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ENVIRONMENTAL AND  
NATURAL RESOURCE MANAGEMENT  
IN DEVELOPING COUNTRIES

A Report to Congress

VOLUME I: REPORT

United States Agency for International Development  
Department of State  
Washington, D.C. 20523  
February 1979

ENVIRONMENTAL AND NATURAL RESOURCE MANAGEMENT  
IN DEVELOPING COUNTRIES

- A Report to Congress -

Volume I: Report

Submitted in response to Section 118 of the  
Foreign Assistance Act of 1961, 22 U.S.C. § 2151p,  
as amended by Section 110 of the International  
Development and Food Assistance Act of 1978,  
Pub. L. No. 95-424, 92 Stat. 948.

United States Agency for International Development  
Department of State  
Washington, D.C. 20523

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## FOREWORD

This report is the final product of a project organized, in close collaboration with the Agency for International Development (A.I.D.), by the Science and Technology Division of the Library of Congress. \*/

The report is based on a wide variety of information sources. First, over fifty A.I.D. Missions throughout the developing world were asked to furnish information relevant to the issues in question. Their responses, fully reflected in the account that follows, were supplemented by a careful review of documentary material. The resulting information was further amplified by the insights of approximately forty experts -- individuals with first-hand experience in the field -- who were brought together for a series of workshops in Washington during January 1979.

Notwithstanding the extensiveness of this survey, however, the report represents at best a preliminary overview. This result is not merely a consequence of the accelerated nature of the study -- the project was a brief three months in duration -- but also of the inadequacy of available data. Indeed, an important result of the present effort is a better understanding within A.I.D. of the paucity of reliable information about the environmental and natural resource problems of developing nations. Available information regarding institutions and their effectiveness, perhaps surprisingly, is equally unsatisfactory.

These obstacles in no way vitiate the importance of the present document, however. Although more detailed investigations are warranted, the report clearly identifies problems which will have to be treated as matters of the highest priority if the goal of sustained development is ever to be achieved by the world's poorer nations. By analyzing in detail the institutional impediments to more effective government responses, moreover, the report suggests important opportunities for future technical cooperation aimed at enhancing the on-going environmental management capabilities of developing countries.

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\*/ PAS No. ZA/DSB-U00-1-79. Contributors to the report are listed in the "Note on Contributors and Methodology" found at the end of this volume beginning at page 177.

Thus the report establishes a useful framework for understanding better the complex relationship between meaningful development and the rational use of environmental resources. It is a framework which also permits a better appreciation of the way in which institutional mechanisms can either encourage or impede sound resource management, and thus either contribute to or detract from a country's real prospects for development.

These are relationships which have been increasingly addressed in A.I.D. activities during the past several years. By working within the analytical framework suggested in the pages that follow, it should be possible to formulate approaches and programs which not only take the need for sound environmental management into account, but which treat it as a critical prerequisite to effective development planning and administration.

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VOLUME II: APPENDIX - Preliminary reports on Mauritania and Sri Lanka  
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## EXECUTIVE SUMMARY

### INTRODUCTION

The critical environmental resources of developing countries are today subject to stresses of unprecedented magnitude. Because the health, nutrition, and general well-being of the poor majority are directly dependent on the integrity and productivity of these resources, the capability of governments to manage them effectively over the long term may well be the single most important prerequisite to the eradication of poverty, the fulfillment of basic human needs, and the ultimate achievement of sustained development.

The governments of many developing nations have begun to recognize the importance of these issues, but the inability of indigenous government institutions to manage natural resources and protect environmental quality often precludes effective action.

A fundamental, direct approach to institution building is called for.

A.I.D. is responding to these needs by requiring a thorough compilation of environmental and natural resource data as part of the Country Development Strategy Statement (CDSS) for each A.I.D.-supported country.

The Agency intends to increase its support for training and institution building in host countries, to increase its programs directed toward protection and rehabilitation of natural resources, and to work to promote greater awareness and understanding among other members of the international donor community.

### GENERAL PERSPECTIVE

The issue that lies at the heart of this report is whether, given the rate at which natural resources are deteriorating, there is any real prospect that the circumstances of the world's poorer peoples can be improved over the long term. If current trends are to be reversed, an immediate improvement in governmental resource management capabilities will be necessary.

#### Environmental and Natural Resource Problems

Food. The quest for an ever-expanding food supply has resulted in great stresses on the croplands and pasturelands of the developing

world. Overcultivation and overgrazing have resulted in waterlogged and saline soils and in spreading deserts. The search for cultivable land has sent many subsistence farmers into forested areas and onto slopes, resulting in deforestation, soil erosion, disrupted hydrological cycles. Flooding and landslides increase in frequency.

Clearing for agriculture has also destroyed wildlife habitat, thus reducing an important source of animal protein in many countries, and threatens to diminish significantly the diversity of plant species in the world, to the serious detriment of agricultural and medical science.

The destruction of forests for agriculture, combined with poorly managed timber concessions, is also depleting a valuable economic resource in many areas. According to a World Bank estimate, the remaining forest stock of developing countries will be totally consumed in 60 to 80 years if current rates are maintained.

Energy. Firewood is becoming more difficult to find in many parts of the developing world. For urban dwellers, this has resulted in higher prices. For rural people, it has meant spending a substantial portion of each working week searching for fuel. The quest for fuelwood has seriously exacerbated the deforestation problem.

Because firewood is in short supply, rural inhabitants of many developing countries turn to alternative fuels. The most common is dried cattle dung. In Asia, the Near East, and Africa, the total quantity of dung burned each year is about 400 million tons. This represents a tremendous loss of natural fertilizer -- each ton burned amounting to about 50 kilograms of potential grain output.

The construction of large river basin developments has brought with it both benefits and detriments. In addition to power and irrigation, large dams can flood valuable agricultural land, destroy forest resources and wildlife habitat, and force the resettlement of people. Increased incidence of water-associated disease can be an additional consequence.

Water, sanitation, and health. People in developing countries are exposed to a variety of diseases seldom encountered in more temperate zones. In addition to typhoid, cholera, and dysentery, a great many debilitating diseases -- mostly parasitic -- diminish the productivity of workers throughout the developing world. As mentioned, the incidence of some of these diseases can be increased by new development projects. In other cases, vector pests can become resistant both to pesticides and to therapeutic drugs. For these reasons, for example, malaria appears to be returning to many areas formerly thought to be free of the disease.

Other problems. Pollution is becoming increasingly serious, not only in urban areas but wherever agro-industrial processing is carried on. The increasing use of pesticides has resulted in dangerous accumulations in the environment. Pesticide poisoning, resulting from improper use, is a matter of increasing concern.

### Institutional Prerequisites to Effective Environmental and Natural Resource Management

Government commitment. The governments of many developing countries have begun to recognize the gravity of the environmental and natural resource problems which confront them, and increasingly understand the relationship between these problems and the prospects for sustained development.

But environmental management in the developing world is still deficient. In many countries, the reason appears to be the lack of an effective institutional infrastructure. Among the elements which must be addressed are:

Government agency structure and administration. Each country must decide for itself the organizational arrangements best suited to the circumstances at hand. But certain basic characteristics must be present if effective resource management is to be possible. Coordination of the environmentally significant activities of different agencies, the ability to monitor and evaluate performance, and effective enforcement mechanisms are among the basic requirements. An "environmental focal point" in each government should be charged with responsibility for seeing that environmental and natural resource considerations are given proper weight in the government's planning, programming, and budgeting functions.

Environmental law. The environmental and natural resource management effort must be based on a solid legal foundation. But very few lawyers in developing countries are acquainted with modern legal mechanisms for maintaining environmental quality. Relatively little effort has been addressed, therefore, to needed legislative and administrative innovations.

Data. The lack of adequate data is one of the principal impediments to more effective environmental and natural resource management in developing countries. There is a continuing need for detailed information about the productivity and vulnerability of renewable resources, about the impact of alternative uses, about optimal rates of exploitation, about tolerable pollution levels, and so on. Economic and social data are also essential to the resource management effort.

Manpower and training. The success of programs for the management of environmental and natural resources is heavily dependent upon the quality of available manpower. A variety of professional and technical disciplines is required, including the environmental sciences and engineering, planning, economics, law, and administration.

Environmental education. To be successful, a country's environmental management effort must enjoy a high level of public support. This is particularly true of initiatives which affect the rural and urban poor. Public school curricula and mass media programming can be used to great advantage as a means of generating awareness and support for better environmental management.

NOTE: Each of the regional assessments is preceded by a summary (text italicized) setting forth briefly the major environmental problems and related institutional issues in the region in question. These summaries may be found at the following pages:

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## INTRODUCTION

By calling for a report on the environmental and natural resource problems confronting the world's developing nations, and on related institutional issues, 1/ Congress has provided an important opportunity. It has been the occasion for a timely and valuable taking of stock. While this is not the first time A.I.D. has examined these questions, it is fair to say that the picture which emerges from the present survey differs in important respects from earlier assessments. It is a picture, moreover, with significant implications for the programs of bilateral and multilateral development agencies.

The environmental and natural resource problems of developing countries are by now the object of global concern. In the present decade, United Nations conferences on the environment, population, food, human settlements, water, desertification, and environmental education, 2/ together with a growing literature, have engendered a wide recognition that the critical environmental resources of developing countries are today subject to stresses of unprecedented magnitude. Because the health, nutrition, and general well-being of the poor majority are directly dependent on the integrity and productivity of these resources, the capability of governments to manage them effectively over the long term may well be the single most important prerequisite to the eradication of poverty, the fulfillment of basic human needs, and the ultimate achievement of sustained development. Conversely, it is the poor who suffer most from the failure to address these problems successfully.

Less widely perceived until now, however, is that the governments of many developing nations have begun to recognize the importance of these issues. The consequences of inadequate resource management are no longer subtle. The continuing loss of tropical forest cover, the exhaustion of croplands, the depletion of fisheries, the advance of desert frontiers, the adverse consequences of indiscriminate pesticide use, epidemic levels of environmentally related diseases -- these and other problems are steadily intensifying, and the need for a more effective response is increasingly felt. There is growing evidence that a number of developing country governments are beginning to treat these issues as matters of high priority.

At the same time, this enhanced awareness of the need for effective resource management in the quest for sustained development has served to highlight newly understood obstacles to the actual achievement of that objective. The principal impediment was once inherent in official attitudes which subordinated the maintenance of critical environmental resources to short-run economic goals. Today, however, an equally serious problem is the inability of government institutions to implement the more enlightened, environmentally sensitive policies which increasingly characterize current long-range development plans.

There can be no doubt that major infusions of capital are needed to support projects designed to rehabilitate damaged resources, to eradicate disease vectors and treat victims, to establish disposal facilities for industrial and municipal wastes, and to augment potable water supplies.

But even a major increase in the amount of financial assistance available for these purposes would leave important institutional deficiencies unaddressed. Manpower must be trained in a host of relevant disciplines; new mechanisms for gathering and assimilating data must be instituted; coordinated planning procedures must be formulated; suitable regulatory frameworks must be established; regional arrangements for addressing transnational issues must be created. All of these elements must be designed, moreover, with special sensitivity to the critical social dimension which characterizes most of the major environmental challenges confronting the developing world.

Just as many governments are increasingly cognizant of the need for better environmental and natural resource management as an element in their overall economic development strategies, many governments are also aware today of the need for trained manpower and improved institutional machinery. Some countries have already created new or reorganized agencies in an effort to address resource issues more effectively. New laws and regulations have been promulgated; new training programs are under way; environmental education has been added to public school curricula; a number of governments have even formulated environmental impact assessment procedures. These developments are described in the four regional overviews that comprise the bulk of this report.

But these are only first steps. Many poorer countries have yet to address their institutional deficiencies in any systematic way, and those that have done so continue to suffer from inadequate financial and manpower resources. Clearly, there is much work to be done. Moreover, the rate at which essential environmental and natural resources are deteriorating in many developing countries suggests that the time for action is growing short.

Effective responses to the critical resource problems of developing countries will require increasingly sophisticated approaches. The need today is not merely for additional consciousness-raising, but also for carefully designed, sharply focused activities aimed at the establishment in developing countries of the effective resource management regimes which are essential to the achievement of sustained development. The environmental impact assessments currently required and the environmental restoration projects being planned and implemented are important steps in the right direction, but they cannot be expected to engender the on-going, routine environmental management capability that is now required. A more fundamental, more direct approach to institution building is called for. By responding more effectively to the recognized institutional needs of developing countries, it should be possible to contribute meaningfully to the effective management of the natural resources of the developing world.

#### A.I.D.'s Role

Despite substantial recent advances in data-gathering technology, resource data remains sporadic, uneven, and, in many cases, unreliable. Basic resource inventories have not been undertaken, pollution levels have not been monitored, important environmental trends, while postulated, remain undocumented. Information regarding institutions is also incomplete. While superficial catalogues of government agencies, laws, research facilities, and the like are generally available, valid assessments of their effectiveness have been undertaken only rarely. For these reasons, the present report should be seen as a prelude to more careful and detailed investigations -- on a country-by-country basis -- yet to come.

One method of obtaining this essential information, at least in the first instance, is by requiring its inclusion in the Country Development Strategy Statement (CDSS) prepared for each A.I.D.-supported country. (See Table 1, opposite page 4.) Instituted this year in preparation for the Annual Budget Submission for FY 1981, the CDSS is the Agency's new basic analytical strategy and planning document. <sup>4/</sup> A "rolling" strategy statement, to be updated annually, it outlines each A.I.D. Mission's understanding of the overall development goals, problems, and issues of its host country. The document proposes the objectives, policies, and programs that A.I.D. should pursue with that country and the reasoning behind those choices.

The CDSS will specifically address the environmental and natural resource issues within a country to the extent that they affect the country's equitable growth, eradication of poverty, and the fulfillment of the basic human needs of the poor. It will be prepared in such a way as to facilitate judgments as to how A.I.D. can best encourage and support

the establishment of a continuing, comprehensive environmental and natural resource management capability on the part of the host government.

The process of gathering information relevant to these issues for the CDSS will produce, in effect, what is often called an "environmental profile" of the country. This environmental profile, more of a process than a definitive document, will be useful to the Agency in a number of ways:

- It will identify relevant information sources, including indigenous and foreign institutions and individuals with country specific experience in appropriate environmental specialities.
- It can provide the basis for a meaningful dialogue with country officials on the need for more effective environmental management policies and programs, environmental resource management legislation specifically tailored to the country's own circumstances, and possibly the establishment of new institutional arrangements.
- It can furnish more adequate information upon which to determine the potentially adverse effects of existing and proposed development policies and projects on long-term resource productivity. It will help in the formulation of strategies for avoiding or minimizing such effects.
- It can serve as a basis for formulating projects specifically addressed to environmental and natural resource problems of the country.

The Agency has begun this process by assembling basic information regarding problems and institutional capabilities of individual countries which can be utilized by field offices in their discussions with appropriate country personnel. The information, jointly evaluated and supplemented, can be assimilated into the ongoing CDSS activity, thus permitting environmental and natural resource issues to be considered as an element of the Agency's assistance strategy for the country.

The incorporation of environmental concerns into the new Agency decision-making process is the most recent of a number of steps which A.I.D. has taken to strengthen the environmental aspects of the U.S. bilateral development assistance program. In 1975, A.I.D. approved a Policy Determination 5/ to (1) assure the environmental soundness of individual projects, and (2) strengthen the institutional capabilities of developing countries to appreciate and evaluate the potential

Development Assistance and Economic Security Assistance  
Countries Assisted FY 1979 - 1980

|                        |             |                 |
|------------------------|-------------|-----------------|
| Afghanistan            | India       | Senegal         |
| Bangladesh             | Indonesia   | Seychelles      |
| Benin                  | *Italy      | Sierra Leone    |
| Bolivia                | Jamaica     | Somali Republic |
| Botswana               | Jordan      | Spain           |
| Burundi                | Kenya       | Sri Lanka       |
| Cameroon               |             | Sudan           |
| Cape Verde             | *Lebanon    | Swaziland       |
| Central African Empire | Lesotho     | Syria           |
| Chad                   | Liberia     | Tanzania        |
| +Chile                 | Malawi      | Thailand        |
| +Colombia              | Mali        | Togo            |
| Costa Rica             | *Malta      | Tunisia         |
| Cyprus                 | Mauritania  | Turkey          |
| Djibouti               | Mauritius   | Upper Volta     |
| Dominican Republic     | Morocco     | Yemen           |
| Ecuador                | Mozambique  | Zaire           |
| Egypt                  | Nepal       | Zambia          |
| El Salvador            | Nicaragua   |                 |
| Ethiopia               | Niger       |                 |
| Gambia                 | Nigeria     |                 |
| Ghana                  | Pakistan    |                 |
| Guatemala              | Panama      |                 |
| Guinea                 | Paraguay    |                 |
| Guinea-Bissau          | Peru        |                 |
| Guyana                 | Philippines |                 |
| Haiti                  | Portugal    |                 |
| Honduras               | Rwanda      |                 |

\*No proposed new obligations in FY 1980

+Operational Program Grants will be obligated from regional funds.

TABLE 1.

environmental effects of all proposed development strategies. This policy was subsequently incorporated in A.I.D.'s Environmental Procedures 6/ which were submitted for public comment and adopted in June 1976. For the past two years priority attention within the Agency has been devoted to internal implementation of those procedures. This experience has shown that if concern is confined only to the environmental soundness of the projects receiving A.I.D. assistance, there will be very limited improvement of the grave circumstances facing most of the developing world as increasing populations compete for decreasing natural resources.

The Agency intends to increase its support for training and institution building in host countries, to increase its programs directed toward protection and rehabilitation of natural resources, and to work to promote greater awareness and understanding among other members of the international donor community. The achievement of long-term benefits to the world's poor, whether rural or urban, must be based on environmentally sound planning and a clear understanding, by all involved in economic development, of a country's natural resource potential and limitations.

#### Organization of the Report

The present document is designed to respond as forthrightly as possible to the Congressional mandate. The major portion of the report, therefore, consists of overviews of the environmental and natural resource problems of developing countries and of the institutional capability of those countries to deal with such problems. The overviews are organized along regional lines: there are separate discussions of the developing countries of Africa, Asia, Latin America and the Caribbean, and the Near East.

As an introduction to the regional overviews, the growing seriousness of the developing world's environmental and natural resource problems is discussed in general terms in the opening section. A brief discussion of the fundamental components of an effective institutional framework for environmental management follows, together with a general assessment of the extent to which such mechanisms have been instituted in developing nations.

Footnotes are listed immediately following each major section.

A "Note on Contributors and Methodology" and a bibliography conclude Volume I.

Volume II is an Appendix containing two examples of preliminary

reports on individual countries -- Mauritania and Sri Lanka -- prepared by the Library of Congress under contract to the U.S. Man and the Biosphere Program for use by A.I.D. Mission personnel.

#### REFERENCES

1. Section 110 of the International Development and Food Assistance Act of 1978, Pub. L. No. 95-424, 92 Stat. 948, amended Section 118 of the Foreign Assistance Act of 1961, 22 U.S.C. § 2151p, by adding two new subsections:

"(b) In carrying out programs under this chapter, the President shall take into consideration the environmental consequences of development actions.

"(c) In furtherance of the purposes of this section, the President shall carry out studies to identify the major environment and natural resource problems, and the institutional capabilities to solve those problems, which exist in developing countries. The results of these studies shall be reported to the Congress by March 1, 1979." [Emphasis added.]
2. United Nations Conference on the Human Environment, Stockholm, June 5-16, 1972; United Nations World Population Conference, Bucharest, August 19-30, 1974; United Nations World Food Conference, Rome, November 5-16, 1974; Habitat: United Nations Conference on Human Settlements, Vancouver, May 31-June 11, 1976; United Nations Water Conference, Mar del Plata, March 14-25, 1977; United Nations Conference on Desertification, Nairobi, August 29-September 9, 1977; UNESCO/UNEP Intergovernmental Conference on Environmental Education, Tblisi, October 14-26, 1977.
3. A.I.D. Airgram, "Request for Environmental Information," December 4, 1978.
4. A.I.D. Airgram, "Guidance for the Country Development Strategy Statement (CDSS)," September 16, 1978.
5. A.I.D. Policy Determination 63, August 1, 1975.
6. A.I.D. Regulation 16, 22 C.F.R. Part 216, 41 Fed. Reg. 26913 (June 30, 1976).

## GENERAL PERSPECTIVE

### A. Environmental and Natural Resource Problems and the Prospects for Development

The environmental and natural resource problems discussed in the four regional overviews which follow are organized on a "sectoral" basis. That is, there are separate examinations of problems associated with particular productive resources (forests, soil, water, etc.), with pollution, with urban areas, and with environmental health.

This pattern was selected because a major purpose of the report is to assess the institutional capability of developing country governments to respond to these problems. There can be no question that the various activities of government which bear on resource productivity and environmental quality must form parts of an integrated, carefully coordinated program. Nevertheless, it is in the nature of administrative institutions that divisions of labor are necessary, that complex responsibilities require specialization, and that the boundaries of administrative jurisdiction must be carefully fixed. These requirements are basic, and apply equally to new, unified environmental ministries and to more traditional natural resource management agencies. If a country's institutional capability is to be evaluated successfully, therefore, the government's specific competence in a great many well defined areas -- mostly technical -- must be analyzed in a functional way. Hence the need to draw what may appear to be almost arbitrary lines between closely interrelated environmental topics.

The difficulty with this approach is that it is unlikely to do full justice to the enormity of the environmental and natural resource problems being experienced today in much of the developing world. By focusing on a variety of different resource issues, and by examining separately the essential elements of an institutional infrastructure, the report may actually distract attention from the growing global crisis at hand.

The issue that lies at the heart of this report is whether there is any real prospect that the circumstances of the world's poorer peoples can be improved over the long term. The rate at which global resources are deteriorating, and the impact of that deterioration on the nutrition, health, and general well-being of the poor majority make it clear that an immense challenge lies ahead. If current trends are to be reversed, a very substantial and immediate improvement in governmental resource management capabilities will be necessary. Because much of the damage already done is irreversible in the short run, further delay can only make the challenge more difficult, and may well result in suffering on a scale unseen before in the history of mankind.

