the following two sections:

In section V.A, the environmental problems identified in Chapter III are translated into targets and the potential actions, or policy options, to achieve the targets are presented.

Then, in section V.B, a comprehensive set of actions required to attain each one of the targets is given. This includes reforms that are already being initiated. All the sector specific targets are grouped by main problem and the actions are presented in table format in one comprehensive plan that addresses the four sector-specific environmental issues: water resources, land resources, habitats, and waste management. These sector-specific actions include institutional and policy reforms as well as key capacity building activities as necessary prerequisites for future investments.

### **A. Comprehensive Environmental Action Program**

#### **1 . Water Resources**

Water supply is a major, national concern in Yemen. Several studies have urged concerted action to help resolve the difficult issues. The consensus is that water resources management should first aim at the passage of a basic water law, on establishing an appropriate institutional framework, on introducing appropriate pricing of water, and participation of user groups in regulation. Although these are the essential pre-conditions for effective management and for obtaining support from the donor community, other fundamental improvements are needed as well. In this respect, the NEAP primarily emphasizes the environmental concerns of depletion and degradation of water resources. The Ministry of Electricity and Water is planning a number of concrete actions, as shown in Table 16 below.

**Table 11: Water Resource Actions Planned by the Ministry of Electricity and Water**

| No. | Actions  | Est. Cost<br>million US\$ |
|-----|--|---------------------------|
| 1   | Design sewer systems for rural areas and governorate centers   | 1.00                      |
| 2   | Establish of a pilot farm for the reuse of treated sewage water  | 3.00                      |
| 3   | Prepare studies and proposals for protection of water sources in all rural areas   | 0.50                      |
| 4   | Build pilot sewer units in a number of governorates and districts  | 2.00                      |
| 5   | Establish 10 water and sewage laboratories in governorate centers and provide<br>20 field labs and chemicals for testing water quality | 1.25                      |
| 6   | Provide of equipment, sterilizing material and chemicals for use in emergencies  | 0.25                      |
| 7   | Conduct research into pests and pest control methods and provide extension<br>services to farmers                                      | 0.20                      |
| 8   | Provide about 10 trucks for emptying and disposing sewage from septic tanks  | 1.00                      |
| 9   | Provide training courses in water and waste water safety   | 0.10                      |
|     | Total  | 9.30                      |

The actions identified in the NEAP aim to integrate the above plans. The three main targets in water resource management are listed in Table 13 and NEAP actions are briefly discussed below.

#### a) Legislative Tools

The passage of new water legislation and related policy reforms are needed to promote the conservation of ground water and influence user demand. New legislation is essential to establish a coherent water rights framework that recognizes both traditional practices and the need for managing water use and quality in line with national objectives. Two draft water laws have been proposed and are under review by a Cabinet committee. This review needs to be followed up by public discussion to ensure that all concerned understand the political and cost implications and that the proposals receive broad public acceptance prior to submission to the legislature.

Improved direct regulation should be based on three principles: (i) simplicity, the simpler the regulation, the more likely that it will be effective, (ii) full community participation, and (iii) alignment with policies that encourage conservation and influence demand.

#### b) Institutional Measures

The most critical institutional reform is the establishment of an effective National Water Resource Authority. A coherent administrative framework for water resource and water quality planning and management should be established. The authority should have an inter-departmental Board, supported by a technical staff, with powers over national policy, planning, data handling, regulation and monitoring. It would consolidate in one organization staff of the Technical Secretariat (TS)/High Water Council (HWC), the Department of Hydrogeology (DH)/MOMR, and Water Resources Sector (WRS)/MAWR. Further, the Authority should have powers over water allocation and water rights administration and work closely with other agencies responsible for: (i) delivery of water services (e.g., irrigation, water supply, sewerage); (ii) administration, registration, and enforcement (e.g., local government, the police, communal entities); (iii) technical and monitoring capacities at the local level (e.g., RDAS, oil firms, water utilities); and (iv) environmental management.

c) Economic Instruments

Setting a price on water for domestic, industrial, agricultural, and municipal uses is the most effective way to promote conservation and allocating it to the most valuable purposes. Specific economic instruments considered include:

1. levying special water charges taxes (based on the size of the irrigated area and cropping regime of each farm) to discourage the production of crops with intensive water requirements or encourage the production of crops with low water requirement;
2. crop taxation to penalize the cultivation of water-intensive crops (for example, raising qat tax and shifting its method of assessment and collection to taxing producers on an area basis as well as maintaining the excise tax on sales to consumers);
3. levying equipment taxes on water pumps (loaded against higher capacities) and spare parts for drilling rigs, pumps, and irrigation equipment to encourage water conservation;
4. land taxes, which can be introduced in areas benefiting from public sector investment projects as a means for recovering investment costs of civil works in irrigation projects; and
5. lifting bans on agricultural imports, which will lessen the demand for agricultural water.

Incentives are further recommended to introduce technical innovations to reduce demand for water and encourage conservation of agricultural and domestic supplies. For example, micro-irrigation has an important potential because evaporation is reduced significantly. Other practices that could play an important role to reduce irrigation water demand include canal lining, pipe distribution, improved accounting for water, and maintenance of distribution systems.

d) Financial Investments

Increased capital investment will be needed for addressing the growing water supply needs in Yemen. Together with any major investments in infrastructure, emphasis should be placed on investigating alternative supplies and technologies. The development of alternative sources of supply involves the investigation of new sources of fresh water to augment existing supplies. The types of alternative system to be investigated include non-conventional sources such as wastewater re-use, brackish water irrigation, and desalination which can involve high costs and environmental risks, but typically face fewer allocation problem.

e) Information Instruments

It is essential in water management to have access to water resource information, and a central water resource data base should therefore be set up.

f) Community Involvement

To involve the public in water conservation, particularly through more efficient farming and irrigation techniques, and to protect its quality, public awareness programs at the grass roots level and the continuation of extension programs, such as those currently being carried out by FAO, will be needed. An important way to promote conservation awareness is to build on the traditions of Islam. A guide is already available regarding "Islamic Principles for the Conservation of the Natural Environment." A similar guide focusing on Yemen conditions and prepared by Yemen sources with the cooperation of religious leaders in the country would facilitate the overall promotion of water conservation in the country.