This section of the report will be a brief discussion of some of the major implications which emerge from the four regional overviews that

follow -- implications for the availability of food and energy, for the supply of safe water, for human health, and finally for the quality of life in general.

Food. The planet's capacity to produce sufficient food for the human population is being severely tested. A major part of the problem is population growth. There were 2.5 billion people in the world in 1950. Today the number is approaching 4.5 billion. By the year 2000, if projections are met, there will be 6.2 billion people. 1/ Numbers alone are not the whole problem, however; where affluence is rising, increases in per capita consumption are a compounding factor. 2/ The rapidly expanding demand for food has unleashed a complex set of forces which will tax the ingenuity of our global society as never before. The most serious challenges are already being experienced today in the world's poorer countries.

From the beginning of agriculture until the middle of this century, expansions in cultivated land area were the principal means of increasing the world's food supply. During more recent years, however, most of the increase has been attributable to intensified cultivation of existing cropland. During the early 1970's, increased output per acre accounted for an estimated four-fifths of annual increases in global food production. 3/

It is expensive to coax more food from the earth than traditional methods yield. The impact of higher food costs on affluent people is often nothing more serious than a net reduction in disposable income. But for those who must spend about four-fifths of their income on food, as do many of the world's poor, major increases in the price of wheat or rice cannot be offset by increased outlays. Diets already at the subsistence level drop further and malnutrition results. 4/

Fish constitute a major element in the national diets of many developing countries. The world's catch more than tripled between 1950 and 1970, rising from 21 million metric tons to 70 million. 5/ In this decade, however, catches have generally leveled off or declined. The annual catch now fluctuates between 65 and 70 million tons. Because of world population growth, the per capita catch has actually dropped by 11 percent and prices have risen sharply for virtually all edible species. 6/ Many marine biologists now feel that the global fish yield has reached its maximum sustainable level. 7/

In the more developed nations, heavy investments in agricultural chemicals and technology have kept crop production on the rise. Among the world's poorer peoples, however, the rising demand for food has led to an increasingly desperate effort to extract more protein from the earth, creating ecological pressures which have severely impaired the often marginal agricultural potential of fragile tropical soils. 8/ Improper practices include overly intensive cultivation, too great a reliance on the limited productivity of semi-arid lands, ill-advised attempts to expand the supply of cultivable land by clearing forested slopes and vast tracts of moist tropical forest, and overgrazing by livestock herds which exceed the regenerative capacity of supporting pasturelands.

The result is that, while global food production figures continue to rise, vast numbers of people in developing countries are facing the prospect of declining nutrition. Tens of millions of subsistence farmers, moreover, are being forced to give up their livelihoods as their lands become useless. A high percentage of these people will migrate to swelling urban slums in search of alternative occupations. 9/

Throughout the four regions surveyed in this report, valuable soil is being lost as a result of improper farming methods and overgrazing. The extent of these problems was revealed two years ago by a survey of U.S. diplomatic posts in 69 countries in Africa, Asia (excluding China), Latin America (excluding the Caribbean), and the Near East. It showed that the urgent need to produce more food has led to widespread overcropping (tilling practices which result in the heavy loss or exhaustion of soil nutrients), overgrazing, deforestation, and water problems. 10/ The countries surveyed had an aggregate population of 1.8 billion -- 90 percent of the people in the four regions and nearly half the world's population. The countries reporting overcropping/overgrazing problems included 80 percent of the people in Africa, 80 percent in Asia, 37 percent in Latin America, and 93 percent in the Near East. 11/

Overgrazing and overcropping are significant causes of "desertification," the end result of man-induced changes which reduce the ability of arid and semi-arid lands to support life. In Africa, about 650,000 square kilometers of land once suitable for grazing have been lost to the expanding Sahara in the last 50 years. 12/ Pastures in India have been reduced to 10 to 15 percent of their former productivity. Similar deterioration is widespread in much of the Middle East and in several semi-arid areas of Latin America. 13/

Of the estimated 630 million people who live in arid or semi-arid regions, about 78 million are said to live on land which is rapidly declining in productivity. These people are found in parts of western Asia, in much of the Near East, and in many parts of Africa, notably the Sahel region (Mauritania, Senegal, Mali, Upper Volta, Niger, and Chad). An estimated 50 million of these people are dependent on agriculture, and they face destitution as croplands and grazing lands become barren. 14/

Wherever farmland is irrigated by diverting surface water from rivers and streams, waterlogging and soil salinity are potential problems. Unless the land has excellent drainage characteristics, the underground water table will gradually rise. As it approaches the surface the soil becomes less congenial to vegetation. Also, instead of draining away, irrigation water evaporates from the soil, leaving behind a gradual build-up of salt deposits. 15/ While a few crops tolerate saline soil reasonably well, most do not. In many areas, salinity has become so extensive that the soil will support no vegetation whatsoever. It is estimated that waterlogging and salinity reduce output on one-tenth to one-third of the world's irrigated croplands. 16/

Perhaps the most dramatic consequence of the quest for the farm and

grazing land is deforestation. This is not a new process. Much of the world's forest loss took place long ago with the clearing of great agricultural plains like those of India, Thailand, and Java. 17/ In the present era, however, the pace at which forest clearance is proceeding has resulted in startling statistics. An estimated 40 percent of the world's tropical rain forests are already gone. 18/ By the end of this century, three-quarters of the original forest in the tropics will be destroyed. 19/ According to the World Bank, the remaining forest stock of developing countries -- 1.2 billion hectares of mature forest -- will be totally consumed in 60 to 80 years. 20/

While large multinational timbering firms are commonly assumed to be responsible for most of this gross destruction of forest resources, the demand of subsistence farmers for new cultivable land is in fact a far more important cause. Much of the clearing is undertaken in furtherance of well-intentioned government agricultural schemes. In many cases, notably in the tropical rain forests of Latin America, insufficient appreciation of the nature of underlying soils has led to early failure. In rain forests, most nutrients are cycled through the vegetation; the soil is generally thin and far less fertile than the apparent fecundity would suggest. Its crop supporting capacity is often marginal. 21/

"Shifting cultivation" -- the practice of clearing and tilling a patch of ground until its fertility is exhausted, and then moving on to a new patch -- has traditionally been an ecologically sound agricultural system, provided that land is abundant and that fallow periods are sufficient. Many people in the Amazon Basin, Central Africa, and the more remote parts of Southeast Asia presently practice shifting cultivation with no significant adverse consequences. 22/

But today shifting cultivation has also become the last resort of many landless people driven to forested slopes by the exhaustion or scarcity of lowland farming acreage. In many cases, new logging roads have opened up previously inaccessible areas, thus leading to forest clearing far in excess of that contemplated in the permits. Because they are unfamiliar with time tested methods of preserving the land's productivity, or because their numbers simply preclude the use of such methods, these new shifting cultivators are outstripping the carrying capacity of the sites they select and thus wreaking havoc in many areas of the developing world. 23/

The ecological disasters which have taken place in Haiti and El Salvador are well known to development specialists. The once dense forest cover of Haiti is now reduced to about 9 percent of the country's land area. Soil erosion is considered Haiti's principal problem. About 77 percent of El Salvador is also severely eroded. 24/ A similar pattern is found in the Andes, the Himalayas, and in the highlands of East Africa. 25/

Unless newly deforested slopes are cultivated carefully, by terracing or contour plowing, for example, the likelihood is that erosion will soon destroy whatever fertility the land might have had. Thus, as in the case of waterlogging and salinization, attempts to grow more food end up actually reducing the availability of cultivable land. The destruction caused by improper

able to cope with it unless subsistence agriculture is managed more effectively in keeping with carefully formulated conservation principles.

The permanent loss of badly overcultivated croplands is only the most immediate consequence of these pressures. Soil washed off abandoned, infertile tracts ends up as silt in rivers and streams. The sediment reduces the productivity of riverine fisheries, and eventually clogs up irrigation systems. Dams built to provide hydropower and an ample supply of water for agriculture may silt up and become useless long before the end of their projected lifespans.

Forests provide catchments for rainfall, controlling runoff and maintaining a productive hydrological cycle. Their destruction can contribute to floods and landslides; there are instances of whole villages being washed away as a result of flooding following upland forest clearing. In India, for example, with flood damage estimated at \$600 million annually, 232 watersheds in 26 major catchment areas have been selected for an emergency soil conservation program. 26/

The destruction of forests also reduces the abundance of wildlife dwelling within them. While poaching, the ivory and skin trade, and illegal smuggling of protected species are the stuff of headlines, by far the most serious threat to the wildlife population is the loss of habitat. 27/ Although not widely recognized, wild animals are an important source of food in many developing countries -- particularly in Africa and Latin America. 28/ Deforestation thus diminishes a valuable source of animal protein.

Forests, of course, are a potential source of economic wealth, and can be maintained as such on a perpetual basis if properly managed. Earnings from the export of forest products from developing countries rose from \$544 million in 1962 to \$3.4 billion in 1973. Particularly sharp increases occurred in Africa and Asia. 29/ Foreign exchange from forest product exports holds important potential for the well-being of the people of countries endowed with commercially valuable forest resources. Unfortunately, short-sighted exploitation policies and clearing for agriculture threaten many of these countries with the total demise of their commercial forestry sectors. A 1974 study of Southeast Asia predicted, for example, that the remaining accessible lowland forests of Malaysia and the Philippines would be exhausted within a decade. Thailand's Forestry Department has predicted that, at the present rate of loss, Thailand's forests will be completely gone in 25 years. 30/

The loss of forest cover as a result of agricultural clearing and timber exploitation in developing countries has implications which extend far beyond the tropics. For example, rain forests and moist deciduous forests are biologically the richest natural systems on the planet. They are major repositories of the world's genetic wealth and diversity. There are an estimated 3,000 tree species in Indonesia, excluding Java; 2,500 in the Malay Peninsula; at least 2,500 in the Amazon. 31/ Although much of the genetic potential of tropical forests is as yet unexplored, one estimate holds that, if global deforestation projections are borne out, at least half the species in the tropics will disappear by the end of this

world's genetic diversity, or the loss of 500,000 to 600,000 species. 32/ According to another account, the loss of a million species by the year 2000 is "a not unlikely prospect." 33/

The diminution of genetic resources on that scale -- perhaps half of the world's unknown species would be lost before they have even been catalogued -- would have serious consequences for the progress of agricultural and medical science. It would certainly impede the development of improved, more productive, pest resistant crop varieties, and it could also deprive mankind of undiscovered chemical agents of special medicinal value. As Erik Eckholm has recently written:

[S]cientists are stepping up their investigations both of ancient folk medicines and of hitherto unused plants with intriguing chemical properties. The plant kingdom is receiving special attention from cancer researchers, who hope to find tumor-inhibiting agents in nature that can provide prototypes or ideas for synthetic anti-cancer chemicals. Tens of thousands of plant species have been screened for this purpose and a number have shown promise, but the search has really only just begun -- and it is being undermined by the extermination of unexamined species. 34/

Finally, although data is as yet insufficient to support more than speculation, scientists are looking into the possibility that reductions in the world's forest cover are producing global climatic changes. In anticipation of further research into what could become a critical issue, one expert has written that "it is clearly very important to approach changes of land use in such sensitive areas with great caution, and everywhere to try and replace forest, if it must be replaced, with systems of land use which reproduce as far as possible the most significant physical features of the vegetation that is being removed." 35/

Energy. The search for food and the search for fuel are closely interrelated in poorer countries. Wood fuels (firewood and charcoal) account for two-thirds of all energy (other than human and animal energy) used in Africa, for one-fifth in Latin America, and for 6 percent in the Near East. In the rural areas of most developing countries, the dependence on wood and other non-commercial fuels is often almost total. 36/

As a result of increased population pressure, sources of fuelwood are being exhausted. The result, for urban dwellers, has been steep rises in price. According to an estimate cited in the African overview which follows, in order to obtain the same amount of usable energy which can be purchased in the U.S. for about \$1.30, a charcoal burning family in Addis Ababa may have to spend about \$8.00.

For the vast majority of people dependent upon woodfuel -- those in rural areas -- the consequences of scarcity are felt in different ways. Many rural inhabitants do not buy wood; they gather it. As nearby vegetation is destroyed, this task becomes increasingly arduous and time consuming, detracting significantly from the quality of life for such people. In central Tanzania, according to one estimate, 250 to 300 days of work are needed to fulfill the annual firewood needs of a single household. In parts of India, the gathering of a week's supply of wood may require two man-days. 37/ Woodgatherers in Niamey, the capital of Niger in West Africa, must travel 20 to 30 miles to find a camel load of firewood. 38/ The difficulty associated with finding woodfuel supplies induces rural people to cut back on some uses. Peasants in Nepal and Haiti, for example, are reported to have reduced their consumption of vegetables that require cooking. 39/

But the impact of the growing firewood shortage on the food supply takes more important forms. First, the gathering of wood for fuel purposes is a major factor in the destruction of forests. The loss of precious soil resources and the impairment of hydrological cycles has serious consequences for agriculture which have already been discussed.

Where firewood is in short supply, moreover, rural dwellers turn to other fuels. In Asia, the Near East, and Africa, one of the principal alternatives is cattle dung. By burning dried dung, however, peasants are consuming a valuable natural fertilizer. According to a U.N. Environment Program report, for example, the amount of dung burned as fuel in India alone is equivalent to about 7 million tons of nitrogenous fertilizers annually. 40/ In Asia, the Near East, and Africa, the total quantity of dung burned annually is about 400 million tons. Each ton burned represents a loss of about 50 kilograms of potential grain output. 41/ A recent World Bank study estimates that the amount of dung burned in Nepal in the year 2000 will reduce grain production by about one million tons. 42/

The quest for energy on a national scale has led to the construction of hydroelectric dams throughout the developing world. The subject of a great deal of study, dams have become a principal focus of the burgeoning debate about "appropriate" development. The problem is that dam construction involves difficult trade-offs. The man-made lakes created behind dams may flood much needed agricultural land and may force resettlements of people. Forest resources and wildlife habitat may also be given up in the bargain. In addition to new hydropower, dams provide water for new irrigation systems, but they may also increase the incidence of waterborne diseases.

Water, sanitation, and health. The people of developing countries are exposed to a variety of diseases seldom encountered in more temperate zones. Among the more familiar to the people of developed countries are typhoid and cholera, caused by fecal contamination of water supplies. Amoebic dysentery, also a product of improper sanitary facilities, is a major killer of children. A billion people are afflicted by roundworm and hookworm diseases each year because of lack of sanitation facilities and inadequate safe water supplies. 43/ Globally, more than two billion

people are exposed to infectious diseases because of contaminated water; 250 million new cases occur each year; the toll is estimated to be 25,000 deaths per day. 44/ As Erik Eckholm said in testimony before the House Select Committee on Population in April 1978: "Judged in terms of the human suffering and death it causes, the poor sanitation faced daily by nearly a third of humanity is by far the world's most critical environmental problem." 45/

As of 1975, according to World Health Organization statistics, 62 percent of the population of developing countries (not including China) -- about 1.2 billion people -- did not have reasonable access to safe water supplies. Adequate domestic water supplies were not available to four-fifths of the rural and one-fourth of the urban population of the developing world. 46/ If the incidence of filth-borne diseases is to be reduced, significant increments in global expenditures for new sanitation programs and facilities will be necessary.

Although they are less familiar to most of us, and although they are less lethal, a number of parasitic diseases -- also associated with water -- are taking an appalling toll in terms of human well-being and productivity throughout the developing world. 47/ Schistosomiasis is the most prevalent of these, affecting some 250 million people. A debilitating disease which strikes primarily the rural poor, it is caused by a parasite which uses certain varieties of snail as an intermediate host. Its symptoms are abdominal pain, fatigue, and, in one common strain, blood in the urine.

Onchocerciasis -- also known as river blindness -- is another widespread affliction, more debilitating than deadly. Transmitted by the small Simulium blackfly, the disease is found chiefly in the vicinity of the fast-flowing waters -- mountain streams and the spillways of dams -- in which the blackfly breeds.

A scarring around the eyes can be found in a high percentage of people in many developing countries. It is the result of trachoma, a disease afflicting more than 500 million people. Preventable by regular washing of the hands and face, the remedy too often requires more clean water than is available.

The "sleeping sickness" long associated with the tsetse fly of tropical Africa is trypanosomiasis, a disease which in its early stages produces headaches, fever, and joint pains, but which can later lead to central nervous system damage, coma, and death.

Perhaps the best known of the tropical water-associated diseases is malaria, transmitted by the Anopheles mosquito. The mosquito does not single out poor people as its principal targets, but will strike anyone not properly immunized. Perhaps for that reason it has been the object of a global eradication effort. Early efforts to control malaria through the use of DDT, the draining of stagnant pools where the mosquitos breed, and

the use of chloroquin and related drugs, were so encouraging that predictions of the total eradication of the disease were being made as long ago as the 1940's. 48/

Today, however, those predictions seem clearly premature. New strains of malaria parasites have now evolved which are resistant to DDT, and strains resistant to chloroquin have been reported in more than a dozen countries. The result has been a dramatic resurgence of malaria. In India the number of reported cases has increased from 40,000 in 1966 to 4.4 million in 1972, and to about 6 million in 1976. Sri Lanka, Pakistan and African countries south of the Sahara have also reported major increases in the incidence of malaria. Increases have also been reported in El Salvador, Nicaragua, and Guatemala. 49/

The controversy over the desirability of large river basin developments often centers around the prospect of increased risks of water-associated diseases. Dams and accompanying new waterways can provide new habitats for snails and breeding places for flies and mosquitos, and the inadequate planning of such developments has indeed produced such set-backs. A number of these examples are mentioned in the overviews which follow. Recent studies of the Aswan High Dam suggest, however, that government intervention in the form of programs for better sanitation, combined with snail eradication and other preventive measures, can significantly reduce the potential adverse consequences of large dams. The need for careful planning, coupled with environmental impact assessment, is nowhere more powerfully demonstrated than in the case of river developments.

This brief summary has touched on only a few of the principal environmental and natural resource problems of the developing world. A number of others are also of increasing concern, and are discussed in the following regional overviews. Pollution, often assumed to be a problem of marginal significance in less developed countries, is in fact fouling rivers and streams in each of the four regions. Untreated domestic sewage, waste from agro-industrial processes, and effluent from new factories and mills has destroyed fisheries, reduced available water supplies, and impaired agricultural productivity. Air pollution in many developing country capitals far exceeds the worst levels experienced today in the U.S.

The increasing use of pesticides has had severe consequences for the populations of developing countries. Often inadequately controlled, pesticide residues are building up in some countries to dangerous levels. Improper handling of these toxic chemicals has led to far more immediate tragedies. In 1976, 2,500 agricultural workers in Pakistan were poisoned by malathion, a pesticide that is considered relatively safe. Five died. Although precise statistics are not available, an estimated 500,000 people throughout the world are killed or incapacitated by insecticide poisoning every year. 50/

B. Prerequisites to Effective Management:  
The Institutional Dimension

1. Government Commitment

In 1971, A.I.D. canvassed its overseas Missions to identify the most serious environmental problems confronting thirty-five developing countries. A summary of the findings mentioned most of the difficulties discussed generally in this report. Notably, however, the report concluded that there was --

little evidence of awareness of environmental problems among the peoples of developing countries, or among their government administrators.... Many countries are preoccupied with the development of their natural resources, and, to the extent that concern does exist for the environment, there appears to be apprehension that social and economic costs of environmental protection may very well outweigh the benefits. 51/

It was undoubtedly an accurate assessment. In the following year, at the 1972 United Nations Conference on the Human Environment in Stockholm, a group of developing country delegates sought to balance what they perceived as an excessively one-sided debate by focusing on the suffering of the poor. The debate summary included in the Stockholm Conference report described their concern in succinct terms:

Developing countries could ill afford to put uncertain future needs ahead of their immediate needs for food, shelter, work, education and health care. . . . [T]he urgent task facing mankind was to solve those immediate and formidable problems. The priority of developing countries was development. Until the gap between the poor and the rich countries was substantially narrowed, little if any progress could be made in improving the human environment. 52/

One of the products of that Conference was a draft "Declaration on the Human Environment." It reflected again the developing nations' point of view:

In the developing countries most of the environmental problems are caused by under-

development. . . . Therefore, the developing countries must direct their efforts to development, bearing in mind their priorities and the need to safeguard and improve the environment. 53/

The notion that the establishment of programs for sound environmental management would have to await the attainment of some prerequisite level of economic development, usually undefined, persisted for some time. In 1974, for example, an A.I.D. memorandum surveying environmental needs in the developing countries of Africa indicated that, for most of those nations, "development is the 'absolute priority' and environmental considerations must not be allowed to interfere with the development process." 54/

Over time, however, as the consequences of inadequate environmental management have become more obvious, priorities have begun to shift. At Stockholm, the real nature and magnitude of the resource problems confronting the developing world were perceived only dimly. In light of the closer examinations undertaken since that time, however, the relationship between environmental management and development has become clearer. While it may be true that some forms of environmental degradation are caused by underdevelopment, it is now more clearly understood that, for the principally agricultural societies that predominate in developing countries, poverty and environmental degradation are in fact two manifestations of the same phenomenon: the unplanned, unmanaged impact of growing populations on a fragile natural resource base whose productivity is measurably diminishing in our own lifetime. If the material circumstances of the world's poorer peoples are ever to be improved over the long term, ways will have to be found to husband the fragile natural resources upon which their well-being depends.