**Table 12: National Environmental Actions Required in Water Resource Management**

| <b>Targets/<br/>Instruments</b>  | <b>Legislative<br/>Tools</b>  | <b>Institutional<br/>Measures</b>   | <b>Economic<br/>Instruments</b>   | <b>Financial<br/>Investment</b>   | <b>Information<br/>Instruments</b>   | <b>Community<br/>Involvement</b>   |
|--|---|---|---|---|--|--|
| <b>To Conserve<br/>Water Sources</b>   | Issue and enact the Water Law.<br><br>Issue regulations regarding import of water exploitation technology.  | Activate the National Water Resource Authority.   | Increase custom duties on drilling equipment.<br><br>Introduce new water tariffs that reflect the real cost.<br><br>Provide incentives to reduce water consumption in irrigation. | Build dams and water reservoirs, based on technical, economical and environmental feasibility.<br><br>Introduce water saving irrigation techniques and systems. | Upgrade information on water balance of aquifers.<br><br>Create a complete water resource database system.   | Continue public awareness campaigns to promote rational use of water.<br><br>Involve water users and local conservation groups in water management.                    |
| <b>To Protect<br/>Water Sources<br/>from Pollution</b>   | Issue by-laws for environmental protection .<br><br>Issue and enact the Water Law   | Establish centers for water quality control.<br><br>Create national network of water analysis labs.                                       | Impose penalties on polluters.<br><br>Support pollution-free industries.  |   | Disseminate information on water pollution, its causes and treatment.  |  |
| <b>To Provide<br/>Clean<br/>Drinking<br/>Water to 75%<br/>of the<br/>Population by<br/>the Year 2000</b> | Purify drinking water (network and wells).<br><br>Prohibit the use of drinking water for iqat irrigation.<br><br>Impose regulations to curb illegal water uses. | Strengthen national water authorities, in technical and administrative ways.<br><br>Promote private sector maintenance of water networks. | Increase tariff for water consumption.<br><br>Use revenues from water fees to protect, develop and conserve water resources   | Encourage private sector to build water reservoirs.<br><br>Adopt new technologies.<br><br>Develop alternative sources of drinking water.                        | Study existing water resources to know available drinking water.<br><br>Collect statistics on population, households and construction water needs. | Decentralize water management.<br><br>Empower local administration in water management.<br><br>Involve NGOs, private sector, and the media in water management issues. |

## 2. Land Resources

Reversing current trends in agriculture, range management, and forestry practices is necessary to sustain Yemen's economy. Priority actions should focus on expanding resource planning, legislation, and raising public awareness.

### *a) Legislative Tools*

Actions should focus on establishing laws and regulations that will modify unsustainable agricultural and other land use practices, particularly the removal of vegetation and poor maintenance of terraces,

that perpetuate land degradation. A priority action is the establishment of a regulatory framework. The national government should establish and properly implement and enforce clear laws and regulations that promote maintenance and use of terraces.

A poorly functioning titling and land registration system as well as inadequate land development regulations, affect the supply of urban land for housing the poor, the occupation of hazard-prone, and environmentally or agriculturally sensitive areas. To address these issues, appropriate land titling and land registration systems should be introduced.

*b) Institutional Measures*

Reversing land degradation also requires the formulation of a land management plan addressing the causes of deforestation and erosion, proposing appropriate curative and preventive solutions, and indicating where particular kinds of land use can best take place. Such a plan should be based on the work of the FAO Rural land use planning project.

*c) Economic Instruments*

In addressing the erosion problem, the Government will need to identify and then provide effective incentives to promote conservation activities such as tree-planting and maintenance of terrace areas.

Development of alternative source of energy should involve interfuel substitution to reduce the demand for fuelwood and slow the rate of deforestation. Actions include improving Liquid Petroleum Gas (LPG) production, bottling, and delivery systems; improving the management of LPG operations; and developing a consistent pricing policy to encourage LPG use.

*d) Financial Investments*

Implement the most urgent, as yet un-funded, project of the National Program for Desertification Control (NPDC). All projects proposed under NPDC that are not funded now are listed in Table \_\_. According to the DG of Forestry Department the first priority projects are No. 1, 4, and 21 shown in the table.

*e) Information Instruments*

To facilitate effective land management, technical support will be needed to expand information on Yemen's land resources (e.g., rates of depletion and degradation) and manage that information through an appropriate data base and introduction of a low-cost GIS. Efforts should focus on critical data needs and the type of data base and GIS that will be required for effective land management.

*f) Community Involvement*

Although environmental awareness campaigns have been launched through the media, there is an urgent need to initiate awareness raising about environmental degradation and soil and water conservation needs at the decision-making level. In addition, public awareness should be enhanced through pilot projects and school programs.

**Table 13: Projects of the National Program for Désertification Control (NPDC)**

| Project Number | Project Title  | Estimated Cost in US S |
|----------------|--|------------------------|
| 1              | Evaluation of desertification and preparation of desertification maps of Yemen                   | 750,000                |
| 2              | Development of public awareness on combating desertification                                     | 256,000                |
| 3              | Sand dune stabilization, south of Wadi Rima'a  | 1,000,000              |
| 4              | Sand dune stabilization, west of Wadi Sihamm   | 1,900,000              |
| 3              | Establishment of green belts around irrigation schemes in Tihama to improve production           | 1,200,000              |
| 6              | Sand dune stabilization and establishment of green belts in Tihama                               | 1,600,000              |
| 7              | Sand dune stabilization and establishment of green belts as windbreaks in Marib                  | 1,100,000              |
| 8              | Preparation of regional maps to plan sand dune stabilization and establishment of green belts    |                        |
| 9              | Fixation of the slopes of Wadi Garthan and Sa'aid by planting trees                              | 50,000                 |
| 10             | Channel improvement of four wadis by plant cover in Hdramawt Wadi                                | 200,000                |
| 11             | Support to the Aden Green Belt project   | 150,000                |
| 12             | Support to the establishment of nurseries in the southern Governorates Kode, Hodah, Dalia, Sayon | 300,000                |
| 13             | Preparation of a soil fertilizer code  | 100000                 |
| 14             | Rehabilitation of Wadi Shariss watershed - pilot project   |                        |
| 15             | Establishment of windbreaks in Delta Lahig   | 125,000                |
| 16             | Sand dune stabilization along the road Aden - Taiz   | 150,000                |
| 17             | Sand dune stabilization south of Abian delta   | 50,000                 |
| 18             | Establishment of windbreaks and green belts in the lower and middle delta of Wadi Bana           | 150,000                |
| 19             | Establishment of windbreaks in the farmland of the Salama area                                   | 100,000                |
|                | Sand dune stabilization in Hadia, Hadramawt  | 100,000                |
| 21             | <b>Establishment of windbreaks in farming areas in Hadramawt</b>                                 | <b>150,000</b>         |

Table 14: National Environmental Actions Required in Land Resource Management

| Targets/<br>Instruments   | Legislative<br>Tools   | Institutional<br>Measures  | Economic<br>Instruments   | Financial<br>Investment   | Information<br>Instruments   | Community<br>Involvement  |
|---|--|--|---|---|--|---|
| <b>To Execute the National Program of Combating Desertification (NPCD)</b>                          | Issue a by-law to define the role of government in NPCD  | .Strengthen the General Department of Forestry and Combating Desertification in MAWR.<br><br>Establish desertification control and training center at universities of Sana'a and Aden. | Prohibit import of certain agricultural products to encourage local production.<br><br>Establish a National Fund to finance desertification combating activities. | Provide the financial support to execute the NPCD.<br><br>Create green belts around coastal cities and towns having desert climate.                 | Review and update the NPCD.<br><br>Identify desertified areas.<br><br>Determine suitability to re-use water in combating desertification.                                    | Arrange awareness programs for decision maker in Governor-ates. |
| <b>To Improve Management of Forests</b>   | Enact forest and grazing ground law.<br><br>Issue by-laws for the forests and grazing groundlaw and clarify penalties.                   | Train staff and technicians of the Forestry Department.<br><br>Strengthen forest research centers.   | Impose penalties on cutting trees.<br><br>Give incentives for using gas, kerosene and solar energy instead of fuelwood.   | Invest in establishing economically sustainable forests with contribution from the private sector.<br><br>Distribute tree seedlings free of charge. | Select suitable and low-cost varieties of trees for forests.   | Support the national program for tree plantation.               |
| <b>To Improve the Management of Agricultural Land and Grazing Ground</b>                            | Issue land tenure law.<br><br>Design and enforce a system for registration of agricultural land holdings.                                | Expand agricultural extension services.  | Improve mechanism of loan provision for terrace rehabilitation.<br><br>Give priority to women in loan provision to improve agriculture.                           | Develop agricultural markets to increase production.  | Classify and zone land according to its agricultural characteristics.<br><br>Study existing conditions of agricultural terraces.   | Promote terrace rehabilitation with local communities.          |
| <b>To Establish a System of Land Use Planning/ Zoning and Identify Protected Agricultural Areas</b> | Conduct EIA for urban development projects.<br><br>Introduce land use planning/ zoning to protect agriculture areas for urban expansion. | Create a unit in MAWR for land use planning and zoning.<br><br>Strengthen land use surveying authorities.<br><br>Strengthen the Statistics, Planning Units in MAWR.                    |   |   | Concentrate research on farming systems.<br><br>Train staff in EPC, MCHUD and Ministry of Legal Affairs in EIA procedures.<br><br>Establish a database and GIS for land use. |   |

### 3. Natural Habitats

Protecting the nation's habitats and reversing degradation requires a good understanding of exactly which habitats are present in Yemen. Other important factors are establishing sound institutional and policy frameworks and the building of coastal zone management capabilities.

#### *a) Legislative Tools*

A Protected Area Law should be enacted: (i) to provide a legal basis for establishing protected sites, (ii) to set penalties for non-compliance, and (iii) to provide for the implementation of EIA. In particular, the authorities should declare Socotra a national Protected Area. Compliance with land use regulations, assessment of environmental impacts, control of ocean dumping, control of discharges on land, and deforestation, control of fishing licenses, and effective conservation, land use, and pollution control policies are among the many further actions required.

#### *b) Institutional Measures*

Managing Yemen's habitats requires the establishment and implementation of an effective institutional framework. The existing mandates of the relevant institutions should be reviewed to ensure that there is no conflict or duplication. The role of EPC in habitat protection should be expanded.

Effective management of coastal resources requires the formulation of a coherent national Coastal Zone Management (CZM) plan that addresses the full range of coastal issues with possible linkages to other regional coastal management initiatives (e.g., West Indian Ocean). An environmental profile of the coastal areas is needed as the basis for a CZM plan. Proper management of coastal and marine resources requires a good understanding of the functioning of the marine and coastal systems, including an analysis to see how commercial fisheries have changed since the privatization of the fishing industry in southern Yemen and the return of the Gulf workers. Coordinated by EPC, organizations such as the Marine Pollution Center of the Marine Science and Resources Research Center and the Oceanography Department at Sana'a University should be involved in the CZM planning process.

#### *c) Economic Instruments*

A program should be initiated to provide, or promote the use of Liquid Petroleum Gas (LPG) in rural areas and to encourage the production of gas and solar energy appliances. Recommendations of the LPG Substitution Program (1993), a GEF pre-investment project, should be implemented.

#### *d) Financial Investments*

Investment in habitat protection should be in the development of national parks, green belts around cities, and public gardens in towns and villages.

#### *e) Information Instruments*

The need for a full biodiversity inventory of Yemen, the related data base, and GIS system, are among the most important actions needed in habitat protection.

#### *f) Community Involvement*

The introduction of environmental education in basic and higher education and the involvement of the public - including the youth and women - is essential in environmental conservation.

## g) Socotra Island Protected Area Management

Of special concern in the conservation of critical habitats in Yemen is the development of a protected area on the island of Socotra. This has been a concern for some time. There is also the concern that the population of the island should fully support and benefit from conservation efforts. Any plans for protection of island resources must at the same time be linked to economic development of the island to achieve sustainability.

The preparation of a land use masterplan is considered a priority prior to achieve a reasonable balance between conservation and development. Clearly, a balance between the two activities is required before meaningful protection measures can be taken. A Socotra land use master plan should integrate conservation and development expectations. Such a masterplan should include some control over further immigration, settlement and tourism on the island to avoid proliferation of human impacts. Plans should be made in close collaboration with the local population and carefully explained in a comprehensive public participation process. Community involvement is crucial for the success of any resource management program in Socotra. It is important to have an approach integrating both conservation and development interests.

**Table 15: National Environmental Actions Required in Habitat Management**

| <b>Targets/<br/>Instruments</b>   | <b>Legislative<br/>Tools</b>   | <b>Institutional<br/>Measures</b>  | <b>Economic<br/>Instruments</b>  | <b>Financial<br/>Investment</b>  | <b>Information<br/>Instruments</b>   | <b>Community<br/>Involvement</b>   |
|---|--|--|--|--|--|--|
| <b>To Stop the<br/>Degradation of<br/>Natural<br/>Habitats</b>  | <p>Declare Socotra a protected area.</p> <p>Declare other areas as protected areas.</p> <p>Prepare and enact a Protected Area Law.</p> | <p>Expand EPC to have branches in all governorates.</p> <p>Establish a joint scientific committee between Yemen and regional countries for exploitation of fisheries resources.</p> <p>Prepare a Coastal Zone Management Plan.</p> | <p>Support a program to provide/ Promote the use of gas to rural areas and encourage the production of LPG and solar energy appliances in Yemeni market.</p> | <p>Develop national parks, green belts around cities, and public gardens.</p> <p>Prepare and implement action plans to deal with catastrophic emergency situations from oil pollution in Yemeni and regional waters.</p> | <p>Prepare studies on critical habitats (e.g., Socotra, Bura'a and Al-Hawf forests, mangrove, coral reefs).</p> <p>Assess fish stocks.</p> <p>Select and rank sites to be developed as protected areas.</p> <p>Complete a sensitivity atlas.</p> | <p>Introduce environmental education in basic and higher education.</p> <p>Involve community leaders, youth and women, and NGOs in environmental awareness.</p> <p>Involve the public in environmental inspection and make use of their traditions and norms in env. conservation.</p> |
| <b>To Protect<br/>Biodiversity<br/>(in Particular<br/>Endemic, Rare<br/>and<br/>Endangered<br/>Species)</b> | <p>Implement the Wildlife Protection Law to prohibit trade, export, and hunting of rare and endangered species, such as falcons.</p>   |  | <p>Provide incentives to farmers who use natural biological control methods instead of pesticides.</p>   | <p>Re-introduce extinct species to their natural habitat in Yemen.</p> <p>Create nurseries for marine turtles.</p>   | <p>Create a national GIS and database for wildlife.</p> <p>Inventory endemic, rare and endangered species and</p>  |  |

| Targets/<br>Instruments                                       | Legislative<br>Tools | Institutional<br>Measures   | Economic<br>Instruments   | Financial<br>Investment                          | Information<br>Instruments | Community<br>Involvement |
|---|----------------------|---|---|--|----------------------------|--------------------------|
|   |                      |   |   | Establish<br>nature<br>museums and<br>genebanks. | their habitats.            |                          |
| <b>To Develop<br/>and Regulate<br/>Eco-Tourism<br/>Sector</b> |                      | Create an Eco-<br>Tourism<br>Department at<br>the GTA and<br>develop its<br>capacity. | Give incentives<br>to private eco-<br>tourism and<br>environmental<br>leisure projects. |  |                            |                          |

#### 4. Waste management

The challenge of waste water and solid waste management in Yemen is to maintain a healthy environment in conditions of rapid economic and social development and unprecedented population growth in the cities.