This understanding is increasingly reflected in the official policy pronouncements of developing country governments. In 1978, for example, President Rodrigo Carazo of Costa Rica pledged his government to the establishment of a "broad, aggressive, and coordinated program for conservation and rational use of renewable natural resources." President Carazo explained his reasons for creating this new plan in vivid terms:

Costa Rica is approaching the point of no return with regard to the management of its renewable natural resources. . . . Travelling through the interior of the country, especially in the dry season, it is possible to contemplate how vast areas have been completely cut over and burned and are suffering the effects of the cancer of erosion. The most lamentable part of all this picture is the obvious instability and poverty of the rural

communities, the reduction in the potential for productivity of the soil, and the loss of options for uses having greater economic and social benefits. 55/

The Government of Nepal has included similar expressions of concern in the draft of its basic 1980-85 plan: "[P]roblems like population pressure, limited cultivable land, and destruction of natural resources will adversely tell on the whole development process itself." The four overviews that comprise the body of this report indicate further the extent to which the developing nations of all regions have given official recognition to the ways in which environmental and natural resource constraints have hampered development. 56/ These new perceptions are not yet unanimously shared, but it is nevertheless clear that there has been, in the years since Stockholm, a widespread, dramatic change in government attitudes about environmental and natural resource management in the developing world.

## 2. Institutional Needs

Now that government planners in many developing countries are more cognizant of the need for environmental management programs as an essential element in the development process, the continued failure of most of these nations to make more than marginal progress in the creation of such programs warrants closer examination. On the basis of the present survey, it can be said that a major impediment to the mounting of a more effective effort is the lack in most developing nations of an adequate institutional infrastructure. A subjective awareness of the environmental and natural resource problems which interfere with development is necessary but not sufficient. Suitable institutional machinery, tailored to each country's special circumstances, is also a critical prerequisite. To the extent that most developing countries do not now enjoy the benefit of such arrangements, they are currently incapable of establishing the effective environmental management regimes which are so urgently needed.

Recent experience amply demonstrates the importance of this point. Even where new training programs have augmented manpower resources in relevant disciplines, newly educated specialists have had difficulty finding agencies which could employ their skills effectively. Foreign technical experts furnished at the request of developing nations frequently find that there is little indigenous capability to evaluate their recommendations, much less to implement them. Even direct financial support of new agency structures is often wasted because underlying administrative and technical skills are not available to ensure that the new mechanisms are utilized properly, or because the new structures are simply unsuited to the existing cultural or political framework.

Many of these problems can be attributed to an insufficient understanding of the basic components of an effective institutional regime for environmental management. Because these basic, underlying institutional problems have generally received the least attention in government attempts to foster an enhanced environmental management capability, other "problem-specific" efforts have suffered. There is reason to believe that, once fundamental institutional prerequisites have been addressed adequately, significant improvements in the ability of governments to respond to their resource problems will be possible.

The rest of this section will be a brief, functional description of the basic elements common to all such institutional frameworks. It should be understood that such arrangements must in every case be tailored carefully to the unique circumstances of each country -- political, economic, and cultural -- and no attempt is made here to relate alternative structures or systems to particular national characteristics. But there are a number of common denominators -- elements present in all successful systems -- that must be incorporated in all of the new arrangements which are required. The following discussion focuses on these more general components.

Government agency structure and administration. The basic institutional capabilities essential to the broad spectrum of government activities are also required with respect to environmental issues. Thus, regardless of a country's political or economic system, its government should be capable of gathering and assimilating data and of basing long- and short-range planning on the resulting body of empirical information. It must have the ability to implement programs effectively, a requirement that calls for rational budgeting, inter-agency coordination, efficient delivery of services to the field, continuous monitoring and evaluation of experience, suitable enforcement mechanisms, a willingness to dispense benefits and sanctions equitably, and the establishment of a meaningful dialogue with the public.

It should be recognized that the governments of many developing countries face special constraints which may be insufficiently considered in U.S. thinking about administrative and institutional mechanisms. The notion that it is invariably the government's function to extend services to all citizens through bureaucratic structures, for example, may have limited application to poorer countries characterized by large numbers of low-income persons, limited fiscal and administrative resources, serious confidence gaps between the government and its intended beneficiaries, and traditions which do not include the regulation of individual behavior through administrative procedures. 57/ Because many of the most serious environmental and natural resource problems of developing countries relate directly to the activities of low-income groups, both rural and urban, the ability of a government

to manage environmental resources effectively is likely to depend in large measure on its ability to reach the poor majority. Western administrative institutions may not in fact be the best models in such circumstances, and alternative approaches therefore warrant greater study. 58'

In assigning environmental responsibility, developing countries currently employ a wide variety of organizational arrangements in their government structures. Some vest most relevant authority in a traditional group of resource management agencies, sometimes adding new environmental offices to facilitate the implementation of more comprehensive programs. Others have created new agencies to respond specifically to newly perceived environmental resource priorities. Still others have attempted merely to coordinate the activities of existing agencies to ensure the integration of necessary environmental and natural resource considerations.

The design of a government's agency structure is to a great extent a matter of sensitive political implications, and it should in every case be a matter of purely national discretion. The variety of arrangements currently in use suggests that there is no single formula for success. But it is fair to say that, given the inherent predisposition of most central planning units to maximize short-run economic return in development activities, genuine integrations of environmental and natural resources components will require the establishment in every government of some entity or entities whose primary responsibilities are to advocate the maintenance of environmental quality in government planning, and to ensure that the activities of different agencies which affect the integrity of natural resources and the environment are adequately coordinated.

The competition for scarce financial resources is intense, and money usually flows toward activities likely to produce the most dramatic results. Agencies attempting to create immediate and highly visible "successes" cannot be expected at the same time to give adequate attention to countervailing considerations regarding the maintenance of fragile ecosystems. They are likely to lack adequate data, for there is no compelling incentive to obtain it. The internal budget allocations of any agency are likely to favor those activities which most clearly contribute to the agency's primary mission rather than those which may be felt to impede it.

These are liabilities which may be overcome by the designation of an environmental focal point whose principal concern is to ensure the maintenance and productivity of the country's essential resource base. Its recommendations must of course be formulated within the context of the nation's perceived development needs, but it is far more likely to demonstrate credibly the environmental prerequisites to sustained development if the maintenance of resource productivity over the long term is its primary objective.

Planning and budgeting. The present survey indicates that a number of developing countries have included environmental components in their national development plans. Because of the division of responsibility for environmental and natural resource management and the lack of adequate coordinating mechanisms, however, there is no administrative foundation in most developing countries for a continuing, comprehensive planning process which properly incorporates considerations of environmental quality and natural resources productivity in the national programming and budgeting system. The usual result is an insufficient allocation of funds to the environmental sector, and continued fragmentation of resource policies. 59/

On the project level, progress is being made with the use of environmental impact assessments as an element in the planning process. Requirements created by some international development financing agencies, including the World Bank and A.I.D., have encouraged increasing use of such studies by developing countries, but improvements in technical capability are needed before they will be fully useful.

Environmental law. Unless the environmental and natural resource management effort rests on a solid legal foundation, it is almost certain to fall short of achieving its objectives. While virtually all developing countries have basic legislation empowering government agencies, among other things, to control some forms of pollution, to regulate certain categories of land use, and to control deforestation, the laws are often of questionable suitability to prevailing political, economic, and cultural realities. For this reason and others, they are often ineffective. Many problems are not addressed at all. Very few lawyers in developing countries, moreover, have been trained in modern legal mechanisms for maintaining environmental quality, and relatively little effort has been addressed, therefore, to needed legislative and administrative innovations. Because the role of law in environmental management has been a limited one, the quality of that management effort has suffered. 60/

There are signs that the situation is likely to change. The need for an effective legal response is increasingly recognized, and steps are being taken in many countries to strengthen the statutory basis for environmental protection and natural resource management. The importance of environmental legislation in developing nations was specifically acknowledged at an intergovernmental meeting in Bangkok in 1978. 61/ A number of international organizations, moreover, have furnished legislative drafting assistance at the request of developing country governments, including the Food and Agriculture Organization (FAO), the United Nations Environment Program (UNEP), and the International Union for the Conservation of Nature and Natural Resources (IUCN).

The much needed improvements in environmental law in developing countries must, however, include an important social dimension. For many traditional societies, new rules may not have any discernible moral content, and may in fact forbid conduct which has been part of a customary way of life for centuries (depositing waste in streams, grazing on any available land, scavenging for firewood). In other cases new laws may severely restrict access to certain occupations. Mere enforcement of such rules cannot alone accomplish the desired objective, which ultimately must be the promotion of the material well-being of currently disadvantaged peoples. Close coordination with carefully designed social and economic programs is thus essential to an equitable legal framework.

Data. The quality of environmental and natural resource planning and management varies directly with the quality of the underlying data base. For that reason, there is a continuing need for detailed information about such important matters as the productivity and vulnerability of renewable and non-renewable resources, the impact of alternative uses, optimal rates of exploitation, and tolerable pollution levels.

Although scientific data gathering technology has advanced rapidly in recent years -- particularly with the advent of remote sensing by aircraft and satellite -- the reliability of available information remains generally poor. At a recent A.I.D.-State Department conference on tropical deforestation, for example, estimates of the worldwide rate of forest depletion ranged from 2.5 million to 20 million hectares per year. 62/ Most forestry experts are in general agreement that reliable figures on global deforestation do not exist.

There are also significant gaps in our understanding of natural systems. Of the estimated 5 to 10 million plant and animal species in the world, for example, only about 1.6 million have been named; a much smaller number can be said to be known completely. 63/ Also, while our understanding of the dynamics of ecosystems is improving rapidly, there is still much to be learned, particularly in tropical and subtropical ecosystems. Given that level of ignorance, human activities which modify natural habitats and threaten the survival of species carry with them potential risks of unknown magnitude.

From the standpoint of national programs for environmental and natural resource management, the more local and specific the data, the more useful it is. The emergence of sophisticated monitoring technology and the development of better data on global trends will not diminish the need for detailed, "on-the-ground" investigations through intensive field work. The increasing use within developing countries of environmental impact assessments of proposed development projects has highlighted the importance of this more specific data; fully considered long-range planning

must be based on information of similar quality.

Also essential to sound environmental and natural resource planning is adequate economic information. Economists have understood for some time that traditional market mechanisms cannot be expected to set the right "price" for renewable and non-renewable natural resources; future generations have a major stake in the maintenance of natural productivity over the long term, but they are unable to enter the bidding. 64/ Not surprisingly, therefore, a great deal of attention has been focused in recent years on ways of determining economically optimal rates of resource use, taking into account future as well as present needs.

Specific economic data should also be made available, however, in the planning of programs and projects. Planners must be cognizant of the "external" costs of particular development activities. Most projects have negative as well as positive effects: a hydroelectric dam may flood prime agricultural land; an agricultural settlement may call for the destruction of large tracts of productive forest; effluent from a new industrial complex may reduce significantly other beneficial uses of an adjacent river.

In these and other cases, hard choices are involved as the development planning process proceeds. Quantified economic data on a project's net contribution to the achievement of development goals can help to facilitate a more rational evaluation of options, provided that future costs and benefits are weighed together with current costs and benefits, and provided that appropriate values are assigned to all significant consequences.

Finally, the importance of cultural and social information cannot be overstated. Projects which affect rural lifestyles, traditional agricultural and fishing methods, and other customary behavior must be based on a thoroughgoing appreciation of relevant cultural constraints. The inherent value of large families among peoples whose subsistence is derived from primitive agricultural labor, and who suffer from high infant mortality rates, is likely to impede the success of population control programs. Local leaders may see in development projects sponsored by a central government a threat to valued self-sufficiency. Because of such examples, the needs, values, and perceptions of those most significantly affected by development activities must be carefully assessed in the course of project planning. 65/

Manpower and training. It should be clear from the foregoing that the success of programs for the management of environmental resources is also dependent upon the quality of available manpower. A variety of professional and technical disciplines is required, including the environmental sciences and engineering, planning, economics, law, and administration. Relatively few countries currently enjoy access to adequate numbers of able and well trained

personnel in these areas, let alone people qualified for leadership roles in resource management programs.

Human resources at the managerial and decision making levels have generally been overlooked in the design of environmental training programs. It is a neglect that has had serious adverse implications for the quality of environmental and natural resource programs in developing countries. If better institutional mechanisms are to be utilized properly, decision makers must understand the complex resource interrelationships that characterize most major program and project decisions. Managers at the highest levels of government must have a sufficiently detailed grasp of environmental and resource issues to know whether data and projections put forth in support of proposals are adequate, whether they address all relevant concerns, and whether they are reliable. Until the proper incentives are created by decision makers who know what they must know in order to make informed judgments, the full utility of other elements in the country's institutional infrastructure for environmental management will not be realized.

Once those incentives are created, however, the achievement of environmental and natural resource management objectives will be particularly dependent upon the availability of a cadre of well trained technical personnel capable of executing research and field studies and skilled in measurement, data collection, and data analysis. In many developing countries, the lack of adequate numbers of technicians is an even more serious obstacle to effective environmental management than deficiencies at higher professional levels.

Most universities and some other educational institutions offer instruction in the environmental sciences and engineering, but few offer interdisciplinary courses fundamental to an understanding of the interactions of environmental and natural resource issues and solutions. Still fewer deal explicitly with economics, law, management, and planning, as those subjects relate to environmental protection and natural resources. There is a need for programs through which universities can upgrade their academic curricula to close these gaps.

The need for technician training is particularly acute in developing countries. Such programs should be structured to provide basic knowledge through short-term courses, workshops, and in-service employment.

Environmental education. To be successful, a country's environmental management effort must enjoy a high level of public support. This is particularly true of initiatives which affect the rural and urban poor. The importance of programs for forest protection, sanitation, family planning, pesticide management, and the like must be fully understood by citizens if long-term

success is to be realized. Also, public concern can be a powerful inducement to more effective government control of industrial pollution.

Many developing countries include environmental education in public school curricula and use mass media to generate popular support for environmental management programs. In many areas, however, it may be fair to say that the most important stimulus to public support has been the public's direct experience of the consequences of inadequate environmental management. If awareness is ever to precede such experience, and if it is ever to persuade governments to establish policies which prevent further environmental degradation, programs for public environmental education will have to be significantly expanded.

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## REGIONAL ASSESSMENTS

### Prefatory Note

This section of the report consists of regional overviews of the environmental and natural resource problems of Africa, Asia, Latin America, and the Near East, respectively, as well as assessments of the institutional capabilities within each region to respond to those problems.

With minor exceptions, each of the regional discussions is basically organized in keeping with the following outline:

#### A. Environmental and Natural Resource Problems

1. Productive natural resources (water, soil, forests, fisheries, etc.)
2. Problems attributable to pollution and other residuals (industrial effluent, agricultural chemicals, etc.)
3. Problems associated with urban areas
4. Environmental health

#### B. Institutional Framework for Environmental and Natural Resource Management

1. Government commitment
2. Government agency structure
3. Laws and regulation
4. Manpower and training
5. Research and data-gathering capabilities
6. Environmental education
7. Bilateral and multilateral activities
8. Non-governmental organizations

Each of the four regional discussions is intended to stand on its own as a self-contained assessment. For that reason, the reader who proceeds from the first region to the last will find some necessary repetition, particularly in the descriptions of certain environmental phenomena and environmentally related diseases. On the other hand, the reader seeking more detailed information about the subjects discussed is urged to consult the references which follow each assessment (organized alphabetically, by region, in the Bibliography near the end of this volume).

## I. AFRICA

SUMMARY: *Overuse and mismanagement of soils, forests, range, water, and genetic resources, and environmentally related diseases, are Africa's most critical environmental and natural resource problems. Contributing factors have been population increases, cultural changes, the introduction of inappropriate technology, and in some cases large development project themselves. Croplands and pasture lands are being subjected to unprecedented pressures, and yields are diminishing as a result; forests are rapidly shrinking as the need for firewood and logging activities increases; water resources are being altered by watershed destruction, river basin development, pollution, and excessive demand. The rich variety of Africa's flora and fauna is increasingly threatened by the destruction of tropical rainforests and by human pressures on other wildlife habitats. The resulting loss of plant and animal species is an increasing source of global concern.*

*Industrial pollution and agricultural residues are not yet major concerns, but are likely to increase in seriousness. Marine pollution by oil is becoming a significant problem in some coastal areas.*

*The rate of urbanization in Africa is substantially higher than the world average, and this will result in rapidly increasing pressures on urban resources and services in the future. Most African cities suffer from inadequate water supplies and sanitary sewerage systems.*

*Environmentally-related diseases are a major issue in Africa. The continent has the world's highest incidence of schistosomiasis. Malaria continues to be a major problem. Trypanosomiasis, associated with the tsetse fly, and onchocerciasis (river blindness) have impeded the development of vast infected areas.*

*Governments in Africa are becoming increasingly aware of and committed to environmental protection and natural resource management. But current institutional structures have not translated this commitment into effective action. Fragmentation of responsibility and inadequate coordination are important deficiencies. Legislation is similarly disjointed, and discourages the harmonization of the various aspects of environmental management. Inadequate manpower resources and scant data further impede the management process.*

This discussion will be an overview of the major natural resource and environmental issues facing the more than forty countries within and, in some cases, adjacent to "tropical" Africa -- the area between the Tropic of Cancer and the Tropic of Capricorn.

Africa is the second largest continent in the world, encompassing more than 22 percent of the earth's land area, with about 10 percent of the world's population. It is an area of great climatic variation ranging from deserts to rain forests. About 73 percent of the African people live within the tropical region of Africa and its islands. 1/ The area encompasses 20 of the world's least developed countries. 2/

The vast majority of people in tropical Africa live in severe conditions of poverty, the effects of which are readily apparent. Out of every 1,000 infants born, an average of 150 die before their first birthday; in some areas within some of the countries, the mortality rate is as high as 50 percent. Life expectancy averages only 43 years, compared to 53 years in the rest of the developing world, and 71 years in the United States. Only one physician is available for every 15,000 people, almost five times less than the developing world average. Approximately 70-80 percent of the population do not have access to health facilities. Only 17 percent of the people are literate and schools are available only to about 28 percent of school-age children. 3/

While the term "tropics" often conjures up images of rich vegetation, nearly two-thirds of tropical Africa is grassland or steppe; tropical rain forests are concentrated in a belt near the equator. Most of the tropical region is warm; climatic variations are determined by different amounts of rainfall received. As one moves farther away from the rain forest belt on each side of the equator, savanna variations and steppe zones appear. These zones then merge into the tropical deserts. In East Africa and Ethiopia, this pattern is interrupted by differences in elevation or wind patterns.

Annual precipitation ranges from virtually zero in portions of the Sahara, Somalia, and Namibia, to 100 or more inches in west coastal regions. The "Sahel" (the recently drought-stricken area of Central and West Africa) includes both the semi-arid (10 to 20 inches) and the sub-humid or savanna regions (20 to 30 inches). Most areas have distinct dry and wet seasons. The rain forest areas have dry seasons up to 2½ months duration; the humid savannas experience a 5 to 7½ month dry season; and the dry savanna to semi-arid regions have 7½ to 10 months with little or no rain. 4/

#### A. Environmental and Natural Resource Problems

##### 1. Productive Natural Resources

The most critical and extensive environmental problems facing

tropical Africa are overuse and mismanagement of renewable natural resources. Soils, forests, range, and water resources are all declining in productivity because human pressures are exceeding the natural carrying capacity. Population increases, cultural changes, and the introduction of inappropriate technology have been among the principal contributing factors. 5/

a. The Land

Historically, the population (farmer and nomad) survived in a delicate balance with each other and with the land. Recent times, with better medical and other services, have brought rapid population growth to the continent. Statistics from 50 years ago would suggest that, at that time, the population growth rate was about 1 percent per year; the average rate now is estimated to be approximately 3 percent, 6/ although the rate varies considerably from area to area. Nearly 300 million people now live in the countries of tropical Africa, more than 250 million of these, or about 85 percent, in the rural areas. 7/

Croplands. The livelihood of virtually the entire rural population is substantially dependent upon farming or pastoral activities. With the partial exception of some relatively advanced countries, and some areas close to cities, recent labor surveys have shown that almost everyone has some connection with agriculture. 8/

The dominant means of food production throughout most of Africa remains some form of shifting cultivation on small plots yielding subsistence production. Traditionally, favorable soils were cleared for cropping, usually on a slash-burn cycle of a few years of cropping followed by many years of natural regrowth (fallowing) which permitted fertility restoration and pest reduction. Today, pressures for more food have cut short this natural process. Erik Eckholm, in Losing Ground, explains: "Once a threshold point is reached at which farmers return to a plot before its fertility is fully restored, a dangerous cycle of degeneration begins...." 9/ Since tropical soils are subject to rapid organic decomposition, nutrients are quickly lost. As the soil structure deteriorates, erosion increases, yields shrink; the farmer is forced to move more frequently and clear more marginal land.

Official statistics show a clear decrease in yields in most of the countries of Africa. 10/ In Nigeria, for example, per hectare grain yields have declined steadily for more than a decade as agriculture has moved into marginal land and as soil erosion has worsened. 11/ In the Sahel, cropping has now been known to take place in areas receiving as little as 10 inches of annual rainfall. Under such conditions, crop expectancy is extremely low. 12/ In Rwanda, one of the world's five poorest countries, farming occupies 95 percent of the population and 87 percent of all cropland is under production. Yet Rwanda is increasingly unable to feed her people because of low land productivity. 13/

Pasture Lands. A large portion of the rural population of Africa has for centuries been nomadic or semi-nomadic. In the past a lower fertility rate plus various communal arrangements for redistributing animals according to need regulated the relationship between the people and the land. Also, pastoralists in major grazing areas such as Somalia kept cattle, camels, sheep, and goats, where each could eat different parts of the vegetation, making good use of the diversity of plants.

Today, however, growing populations and increasing livestock numbers have begun to exceed the carrying capacity of available pasture lands, in many areas. At present in Swaziland, for example, it is estimated that 525,000 head of cattle and 27,000 head of sheep and goats graze 700,000 hectares. The resulting average stocking rate -- one animal to 1.6 hectares of grazing land -- is the highest in Africa, and has led to serious soil deterioration. 14/

Furthermore, while data is rare and of varying reliability, there is growing evidence that the area devoted to pastoral activities has declined. 15/ This reduction is partly the result of encroachments by cultivators driven to expand their farms. Pressures of land deterioration and greater food needs are requiring more subsistence farm area. Equally important, the introduction of cash crops, mainly cotton and ground nuts, has made it worthwhile to cultivate a greater area than that needed for subsistence.