##### *a) Legislative Tools*

Regulatory measures are required to better control sewage disposal, and to prohibit the discharge of untreated solid and hazardous waste to sewage networks. By-laws and regulations are needed on disposal of solid waste, including the disposal of hazardous waste.

##### *b) Institutional Measures*

The institutional measures proposed aim at capacity building, a critical factor to improve waste management. Such management requires competent institutions with the skills and capabilities to develop, implement and enforce environmental laws, regulations and standards, mobilize revenue, and to develop urban infrastructure and services that incorporate appropriate technologies and standards.

Capacity building programs should be extended to two groups: (i) the public sector, at the national and local level, and (ii) the private sector, including industries, small enterprises and services, and local communities. The principal means by which these actors can build capacity include training, technical assistance, private sector participation, and public information and outreach programs.

##### *c) Economic Instruments*

Among the most important actions required is to give some incentives to the private sector to maintain sewage networks and waste water treatment plants.

##### *d) Information Instruments*

It is also recommended to conduct technical and economic analyses on solid and hazardous waste management. To address the growing threat of poorly managed solid waste, this study would include making an inventory of solid waste sources and its generation, evaluate waste management practices, assess technical and institutional alternatives to controlling wastes, and identify measures that need to be taken for hazardous waste, such as hospital wastes, oil waste, and obsolete pesticide stocks.

e) *Financial Investments*

A critical means for reversing environmental degradation and improving health conditions in urban areas is to upgrade the coverage, efficiency, and management of urban waste water and solid waste infrastructure and services. Many investments in waste water collection, treatment, and disposal as well as in solid waste collection, treatment, recycling, and disposal, can be left to the private sector. This can be done through competitive bidding arrangements, with initial support from the local Government, if necessary, and under license of the same Government to ensure quality services.

f) *Community Involvement*

Public awareness programs should inform those affected by uncollected and untreated waste or by improperly disposed waste about the risks and alternatives. Generally, this motivates such groups to monitor improvements in waste management and suggest appropriate changes.

**Table 16: National Environmental Actions Required in Habitat Management**

| <b>Targets/<br/>Instruments</b>  | <b>Legislative<br/>Tools</b>   | <b>Institutional<br/>Measures</b>  | <b>Economic<br/>Instruments</b>   | <b>Financial<br/>Investment</b>  | <b>Information<br/>Instruments</b>  | <b>Community<br/>Involvement</b>   |
|--|--|--|---|--|---|--|
| <b>To Provide<br/>Waste Water<br/>Collection,<br/>Treatment,<br/>and Disposal<br/>facilities</b>               | Regulate<br>sewage<br>disposal.<br><br>Prohibit<br>discharge of<br>untreated solid<br>and hazardous<br>waste to<br>sewage<br>networks.<br><br>Issue waste<br>water standards<br>and specs. | Strengthen the<br>capacity of<br>National<br>Water and<br>Sewage<br>Authority<br>(NWSA) to<br>organize<br>effective<br>sewage<br>disposal.<br><br>Develop a<br>national<br>policy for<br>urban waste<br>water<br>disposal. | Impose<br>equitable fees<br>for sewage<br>discharge.<br><br>Give incentives<br>to private sector<br>maintain<br>sewage<br>networks and<br>waste water<br>treatment<br>plants. | Maintain<br>existing<br>collection<br>networks.<br><br>Build new<br>waste water<br>treatment<br>plants.<br><br>Encourage<br>private sector<br>to invest in<br>sewage<br>disposal.                  | Issue<br>standards for<br>drinking<br>water, waste<br>water, and use<br>of treated<br>sewage water.<br><br>Collect<br>information<br>on existing<br>sewage<br>networks and<br>necessary<br>future<br>expansion. | Involve the<br>public in<br>decisions<br>regarding<br>sewage<br>disposal.<br><br>Use treated<br>waste water in<br>irrigation and<br>develop the use<br>of treated<br>sewage water. |
| <b>To Provide<br/>Solid Waste<br/>Management<br/>(including<br/>Recycling and<br/>Re-use of<br/>Waste Oil)</b> | Issue by-laws<br>on disposal of<br>solid waste.  |  | Impose fees for<br>the collection<br>of garbage.  | Improve<br>existing<br>landfills.<br><br>Develop new<br>landfills.<br><br>Encourage<br>private sector<br>to invest in<br>recycling<br>projects.<br><br>Build waste<br>oil treatment<br>facilities. | Inform<br>agencies<br>concerned on<br>waste disposal<br>procedure.<br><br>Collect data<br>on the amount<br>of used oil.<br><br>Conduct<br>research and<br>studies on<br>solid waste<br>management.              | Support the<br>public and<br>NGOs in<br>publishing and<br>following up<br>waste disposal<br>issues.<br><br>Execute<br>awareness<br>programs on<br>waste oil<br>disposal.           |
| <b>To Manage<br/>Hazardous<br/>Waste</b>   | Issue by-laws<br>on disposal of<br>hazardous<br>waste.   |  |   | Install<br>incinerators in<br>hospitals.   | Conduct<br>research on<br>hazardous<br>waste  | Operate<br>existing<br>incinerators in<br>hospitals.   |

| Targets/<br>Instruments                             | Legislative<br>Tools  | Institutional<br>Measures   | Economic<br>Instruments  | Financial<br>Investment | Information<br>Instruments  | Community<br>Involvement  |
|---|---|---|--|-------------------------|---|---|
|   |   |   |  |                         | management.   |   |
| <b>To Organize<br/>Environmental<br/>Inspection</b> | Issue-laws and<br>by-laws for<br>testing and<br>inspection. | Strengthen<br>testing and<br>inspection<br>capacities in<br>ministries<br>concerned.  | Impose<br>penalties on<br>violation of<br>environmental<br>pollution<br>regulations. |                         | Prepare<br>training<br>programs for<br>env.<br>Inspection<br>teams.                 | Involve the<br>public in<br>environmental<br>inspection and<br>awareness. |
| <b>To Manage<br/>Pesticides</b>                     | Issue pesticide<br>law and by-<br>laws.                     | Designate one<br>central<br>authority to<br>control<br>import,<br>distribution,<br>collection and<br>disposal of<br>pesticides. | Impose fees for<br>pesticide users<br>and penalties<br>on violators.                 |                         | Provide<br>statistical data<br>on required<br>quantity and<br>type of<br>pesticide. | Initiate public<br>awareness<br>programs on<br>the use of<br>pesticides.  |

## B. Priority Actions

The setting of priority actions within the context of the comprehensive, long-term action plan should ideally be based on quantification of the issues and actions involved, and their subsequent ranking. Unfortunately, only some environmental benefits can be quantified to some extent. Therefore, in order to determine the most urgent actions needed to address Yemen's environmental concerns, a pragmatic approach was adopted. This selection process was based on the judgment of environmental and sector experts, and aimed at avoiding duplication of ongoing efforts, at maximum environmental benefits, and at modest institutional requirements for implementation.

Some of these actions require only a minimum amount of financial resources and capabilities and can be successfully implemented at an early stage, others require more financial, political, or social preparation but are urgent. The remainder of this chapter identifies those institutional and sector-specific reforms that should be undertaken immediately. These are the urgent actions to be implemented over the coming five years. In the NEAP process, these actions were all selected from among those listed in Table 17, Table 19, Table 20, and Table 21. All other actions listed in the tables should be initiated at a later stage and should be examined again for the second phase of NEAP implementation.

As selected in the above manner, the priority actions of the Yemen National Environment Action Plan, are presented below in Table 22. The actions include urgent institutional actions, at the national, local, and regional levels, as well as sector-specific actions that are urgently needed. In the final stages of the NEAP process, a special effort was made to define the urgent actions more precisely. This was done to make the actions as explicit as possible. This was also done to facilitate and accelerate future detailed project design. For each of the urgent actions the following characteristics were determined: (i) overall goal, (ii) objective, (iii) expected outputs, (iv) key implementors, and (v) preliminary cost estimate in US\$. The detailed descriptions of the urgent actions are presented in tabular format from Table 23 to Table 29.

**Table 17: Priority Actions of the Yemen National Environment Action Plan**

| CATEGORY         | PRIORITY ACTION   |
|------------------|---|
| Institutional    | <ul style="list-style-type: none"> <li>• National - Capacity building of the Environment Protection Council (EPC) and its Technical Secretariat.</li> <li>• Local – Pilot program from improvement of environmental conditions at local level.</li> <li>• International – Disaster preparedness at Aden and Hodeidah ports for oil spills.</li> </ul>                         |
| Water Resources  | <ul style="list-style-type: none"> <li>• Strengthening of the National Water Resources Authority.</li> <li>• Development of a National Water Resources Information System.</li> <li>• Design of a comprehensive Water Law.</li> <li>• Improvement of rural and urban water supply services</li> <li>• Economic control of water waste and water pollution.</li> </ul>         |
| Land Resources   | <ul style="list-style-type: none"> <li>• Establishment of land use planning center to promote land zoning and land registration.</li> <li>• Implementation of identified priority projects in desertification control.</li> <li>• Promotion of traditional grazing reserves and modern pest management techniques.</li> </ul>   |
| Natural Habitats | <ul style="list-style-type: none"> <li>• Establishment of a National Protected Area on Socotra.</li> <li>• National inventory and data base development of fauna and flora.</li> <li>• Preparation of a Coastal Zone Management Plan.</li> <li>• Constitution of eco-tourism department at General Tourism Authority.</li> </ul>  |
| Waste Management | <ul style="list-style-type: none"> <li>• Closure/replacement of waste disposal site of Sana'a (Al-Azratayn), and elsewhere.</li> <li>• Privatization of solid waste collection and recycling.</li> <li>• Privatization of treatment, storage, and disposal of hazardous waste.</li> <li>• Regulation of hospital waste treatment and disposal, plus pilot project.</li> </ul> |

### 1. Institution Building Priority Actions

Among the urgent actions recommended, are those that are needed in building the country's institutional and regulatory framework for national environmental management. The first round of actions includes institutional strengthening at three levels, as follows:

National: strengthen EPC

Local: strengthen the role of local level administrations

international: strengthen Yemen's capability to meet its international obligations

The first priority action recommended by NEAP is to build the environmental management capacity of the EPC and its Secretariat (see Table 23). As shown in Table 8, many environmental responsibilities have already been assigned to EPC, and several of these ongoing operations need to be reinforced.. The NEAP program increases the management and coordination tasks of EPC substantially. NEAP specifically calls for direct supervision and management by EPC of cross-sectoral issues such as:

- Design of Environmental Impact Assessment procedures and standards
- Coordinating the compatibility of Government-owned GIS systems
- Development of the Environment Protection Fund
- Support to environmental units in line ministries
- Design of detailed by-laws of the Environment Law

EPC is further expected to take responsibility for coordination and monitoring of three sector-specific issues, as follows:

- Establishment of Socotra as a National Protected Area
- National inventory and data base development of fauna and flora
- Preparation of a Coastal Zone Management Plan

In addition, many sector-specific issues were identified that need to be implemented by line agencies, but that do require initiatives, coordination, or monitoring by EPC.

For EPC to operate in an effective manner, adequate human and financial resources must be allocated. At the same time, expanding the composition of the EPC and initiating the establishment of a national environmental authority are among important actions to be considered at an early stage to improve EPC's effectiveness.

Important capacity building results are expected from the two other, local and international, institution building priority actions, but with additional concrete side effects. The pilot program for improvement of environmental conditions at local level (see Table 24) is expected to enhance local institutional capabilities while improving land, water, and/or fish resource management, solid waste and waste water management, and in particular community involvement in environmental management. The marine disaster preparedness action at Aden port (see Table 25) will ensure that the port is prepared and that all emergency equipment is place in the port of Aden to rapidly deal with major oil spill disasters occurring in the Red Sea and West Indian Ocean areas.

Table 23

**Priority Action to Strengthen National Environment Management - EPC**

| Priority Action   | Overall Goal  | Specific Objective  | Expected Outputs                           | Implementation | Estimated |
|---|---|---|--|----------------|-----------|
|   |   | responsibility  | cost US \$                                 |                |           |
| Capacity building of Environmental Protection (EPC) of the national and regional level environmental management, and procedures and standards management in particular to coordinate the Government implementation of the NFAP owned GIS systems priority program | To contribute to national and regional level environmental management, and procedures and standards management in particular to coordinate the Government implementation of the NFAP owned GIS systems priority program | To enable Yemen's Environment Protection Council (EPC) to fulfill its mandate in the management of the Ministry of Planning and Development | In addition to ongoing EPC tasks, specific | EPC            | 4 million |
| Development of the Environment Protection Fund  |   |   |  |                |           |
| Support to environmental units in line ministries   |   |   |  |                |           |
| Design of detailed bylaws of the Environment Law  |   |   |  |                |           |
| EPC is also expected to coordinate three NEAP action as follows:  |   |   |  |                |           |
| Establishment of Socotra as a National Protected Area   |   |   |  |                |           |
| National inventory and data base development of fauna and flora   |   |   |  |                |           |
| Preparation of a Coastal Zone Management Plan   |   |   |  |                |           |
| '7 Ongoing EPC tasks continue in the following are": general environmental policy development; coordination among agencies and international organizations setting  |   |   |  |                |           |
| SUURW&', Pmffl laws and regulations*, organize international cooperation; collect information and conduct   |   |   |  |                | A- 1-à    |
| ng the condition of domestic national environment; prep« training programs, org&dm seminars and lectures 3*,ve op ucation uld 8wamess   |   |   |  |                |           |
| PrOgmms; monitor  |   |   |  |                |           |