The introduction of irrigation schemes has also affected the pastoral areas by either swamping good pasture lands on the river banks or preempting them for cultivation. In central Sudan, large-scale rainfall irrigation schemes have removed vast tracts from pastureland, putting great pressure on the area that remains. 16/

While the pasture land area is shrinking, at least two factors have helped nomadic herdsmen in the short run to increase their herds. One is the spread of improved veterinary medicine and animal disease controls; the other is the provision of new wells. 17/ The construction of wells without the establishment of concomitant range management programs or the development of new range resources, however, has tended to advance the processes of desertification in some areas. Throughout Africa, due to a breakdown in the authority of local chiefs, who might have been able to decree control measures for the use of watering points, livestock grazing has intensified around the wells without allowing time for the pastures to regenerate. In such circumstances, areas surrounding the wells lost most of their nutritious grasses, became more susceptible to increased wind erosion, and eventually lost all traces of vegetation.

Economic incentives also encouraged larger herds as the market value increased in urban areas. Not only the nomads were at fault. In some areas small herds of cattle belonging to sedentary cultivators were a new feature that led to localized overgrazing.

In Mauritania, it has been argued that the chief malefactors are the urban cattle owners who do not have the same interest in conservation as the nomads, for whom pastoralism is the only means of livelihood. Even in Upper Volta, studies have found that agriculturalists were converting their savings into cattle, for economic reasons and increased cultural prestige. 18/

Ecological damage occurs when the carrying capacity of the land is exceeded. This is increasingly a consequence of the combined land use activities of the farmers and nomads in Africa. The Sahel is perhaps too familiar an example. But areas of East Africa are suffering similar hardships. Somalia has a large nomadic population. The situation in that country, as described by Kai Curry-Lindahl of the United Nations Environment Program, is acute. Curry-Lindahl predicts that without a radical change in land use practices, within a few decades the whole country will be desert-like except for some perennial river valleys and the moist southernmost region. He describes the country as "on the verge of a disaster." 19/

Vegetation. South of the Sahara, the long-term misuse of the land has contributed to a large-scale shift of all vegetation zones. The bare rock and sand dunes of the desert are now found in former sub-desert and Sahel zones as a result of desertification. Vegetation native to the Sahel is now found in the Sudan, and now the high forests are degenerating, with virtually no first generation cover remaining.

A UNESCO study of the Sudan reports that the southern boundary of the Sahara "has shifted south by an average of about 90 to 100 kilometers during the last seventeen years." 20/ An A.I.D. study has estimated that, in the past 50 years, 250,000 square miles of agricultural and grazing land have been lost to the Sahara from overcropping, overgrazing, and the extension of agriculture into unsuitable climatic regions. 21/

In Sahel and neighboring zones, widespread use of fire, usually intentionally set as part of slash-and-burn practices, is also affecting the general southward shift of vegetation zones. An analysis of satellite imagery photographs of this region indicates that a band approximately 400 miles in width, running completely across Africa south of the Sahara and north of the equator, is being burned each year. 22/

Forests. African forests constitute 27 percent of the world's forest cover. 23/ One of the essential elements in the continent's ecological stability, Africa's tropical forest is suffering a serious toll as the result of combined pressures on vegetation systems.

Two major causes of deforestation are land clearing for agriculture and wood gathering for fuel. According to a 1978

study sponsored by the Interstate Committee for the Struggle Against Drought in the Sahel (CILSS), wood, charcoal, and to a lesser extent, agricultural wastes represent more than 99 percent of the fuel burned by Sahelian households. Wood often absorbs 25 percent of a family budget. The Study concludes that this stems from the extreme inefficiency of Sahelian cooking stoves, which convey only a very small portion of the heat generated by combustion to the cooking vessels. The high consumption rate puts great pressures on the family. In the country side, because wood availability is deteriorating seriously, women often have to walk 5 to 10 kilometers away from their villages to collect wood, an activity which may absorb more than half of their time. 24/

Deforestation accelerates once the rapid growth of population causes greater and greater wood need, particularly in the urban areas. On the basis of the CILSS Study's estimates as to Sahelian consumption, to supply 30 million Sahelians in the year 2000 (out of a total population of approximately 50 million), three to six million hectares will have to be planted; this involves planting an average 160,000 to 300,000 hectares of forest annually, up to the end of the century. 25/

While situations vary and information is limited, other parts of Africa have analogous difficulties; the demand for wood, whether for firewood or timber, is becoming increasingly difficult to meet. 26/ While Ethiopia has relatively large forest resources, a large portion of this volume is in inaccessible regions; there is consequently, a serious lack of fuel wood over large areas of the country, and it is therefore becoming an expensive commodity. To obtain the amount of energy which an American can purchase for \$1.30, a resident of Addis Ababa must purchase firewood at a cost of \$8-10. 27/

A recent energy study of African villages revealed that in Ethiopia, villages are already using animal dung for fuel because trees are inaccessible. 28/ Dung is also a natural fertilizer and the trade-off, therefore, is generally undesirable. It was reported at a recent U.S. A.I.D. Firewood Conference for the Africa region that "in many African countries, more than four-fifths of all energy comes from non-commercial sources, especially firewood and charcoal. The pool of such material is becoming smaller . . . as deforestation proceeds at a rate that could leave Senegal bare of trees in 30 years, Ethiopia in 20, and Burundi in seven." 29/

Logging activities also lead to forest depletion in Africa. In many of Africa's tropical forest areas commercial loggers cut selectively, gradually eliminating the most valuable species. Logging roads constructed to move out the timber also increase the forest's accessibility to farmers, accelerating its eventual destruction. 30/

Reforestation has not kept pace with the loss of forested land due to logging, clearing for farmland, and conversion to

pasture. 31/ Even in Nigeria, where an FAO reforestation program is under way, only 25 percent of the removals from the forest are regenerated. 32/

b. Water Resources

Groundwater. The effects of the drought in the Sahel caught the attention of the developed world. But throughout Africa water is a serious problem. In Kenya, for example, which is 75 percent semi-arid, a high proportion of the population raises livestock, making water one of the country's top priorities. In Ethiopia, a recent drought caused at least 100,000 human deaths. 33/

In semi-arid regions, groundwater is seen as convenient means of responding to domestic and industrial demands and supplying agricultural and livestock needs. Unless groundwater supplies are developed carefully in relationship to range management considerations, however, serious imbalances can occur. The creation of new fixed water supplies induces excessive concentrations of livestock in adjacent areas. The carrying capacity of the range land is thus quickly outstripped, and desertification results. 34/

More than half of Africa's cities depend to some extent on groundwater. 35/ In these urban areas, groundwater depletion is becoming increasingly serious. Little is known in many areas about aquifer characteristics and the monitoring of pumped water is often unreliable -- more may be pumped than recorded. Part of the increased need comes from rapidly growing cities like Lagos, Nigeria, where industry requires more water than was foreseen at the times of the town's establishment. 36/ Coastal cities like Lagos and Dakar may soon have the additional problem of salt-water intrusion into the aquifer. While very little data is available, this may already be a problem in some areas.

While African groundwater resources are generally more plentiful outside of the continent's arid regions, water availability can nevertheless be a problem, particularly at the end of the dry season or following a dry year in which total rainfall was insufficient to replenish the groundwater storage. Wells may dry out, and even drilled bore holes may fail to supply water due to the unfavorable geological structure of the aquifers. On the left bank of Lake Kariba, in Southern Rhodesia, for instance, after one development project had been completed, it was discovered that half of the approximately 200 bore holes and wells failed to produce the anticipated amount of water and some of them had no water at all. 37/

Rainfall. Rainfall is erratic throughout Africa and droughts are not unusual. Annual rainfall figures confirm that in the Sahel region spells of rain are commonly interrupted by long dry periods and that extended periods are not an exception. In the region there have been several periods of consecutive years of

drought followed by series of years with rain exceeding the long-term averages. For example, the 1910-15 drought in the Sahel was more severe than during 1968-73, whereas the 1944-48 period was roughly similar. These statistics reveal that the recurrence of such droughts is extremely irregular and virtually unpredictable. 38/

The fact that rainfall and droughts are erratic places an extra burden on rural people. The natural vegetation, agriculture, and mode of life in the region largely depends upon the amount of precipitation. Historically, nomadic herdmen adapted to the erratic nature of the regional rainfall. Prior to the 1900's, the Malian nomadic people commonly stored grain for up to seven years in preparation for the inevitable drought years. As colonialism spread to the rural areas, the practice was abandoned.

River Basins. The tropical part of the African continent has 45 coastal and 12 inland drainage basins. About 40 percent of the continent is included in such areas.

Partly due to extreme seasonal variations, the conditions for transport on Africa's rivers are not favorable in the tropical region. Most of the navigable rivers have ungraded courses. Owing to large surf and shifting sands, the connection between oceans and the interior is very limited. Although the river systems have impressive lengths and drain relatively large areas, their impact has been limited by the extensive desert and semiarid regions of the continent.

Particularly in recent times, river basin development in Africa through the construction of capital-intensive projects, especially large hydro-electric dams, has had great appeal. In the Sahel region alone, while financing is not yet available, 39/ several large water basin development schemes are under consideration: e.g., the Senegal River Basin, the Gambia River Basin, the Niger River Basin, the Lake Chad Basin.

Such projects have been promoted for several reasons; production of electricity; accumulation of water for domestic, irrigation, industrial, and recreational uses; and flood control. On the other hand, the projects have generated considerable controversy in Africa as to the lost natural resources and disrupted lives which have often been traded for the benefits achieved.

For instance, the Kariba Dam, constructed twenty years ago on the boundaries of Zambia and Southern Rhodesia, created what was then the world's largest man-made lake. While being applauded by some for increasing electrical power for copper mining, the Kariba Dam was viewed by others as disrupting local populations without much local benefit. Over 50,000 people were resettled, and foreign species of fish replaced the indigenous varieties, thereby upsetting local livelihoods. 40/

Similarly, the Kainji Dam on the Niger River in Nigeria changed the river's shape and considerably altered the landscape and land use patterns. Some have declared that the dam has reduced productivity of the local land and water use systems while not providing much benefit in exchange. 41/

Large river projects almost certainly increase the risk of some endemic diseases. This has been clearly recognized in connection with the Volta Dam, where the incidence of urinary schistosomiasis increased to about 70 percent in some areas. 42/

African countries are themselves beginning to question the benefits of large dam construction. A Republic of Kenya representative to a Seminar on Environmental Aspects of Industrial Development held in March, 1978, observed: "The Kafue Dam construction in Zambia has increased loss of water by evaporation and transpiration in flooded vegetated areas, thus decreasing development options in the Kafue Basin. The dam has also adversely affected the grazing of local wildlife and aquatic populations which has a greater production potential than domestic stock in the Kafue flats area." 43/

In virtually every case, irrigation projects and large-scale river basin development in Africa have disrupted to some extent social structure, tenure patterns, local work habits, and ecosystems all along the basin area. Because of the proven risks associated with big projects, FAO is recommending only medium-sized irrigation schemes (100-10,000 acres) and small ones. In the words of one observer: "It has been concluded from an economic analysis that priority should be given in the Africa tropics to small-scale village-type irrigation schemes which can be easily managed and financed and in which farmers can fully participate." 44/

### c. Fisheries

Tropical Africa has about 3,750,000 square miles of land-bound water without any outlet to the sea. 45/ In addition, the tropical region has 28 coastal states.

Generally, African fisheries are a potentially important source of food. The rivers and lakes are rich in a variety of fish species. While data is scarce and inventories are rare, research on Lake Malawi identified over 200 species of fish, a diversity similar to that in the coastal waters of the Indian and Atlantic Oceans. 46/ Some sources have projected that the annual commercial production of fish in small ponds or intermittent streams carrying water for about nine months could be 8 to 10 times higher than in Europe. 47/ However, there is very little local commercial interest in this inland fish industry as yet because of preservation and transport difficulties and taste preferences for other food in some areas. Although fish are not looked upon as a com-

mercial commodity or staple diet by many tribes, practically all the rivers are fished at one time or another for local use.

The fisheries along the west coast of Africa are particularly plentiful, and migratory stocks are especially attractive to foreign fishermen. It is common for foreign trawlers, from Japan, Russia, Poland, Italy, etc., to have sizable and often very favorable contracts with the coastal West African countries for fishing rights. Some of the countries along the western coast have an active local fishing industry, as well as joint ventures with other countries. Senegal, for example, has increased its annual fish production from 100,000 to 250,000 tons in seven years. About 85 percent of the fish caught by traditional fishermen there are consumed fresh by the population along the coast, including Dakar. <sup>48/</sup> A good road network makes rapid distribution of fresh fish possible within 100 kilometers of the Atlantic coast. The remainder of the fish are dried, salted, grilled, smoked, sundried, or fermented.

Similarly, fish are an important food resource in Ghana, with the bulk of the catch staying in the country to provide a much-needed source of protein. Although figures vary, the estimated availability is on the order of 150,000 to 200,000 metric tons per year, less waste and spoilage. <sup>49/</sup> Most of the fish are smoked, both for flavor and preservation, and fish consumption probably exceeds that of other meat, which is in scarce supply. In Ghana, as in Senegal, most fish are taken from the sea rather than from inland waters.

Problems relating to management and conservation of stocks, particularly the migratory stocks along the coasts, will increase as the harvesting becomes more intense. In the coastal states the capacity and resources for data collection on migratory stocks are inadequate or nonexistent. Therefore, it is difficult to determine fishing quotas for each of the different foreign fishing fleets, let alone for the numbers of existing stocks as a whole.

River basin development along the west coast of Africa may seriously affect the coastal fisheries there. The cumulative effect of large-scale projects on several of the rivers which flow into coastal waters may change the quantity and chemical composition of the water. In addition, breeding areas for migratory fish and shrimp in some of the estuaries may be affected. While river basin projects appear to be looking at the potential impact on individual fisheries, more attention should be paid to the cumulative effect on the entire coastal system.

Industrial wastes discharged either directly into the sea or into rivers which flow to the sea have also begun to disturb coastal fisheries. In Tanzania, for example, effluents

from pulp and paper mills, textile factories, and fertilizer processing plants have been cited as increasingly troublesome in this regard. 50/

d. Flora and Fauna; Genetic Resources

Wildlife can serve at least three purposes in Africa. It can play an important role in perpetuating the national heritage of a country. It also can attract tourism, bringing in significant income in foreign exchange. Finally, it can be an important source of protein.

The various uses of wildlife apply to most of West and Central Africa. Cameroon, for example, has tried to base its wildlife policies and management practices on these three uses. 51/ The tourism aspect has been particularly promoted in East Africa. Kenya and Tanzania have initiated uniquely farsighted conservation policies, Kenya going so far as to ban the sales of animal trophies. 52/

Efforts to preserve national heritage through wildlife conservation and management practices reflect the realization that many wildlife species in Africa are endangered or already gone. The tropical areas of the world are genetically the richest regions on earth. The need to preserve this diversity of species in order to maintain ecological systems is perhaps one of the least perceived but most immediate priorities.

The preservation of plant species is also essential in Africa. Plant gene pools are an essential resource to agricultural scientists and farmers. In addition, many medicinal plants have been successfully used for centuries, but are now losing their habitat and are harder to find for local use. The value of medicinal plants and new chemical compounds derived from plant species has been noted by Harvard botanist, Richard Evan Shultes: "The mid-twentieth century discovery of a series of wonder drugs from natural sources (some of which have been used for centuries by traditional folk healers) has sparked a revolution." 53/ Erik Eckholm has written that "probably fewer than half the species of the humid tropics have ever been seen or catalogued by scientists. Even in Africa, the best explored [region], an average of more than 200 new plant species are still collected every year." 54/ Yet the spectacular wildlife of the East African savannas are in peril, Eckholm says. Africa's chimpanzee population is dwindling because of increased use by medical researchers to test hepatitis vaccines. Continuing threats posed by poachers, human settlements, and shrinking of protected areas all contribute to the wildlife threat.

Indeed, the very existence of the renowned East African game parks themselves is in jeopardy. As wildlife specialist Norman Myers has written, many parks "could be impoverished by

1990, and few parks could survive at all by the year 2000" considering these serious pressures on the wild community. 55/

With respect to the use of wildlife for nutrition, a recent study indicated that a wide range of animals currently provide edible meat in West Africa. Among them are rodents, antelope, duikers, and bush bucks. Also virtually all species of wildlife -- mammals, birds, reptiles and invertebrates -- serve as sources of wild meat. In Ghana, as much as 73 percent of locally produced meat may come from wild animals, particularly from some of the smaller types such as grass cutters and giant rats. 56/

While wildlife is not a panacea for solving global food problems, the potential for use, especially in the developing countries of Africa, is greater than generally appreciated. Game animals are believed to be far more efficient protein converters than domestic livestock. Moreover, they are more adaptable to the African climate, resistant to local pests, and can go for long periods without water.

## 2. Problems Attributable to Pollution and Other Residuals

### a. Agricultural Chemicals

Pollution from agricultural chemicals is still not extensive in tropical Africa, where most agricultural production is accomplished by hand labor and without benefit of fertilizers or pesticides. The pressure to use chemicals is increasing, however, as local soils degenerate, and as periodic pest outbreaks (such as the desert locust in East Africa, 57/ and grasshoppers in West Africa) are experienced. Exact figures on the amount and kinds of pesticides spread annually do not appear to be available. It is known, however, that most uses of these pesticides used (e.g., DDT and Dieldrin) have been cancelled in the U.S. They continue to appear in African markets because they are cheap, persistent, and easy to obtain, and because hazards to users are relatively low.

There have been scattered alarms where pesticides are used. But African data on side effects to people or biological systems is virtually nonexistent. In parts of Kenya, while there is an extensive and probably increasing use of pesticides, one local investigation of residual levels in Kenya nevertheless concluded that contamination from DDT, dieldrin and BHC was still not alarmingly high. 58/ High temperatures may hasten the breakdown of chemical components.

It would appear that with Africa's typical flash rains, there will be substantial run-off of agricultural chemicals as their use grows. Sizable build-up of residues in local lakes, rivers, and eventually the nearby ocean waters is likely to accompany the

inevitably increased use of pesticides.

b. Industrial Pollution

While not yet a widespread problem for the continent, industrial pollution is growing in certain areas of Africa. It is a matter of concern because most African communities rely on relatively few water sources for a variety of purposes. The introduction of contaminants can therefore disrupt a wide range of uses. 59/

Nigeria, for example, has significant pollution sources concentrated in the textile, brewing, slaughtering and rendering, pulp and paper, sugar refining, and chemical industries. Approximately 60 percent of these industrial sources are located in the vicinity of Lagos. In general, existing sources have little or no facilities for either air or water pollution control. Waste water is discharged directly either to rivers, other receiving waters, or to open drains, which in effect serve as sewers. 60/

Similar situations exist in other localities with industrial activities. Agro-industrial activities present some of the most serious environmental problems in terms of industrial pollution in Africa, although over the past few years chemical and water-based industries have begun to cause concern as well. In Kenya there is a wide range of organic effluents containing soluble substances, of which coffee wastes are the most widespread and the most serious. Kenya is a major coffee grower with a large number of coffee factories. In addition, Kenya has three pesticide manufacturing or compounding factories. As with virtually all such activities in Africa, Kenya has not promulgated any policies or regulations governing the formulation of the substances. 61/

The increasing industrial water pollution problem in Tanzania has already been mentioned. Similarly, gaseous discharges into the air from utility plants, fertilizer and chemical plants, and iron and steel mills, pose increasing air pollution problem. 62/

Some 40 percent of total African oil production, of about 4 percent of the total world production, presently comes from the sub-Saharan African countries. Of these, Nigeria, Angola, Gabon, and the Congo are significant producers. 63/ These countries export a significant amount of their production and a considerable portion comes from offshore oil areas. Zaire became a commercial petroleum producer in 1975. Exploration has recently begun, or been stepped up, in Mauritania, Mali, Chad, Guinea, Zaire, Somalia, Ethiopia, Senegal, Ivory Coast, Ghana, Benin, and Cameroon. 64/

The effects on local communities of crude oil exploration, production, transportation, and processing do not seem to have yet

received appreciable study in Africa. Offshore production may have considerable impact on the local environment, particularly since most offshore drilling occurs in relatively calm and protected areas near biologically vital sites. As yet, there are virtually no effective regulations on oil pollution control in the producing African countries. Offshore drilling accidents or discharges inevitably occur. In addition, some of the drilling is conducted in delta waters, and there have been several spills in Nigeria which local villagers cite as having taken heavy tolls on local fisheries.

Coastal pollution problems from oil have also begun to draw attention in East Africa. For example, the effluent and atmospheric pollution from an oil refinery in Mombasa, Kenya, has raised concern for the local marine ecology and tourism on the Kenyan coastline. Tanzania is beginning to experience a similar problem. 65/

While the beaches in East Africa are still relatively clean, all along the west coast of Africa pollution from passing ships has fouled the beaches. Discharged bilge water leaves shorelines covered with tar during certain seasons every year, thus eliminating any recreational use. A similar experience is foreseeable in East Africa with the anticipated expansion of shipping and refinery activities, unless effective controls can be implemented.

### 3. Problems Affecting Urban Areas

Africa is predominantly rural and nomadic. But a United Nations report has projected that, from 1920 to the year 2000, while the world's urban population will increase by nine times, Africa's urban population will increase by 31 times. 66/ Africa is thus expected to experience exceptional pressures on its urban environment.

Rapid urbanization has created severe problems. In Khartoum, Sudan, for example, failure of electricity supply due to overloading is an almost everyday occurrence. It is frequently difficult to obtain water at levels higher than the ground floor, and the overloading of the public sewage system has been officially acknowledged. 67/ The large cities of Nigeria, such as Lagos and Ibadan, have chronic water shortages. Air pollution from motor vehicles, power plants, and other industry is becoming a serious problem in the larger metropolitan areas such as Addis Ababa, Ethiopia, and Lagos, Nigeria.

The high urban growth rate in Africa, 5.6 percent (2.5 times higher than the rural rate), underscores the demands that millions of new urban residents will increasingly make in the next several years upon service facilities. 68/ Virtually every country in Africa is experiencing an rural-urban migration. Senegal presently

has a 4 percent per year growth rate for all its towns. By 1973, approximately 25 towns exceeded 10,000 people and more than 1.2 million, or 30 percent, of the nation's population were tabulated as urban residents. More than half were in Dakar, the capital city on the coast. 69/

Similar examples can be found in Central and East Africa. Zaire, an essentially rural country with approximately 75 percent of its population living in areas with 5,000 or less, is experiencing rapid urbanization. This is due both to high fertility and rural-urban migration, currently putting the rate of urbanization to about 8.1 percent. The capital city of Kinshasa, Zaire, currently estimated to have about 1.7 million residents, is expected to double in size to an estimated 3.4 million by 1980. Given these high urban growth rates, it is estimated that the ratio of urban to rural residents will change from 22:78 in 1970 to 36:64 in 1980. 70/

a. Water Supply and Sewage Treatment

For the urban dwellers of Africa, water supply and sewage treatment are critical problems. For example, all household water for Senegalese cities and towns in the river basin area is pumped directly from lakes, rivers, or water holes without being treated. The exception is the Dakar supply, which is processed by a modern treatment plant. The distance between the treatment plant and the consumption center, however, is 280 km, which presents serious problems for protecting water quality. The lack of a consistently safe source of potable water prompts the more affluent in Senegal to buy bottled water at a cost roughly 100 times higher than ordinary drinking water. 71/

In Zaire, as of early 1974, only an estimated 1.6 million persons, or approximately one-fourth of the total urban population, had access to a piped water supply system. Of these, there were only about 125,000 private house connections, or less than three connections per hundred dwelling units. 72/ In Addis Ababa, Ethiopia, approximately 55 percent of the people have access to clean, piped water for drinking. 73/ Generally in the urban areas of Africa, the majority of the population is not hooked to the piped water system. Rather, water is distributed through hydrants, or public spigots, and is carried to homes in open containers. While officially prohibited, public faucet areas are often gathering places for people washing clothes, dishes, etc.

Sewage systems are even less adequate throughout Africa. In Senegal, for example, only Dakar and Saint-Louis have sewage systems. Even in these two cities, however, large areas are not served and often open storm water drains are used to dump garbage and waste water. In Dakar, only two-thirds of the houses which have private water connections are joined to the sewage system.

Further, the drainage system in Senegal is not designed to handle the yearly floods, and large areas of these cities are periodically inundated by contaminated waters. Also, in the vicinity of sewer outfalls, the sea water along Dakar's beaches is heavily polluted. 74/

In Ethiopia, 40-60 percent of urban residents have access to sanitary facilities, most of which consist of pit latrines. Sewage treatment plants are nonexistent even in the two major cities of Addis Ababa and Asmara, and raw sewage is discharged into open ditches and nearby water sources. 75/ This is not untypical of much of Africa. With the exception of small sewers in the major urban centers of Zaire, that country has no organized sewerage program. 76/ Studies have revealed a similar situation in Ghana, although a modern sewerage system for the Accra municipal area has been under construction. 77/ It appears that Nairobi, Kenya, has perhaps the most effective water supply and sewage treatment on the continent.

#### b. Town Planning

One of the remnants of the colonial days is the concept of town planning. The urban areas of Francophone and Anglophone countries, for instance, were initially structured along town planning principles originated in the colonial countries. But rapid urban migration has flooded the towns faster than plans and systems have been able to adjust. Many cities in Africa have established, or tried to strengthen, zoning and planning units. Their efforts will need strong government support, however, to survive current rates of urban migration.

#### 4. Environmental Health

Lester Brown has observed, in The Twenty-Ninth Day, "illnesses caused directly or indirectly by human alterations of the environment now rank high among the worldwide causes of human suffering." 78/ Human alterations, in the name of development, have played a significant role in the spread of disease vectors in Africa.

#### a. Schistosomiasis (Bilharzia)

While data and statistics are deficient as to specifics, Africa has by far the world's highest incidence of schistosomiasis, 79/ which now rivals malaria as a leading world disease.

The disease is common wherever there are bodies of fresh water. The schistosomiasis parasite must spend some time in the human body, some time in water, and some time in certain snails. The snails are found in a variety of habitats, such as streams, irrigation canals, ponds, burrow pits, flooded areas, lakes, and rich fields. As noted by Erik Eckholm in Picture of Health, "schistosomiasis is a disease of the rural poor... [O]nly where

sanitation is poor can the infection persist...." 80/ While rates vary throughout Africa, poor sanitation in almost all rural areas virtually assures its existence.

The growing interest in river basin development and the spread of irrigation projects has expanded the habitats for schistosomiasis. In Senegal, up to 82 percent of the population have been determined to have some form of schistosomiasis. 81/ But due to Senegal's several river basin projects rates sometimes have been higher, approaching 100 percent of the population in the eastern Casamance region during the early 60's. 82/ Current estimates indicate that approximately 30 percent of the population of Swaziland currently suffers from schistosomiasis, and present plans for increasing areas under irrigation, construction of livestock-watering reservoirs, and building fish ponds will probably increase its incidence in the absence of a comprehensive control program. 83/

Eckholm underscores the health dilemma posed by river development: "the construction of countless small-scale irrigation projects as well as of several large dams throughout Africa has afforded schistosomiasis an unprecedented prosperity and prevalence. Every major man-made lake on the continent harbors the [parasite], and some variety of the disease now blights every African country except Lesotho." 84/

A 1978 Earthscan report has recently raised new alarm over this disease. One of the world's largest farms -- the two-million-acre Gezira irrigation scheme in Sudan, just south of Khartoum -- has been invaded by schistosomiasis. Conditions in Gezira were reportedly ideal for the spread of schisto and "until quite recently, virtually no preventative measures had been taken against it." As a result "the general incidence of the disease among Gezira residents is 60-75 percent, and in the age group 8-14 years almost every individual is infected." 85/

#### b. Malaria

Malaria is one of the most commonly known and widespread of the water-related diseases in Africa. Stagnant water, for example, contained in poorly drained ditches, is a highly suitable environment for breeding malaria-carrying mosquito larvae. Water development projects, both small and large-scale (similar to those which expand habitats for schistosomiasis) can also aggravate the malaria situation.

The rates of infection for malaria vary from region to region. For Ethiopia, this is the major single disease problem in terms of epidemic potential and economic burden. It is estimated that almost one-half the people live in areas where the disease is prevalent and that several million persons are infected. Some

estimate an infection rate as high as 60 percent. Seasonal outbreaks occur each year along the Blue Nile, Jila, and Baro Rivers. 86/ In Senegal, approximately 82 percent of the population lives in areas of endemic malaria. 87/ In Zaire, the disease is endemic in the lowland areas and occurs in unstable epidemic form in the highlands at elevations of 2,000 meters or more. 88/ Malaria is a major problem in Ghana and causes an estimated 10-15 percent of all deaths in children. 89/

The difficulties facing malaria control in Ghana are numerous and typical of the problem: increased mosquito breeding sites created by water impoundments for developments such as the Volta River Basin; increased mobility of the population facilitating transmission of the disease into new areas not subject to control measures; the resistance of some mosquito vectors to DDT and dieldrin; and the limited resources that the government can bring to bear. 90/ Since eradication of the mosquito vector is costly and nearly impossible in tropical Africa, reliance is placed on the utilization of drugs such as Nivaquine to protect the population. These are distributed by health outposts and by mobile health teams. Supplies in rural areas are often inadequate and are frequently disrupted because of rural health workers failing to keep track of stocks.

### c. Trypanosomiasis

The "fly belt" of Africa (that which is infested with the tsetse fly) lies roughly between 12 degrees north and 20 degrees south (with exceptions in East Africa) and covers some 4 million square miles. Of this vast area, it is estimated that approximately 1/5th -- or more than 500 million acres -- are suitable for extensive grazing or range management practices; 91/ however, livestock production and, to a lesser degree, human habitation, are restricted in these regions. As a result, the tsetse fly and trypanosomiasis, the protozoan infection that it carries, have long been identified as primary obstacles to the development of large areas of Africa.

While the costs of eradicating the tsetse fly are themselves considerable, the possible environmental impacts of clearing tsetse flies from an area must also be recognized. Opening grazing land will increase human habitation and risk the same cyclical process of land degeneration experienced further north. Consequences for wildlife should also be considered. Because wildlife animals are generally resistant to trypanosomiasis, the disease in fact serves as a natural habitat protection mechanism. 92/

Again, as with the other diseases discussed, trypanosomiasis has varying rates in different regions. In Senegal, the human form of trypanosomiasis has declined in recent years and does not

present a serious problem. However, the disease has been reported to exist among a large number of animals, wild and domestic, which leaves a potential source for infection of the human population. The tropical rain forest area of Ghana, like that of a number of its neighbors, is infested with the tsetse fly over large areas. This has seriously limited economic development and the raising of livestock as a much needed source of protein. Attempts have been made in Ghana to reduce the flies' breeding areas by burning or pruning brush and spraying larvicide along bodies of water. The flies have adapted, however, by moving to areas that are less accessible or to plants resistant to fire. 93/ In Central Africa, one third of the Zairian people, for example, live in regions heavily infested with the tsetse fly. 94/

Several factors have hampered efforts to control this debilitating disease, including large-scale infestation of many areas, increasing vector resistance to chemical control measures, some resistance to treatment on the part of the afflicted, and substantial population mobility. On the other hand, some success is being achieved with methods of biological control of the tsetse fly. Male flies bred in captivity are sterilized by radiation and released in an area where the fly population has been reduced through chemical control, thus further reducing succeeding generations of the fly. Projects are being carried out in both Upper Volta and Tanzania on different fly species. Chemical control is still practical and effective, however, in northern, more semi-arid areas. 95/

#### d. Onchocerciasis

Onchocerciasis, also known as river blindness, is an infection of man by a worm, the nematode. It is transmitted by a small fly which breeds in rivers and streams with fairly swift currents, laying eggs on plants and rocks. The parasite which causes the disease creates in man many different clinical manifestations, from chronic skin conditions, including atrophy, depigmentation and severe rashes, to eye problems which may culminate in blindness. The eye condition is the most important and destructive consequence of the disease. In severely affected areas of Africa 30 to 50 percent of the adult male population may be severely incapacitated by loss of vision and over 10 percent of the population may be blind. 96/

In West Africa, where it is especially prevalent in the fast currents of the regional rivers, people have responded to onchocerciasis by abandoning their villages. Population studies in local areas of West Africa show a strong out-migration from heavily infested river basins. Trends in the infected areas of northeast Ghana in the last decade, for example, show an overall net migration loss per district of up to 2.9 percent per annum, but with the

pattern of heaviest declines clearly in the river blindness locations with movements of people to upland watershed areas. 97/

Several areas in Africa have small streams which are capable of harboring the organism. Because the streams change in volume with the seasons, it is difficult to determine the exact location of the infection as well as the proper use of insecticides. While the exact incidence and geographic distribution is not known, some villages in the Central African area have been known to have 100 percent infection rates, including up to 10 percent associated blindness. 98/

e. Other Common Diseases

Other common and sometimes fatal development-related diseases occurring in various parts of Africa include leishmaniasis and gastro-illnesses, results of high levels of contamination in water, milk, or food; hookworm, a parasitic infection which almost all Zairians have, for example, again aggravated by environmental sanitation problems; and malnutrition, caused by real food shortages in certain places and during certain seasons, as well as poor utilization of existing resources in some areas.

B. Institutional Framework for Environmental and Natural Resources Management

As noted in the preceding part of this paper, tropical Africa has critical environmental and natural resource problems in almost every area where human populations have interacted with the environment. The pressure for land to grow food, to raise cattle, to plant trees, to cut trees, to build cities, and to exploit minerals seems almost overwhelming. Responsive administrative mechanisms must be developed to integrate activities and goals.

1. Government Commitment

The people of Africa have for centuries been in touch with the land and the environment, and there are now strong indications that African governments are becoming increasingly aware of and committed to environmental protection and natural resources management. 99/ Government policies are officially beginning to reflect these concerns. For example, chapter eight ("The Environment") of the Gambia's National Five-Year Development Plan, 1976-80 identifies as the government's "clear objectives" the ordering of development in the Gambia:

. . . in such a way as to ensure a continuance of its sources of potential welfare in the future. This will involve not only reclamation, restoration, and perservation, but also enhancement of the environment. When a con-

flict arises between sustained yield and short-term exploitation, the former will prevail. 100/

Policy commitments have also come in specific natural resource areas. For example, in a March 28, 1975, address the President of Botswana explained:

The time has come to tackle the subject about which there is a lot of talk and not much action -- the better use and development of our land. As our human population and numbers of our cattle and other livestock increase there is a growing danger that grazing will be destroyed by uncontrolled use of communal grazing areas by ever-growing numbers of animals. Once grazing has been destroyed it is extremely difficult to get grass re-established... [W]e are faced with a situation that demands action. 101/

## 2. Government Agency Structure and Administration

It is possible to find throughout tropical Africa elaborate systems for government administration and decision making, most patterned after colonial forms, and often somewhat modified since independence. Essentially, however, the civil service bureaucracy's administrative frameworks have remained generally intact so that, even during periods of unrest, most governments have been able to function to some degree.

In addition, because rural activities are involved in almost every aspect of national life in Africa, almost every ministry in government is likely to have some responsibility directly or indirectly related to environmental resources. However, a few ministries are particularly worthy of mention.

Frequently found are ministries which deal directly with natural resources. The Ministry of Agriculture and Natural Resources in The Gambia is one example; the Ministry of Agriculture, Natural Resources, and Rural Development in Nigeria is another. Such ministries often have comprehensive responsibilities with respect to environmental matters. For example, they may handle forestry, fisheries, livestock and animal husbandry, agriculture (sometimes also including drainage and irrigable land), research and development in all of these areas, and overall water management.

Ministries responsible for economic planning and/or industrial

development have taken on special importance in most countries, with the recent emphasis on industrial goals. National development plans, often for a five-year period, are essential government expressions of policy and development goals, with specific projections and priorities for development (including environmental priorities).

A ministry responsible for local government and land matters is another potentially powerful and influential government unit with respect to environment and natural resource management, since this ministry usually deals with and is responsible for local-level activity. It therefore has significant influence and can provide substantial guidance to local government leaders on a wide variety of matters. Its importance is underscored by the fact that local government leaders are often responsible for implementing programs at the grassroots level. In addition, local leaders often have traditional ties with the village community, increasing their influence and public administrative power over all social matters of any consequence.

A ministry of public health is of course an important government body in terms of environmental health, especially sanitation in urban areas. It usually has authority to control nuisances, a category in which air, water, and noise pollution are often included, to detect foul water, to regulate latrines and public drains, and sometimes to assume responsibility over municipal clean-up duties and maintenance of storm sewers and drainage canals.

With respect to administration, the elaborate, often centralized government structure in most African countries has bred a very complicated system. The decision-making process may seem confused in project development because ministerial responsibilities are sometimes not clear or may overlap. There is generally no central government representative to coordinate separate projects in terms of their cumulative and interrelated impact on the environment. A well project for a rural village, for example, might involve separate decision-making activities by several government bodies and programs: a local authority, a water department, a lands office, a town planning office, public works, perhaps animal husbandry if livestock will use the well, public health, and so on. Independent activities may well contradict or impede one another.

In response to this dilemma, some African governments have established special environmental or natural resource units with primary responsibility for coordinating and initiating environmental projects. Kenya, for example, has a National Environmental Secretariat which is attached to the office of the President, deals directly with environmental matters, and has several committees concerned with environmental issues. <sup>102/</sup> Ghana has an Environmental Protection Council which was established by decree in 1974. The creation of the council brought under one roof for the first time the management of all environmental matters. <sup>103/</sup> Nigeria, on the

other hand, established in 1976 a Division of the Environment which is now situated within its Ministry for Industries. 104/

In 1977 a five-person mission from the United Nations Environment Program and the Economic Commission for Africa visited 15 African countries to assess the extent of active awareness of environmental problems by policymakers, administrators, and the public and to promote environmental institution-building. 105/ This mission reported that the environmental agencies visited were relatively young, with many created in the period from 1974 to 1976. It concluded that "there is a dynamic awareness about the environment and a general acceptance that concern for environmental protection is not a luxury...." At the same time the mission found that it was premature to evaluate the effectiveness of programs which were still "groping to find their level in their national setting." All environmental efforts seemed "to experience similar problems of shortage of expert personnel, financial resources and authority and ability to enforce decisions or monitor achievements of desirable environmental goals." 106/

### 3. Laws and Regulations

Generally, environmental laws dealing directly with specific pollution control areas (air, water, noise, solid waste disposal, pesticide control, etc.) are in the very early stages of development in Africa. And while natural resource statutes have existed in some form since the colonial days in many African countries, recent government commitments to rational management of natural resources have yet to be translated into responsive law and effective implementation in most areas. In addition, as increased attention is paid to international environment conventions dealing, for example, with international trade in endangered species, oil pollution, marine pollution from dumping of wastes, wetlands preservation, marine fisheries, migratory birds, and so on, African nations will increasingly need to adjust their national systems to comply with the international mandates and standards.

Perhaps the single most outstanding factor in African law, as compared with western law, is its pluralism. In Africa several distinct legal systems may coexist within a given geographic area. Various systems can be identified in many parts of tropical Africa: indigenous or customary law, statutory law, and common law principles enacted by colonial powers and carried over after independence.

The effect of this pluralism is that more than one legal system influences and dictates behavior within any single territorial jurisdiction. When enforcement or conflict resolution is involved the African judge, enforcement officer, and citizen often may have to choose between, or try to integrate,

two or more systems of law which may apply concurrently.

Laws in Africa dealing with the environment and natural resources have been fashioned by these systems. While much of the relatively recent environmental health, pollution, and conservation legislation has come about through colonial or post-independence enactments, basic relationships governing land use and water rights are still covered by customary law and practices in many areas, especially among rural populations. In fact, statutory law often recognized the continued operation of indigenous law where it is consistent with natural justice and other laws in force. 107/

In terms of statutory law, while gaps still exist, a combination of colonial and African law in many countries has resulted in some useful environmental legislation, both in the pollution and natural resource management areas. It is not possible to reflect in any complete sense the legislative circumstances of each of the countries in tropical Africa with respect to these areas. Generally, however, a few examples can be given to illustrate some areas being addressed.

In the environmental health area many of the colonial governments left general public health codes which prohibit nuisances (often defined to include air, water, and noise pollution) and authorized regulation of various types of pollution. 108/ Usually a specific minister has the authority to make rules and regulations to prevent water pollution.

Several countries have national water legislation, 109/ again often enacted during the colonial period and amended since independence, granting various degrees of authority to control, conserve, apportion, and use water resources. 110/ Further general statutes conferring regulatory authority in environmentally related areas include: factories acts, town planning ordinances, and legislation establishing various government corporations to provide basic water and utility services.

A few countries have begun to legislate in specific pollution areas. Botswana has enacted legislation, for example, specifically directed to air pollution; 111/ Mauritius has enacted a Pesticides Control Act. 112/

With respect to natural resources, the colonial powers left substantial pieces of legislation which have carried over since independence and which in many cases remain similar to their colonial versions. Forestry, wildlife, agriculture, and mineral exploitation laws are examples. Much of this legislation could provide some manner of protection and management authority for existing resources. For example, many of the forestry laws contain provisions for establishing government forestry reserves and protected forest areas, as well as prohibitions against tree cut-

ting, burning, and so on, in certain designated areas. 113/ Similarly, much wildlife legislation has basic provisions regulating the amount of hunting, and often contains lists of prohibited or restricted animals.

In principle, the kinds of statutes cited above provide some basis for environmental protection and natural resource management in Africa at the present time. However, enforcement and implementation are lacking. It is self-evident that enactment of a law will not ensure implementation unless there are resources and commitment. As noted throughout this report, staff and support resources are extremely limited in most developing countries. This applies equally to the legal area. The discipline of environmental and natural resource law is a relatively new one and, if few ecologists are currently being trained in Africa, the number of environmental lawyers being trained is even smaller. In many areas regulations have not been promulgated even though the power to do so exists. Revisions of out-of-date colonial laws are not attempted even if their inadequacy is recognized because in large part there is not sufficient expertise to identify and devise workable alternatives. In other cases, countries may find themselves in a situation where they must literally duplicate another country's legislation without local adaptation due to lack of sufficient indigenous expertise and the inability to obtain from outside.

In addition, as discussed above, one of the fundamental features of much of the African legislation, including that which is environmentally related, is that it is largely based on or borrowed from legal systems outside these countries. 114/ Consequently, the unfamiliarity or new concepts may work against ready understanding and commitment of the local populations. Public understanding and support is, obviously, a critical element for environmental policy and regulation.

In addition, there was a tendency in the colonial legislation to treat different resources separately. While an inherent interdependence between natural resources and their various uses exists in fact, and while resources were so treated in customary settings, the colonial laws generally set the stage for separate regulation of resource sectors (forestry, wildlife, agriculture, water, fisheries, etc.) without a coordinating mechanism. This approach has intensified use conflicts between resources or between different uses of a particular resource. For example, land, forests, and water resources may be caught in the midst of battles for competing needs rather than being integrated into an overall land and water use plan for the region or nation.

#### 4. Manpower, Training, and Research

Programs in environmental education are beginning to appear

in Africa. In Cameroon, for example, a College of Wildlife Management to serve the needs of the Francophone West African countries has recently been established. Sudan has two higher secondary schools which are almost exclusively agricultural, and several postgraduate degrees relating to environmental studies. The Kenya Science Teachers College has a compulsory one-year course in environmental science education. 115/

Generally, environmental training for any discipline in Africa is still a relatively new idea. There are very few places where an ecologist, or environmentally sensitive specialist, can be effectively used within government structures in most countries. Not only will training facilities need to be strengthened, but also government ministries and facilities will need to be adjusted to best use the staff who receive training.