Table 24

Priority Action

Priority Action to Strengthen Local Environment Management

Specific Objective

Implementation

responsibility

Local administration

NGOs and EPC

Estimated

cost in US \$

3 million

Overall Goal

Expected Outputs

pilot program for improvement of environment

To contribute to local level environmental management

Table 25

**Priority Action**

Program

Aden/Al Hudaydah

Hodeidah Port Authority

oil spill

management

To contribute to the protection of the region's coastal and marine environments

To test the potential for improved resource management in three local areas, particularly for farming, fishing, and urban communities"

Land, water, and/or fish resource management

improved

Solid waste and waste water management

improved

Alternative energy sources tested

Community involved in environmental

management

Productivity and family incomes increased

Production costs decreased

Nutrition improved

Quality of the environment enhanced

**Priority Action to Strengthen International Environment Management**

Specific Objective

To control the damage of major oil spill incidents and to manage the transfer and disposal of port ship waste

Expected outputs

Availability of emergency equipment in place in the ports of Aden and Hudaydah to rapidly deal with major oil spill disasters occurring in the Red Sea and West Indian Ocean areas.

Ports have facilities in place to receive and dispose of ship waste

Implementation

responsibility

Aden and Hudaydah Port Authorities

Estimated

cost in US \$

3 million

<sup>21</sup> The following representative sites are recommended for this project:

Fanning village: Qutaia in Rodcidah Governorate

Fishing village: Al A'am in Labey Governorate

Urban area: Beit Al Komani in Dhawra Governorate

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## 2. Sector-Specific Priority Actions

This section includes detailed specifications of the sector-specific priority actions recommended by NEAP. The priority actions are grouped in four categories: (1) Water Resources, (2) Land Resources, (3) Natural habitats, and (4) Waste Management. Each of the NEAP actions is described in the following tables: Table 26, Table 27, Table 28, and Table 29. Sector-specific priorities include financial investment, but cover establishing effective institutional and policy frameworks as well as expanding environmental information and public awareness.

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| Priority Action<br>Estimated   | Overall Goal  | Specific Objective   | Expected outputs   | Implementation<br>nsibility   | cost |
|--|---|--|--|---|------|
| in US \$<br>Stmngthening of<br>million<br>the National Watet<br>Resourcu<br>Planning<br>Àkuthotity<br>Development, F-PC<br>Developnient of a<br>National Water<br>National Water | To contribute to<br>sustained use of<br>Yemen's water   | To enable the National<br>Water Rtwurce Authority to<br>manage the nation's water  | NWRA staff trained<br>Water Management policy established<br>Plans for water basin dmplopmnt prepared  | National Water<br>Resources Authority<br>+ Nfnistry of  | 2    |
| <b>Re»Irm.</b><br>for modeling water<br>Information System   | Yemen's water<br>+ various line<br>remurm   | resources and plan water use<br>and monitoring network and<br>data systemresmrce management<br>Compatible data systems (GIS) ai water agencies | Water Basin Commissions established<br>Comprebensive hydro--melco network installed<br>Exploration drilling conducted to rili data gaps            | and<br>Computer capacity in place<br>entities which operate<br>data acquisition systems<br>National Water |      |
| Design of a<br>comprchensive<br>Wàier Làw<br>Nfnistry of Legal<br>resources<br>Affairs, and various line<br>ministries,  | To contribute to<br><b>100,000,9</b><br>sustained use of<br>Remurces Authority<br>Yemcn's water | Provide the recently<br>established National Water<br>Resources Authority  | Water policy statement approved<br>Water rights, particularly groundwater, clarified   | National Water  |      |
|  | (NWRA) with the legal<br>franiework to better manage<br>the scarce water resources              | Resources Authority  | Legal basis lo regulate water use established<br>Lcgal basis to deal with regional water transfers<br>Water Basin Administration Units established |   | +    |
| Implmment ofTo imprm the<br>mùlion"<br>rui-â and urban   | To imprm the<br>quality of life in  | To improve existing water<br>supply networks in urban  | Water users shm in management decisions<br>Water supply Master Plan prepared<br>Private pilot projects operational in rural and                    | Parliament<br>National Water and<br>Sewerage Authority'   | 3    |

Work has started under a UNDP- Duleh Project. Funds are needed to develop standards and specifications, to carry out 3 national workshom, and rerine the draft law Funds to uM out studies to assm netwoek losses (worthiness of expenditure on loss reduction), to prepare Master Plan, and amss the required investments To carry out nuver of water use (houmhold, on-farm, ...) and studies to determine technical modifications (drilling market ...)

| Priority Action<br>Estimated  | Priority Actions for Land Resource Management  |   |   |   | Implementation  |     |
|---|--|---|---|---|---|-----|
|   | Overall Goal   | Specific Objective  | Expected Outputs  | responsibility  |   |     |
| Establishment of million land use Planning center to promote land zoning and land registration Development, | To contribute to the protection of Yemen's land resources  | Establish a center of land use planning, zoning, and registration. to complement the ongoing FAO land use project (GCP/YEM/021/NET) | 1-3rd use center established in appropriate   | Government agency<br>Land use plans prepared<br>Land title registered in priority areas of urban encroachment on agricultural land  | Ministry of Agriculture and Water Resources<br>+<br>Ministry of Urban | 2   |
|   | Implementation of million the top-priority Water Resources projects in ... , capacity and demand, (see Table 18) | To contribute to the protection of Yemen's land resources   | Land use legislation drafted<br>Land use center equipped<br>To implement three priority projects already identified in the national program for combating desertification | Survey Authority<br>Staff trained<br>General return of Forestry and Combating Desertification in the Ministry of Agriculture and Water Resources (ODFCD) has the facilities to forecast and monitor | Ministry of Agriculture   | 2.8 |

<sup>31</sup> Names of 3 des. projects

| Priority Actions for Habitat Management   |  |   |   |   |   |
|---|--|---|---|---|---|
| Priority Action<br>(y Action<br>Estimated   | Overall Goal   | Specific Objective  | Expected Outputs  | Implementation  |   |
| E"lishmnt of<br>million   | To contribute to   | To presme the unique  | responsibility<br>Socotra land use master plan iniegrating  | cost US S<br>Local Environmentai  | 3 |
| National Pnx . cted<br>Area bn Somii<br>Ministry of Agriculture<br>bk)diversity<br>and Water Resources<br>development   | the conservation<br>of Yemen's<br>isiand's economie  | Biowversity of Socotra<br>Island in linkage to the  | conservation and dewlopmnt prepared<br>Baseline swies of island's habitais completed  | Protection Council  | + |
| National inventory~, To contfibe to<br>endangered spwies inventoried<br>m d data base,<br>developineimt of<br>Agriculture<br>fauha and flora<br>Resouroes,,<br>General Tourism<br>Authority, universities,<br>~preparation of a<br>EPC, General Authority<br>Coastal Zone | To contfibe to<br>the conservadon<br>of Yemen's<br>naturai habitats<br>monitoring, and to fonnwate<br>a strategic conservation<br>policy | To conduct bpseline studies<br>Environmental Protection3 million<br>on Yemen flora and fauna<br>and their habitats fer<br>conservation and future<br>conservation and future<br>monitoring, and to fonnwate<br>a strategic conservation<br>policy | To conduct bpseline studies<br>Environmental Protection3 million<br>A database and/or GIS established<br>Protected arus selec(ed and ranked<br>Conservation awareness cahanced<br>Resurch opportunities in biological conservation<br>available at universities and rescarch centers<br>Species-spedfic regulations established to<br>prohibit trade in endangered'species (CITES)<br>To better nianage coastai<br>A plan whieh identifies critical coastai habitats<br>zones lowards a sustainable | Endemic, rare &<br>Council<br>+ Nfinistry of<br>and Waler<br>research centers<br>and zoning for various |   |

Table 29 **Priority Actions for Waste Management**

| Priority Action   | Overall Goal  | Specific Objective   | Expected Outputs   | Implementation  | Estimated responsibility cost in US \$ |
|---|---|--|--|---|--|
| Privatization of waste collection and transfer to disposal            | To contribute to  | To develop effective systems   | Information available on the scope of hazardous waste, the potential for re-use of treated waste, and EPC of the private sector to participate in collection, transport and disposal of hazardous waste. Private sector involved in hazardous waste management | Ministry of Housing, Construction, and Urban Planning                 | 1 million                              |
| Privatization of treatment, storage, and disposal of hazardous waste  | To contribute to a safer urban environment and prevention of soil and water contamination | To design and implement a test program on the collection and disposal of hazardous waste, in particular waste oil and hospital waste | Information available on the scope of hazardous waste, the potential for re-use of treated waste, and EPC of the private sector to participate in collection, transport and disposal of hazardous waste. Private sector involved in hazardous waste management | Ministry of Housing, Construction, and Urban Planning                 | 1 million                              |
| Regulation of hospital waste treatment/disposal and illegal practices | To contribute to improvement of public health conditions                                  | To issue regulations concerning hospital waste disposal  | Regulations controlling hospital waste in effect. Hospital waste collection and disposal organized by private sector   | Ministry of Health and the private sector + Ministry of Legal Affairs | 0.6 million                            |

## **B. Environment Investment program**

To implement the priority actions identified in the NEAP process for the next three years, it is conceivable to combine most or all of the proposed priority actions into one environmental management program. The basic design of such an Environment Investment Program would include the following components:

### **Institution Building Component**

This would entail capacity building support at the national, local, and international level. The component would (1) strengthen FPC, (2) empower and build up local level capabilities in integrated resource management, and (3) strengthen regional efforts at oil spill control.

### **Sectoral Investment Component**

This would involve the provision of environmental services and in management of environmental assets. The component would include among others: water supply for rural and urban areas, desertification control, coastal zone management, and waste management - much of it to be executed by respective line ministries.

In order to facilitate detailed design of an Environment Investment Program, cost estimates of each of the specific NEAP priority actions were made. Table 30 gives a synopsis of the Environment Investment Program including the time and indicative cost of a proposed priority action required to safeguard Yemen's environment. For more detailed descriptions of the specific actions reference is made to data in Table 23 through Table 29.

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| T Environment Investient      |  |                       |
|-------------------------------|--|-----------------------|
| - PRIORITY.-AC.,TION,-:.....: |  | IN:us,                |
|                               |  | COST::                |
| Institutional                 | National - Capacity building of the Environment Protection Council (EPC)             | 4 nullion             |
|                               | a Local - Pilot program for unproverment of enviromntal conditions at local level    | 3 million             |
|                               | o International - Disaster preparedness at Aden and Hodeidah ports for oil spills    | 3 million             |
| Water Resources               | o Strengthening of the National Water Resources Authority                            | 2 million             |
|                               | o Development of a National Water Resources Information System                       | 5 million             |
|                               | • Design of a comprchensive Water Law  | 100,000               |
|                               | • Irnprovement of rural and urban water supply services                              | 3 million             |
|                               | o Econonuc controif of water waste and water pollution                               | 200,000               |
| Land Resources                | a Emblshrnt of land use planning cewer to promote land zoning and land registmtion   | 2 million             |
|                               | o Implernentation of &= top-priority projects in desertification control             | 2.8 million           |
|                               | o Promotion of traditional grazing reserves and modern pest management techniques    | 200,000               |
| Natural Habitats              | Establishment of Socotra as a National Protected Area.                               | 3 nullion             |
|                               | " National inventory and data base development Of fauna aûd flora                    | 3 million             |
|                               | o Prepamtion of a CxaçW Zone Management Plan   | 2 million             |
|                               | o Constitution of ec,>tourism departrnt at General Tourism Authority                 | 100,000               |
| Waste (Sanaa) Management      | a Closure/ replacement of waste disposal site of Sana'a (Al-Azratian), and elsewhere | 2 nullion (elsewhere) |
|                               | a Privaùzation of solid waste collection and irecycling                              | 1 million             |
|                               | Pnvatization of treatment, storage, and sposal of hazardous waste                    | 1 mùlion              |
|                               | Regulation of hospital waste treaumt and disposal, plus pilot project                | 0.6                   |
|                               |  | 1                     |
| TOTAL ESTIMATED COST          |  | 1 US \$40 MILLION     |

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## ANNEX 1.

ON-GOING PROJECTS

## General:

STRENGTHENING THE ENVIRONMENTAL PLANNING AND MANAGEMENT CAPABILITIES

Amount: 222,496 US\$ UNDP / TPF  
14,496 US\$ CANADA

Implementing agency: Environmental Protection Council

The objective of the project is to strengthen the capacity of the Environmental Protection Council in environmental management in addition to undertaking several environmental surveys

## Water Resources:

STRENGTHENING OF WATER RESOURCES MANAGEMENT CAPABILITIES

Amount: 2,066,050 US\$ UNDP / TPF  
2,000,000 US\$ NETHERLANDS GOVERNMENT

This project is aimed at national capacity-building in water resources management to establish an independent and neutral water resources authority, in view of the urgency of the effort to rationalize the exploitation and the protection of the finite water resources that are being seriously depleted by overexploitation and uncontrolled developments.

Integrated water resources assessment is proposed for the authority and includes water resources

## Land Resources:

LAND AND WATER CONSERVATION PROJECT

Amount: 32.8 million US\$ World Bank  
3.2 million Ug\$ UNCDF

Implementing agency: Ministry of Agriculture and Water Resources

Duration: 7 years (1993-1999)

Project Objectives: To strengthen sustainable agriculture through: (i) Institutional and Technical development in irrigation and forestry (ii) Initiating a program of water resources monitoring & regulation in the agriculture sector, (iii) Improving water use efficiency in irrigated agriculture; (iv) Conserving key indigenous forest areas, allowing tree planting and extending soil and water conservation; and (v) Establishing approaches for watershed management and land stabilization.

The project would provide:

Improved ground water irrigation conveyance system, using PVC pipes, for about 14,350 ha

Equipment to demonstrate Improved Irrigation Application Technologies

Mau-nais for constructing improved structures for spaced irrigated schemes on identified Wadis.