There is room for expanded research facilities and activities throughout tropical Africa. Resource inventories and surveys, testing facilities for levels of contaminants, documentation measures, exchange of experts throughout the region, analysis of local use practices and regeneration studies are among the possibilities.

To note a few research facilities: the Ivory Coast created a Ministry of Scientific Research in 1971 to unify and integrate all research activities, including those on environmental matters. 116/ The University of Nairobi, particularly the Department of Geography, is involved with environmental research, as is the Kenyan Ministry of Agriculture. The University of Ife, near Ibadan, Nigeria, is becoming more involved with applied research on environmental issues. Other facilities are the Bureau of Resource Assessment and Land Use Planning in Tanzania, the Center for Environmental Studies at the University of Khartoum, and the Center for Ecological Studies in Cameroon.

##### 5. Data Gathering

The data base and data-gathering capabilities serving the governments of most African countries are weak or virtually nonexistent. Ethiopia, for example, has never carried out a population census, knowledge of population size distribution and structure has always been based on estimates. 117/ Throughout Africa available demographic data is not of high quality. Even where censuses have been conducted, a population count, or any type of information drive, is often correctly associated in the public mind with tax burdens and therefore undercounts are almost inevitable. Livestock data is unreliable. Even the CILSS organization in West Africa, which includes local forestry experts, admits "there is no reliable forest inventory for the Sahel countries." 118/ Similarly, participants at the recent U.S. A.I.D. Firewood Conference on Africa agreed that several firewood and related areas had "information gaps." 119/

In general, more effective programs for environmental and natural resource management will require a far more detailed data base than is currently available. Inventories of plant and animal species, pollution levels and the assimilative capacity of rivers and streams, rates of resource depletion, and other categories of information must be developed. It is likely that the training facilities discussed above will be able to close these gaps over time. The process should be hastened through programs of technical cooperation and exchange, both among similarly situated African countries, and between African countries and the rest of the world.

#### 6. Bilateral and Multilateral Activities

Development assistance activities are constantly being initiated in tropical Africa. Three of the "environmental" activities will be noted here.

CILSS (the Permanent Interstate Committee for Drought Control in the Sahel) was established after the recent drought by the Governments of the Sahelian countries. Its Secretariat is in Ouagadougou, Upper Volta. Presently, eight countries are members of CILSS: Mauritania, Mali, Chad, Upper Volta, Senegal, Cape Verde, The Gambia, and Niger. The Secretariat staff includes an ecologist and is striving to coordinate and initiate programs on a regional level to combat desertification. A substantial interest of the CILSS countries is forestry management. From time to time they have supported a "green belt" approach to stopping the advance of desert frontiers.

There are several river basin commissions in Africa, especially in the western region: the Lake Chad Basin Commission, the Niger River Basin Commission, and the Senegal River Basin Commission are three prominent examples. Such commissions are established as executive agencies for the management of basin projects and to plan the development of the water and related resources for the basin. The Commissions have had varying degrees of success and effectiveness because, in part, it has been difficult to satisfy the interests of all countries in each basin. The basin commissions have received considerable encouragement from the international donor community, since in virtually all large scale water projects the donors have required institutional arrangements. The Commissions could potentially cover large areas of territory and authority, and thereby have considerable impact on regional development of entire biological systems.

The Man and the Biosphere Program (MAB) is an intergovernmental and an interdisciplinary program, established in 1970, and overseen by UNESCO. It is oriented toward actual management of problems arising from the interactions between human activities and natural systems.

National committees for MAB have been set up in almost all African countries. These Committees define and organize activities concerning particular national problems within guidelines from the MAB International Coordinating Council. Projects often focus on regional or sub-regional areas, with an emphasis on research of geographical areas.

Selected MAB projects include research into the ecosystem of the Tai Forest in the Ivory Coast, one of the last remnants of primary forest in all of West Africa. 120/ Through MAB a considerable number of ecological studies on the tropical forests of Nigeria have been undertaken. 121/ A new UNESCO-UNEP-MAB proposal presently under consideration calls for the creation of a Regional Scientific Information and Documentation Center on Tropical Ecology at Yaounde, Cameroon. 122/ This Center would help to satisfy a pressing need for pertinent documentation relating to tropical humid forest ecosystems.

#### 7. Non-Governmental Organizations (NGOs)

Several non-governmental initiatives in the environment are underway in Africa. A recent profile survey conducted by the Environmental Liaison Center, Nairobi, Kenya, identified 178 NGOs active in Africa. 123/ The range of NGOs is broad, from the Sierra Leone Nature Conservation Association (protecting wildlife), the Chad Christian Agricultural Youth Group (sinking wells), and the Environmental Health Officers Association of Zambia (protecting existing wells), to the National Council of Women in Kenya (planting trees), and the African Wildlife Leadership Foundation. There are learned societies such as the East African Natural History Society and East African Wildlife Society of Kenya. 124/ Nigeria has recently launched a National Union for the Conservation of Nature and Natural Resources 125/, a national chapter of the International Union for the Conservation of Nature and Natural Resources, a broad-based organization which is working to set up national chapters throughout Africa. Similarly, the International World Wildlife Fund has developed several national chapters in Africa.

While it is not possible to identify all the active NGOs in Africa, partly because documentation in this area is not available, it is clear that African NGOs could play a substantial role helping to increase public understanding of and participation in environmental programs as well as promoting policy and legislation. At present such groups are often composed primarily of students or professionals who could have some influence on national developments. It does not appear that the majority of the rural poor are as yet very involved as direct participants in non-governmental organization activities.

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## II. ASIA

SUMMARY: *The environmental and natural resource problems that afflict the developing countries of Asia vary in intensity with the physical characteristics of specific sub-regions. Erosion has destroyed the productivity of mountain slopes in the Himalayas; deforestation is of urgent concern in much of Southeast Asia; and waterlogging and soil salinity, often leading to the loss of cropland, beset the plains of Pakistan and parts of India. Responsible for these circumstances are human activities, often arising from the needs of growing populations for land to cultivate subsistence crops; these include the farming of marginal land, particularly on slopes; insufficient fallow periods; the clearing of forest land for agriculture; and the felling of trees for firewood and timber. Common to all areas are water-resource related problems, especially insufficient supplies of safe drinking water and lack of water for agricultural purposes, while pollution of marine waters and overfishing threaten the fisheries resources of coastal states. Because of poor planning, projects intended to improve and expand water resources and agricultural production often result in social disruption, destruction of ecosystems, and loss of wildlife habitat and yield only minimal benefits.*

*Industrial wastes are a source of increasing concern in developing Asia. Localized pollution from agro-industrial operations such as sugar and palm oil processing mills adversely affects water supplies and fisheries and has become a major problem in some areas. Mineral and petroleum extraction also lead to pollution.*

*The rapid growth of cities has placed serious strains upon inadequate urban water supply and sewerage systems, while air pollution, particularly from buses and trucks burning low grade fuels, creates a considerable health problem.*

*Debilitating diseases, often directly related to such environmental factors as contaminated water and aggravated by widespread malnutrition, include intestinal infections, schistosomiasis, and filariasis. Malaria, once nearly eradicated over large parts of Asia, has recently re-emerged as a major health problem throughout the greater part of the Indian subcontinent.*

*Asian governments have responded to the threats to their resources and environment with varying degrees of commitment. Environmental boards and ministries have been set up in several countries, and many nations have passed new environmental legislation. Programs to combat problems such as deforestation and soil erosion have been established in several countries. However, implementation is severely hampered in most countries by a lack of both data and trained personnel.*

Asia, as covered in this report, encompasses three regions: the Far East, Southeast Asia, and the Indian subcontinent. It is a vast area of highly diverse physiographic characteristics, ranging from the equatorial, tropical areas of Indonesia to the mountainous regions of South Korea. In Southeast Asia are the high mountains of Burma and Malaysia, the lowlands of Thailand and Cambodia, and the deep coastal waters of the South China Sea between South Vietnam and the Philippines. The Indian subcontinent includes the Himalayas of Nepal, the great plains of the Indus River in Pakistan and the Ganges in India and Bangladesh, and India's Deccan Plateau.

The area is composed of countries in varying stages of development. The per capita income ranges from \$100 in Nepal to \$2560 in Singapore; the literacy rate ranges from 12-17 percent in parts of the northern Indian subcontinent to 70-90 percent in major parts of the Far East and Southeast Asia. The population growth rate ranges from 1.3 to 3 percent a year. Eight of the world's 48 least developed countries are in the region, including all countries in the Indian subcontinent, and Burma, Cambodia and Laos in Southeast Asia. <sup>1/</sup> The environmental problems of Korea and Taiwan differ from those of other countries because of their advanced and continued rapid industrialization. The limited geographic areas and advanced industrialization and urbanization of the city states of Hong Kong and Singapore distinguish them from other parts of the region.

#### A. Environmental and Natural Resource Problems

##### 1. Productive Natural Resources

##### a. Water Resources

One of the most serious environmental problems in Asia is water supply. The majority of the population lives in rural areas, and statistics compiled by WHO suggest that only about 10 percent of these rural residents have access to water supplies which meet minimal health standards. <sup>2/</sup> Most countries lack the resources to control water pollution from primary human and agricultural wastes or to offset its effects by providing treated water. Accumulated wastes mix with the surface and ground water resources creating serious problems in the area.

In Nepal only 8 percent of the population has access to a safe and convenient drinking water supply. Coliform amounts exceeding U.S. standards have been found above 14,000 feet in the vicinity of Mount Everest. <sup>3/</sup> In rural India, only 5 percent of the population receives a piped water supply. There are 152,000 villages in which the water source is at a distance of one mile or more, or which are

situated in areas having only brackish water. The immediate consequence is that 50 percent of the diseases commonly encountered in India are water-borne. Most of these could be prevented by supplying safe drinking water. 4/

In the rural areas of Thailand, only 10 percent of the population has safe potable water. The result of this, coupled with the absence of adequate sanitary facilities, is that 80 percent of all illness and 40 percent of all deaths are attributable to human waste or "filth" diseases. 5/

River Basins. The river resources of the Indian subcontinent include the Indus, the Brahmaputra, the Ganges, and the feeder rivers of the Himalayas. In Southeast Asia, the Mekong River complex, one of the largest in the world, is an important resource base for the countries of Laos, Thailand, Cambodia, and Vietnam.

These river resources are as yet under-utilized. Many river projects have been undertaken with insufficient attention to the full resource potential of the water (because of inadequate infrastructure, for example, or the lack of grid systems for power transmission). For example, Nepal reportedly has the highest potential hydroelectric generating capacity in the world. Although an Indian-funded generating plant has been built in eastern Nepal, and despite the construction of dams in the Kathmandu areas and a proposed project to be funded by the United Nations for the Karnali River, the total potential of the resource is virtually untapped. 6/

Throughout Asia, river basin projects have been or are being developed for power generation, water conservation, flood control, and irrigation. Traditionally, the emphasis at the time of conception and in the early developmental stages was on engineering aspects with minimal consideration given to the many environmental and sociological impacts of the projects. Now there is increasing concern about the consequences of river basin development, including the downstream effects, the effects on fisheries resources, natural areas, wildlife and native flora and fauna, and the problems associated with resettlement and subsequent social disruption of local populations.

The Lower Mekong River Basin Development Project includes a drainage area of some 235,000 square miles in Laos, Thailand, Cambodia, and Vietnam. It is one of the largest projects ever undertaken and includes 40 to 50 mainstream and tributary dams. The principal objectives of the project are power production, flood control, and irrigation. The ecological consequences of the development have become more apparent in recent years and the national and international agencies involved in the project have voiced their concerns and are attempting to mitigate between the developmental and conservation aspects of the project. 7/ A.I.D. has sponsored several studies to assess potential impacts on fisheries, human

settlements and health, and the Mekong Committee Secretariat has coordinated these studies with others, including assessments of potential impacts on archeological remains and parklands. 8/

Inadequate or improper management of water resource projects has often thwarted development objectives. Expected benefits have failed to materialize, and costs have been greater than anticipated. One such example is the Nam Phong dam and reservoir system in Northeast Thailand. The reservoir failed to fill as predicted partly because of series of dry years and partly because of incomplete or inaccurate hydrological information. Consequently, the reservoir has been managed for power generation. No water is available for irrigation in the dry season and only limited amounts are available in the wet season. Inadequate planning for resettlement and a failure to anticipate the detrimental social impact on the 30,000 people displaced by the flooded valley behind the dam resulted in severe societal disruption. Some of the displaced people became fishermen on the reservoir, but the newly created resource was not as productive as anticipated. Other families have moved away due to poor soils near the shore. Since the reservoir has not supported irrigation, additional drilling for water to satisfy agricultural needs has been necessary, increasing total project costs. 9/

As a result of such experiences, and with growing recognition of the magnitude of the impact of major development projects, national governments and international funding agencies are increasingly including these considerations in the planning process. The Mangla Watershed project in Pakistan and the Mahaweli Basin Development Project in east central Sri Lanka are examples. A planning paper for the development of the latter includes an Environmental Impact Assessment prepared by A.I.D. which analyzes environmental impacts and proposes possible alternatives. 10/

The United Nations Environment Program has funded the design of an environmental, economic, and social post-audit of a dam and irrigation project in northeast Thailand. 11/ An A.I.D. project has been proposed to expand watershed management activities in catchment areas of the Indus River and its tributaries, taking into account environmental needs and problems pertaining to reforestation, erosion and pasture management. A similar A.I.D. land and water management project for selected areas of the Punjab and Northwest Frontier Provinces in Pakistan is planned for implementation in 1979. 12/

b. Forests

Tropical forests are a critical resource in Asia, as elsewhere, and cover more than 50 percent of the land area of Indonesia, Malaysia, Papua New Guinea, Cambodia, and Burma. Important forest resources are also located in Sri Lanka, Nepal, the Philippines, and Thailand. Countries where forests have been severely depleted and now cover less than 20 percent of the total land area

include Bangladesh, Pakistan, and India.

Leading causes of deforestation in the Indian subcontinent and Southeast Asia are land clearing for agricultural settlements, the collection of firewood to meet fuel needs of rural populations, and the granting of logging concessions. Throughout many parts of the region, timber is being cut at rates which exceed replacement and in areas not suitable for logging.

The loss of a sustained forest resource deprives rural residents of their primary source of fuel. Reductions in forest cover also result in wildlife depletion and disruption of local hydrology. The water holding capacity of forests is important in moderating water flow and preventing floods and droughts. Destruction of watershed forests also leads to a loss of fertile soil in cut-over areas, interference with downstream agriculture, and, because of excessive silt deposits, a reduction in the useful life of water storage reservoirs. Destruction of stream, lake, and nearshore marine fisheries is a further potential consequence.

Projections for individual countries are discouraging. Total forest area in Nepal decreased by about 25 percent from 1964 to 1975. Without the initiation of large-scale reforestation projects, accessible forests in the hill areas could disappear within 15 years and those of Terai within 25 years. 13/ India's forest resources are similarly in jeopardy unless viable reforestation projects are implemented and alternative cheap fuel resources made available. 14/ Sri Lanka's forest lands have been largely depleted during the last two decades. A concerted ongoing national and private organization effort is in effect to reverse the trend. 15/ In the Philippines, forest cover decreased from 44 percent of total land area in 1957 to 33 percent in 1976, with most significant decreases in the late 1960's and early 1970's. 16/ The National Forestry Department of Thailand estimates that at the present rate of loss -- 2,500 square kilometers a year -- Thailand's forests will be completely denuded in 25 years. 17/ A recent study predicted that the remaining accessible accessible low-land forests of Malaysia could be exhausted within a decade. 18/

One well documented example of the adverse effects of deforestation in Asia is the silting of the Ambuklao Dam in Northern Luzon, Philippines. The cutting of timber and subsequent loss of water retention capacity of land surrounding the reservoir has resulted in massive silting of the reservoir, reducing its useful life from 60 to 32 years. The Buhisan Dam, outside of Cebu in the Philippines was built in the 1940's and had an abundant water supply until the late 1960's. Subsequent cultivation of the surrounding watershed resulted in such massive silting of the reservoir that it can no longer serve the purposes for which it was originally planned. 19/

In the Indus plains in Pakistan, high floods as a result of deforestation have occurred more frequently during the last twenty-five years than over the previous sixty-five years. In August 1973, a flood considered to be the worst in Pakistan's history inundated nearly two million hectares of standing crops and ten thousand villages. 20/

There are exceptions to excessive deforestation. The teak forests of Burma are underutilized, for example, and the Asian Development Bank is funding a project to sustain cutting to maintain an economically viable yield level. Remaining forest resources in areas which have not been devastated -- in Papua New Guinea, Malaysia, and Indonesia, for example -- could be maintained with proper planning and utilized as perpetually valuable resources.

Reforestation campaigns and stepped up enforcement of forest protection laws in some Asian countries -- Sri Lanka 21/ and Thailand, 22/ for example -- offer hope that recent declines in forest cover may be reversed. The Philippine government recently reported that, for the first time in 1978, newly planted forest acreage exceeded the amount of acreage harvested. A proposed A.I.D. nonconventional energy development and agroforestation project in the Philippines may well contribute to this success in the future. As a part of the energy project, tree plantations will serve as a source of raw materials for a thermal generating plant. As part of the agroforestation project, denuded areas are to be replanted. 23/

### c. Fisheries

The fisheries of Asia are a major and highly productive source of protein for many residents of the region. The annual consumption of fish in Southeast Asia, for example, is two to four times the world average.

There have been major increases in the output of inland fisheries due to aquaculture but inland fishing grounds have not yet been developed to their full potential. Nevertheless, there is an increasing possibility that greater yields may never be realized. The increased application of fertilizers and pesticides required by modern agricultural technology calls for particularly careful management in areas where aquaculture is being encouraged.

The productivity of nearshore fisheries has been threatened in many Asian countries by over-exploitation. Fishermen continue to use outmoded technology which limits them to intensive fishing in shallow coastal waters. In addition to overfishing, coral reef habitats essential for the maintenance of productive fisheries are being destroyed by fishermen using dynamite and toxic chemicals. 24/ The problem is exacerbated in Sri Lanka by small entrepreneurs extracting coral for the manufacture

of lime. 25 / A recent survey in the Philippines indicated that more than three-quarters of the country's coral reef resources have suffered "heavy damage" (defined as more than 50 percent destroyed). 26/

A longer-term and more significant threat to the basic productivity of fisheries throughout Asia is the discharge of urban and industrial wastes, drainage of coastal swamps, and the increasing sedimentation of estuarine and coastal waters by silt laden rivers emptying into the sea.

Offshore fisheries in many areas have not yet been tapped or adequately utilized because of lack of technology and equipment. This is especially true in the South China Sea and Indian Ocean. 27/ This potentially important resource could be adversely affected by the increasingly important offshore oil-drilling and mine waste residuals deposited in marine waters.

#### d. Croplands and Grasslands

Rapid increases in human population have steadily intensified pressures to make existing grazing and agricultural land more productive. 28/

Grazing lands of the Indian subcontinent and isolated islands in the Philippines and Indonesia have a relatively low carrying capacity and are currently capable of sustaining only marginal levels of subsistence. Over-exploitation has not only decreased their productivity but is continuously destroying the fertility and stability of affected soils. The problem is particularly serious in areas of Pakistan and Northwest India where over-grazing is resulting in desertification. In the Luni block in Rajasthan, for example, most pastures now have only 10 to 15 percent of their original carrying capacity and the forage deficit is met by expansion into standing vegetation. Within a twenty-year period, sand cover has increased from 25 to 33 percent of the area. 29/

In most Asian countries rice is the principal food crop. Increased cultivation in most of these countries has barely met the demands of growing populations. In the Philippines, for example, while food production has increased marginally faster than the size of the population, even greater increases in per capita food demand, resulting from increasing income and changing expectations, have created new shortfalls. 30/ Indonesia, once an important rice exporter, has been dependent upon imported rice for several years. 31/ Most countries are just keeping up with their current needs, and future shortages, with growing populations, can be anticipated.

The intensified agricultural production required in these countries has potential adverse side effects on other resources. The disruptive effects of the large scale reservoirs needed for irrigation of more land have already been discussed. Some other problems include waterlogging and salinity, soil erosion, increased populations of disease vector pests and agricultural chemical pollution.

Waterlogging and salinity can be a problem wherever surface water is applied to irrigated land with inadequate underground drainage. Water will rise to within a few feet of the surface, impairing the growth of deep-rooted crops and allowing a concentration of minerals and salts to build up near the surface. This has been seen in China, India, and Pakistan. In Pakistan, for example, a recent study disclosed that almost one-third of Punjab Province and almost one-half of Sind Province suffered from moderate or severe waterlogging. More than 98 percent of agricultural land in Sind was affected by salinity. Control projects involving construction of new wells and drainage systems have been successful in reversing some of the adverse effects, but at very high resource costs. 32/

The establishment of broad area monoculture, primarily irrigated riceland, can result in difficult pest management problems. Recently, Indonesia has had some destructive pest outbreaks, as, for example, in the Upung Delta where the stinkbug has reduced rice yields up to 60 percent in the last two years. Of more widespread importance is the brown leafhopper, which is particularly destructive of the high yielding rice now cultivated in Java. Double-cropping practice does not allow dry season pest population reduction and their numbers are therefore maintained. An integrated pest management program is needed in this case to realize fully the potentially increased productivity associated with the rapid intensification of rice culture. 33/

Soil erosion is occurring in hilly and mountainous areas, which often constitute the only remaining land available for cultivation. With the monsoon rains, erosion is inevitable unless there is an extensive terracing system. The rivers of Nepal annually carry over 240 million cubic meters of soil to India. This loss has been called Nepal's "most precious export." 34/

e. Coastal Zone

The coastal zone, an extremely important resource because of the island archipelago nations and extensive national coastlines, includes the coastal waters, the continental shelf, adjacent shorelands, and water bodies influenced by and in proximity to the shoreline. It is the most productive ecological unit in terms of biomass (the amount of extant living matter) and other natural resources and is also the most desirable area for human habitation. Attempts to increase utilization of coastal zone resources will result in inevitable conflicts. Unless competing uses are regulated, over-exploitation and increased pollution from on-shore industrial, urban, and touristic sources will severely decimate the productive capacity and resource value of the coastal areas throughout the region. The section on fisheries described the over-exploitation of subsistence and commercial fisheries in the coastal zone; forthcoming sections will mention the adverse effects of the discharge of industrial residuals and increasing urbanization.

This section discusses other existing and potential adverse effects associated with development activities.

One of the greatest threats to the coastal zone is increasing urbanization. The capital cities of most countries in Southeast Asia are located in the coastal zone, and they continue to grow rapidly with the influx of rural inhabitants. These cities are not institutionally or financially able to meet the needs of the new migrants. Many services, including waste disposal, water supply, and housing are not available. These inadequacies result in serious damage to local coastal areas and their fishery resources. Mussel and oyster beds around Manila Bay and brackish water fishponds north of Manila have experienced reduced production due in part to raw sewage discharges. Oysters in Deep Bay, Hong Kong, are reported to contain fecal bacteria, and dysentery is thought to have been transmitted through consumption of cockles in Malaysia. Epidemics of typhoid and hepatitis have been linked to consumption of sewage-contaminated water and shellfish in Vietnam. 35/

Another threat to the coastal zone mentioned earlier is the destruction of coral reefs by such activities as dynamite fishing and coral extraction. The impact of this destruction, including its detrimental effect on coastal communities, can be seen with particular clarity on the east coast of Sri Lanka. In one location, for example, approximately one-half million cubic feet of coral are removed annually and brought to kilns in local villages for the production of lime. The consequences of this activity include the disappearance of mangrove communities, small lagoons and cultivated coconut land because of sea erosion; the virtual cessation of fishing activity because of the elimination of breeding and feeding areas; the disappearance of useful plants within a half-mile of the coast because of increasing salinity of the soil; and a high level of salinity in local wells. 36/

Unrestricted disposal of untreated sewage and garbage is also proving incompatible with tourism and thus reduces potential foreign currency revenues. Beach resorts near Manila have been abandoned for this reason. Malaysian coastal waters off Johore Baharu and the tourist mecca of Penang have become unfit for swimming, as have several beach areas in Sri Lanka. 37/ The beaches of Pattaya in Thailand are similarly threatened by untreated sewage from hotels and by untreated organic wastes from local tapioca starch processors. 38/

#### f. Flora and Fauna; Genetic Resources

The tropical forests of Southeast Asia are located primarily in Indonesia, Malaysia, and the Philippines, and cover about 618,000 square miles. Southeast Asia's forests contain many species found only in this region. In addition to the uniqueness of many plant species, certain wildlife species are also unique to the area. For example, 620 species of bird have been identified in the eastern sector

of Papua New Guinea; 320 of those species have not been identified in any other part of the world. Of the 317 bird species identified in the lowland forests of Malaysia, 152 are not found elsewhere. 39/

The greatest single threat to the abundance and diversity of species in Southeast Asia is the rapid destruction of habitat, primarily forest cover, as documented in other sections. If the present trend continues, most of the lowland forest of Peninsular Malaysia and the Philippines will be logged in the next ten years and all lowland forests in Southeast Asia could be exhausted by early in the next century. 39/ The result would be the extinction of many species that have not even been identified, and a permanent loss of genetic materials that would be incalculable.

g. Natural Areas

Many countries in Asia have made only limited commitments to protect and manage natural areas. This minimal commitment is evidenced by the failure to designate areas with potential according to international standards and by a failure to protect and manage those areas which have been designated already.

The lists of potential park and wilderness preserves with unique features now subject to development pressures is a long one. Magnificent virgin forests are being logged in Pakistan's Himalayan region north of Rawalpindi. Several areas in Kalimantan and Celebes in Indonesia are also being logged. In the Philippines, the unique mossy forest area of Mount Pulog in Northern Luzon and many unique coral formations are now threatened by development.

Equally serious is the failure to protect and manage areas already designated as national parks or wilderness areas. A survey of the more than 100 natural areas in the Philippines revealed that only 10 percent of them retained the unique features which once brought them up to international standards for protected areas. Not even a sign indicates the presence of the one marine reserve in Puerto Galera. 41/ Commercial-scale logging within nature reserves is disrupting essential habitats in Sumatra. Over one-half of the 166 designated natural areas are game reserves which protect wildlife, yet lumber cutting allowed in the reserves destroys essential habitat. Other nature reserves legally restrict logging severely; in the Kulai Reserve in East Kalimantan, however, an area with one of the largest known orangutang populations, 386 out of 1,158 square miles have been logged by "informal operators." 42/ In Sri Lanka, logging was permitted until 1977 in Sinharaja, the country's last extensive tract of original tropical rain forest. 43/

h. Cultural Resources

In most Asian countries there is an awareness of the value of historic sites, buildings, and monuments. Yet funds provided are

inadequate to protect these resources from natural and human destruction. For example, at Sukhothai, the first capital of Thailand, cattle indiscriminately graze through structures over 500 years old.

A more recent threat is increasing industrialization. Statues and temples in urban areas typically suffer deterioration from air pollution. Indian officials recently determined that emissions from an oil refinery, foundries, and two thermal power stations could significantly damage the Taj Mahal. 44/

## 2. Problems Attributable to Pollution and Other Residuals

### a. Industrial Pollution

Increasing industrialization has created extensive pollution problems in rapidly developing Korea and Taiwan. Pollution is also becoming a serious problem in India (steel processing and petro chemical complexes), Indonesia (oil extraction), Thailand (paper and sugar mills, vegetable oil refineries, and food canneries), and Malaysia (rubber and palm oil processing).

And yet in other countries, effluent emissions from widely scattered industries, while not significantly contributing to regional pollution, have adverse and direct health effects on workers and those people living near the pollution sources.

Air pollution levels in industrialized areas of Korea far exceed those suggested by WHO for protection of the public health. For example, in Ulsan and Pusan the levels of nitrogen oxides and sulfur dioxide for 1973 exceeded WHO desirable levels by as much as five and ten times respectively in the vicinity of industrial plants. 45/

The disastrous effects of the concentration of industry were evident in the increase from six to 17 sugar mills along a 12 mile stretch of the Mae Klong River in Western Thailand. As long as there were only six mills, the aquatic ecosystem and maraculture (shellfish and shrimp farms) continued to be very productive with an annual output valued at \$1.8 million. By 1970, however, the increasing price for sugar resulted in a more than doubling of production capacity. The result was that several segments of the Mae Klong River became so heavily polluted that the fisheries were virtually destroyed. With the recent introduction of central and individual plant pollution control systems, the fishery resources have been partially restored. 46/

One very successful economic development in Peninsular Malaysia has been the establishment of palm oil plantations, and processing mills. The effluent discharged from the processing plants has a high organic concentration and is rarely treated, thus polluting water supplies, creating noxious odors, damaging productive fisheries, and adversely affecting the health of those in the adjacent human settle-

ments. The total organic waste loading from oil palm wastes in 1975 was equivalent to the total wastes from a community with a population slightly larger than the present population of West Malaysia. 47/

b. Accumulation of Agricultural Chemicals in the Environment

The drive to become agriculturally self-sufficient has resulted in an expanded use of agricultural chemicals to increase production and protect crops. A country-by-country comparison of the magnitude of the increase is not available and even single-year observations are difficult to obtain in developing countries. Some isolated observations are that fertilizer use in the Philippines increased more than threefold between 1973 and 1976 48/ and that the use of pesticides, many of which were chlorinated hydrocarbons, increased fivefold in India in the period 1960-1975. 49/

Even more difficult to obtain are measures of the effects of these chemicals on the environment. While one might expect reports similar to those from Western countries to appear in the next ten years, as of now there is little information about the accumulation of the chemicals in water bodies, soil, vegetables, fruit, fish, birds, and mammals. However, there are again isolated examples such as reports of high levels of chemical pollutants in Laguna de Bay, a lake just outside of Metropolitan Manila and the location of the International Rice Research Institute, the primary agricultural research center in Asia. The lake is surrounded by irrigated rice-lands which degrade the lake with fertilizer laden run-off. High levels of health damaging chemicals have been found in catfish, balut (duck eggs), and ducks raised in the lake. 50/

c. Mining Wastes

The uncontrolled disposal of mining wastes in Indonesia, Malaysia, the Philippines, and Thailand are damaging to marine resources, agricultural production and tourism.

One well documented case is the incompatibility of nearshore tin mining with other activities on the south coast of Thailand. Deposits of silt from this activity on corals and beaches around Phuket has been one important obstacle to the development of the tourism industry. In addition, the fish catch has declined, reportedly due to migration by fish and fishermen away from turbid areas, the potential for pearl oyster culture has been diminished and the harvesting of mangroves inhibited. 51/

In the Baguio area in Northern Luzon, Philippines, some 50 metric tons of copper, gold and silver mine tailings are discharged daily into the local rivers by six mining firms. The annual damage to down-

stream agriculture by clogging irrigation canals and silting fields of rice and tobacco has been estimated at \$10 million. The wastes have caused extinction of aquatic life, and added increased amounts of toxic metals to fish and agricultural products grown in contaminated areas. 52/

In both cases, the polluting firms are attempting to control their residuals, but the task is difficult. In the case of nearshore tin mining, there is no known technological solution. In the case of the Baguio mines, there are not sufficient areas to build holding ponds with capacities for both mine wastes and typhoon waters. Mining in these two situations may be incompatible with other activities.

d. Toxic Substances

Toxic substances, defined in this case as heavy metals, are found in quantities exceeding natural levels in isolated areas in Asian countries. As one would suspect, these concentrations are most prevalent in more industrialized countries like South Korea and Taiwan and less prevalent, but still evident, in less industrialized countries like Thailand. An increasing trend of heavy metal concentration has been reported in the rivers and coastal waters of Korea; the presence of cadmium, mercury, copper, and lead exceed water quality standards of Japan, the U.S., and those suggested by WHO. 53/ In general, water and sediments in the vicinity of Bangkok showed a level of heavy metals higher than natural concentrations, and in the case of mercury the levels in a few instances exceeded international standards. 54/

e. Marine and Coastal Pollution

Deforestation and industrial and mine waste discharges, described in previous sections, contribute to marine and coastal pollution. Other commercial and industrial activities have also had adverse effects on marine and coastal environments.

Oil recovery, transportation and disposal are recognized as major threats. The numerous oil spills and discharges in the South China Sea, particularly the Straits of Malacca, and oil discharges during tank cleaning and transfer operations contribute undesirable hydrocarbons to the marine environment. Oil recovery operations constitute an increasingly serious problem since many areas with high petroleum potential, such as northwest Palawan, the Gulf of Thailand, and the northern Malacca Straits are located in the vicinity of major fishing grounds. 55/

An already serious but isolated example of coastal pollution is seen in Korean seaports, where industrial wastes and wastewater discharged from industrial plants are combined with oil and grease from boats and ships. 56/ The levels of oil and grease in Incheon and Onsan Bays already exceed to a considerable degree the standard set by the

Korean government to protect marine resources. Fisheries and farmlands have been seriously damaged and the central government has had to compensate fishermen and farmers.

Environmental disruption has resulted from tin mining in waters off the coasts of Malaysia, Indonesia, and Thailand. This bottom mining adversely affects the harvest of important fish crops. Increased turbidity also affects primary productivity and damages beaches and human settlements. 57/

### 3. Issues Associated with Urban Areas

All major cities in Asia have experienced rapid urbanization and population growth in the past two decades. The populations of most cities have at least doubled in that period due to high birth rates and the heavy influx of displaced rural people creating squatter settlements. These densely populated slum areas often include a major portion of the total urban population; about one-third of Manila's population and possibly more than one-third of Jakarta's are slum residents. The pattern of growth is chaotic with human shelters located in peripheral areas of cities, along railroad tracks, in the flood plains, and on steep hillsides. Large and small industries, and factories, commercial buildings, and small shops are located at random. Appropriate support services are inadequate or non-existent. Existing land use planning departments or agencies, typically under-financed and without needed manpower, have been unable to cope with the overwhelming magnitude of the growth problem. As in other parts of the developing world, it is the poor majority that suffers most from environmental degradation resulting from high population density, inadequate water supply and sewer services, transportation facilities, and increased water and air pollution.

#### a. Water Supply, Sewage Disposal and Solid Waste Collection

Despite heavy capital investment for water supply facilities, the needs of the rapidly growing population have not been met. In Indonesia, the number of urban residents served by public water supplies tripled between 1962 and 1970, yet the proportion of the population served remained at 35 percent. 58/ Even today in the capital city of Jakarta, a city of more than five million, less than 50 percent of the population has a safe water supply. 59/

Inadequacy of sewage disposal systems is evident throughout region. The urban population in India is better served than that in most countries; 38 percent of that population has access to sewerage facilities 60/ whereas in a country such as Indonesia sewerage facilities are almost non-existent. 61/ Human wastes are disposed of in septic tanks or directly into rivers, streams and coastal waters.

In some areas, such as Seoul, Korea and Colombo, Sri Lanka, provision has been made for periodic collection of human wastes from residential holding tanks. Spillage at the time of collection and deposit at the disposal sites has been cited as a major contributor to the high rate (80 percent) of acute and chronic intestinal infections in the Seoul Metropolitan area. 62/

Highly urbanized areas generate large quantities of refuse. For the most part, solid waste collection and recycling are fairly efficient, largely as a consequence of the existence of a large number of collectors, scavengers, and buyers who find value in wastes. Even then a considerable amount, estimated to be as high as 30 percent in Jakarta, is uncollected and eventually finds its way into canals, klongs, and other water bodies. 63/

#### b. Water Pollution

Water bodies in virtually all major urban areas are polluted by untreated organic discharges from human and industrial activities. For example, serious pollution conditions are evident in the Pasig River in Manila, the Hon River in Seoul, and the Tjiliwung River in Jakarta. Pollution of these rivers and the resultant lack of oxygen has eliminated local fisheries, precluded recreational activities, and seriously affected city water supplies.

Contamination of water and related ecosystems also results from urban and industrial activities when airborne suspended particulate matter is deposited on buildings, roads, and agricultural lands and is later transported by rain or irrigation to drainage systems and rivers. Lead from gasoline and local secondary smelters, and other metals such as cadmium, copper, and zinc from foundries and metal works find their way into the human support ecosystems and can have serious adverse health consequences.

#### c. Air Pollution

While systematic and comprehensive data on air pollution levels are sparse for most Asian cities, the available data, isolated reports, and visual inspection indicate serious violations of internationally accepted ambient air quality standards, particularly in the industrialized areas.

As one might suspect, a heavily industrialized urban area such as Seoul has serious ambient air pollution problems for several reasons. Many industrial establishments in metropolitan areas have not installed pollution control equipment and stack emissions are excessive; heavy oil used for heating and power plants results in health-damaging sulfur oxide and particulate emissions; automobiles, trucks, and buses pollute heavily in the metropolitan areas; and home heating, including

use of inefficiently or incorrectly operated "ondol" (anthracite briquet) heating and cooking systems, generates a significant amount of residuals including highly toxic levels of carbon monoxide. The result of all of this, while not systematically documented, constitutes a serious problem. Sulfur dioxide and dustfall have been increasing, and nitrogen oxides have risen to dangerously high levels. 64/

The excessively high concentrations of nitrogen oxides measured in Manila in 1975 and 1976 clearly implicate the motor vehicle as a principal contributor to unhealthy air pollution levels. Continuous monitoring indicated that carbon monoxide concentrations in Manila exceeded WHO recommended levels in both 1975 and 1976. 65/

A report from India notes a decline in air quality in urban areas due to the heavy dependence on coal and wood, industrialization without pollution control devices, and automobiles which generate 2 to 3 times the quantity of air pollutants as automobiles in developed countries. For example, the carbon monoxide level of Calcutta is found to be higher than that of New York and London. In several places in Bombay there was twice as much sulfur dioxide as that allowed by Indian standards. 66/

#### d. Noise

As in Latin America, noise levels in major cities are extremely high and the problem will become more severe with continued urban growth. Dangerously high noise levels have been reported in Bangkok and Dehli. 67/ In Seoul, levels regularly exceed those considered safe in the United States. The mean daily level there increased about 20 percent between 1965 and 1971 and even at that time exceeded the accepted U.S. level. Seoul, in recognition of the problem, did enact an ordinance in 1973 prohibiting the use of horns in the central business district. 68/ Other cities have similar restrictions but they are generally ineffective. There is generally low recognition of this potential health hazard, and it consequently receives low priority.

#### 4. Environmental Health

Rapid development in some areas of Asia has led to dramatic increases in the incidence of environmentally related diseases, notably schistosomiasis and malaria. Schistosomiasis, for example, has increased in rural and moist lowland areas of the Philippines. The affected area is not yet well defined, and new areas are still being found. 69/ There has been some effort to control the spread of schistosomiasis over the past twenty-five years through land reclamation and proper maintenance of irrigation canals. However, the opening of virgin lands in Mindanao for irrigation has resulted in the creation of new habitats for the vector snail. In the past, even A.I.D.-funded irrigation projects have been located in infected areas without adequate

precautionary measures. 70/

Schistosomiasis is also endemic in the vicinity of Lindo Lake in Celebes, Indonesia. The snail vector is found in large numbers in Laos and northeast Thailand. The human lung fluke, Paragonomus sp., is also found for the first time in Thailand, along with other trematodes newly introduced as a result of increased water resource developments.

WHO issued a status report on malaria control in Asia in 1975. It showed that in the Indian subcontinent, with the exception of the Maldives and Nepal, malaria has re-emerged as a major public health problem. The incidence of the disease has increased in areas formerly considered free of malaria and populations living in areas where the disease had been eradicated can now again be considered in jeopardy of contracting it. An increasing number of cases have been reported in Burma, Malaysia, Sri Lanka, and Thailand. The strain which has re-appeared in Thailand, moreover, is reportedly drug resistant. 71/

#### B. Institutional Capability for Environmental and Natural Resource Management

As seen in preceding sections, the environmental problems and developmental needs, in the immediate future and the long run, vary widely from country to country.

Different solutions and institutional arrangements are required to cope with the particular problems of each country in light of ecological differences and the diversity of political, legal, and cultural backgrounds. Complex governmental and legal heritages exist -- federal systems, newly independent countries, trust territories, countries administered by martial law, and ancient monarchies. Because of this variety, national capabilities to meet environmental problems cannot be judged in relation to or on the basis of adherence to any "model legislation" but must be judged on a country-to-country basis. 72/

##### 1. Government Commitment

An acknowledgment of the environmental consequences of development has been expressed in the constitutions of India, Indonesia, Papua New Guinea, and Pakistan. 73/ Development plans promulgated in India, Malaysia, Indonesia, the Philippines, and Thailand also include statements about the need to balance developmental goals with environmental protection. 74/

The strongest legislative commitment to environmental protection is found in the more developed countries. The Korean Environment Preservation Bill states as its purpose the preservation of the environment and the prevention of hazards to the public health due to pollution. A

1977 presidential decree in the Philippines made the government responsible for establishing a harmonious relationship between man and the environment and for the environmental needs of future generations. 75/ Thailand enacted national environmental legislation in 1975, establishing a National Environment Board. 76/

All member countries of the Association of Southeast Asian Nations (ASEAN) are expected to have environmental ministries by mid-1979. 77/ The Government of India established a National Committee on Environmental Planning and Coordination in 1972 and assigned it an advisory role to other governmental departments. 78/ An Environmental Protection and Improvement Ordinance which would have created a ministerial level agency in Pakistan was proposed in 1978 but was rejected on the ground that existing municipal codes, if enforced, would provide adequate environmental protection. 79/

Nepal's Sixth Development Plan (1980-85) discusses the relationship between the government's resettlement program and the country's limited natural resource base, and the associated need to provide alternative employment opportunities in the non-agricultural sector. 80/ In the very poorest countries, such as Nepal and Bangladesh, emphasis is on the immediate problems of feeding burgeoning populations and providing sanitation and health services.

Budget allocations for environmental protection projects and manpower assignments for environmental programs are better measures of national commitment. This type of information, however, is difficult to obtain. Because institutional arrangements vary from country to country, a valid identification of environmental and natural resource budget items cannot be made without careful study.

Despite the paucity of reliable information, however, trends in a number of countries are encouraging. For example, budgetary commitments to environmental management have increased by a factor of ten in the past two years in Indonesia. The Philippines recently prepared a long-range pollution control program with goals identified up to the year 2000. 81/

## 2. Governmental Agency Structures

Several organizational approaches have been adopted to deal with environmental protection. 82/ They range from virtually no institutional commitment at all to a highly visible central ministry which controls and coordinates established agencies.

The more traditional approach, which involves several departments covering a range of environmental issues, is still prevalent in many countries. Sri Lanka is a good example of this approach. It has no specific environmental agency but responds to environmental problems through the National Science Council and other ministerial agencies.

In India there is a National Committee on Environmental Planning and Co-ordination to advise other government departments. At the national level there are separate water and air quality agencies but actual implementation is handled primarily at the state level.

The growing awareness of the importance of integrated environmental management is best reflected in post-1970 legislation, involving the establishment of specific environmental agencies. Thailand established a National Environment Board in 1975; Malaysia, a Division of Environment in the Ministry of Science, Technology and the Environment in 1974; and Korea, a division in the Ministry of Health and Social Affairs in 1978.

Significant commitments to integrated environmental management appear to have been made in the Philippines, Indonesia, and Singapore. The Philippines in 1977 established a National Environmental Protection Council with a clear mandate to act as the country's principal policy-making and coordinating body. In 1978 it created the Ministry of Human Settlements and Ecology, which brought into one organization the National Environment Protection Council, the National Pollution Control Commission, and the Human Settlements Commission. Indonesia in 1978 created a Ministry of State for Supervision of Development and Environment for the express purpose of restoring deteriorated environmental resources and preventing future damage to the environment from development projects. Singapore handles this issue through its Ministry of Environment.