Equipment and vehicles for irrigation system maintenance.

Materials and equipment for forest nurseries, fixation, flood control activities, watershed management and terrace stabilization.

Construction of offices and provision of vehicle, equipment training, and technical assistance for the water resources sector.

## TIHAMA ENVIRONMENT PROTECTION PROJECT

**Amount** 11.72 million US\$ IFAD  
 Implementing Agency: Ministry of Agriculture and Water Resources  
 Duration: 7 ~-ws (1996-2002)  
 Project Objectives: The project has an overall goal at the national level of contributing to Yemen's prog  
 for ùnproving the standards of living of rural people. Achievement of this goal involves enhancing production and productivity from crops and livestock, and supporting essential household activities  
 The primary objectives, would be:  
 To identify and prove, by implementation on a

Waste Management:

## TAIZ FLOOD DISASTER PREVENTION AND MUNICIPAL DEVELOPMENT PROJECT

**Amount:** 15.0 million US\$ IDA  
 8.4 million US\$ Government of Yemen  
 Implementing agency: Ministry of Construction, Housing and Urban Planning  
 Duration: 5 Years (1992 - 1996)  
 Project Objectives:  
 To provide most needed flood control structures to protect private and public buildings and infrastructures.  
 To implement a project cost recovery mechanism at a municipal level, and to promote implementation of a national municipal resource mobilization policy.  
 To strengthen the urban management capabilities  
 To strengthen the institutional capacity to address urban problems more effectively.  
 Project Description: The project consists of the following main components:  
 Essential flood control structures  
 Removal of sum« pavement and the conservation of soil  
 The purchase of equipment for the maintenance of flood control structures  
 Technical assistance  
 Introduction of a national municipal resource mobilization policy initiated under on-going urban projects

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Habitat Protection:

**FOURTH FISHERIES DEVELOPMENT PROJECT (FISHERIES IV)**

Amount. IDA IFAD EEC Government Total  
 13.2 6.5 16.3 9.3 39.9 millions US\$

Duration: 7 years (1992-1998)

Project Sites: Seiyon, Mukalla, Shihr, Diss, AL-Hanù, AL-Qam, Qusier, Musaiab and Sayhut.

Implementing agency: Ministry of Fish WWth

Project Objectives: The objectives of the project are to:

Increase fish catch and improve processing for both local consumption and export Improve the efficiency of do ish

domestic and export marketing of f

improve the assessment and management of the fisheries resources in Yemeni waters

Help improve the position of fishing communities

Project Description. The project would provide the following:

(i) The construction, furnishing and equipping of primary facilities for handling, preserving and distribution of fish

in seven villages; and the construction of an asphalt road between Foqum and Ras Imran

(ii) The import of intermediate technology, construction materials for fishing boats; outboard engines, spare parts

and fishing gear; a fleet of insulated trucks; and plastic boxes (Ice boxes)

(ii,i) Technical assistance for coastal fisheries corporation (CFC), National Corporation for fish marketing (NCFM), Marine Science Research and Resources Center (MSRRC), cooperatives, and the Ministry of Fish weath

(iv) The strengthening of the MSRRC's fish stock assessment and resource management program and environmental monitoring capability, and the import of materials to construct lobster traps to reduce the depletion of

this resource

(v) Provision of services to women in fish fishing communities including the rehabilitation of community

Habitat Protection

**FORESTRY DEVELOPMENT IN THE REPUBLIC OF YEMEN - PHASE 111**

**Amount:** 3,195,753 US\$ Switzerland

Implementing agency: Ministry of Agriculture and Water Resources

Project Objectives: Appropriate support structures to increase tree and forest cover in order to maintain the

ecological stability upon which food production and producers depend.

Project Description: The project would provide:

Institutional and organizational support

Coordination of forestry activities

Training

Forest management

Information support

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**PROTECTION OF MARINE ECOSYSTEMS OF THE RED SEA COAST (YEW92/G31)**

Amount: 2.8 million US\$ GEF

3,806,000 Yemeni rials Government (in kind)

Duration: 3 years (1996-1998)

Implementing agency: Ministry of Fish Wealth

Project Objectives: This project aims to protect marine ecosystems of the Yemen Red Sea coast including

coral reefs and other critical habitats, by assisting Yemen to develop the sustainable use of its marine resources.

Project description: Project activities will include:

Surveys of marine habitats to determine environmental trends;

Creation of an interactive database;

Establishment of a monitoring program to protect the waters of Yemen as well as adjacent international waters

**PIPELINE PROJECTS****SUPPORT CLEANSING PROJECT IN THE GOVERNORATES**

Amount: 630 million Yemeni rials = 6.3 million US\$ Government of Japan

Implementing agency: Ministry of Construction, Housing and Urban Planning (Municipalities Department)

Duration: 5 years (1996 - 2000)

Project Objectives: - Develop cleaning measures  
- Protection of environment

Project Description: The project would provide assistance for about 19 towns in the Governorates through

**DEVELOPMENT OF URBAN SERVICES AT NUQUM CENTRE /DISTRICT AT THE SECRETARIAT OF THE CAPITAL**

Amount: 2.5 million US\$ Government of Japan

Implementing Agency: Ministry of Construction, Housing and Urban Planning (Municipalities Department)

Duration: five years (1996-2000)

Project Objectives: - Completion of infrastructure  
- Protection of environment  
- Improvement of living in Nuqum Centre of a total area around 105 ha. The

**WATER SUPPLY AND SEWAGE REHABILITATION IN THE CONFLICT-AFFECTED AREAS**

Amount: Total cost 4.2 millions US\$ from Italy, and Japan

990,000 US\$ UNDP /IPF (allocated)

Project Objectives: The Project is an emergency one that assists the government in alleviating the consequences

of the last conflict. The project will support the government efforts in addressing the immediate needs of



#### REHABILITATION OF TAWILA WATER TANKS (ADEN)

Amount: 620,300 US\$ UNESCO

The ancient Tawila water tanks in Aden, aside from their historical and monumental importance, play an

#### COASTAL FISHERIES DEVELOPMENT PROJECT IN THE SOUTHERN REGION, COOPERATIVES OF THE GULF OF ADEN

Amount: 3 million US\$ Government of Japan

Duration: 3 years

Implementing agency: Ministry of Fish Wealth (Cooperatives Department)

Project Objectives: The project is intended to develop fishery production by supplying required items of

fishery equipment and gear to fishermen and fishermen's cooperatives along the Gulf of Aden coast

Project Description: Supply of fishing gear and equipment, outboard gasoline engines, onboard

#### COASTAL FISHERIES DEVELOPMENT IN THE NORTHERN AREA

Amount: 5.8 million US\$ Government of Japan

Duration: 3 Y=

Implementing agency: Ministry of Fish Wealth, Gencri Corp. for Development of Fisheries Resources

Project Site: Red Sea coast villages

Project objectives: The project aims at the modernization of traditional artisanal coastal fisheries of the northern region to establish a well-balanced fishery in all aspects of production, preservation, processing,

distribution and consumption. Introduction of fishing gear and equipment. Demonstrating the extrusion handling facilities, insulated vans, fishing research plants.

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