Given these recent changes in institutional arrangements, it may be too early to evaluate the potential of the new organizations. In some cases, such as Singapore, the new institution can be credited with genuine achievement. In other cases, such as Thailand, the new institution has had only limited success. The National Environment Board has not been able to redirect the effort of the pollution control agencies nor institute a systemic requirement for environmental assessments.<sup>83/</sup> Even where there appears to be a high level of commitment, such as in the Philippines, some of the agencies continue to act in traditional ways. The National Environmental Protection Council has not yet persuaded the Bureau of Forest Development to modify its expansionist management policies, nor the Department of Agriculture to regulate the more persistent agricultural chemicals. On the other hand, the newly established National Pollution Control Commission has been able to implement regulations relating to commercial buildings, industry, and transportation.

### 3. Laws and Regulations

The quality of environmental legislation in Asian countries is mixed. Those countries with the strongest policy statements usually

have specific laws and regulations, but often they do not cover all potential management areas. Those countries with little or no commitment generally have a weaker legislative framework. 84/

The adoption of the concept of environmental impact assessment is evidenced in several ways in Asian countries. The Philippines has a strongly worded statute, modeled on the U.S. National Environmental Policy Act, 85/ requiring the submission of environmental impact statements in connection with major project decisions. 86/ Recent legislative provisions in Malaysia and Thailand furnish an ample legislative basis for requiring similar information. 87 / Several nations, including India, Indonesia, Pakistan, Singapore and Sri Lanka, state that even in the absence of statutory legislation, they conduct such an analysis as a policy matter. 88/

The need for land use regulation is being increasingly recognized within the region, and most governments have adopted land use legislation and zoning requirements. Examples are Singapore's Planning Act (1958), Thailand's City Planning Act (1975), and Malaysia's Town and Country Planning Act (1976).

Statutes on water pollution vary within the region. Sri Lanka apparently has no water quality legislation. In some cases water pollution is covered by general statutes (Bangladesh, Pakistan, and Thailand). In other cases, there is specific water quality legislation (Malaysia, the Philippines, Singapore, India, and Indonesia). As could be expected, legislation that does exist relates principally to drinking water quality because of the high incidence of waterborne disease.

Laws and regulations controlling air pollution from industrial stationary sources are minimal in India, Indonesia, Pakistan, and Sri Lanka. Recent legislation in Korea, Malaysia, the Philippines, Singapore and Thailand is designed to control emissions from stationary sources, but the necessary infrastructure for implementation is lacking. Legislation to control air pollution attributable to motor vehicles is rudimentary. Some countries and cities have regulations designed to control traffic flow or to limit visible emissions, but enforcement is at best sporadic, with the notable exception of Singapore.

Most of the littoral countries of the region, including Bangladesh, India, Malaysia, the Philippines, and Korea do not appear to have any specific national legislation on coastal zone management; rather, as in the case of India, it is left to the states. Other nations, including Pakistan and Sri Lanka, are in the process of drafting national legislation.

Most countries have laws and regulations designed to protect forests, controlling cutting and requiring replanting, but they are rarely implemented. The same is true with regard to park and wildlife

protection. Numerous laws have been enacted designating park preserves and specifying endangered wildlife species and regulations for their protection have been widely promulgated. Enforcement, again, is generally deficient. 90/

#### 4. Manpower and Training

One of the major constraints faced by developing Asian nations in implementing their environmental and natural resource policies is an inadequate number of trained personnel in relevant disciplines. An ESCAP survey reported that there were inadequate numbers of trained personnel in Indonesia, Pakistan, Sri Lanka, and Thailand. 91/ The level of trained manpower was believed adequate in Bangladesh, the Philippines, and Singapore, but informal observations indicate that deficiencies remain in these countries as well. 92/

The need for trained manpower varies among nations. In a few cases there is still a great need for people trained in traditional natural resource management. Indonesia, for example, is in need of trained foresters and technical personnel of various types for employment in watershed restoration work. At the present time, the Indonesian government has only 400 foresters, or one forester for each 1160 square miles and less than one for each timber concession. Seven times that number would be more appropriate merely to effect an improvement in forest utilization. 93/ The watershed restoration program in Java is limited to just a few areas because of the scarcity of technicians in the fields of soil and water conservation. 94/

Even in the countries where there may be an adequate number of trained personnel in traditional areas, they are usually located in the national or provincial capitals. For example, over half of the trained foresters in Thailand work in Bangkok. The hardship of living in the field and low salaries for field personnel discourage all but the most committed from performing needed field work.

There appears to be a great need in many countries for trained technicians to monitor air and water quality and to operate pollution control equipment. There are rarely enough public health and sanitary engineers, and there is no adequate technical work force to carry out field, laboratory, and information services programs. The development of other essential environmental sciences -- geology, hydrology, the biological sciences, and others -- is similarly hampered by insufficient trained manpower.

Environmental management also requires the services of trained people in economics, law, planning, and the social sciences. Environmental lawyers are required to formulate more suitable legislation and to assist in its implementation. This is increasingly a recognized need. Thailand's National Environment Board, for example, has created

an Advisory Committee on Environmental Law. <sup>95/</sup> An intergovernmental meeting on environmental law in Bangkok, held in July 1978, reflected "a new recognition of the importance of legal and institutional environmental management in the countries of Asia and the Pacific." <sup>96/</sup>

Environmental economists are needed to show that environmental goals facilitate, or are at least consistent with, the achievement of existing development objectives. And they are needed for the more routine tasks of setting economically reasonable ambient and effluent standards. Environmental planners are needed to direct economic development into areas where it is consonant with efficient resource utilization and compatible with the ecosystem, or to formulate alternative modifications so that harmful effects are minimized.

Even where trained technical staff are available, the lack of environmentally sensitive managers and decision makers may impede the implementation of rational resource management. The ability to distinguish significant from insignificant issues, reasonable from unreasonable costs, and valid predictions from specious estimates is essential to the implementation of environmentally sound economic development programs.

Countries have responded to the shortage of trained personnel in several ways. First, they have established short-term training programs, which often receive technical assistance from bilateral or multilateral lending institutions. Second, they have developed their technical training institutions. Some of the better known programs are the National Biological Institute (including the Institute for Tropical Biology) at Bogor, Indonesia; the University of Malaya Ecology Unit; the Kasetsart University School of Forestry in Thailand; the University of the Philippines, Los Banos Campus; and the Asian Institute of Technology near Bangkok. <sup>97 /</sup> Third, they send students and government employees abroad, often with support from foundations, and bilateral and multilateral organizations.

A newly established regional environmental management, planning, and education and training program is the WHO-sponsored Western Pacific Regional Center for Environmental Planning and Applied Studies (PEPAS) to be located in Kuala Lumpur. Center activities will include development and implementation of teaching and training for professionals and technicians in environmental health and related resource protection issues, including environmental planning, pollution control, water supply, and waste disposal.

##### 5. Data-Gathering and Research

The ability of developing institutions to implement environmental policies is limited by the absence of adequate environmental data. For many of the important problems discussed earlier, there are neither

comprehensive data on existing conditions or sufficient data over time to estimate trends in environmental quality.

Air quality monitoring appears to be an exception to the general rule. Air quality monitoring in selected urban areas was undertaken through WHO-sponsored programs in 1973. Today there are ongoing air quality monitoring programs in India, Indonesia, Korea, Malaysia, Pakistan, the Philippines, and Thailand. Continuous air quality monitoring with automatic instruments is regularly operated in Manila and Seoul. Sufficient data has been collected in some principal cities to show trends which justify new government sponsored pollution control programs for the protection of public health.

On the other hand, there is little systematic information on the nature of effluent discharges from industrial activities. Data on the productivity of natural resource systems, such as fisheries and forests are also generally deficient. Even where such data have been collected, improper analysis often yields misleading results.

This situation could be improved with the introduction and proper installation of monitoring equipment and training of technicians. The ESCAP regional survey indicated a need for better instrumentation and technical assistance for its use. 98/

There is a need not only for better data but also for applied research on specific ecosystems and their modifications. More research on technology appropriate for solving existing problems is also required. Additional increases in agricultural productivity are dependent upon improvements in watershed management, integrated pest control, and multiple cropping systems. The innovative work at the Asian Institute of Technology on water supply and human waste disposal represents an encouraging first effort at the type of technological innovation needed for Asia in the field of environmental management.

#### 6. Attitude of the Public

While a segment of the elite in most developing nations perceives the need for better environmental management, this perception is not widely shared by the general public. Environmentally destructive behavior thus persists. Fishermen in the Philippines, for example, continue to use dynamite on coral reefs, and agricultural settlers continue to encroach on parks and reserves.

Popular education is one way to increase awareness of the necessity of ecologically sound development. While science instruction at the primary and secondary levels of education is important, there is also a need to show the relationship between the actions of individuals and their ultimate effects in terms of agricultural and resource development, urban and population growth, and other issues. 99/

The school syllabi of many Asian nations include several disciplines that routinely include environmental matters. But the needs of the region would be better served by a more specific commitment in the field. Indonesia can be cited as a possible model for the developing nations of the region. It has launched a "Popular Campaign for Environmental Awareness" and has geared its educational program accordingly. The effort in the Philippines, the only country in the region to require environmental education in the school by law, is also noteworthy. 100/

Mass media are another essential tool in enhancing environmental awareness. Radio, television, and newspapers are excellent means for informing the vast majority of the population. While the quality and quantity of newspaper articles on environmental issues has been increasing, radio, television, and film have not been used sufficiently in most cases to arouse public interest. Singapore and the Philippines, however, have made exceptional use of these tools to heighten the environmental awareness among all segments of the population.

#### 7. Bilateral and Multilateral Arrangements

The Association of Southeast Asian Nations (ASEAN) has made some progress towards its goal of regional economic cooperation in its 10 years of existence. However, ASEAN has yet to deal with transnational issues such as marine fishing and hydrocarbon recovery in the South China Sea.

In 1977, the nations of Malaysia, Singapore, and Indonesia signed a tripartite Straits Safe Navigation Scheme for the Malacca Straits in order to minimize the potential for oil spills. The agreement limits the size of tankers which can pass through the Straits and establishes a revolving fund to cover the costs of cleaning up and preventing oil spills from transiting tankers. 101/

Several Southeast Asian nations participate in regional natural resource management organizations. These organizations include the UNDP/FAO South China Sea Fisheries Development and Coordinating Program, the Southeast Asia Fisheries Development Center (SEAFDEC), the International Center for Living Aquatic Resources Management (ICLARM), and the International Rice Research Institute (IRRI).

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### III. LATIN AMERICA AND THE CARIBBEAN

SUMMARY: *Problems of desertification, soil erosion and depletion, water and air pollution resulting from urbanization and industrialization, the destruction of critical wildlife habitats, ecologically traumatic changes in climate, decreases in available water supplies, increased incidents of flooding, rising levels of environmental health problems, and the often permanent loss of renewable natural resources are all in evidence in Latin America and the Caribbean.*

*Economic and social demands to exploit natural resources as well as open new lands for agricultural development have resulted in placing the resource base of Amazonia, the Andes, and the lesser developed areas of Central America under great pressure to yield short-term economic gains -- often at the expense of long-term productivity. A lack of careful planning coupled with inappropriate development technologies has resulted in marked increases in severe environmental management problems.*

*These problems are, in turn adversely affecting major economic investments. Irrigation water from polluted rivers has caused severe damage to soils and crops. Soil deposited in reservoirs is threatening the viability of hydroelectric facilities throughout the region. Deforestation has resulted in the loss of dry season water supplies for urban areas. Export commodities such as beef and produce are being rejected by other countries because of excessive pesticide residues. Economically important forest industries may soon close in a number of countries because of near total deforestation. Pollution of coastal waters is damaging coastal fisheries and tourist beaches.*

*Explosive urbanization has placed severe strains on historically inadequate water supplies and sewage handling and solid waste disposal facilities. Air and water pollution levels in major cities frequently exceed health standards. The inadequacy (and often complete lack) of sanitation facilities in high-density low-income urban areas creates serious health hazards. Gastrointestinal and other waste-borne disease organisms are responsible for high morbidity and often shocking infant mortality levels.*

*Awareness of environmental and natural resource problems varies greatly among the countries in the region. The public sector's response to these problems is limited because of a general lack of financial resources, technical, managerial and administrative expertise, and substantial political commitment. At this time only the most developed nations in the region have begun to take substantive action to address environmental issues. To bring about a change in the way environmental problems are being dealt with, substantially increased international assistance will be needed in the areas of institutional development, manpower training, technical assistance and support for environmental protection and resource management programs.*

Latin America as discussed here consists of 38 countries and territories including Mexico and Central America, the islands of the Caribbean, and South America. It covers an area of almost 8 million square miles with a population of about 350 million or 8 percent of the world's total. With an average increase of almost 3 percent per year the population will nearly double by the year 2000 to over 650 million. Over half of the population was rural in 1974, but with the rapid migration from rural to urban areas, 60 percent of the population was urban in 1978, and the proportion is expected to grow to 75 percent within the next 20 years. 1/ Latin America will have many of the largest urban complexes in the world within the coming decade. This growth, combined with rapid and large-scale industrialization, can be expected to result in increased environmental degradation and natural resource depletion with concomitant adverse impacts on society unless future developmental projects and plans incorporate concepts of environmental conservation, protection, and management.

Average per capita income in Latin America (unadjusted for differences in the cost of living) is 2 to 3 times that of Africa and Asia, but the majority of the population still subsists at poverty levels. Fifty percent earn less than \$130 per year and only 5 percent earn more than \$2,600. 2/

Three countries in the region are considered "least developed nations" -- Haiti, Honduras, and Bolivia. Venezuela, Mexico, Argentina, and Brazil are relatively industrialized, yet large portions of their populations continue to live in poverty.

The major ecological regions include arid zones in much of Mexico, northern South America, and coastal Chile and Peru; fertile extensive forested mountain range which extends from Mexico through Central America and the Andes of South America; vast tropical rain forests in the Amazon and Orinoco River watersheds; and extensive fertile temperate grasslands in southeast and southern South America. The region also includes tropical islands in the semi-enclosed Gulf of Mexico and the Caribbean.

Development and economic growth are basic goals in all of Latin America. During the next few decades, many billions of dollars will be invested in social, industrial, and resource development projects. All of the nations are under intense pressure to exploit energy resources, improve agriculture, develop frontiers, and accelerate industrial growth. As a result, they are increasingly exploiting and consuming their own resources. Per capita demands for resources and services are increasing at higher rates than the rate of population growth, creating ever-increasing pressures on the resource and service bases, and outstripping the economic and technical capabilities of virtually every less developed country.

Problems with population in most countries stem from poor distribution as well as from excessively high numbers. While one or more urban areas in each country suffer from extremely high human densities, some tracts of land are capable of supporting larger populations. 3/ Colonization projects designed to achieve more logical and balanced population distribution have been implemented in many countries, including Mexico, Venezuela, Columbia, Brazil, and Nicaragua. Their success or failure depends on the nature and adequacy of social, economic, and environmental planning and careful management of the natural resource base. 4/

A. Environmental and Natural Resource Problems

1. Productive Natural Resources

a. Forests

The forest resources of Latin America extend from Mexico through Central America and the Andes of South America and include the great tropical rain forests of the Amazon and Orinoco River basins.

Most environmentalists and government officials in Latin America identify deforestation as the most crucial natural resource problem in the region. 5/ The ecological consequences of deforestation include altered hydrological cycles, increased erosion, a threat to the survival of many species of flora and fauna, and destruction of the means of sustenance for large numbers of people who live within or on the margins of forests. Through subsequent erosion and sedimentation, negative impacts can also be measured on aquatic ecosystems.

Factors contributing to the continuing destruction of the tropical forests are extensive agriculture, cattle ranching, colonization, highway construction, industrialization, mining, and hydropower development. Major portions of the mountain forests have already been cut over in order to accommodate agricultural demands. But the nutrients upon which tropical forests depend are chiefly cycled through the vegetation itself; the soil tends to be thin and unfertile. Thus, land available in such areas is likely to be productive for no more than two to five years; it then requires a fallow period of 8 to 20 years or more before agriculture is again possible. Low fertility and prolific weed growth often prevent further cultivation. The cutting of forests to provide grasslands for grazing livestock follows a similar pattern when fertilization and weed control measures are not practiced. 6/

Extremely large forested tracts are cleared annually by bulldozing, cutting, burning, or aerial bombardments of herbicides, and later planted with exotic grasses for cattle pasturage or a monocultural cash crop for

export. Even when the fragility and low fertility of most tropical soils are apparent, projects proceed with full government endorsement. When the soils quickly lose what little residual fertility they once possessed, it is more convenient for agricultural enterprises to move operations to newly deforested areas than to attempt to restore fertility to the old sites. 7/

Forests are being further exploited by small landholders, or campesinos. Settlers, employing slash-and-burn agriculture, decimate newly opened areas in a fashion similar to the large commercial enterprises, although the loss of fertility may be delayed because the smaller tracts are less intensively utilized and some nutrients are returned to the soil. Small landholders also remove timber for use or sale as firewood, the most common energy source in rural Latin America, or for lumber export. In Panama, small landholders have been known to clear land for their own use and then, after several years, sell the cleared land to cattle ranchers. 8/

Approximately 45,000 square miles of the tropical forests in Brazil's Amazon Basin were destroyed between 1966 and 1978. Officially authorized colonization and cattle ranching projects were responsible for about one half of the deforestation, highway construction for almost a quarter, and spontaneous colonization a full quarter. Forestry production accounted for only 5 percent. 9/

In Paraguay forest resources have been seriously reduced. In 1945, 64 percent of the total land area was forested; by 1976, forests covered only 37 percent of the total country. 10/ The tropical deciduous forests that once covered 90 percent of El Salvador have been totally destroyed by centuries of clearance for grazing, plantations, mining, charcoal manufacturing, and, within the last century, the spread of subsistence cultivation. 11/

Haiti too was once heavily forested, but its forest areas now occupy only 9 percent of the country. 12/ Deforestation is also named as a principal environmental problem in the Central American countries. 13/

Tropical forests are extremely rich in number of species. At least 2,500 plant species are said to exist in the Amazon basin alone. 14/ This diversity is not merely valuable in its own right as a vast genetic pool; it carries with it largely untapped economic potential as well. According to a 1968 report, for example, of the 500 Amazonian species thought to have commercial value, only about 60 were actually utilized. Of those, less than a third were marketed in commercial quantities. 15/ It is a potential that is rapidly diminishing, however, as vast tracts are cleared for a variety of other uses.

Reforestation programs that do exist show a disturbing ecological trend. Trees selected for reforestation are quick-growing "exotic"

species such as Eucalyptus, Pinus, and Gmelina. Research on reforestation with native specimens or natural mixtures is conducted only at a few research stations, and such reforestation has not been attempted in field experimentation sponsored by government programs. Their commercial value notwithstanding, the newly introduced species are capable of inhibiting natural regeneration and can lead to the destruction of native plant species. Loss of dependent animals, increased erosion, and biologic sterility of adjacent aquatic systems are corollary results. Newly introduced trees may be less resistant to local pests than native species, and the application of chemical controls may be required. Research on reforestation is addressed to growth rates, silvicultural techniques, nutrient requirements, and pest management. It generally ignores the ecological impacts of the wide-spread introduction of exotic species. 16/ The implications of of this type of reforestation are just beginning to emerge.

b. Soils

The quality and quantity of soil resources vary widely in Latin America. There are several geophysically distinct areas: tropical lowlands, tropical highlands, arid and semi-arid regions including the grasslands of Patagonia, and the savannas of the mid-continent, and the alluvial flood plains of the Amazon and Orinoco Rivers. With the exception of the alluvial plains and the grassland plateaus, soils are generally low in fertility and highly erodible. Human concentrations in these areas place heavy demands on soil productivity. 17/

As indicated earlier, nearly all of the nutrient material in verdant tropical and sub-tropical areas is held in the vegetation itself, and the underlying soils contain little fertility. When vegetation is removed, land can soon become sterile and unproductive. This is in marked contrast to the deep, rich soil under North America's deciduous forests and grasslands.

The soil cover of much of the mountainous part of Latin America and the Caribbean is heavily eroded and nearly sterile due to the removal of vegetation, overgrazing, and overcultivation. Frequently, after soil has been exposed to the sun, it can no longer support vegetative growth. This is particularly true of the laterite clays which, when exposed alternately to heavy tropical rains and the strong tropical sun, may bake into a brick-like material. Dry mountainous terrain which is only occasionally cultivated because of the unreliability of rain is often susceptible to the most serious erosion. Where land use in mountain areas is dominated by goat and sheep herding, wood gathering for charcoal, or other activities which deplete the scant vegetation cover, landslides and the total denudation of mountainsides often occur. 18/

Ancient peoples of Mexico and Guatemala farmed tropical highlands successfully, growing corn concurrently with fast growing bush beans,

followed by vine beans using the standing corn stalks for support. Selected young weeds were harvested as greens and the soil was covered at all times and enriched by the legumes. In Peru, the ancient Inca practice of terracing was efficient and protective of the soil. Terracing fell into disuse when no longer enforced by ruling classes after the Spanish Conquest, and these proven techniques are little used in present monoculture agricultural production. 19/

In arid and semi arid regions -- the Piura area of Northern Peru is an example -- a major soil problem is the build-up of salts and waterlogging with acknowledged adverse effects on agricultural productivity. Both waterlogging and salinization, found in areas of heavy water usage and inadequate drainage, are often a result of poorly planned large scale irrigation schemes. The effects are cumulative and restoration can be economically prohibitive, especially when tubewells must be sunk to ameliorate waterlogging. 20/

Desertification of semi-arid lands, categorized as severe or very severe, is being experienced in areas around the Gulf of California, northern and central Mexico, Argentina, Bolivia, Chile, and Peru. 21/

The rich alluvial soils found in the narrow plains along the banks of major rivers are an all too limited resource. In the 500,000-square-mile Amazon Basin, for example, only 5 percent is fertile alluvial soil and much of this is not available for agricultural production because of seasonal flooding. 22/

Other problems with soil of poor quality are compounded by the use of inappropriate agricultural technologies. Removal of the natural vegetative cover exposes soil to wind and water erosion, leaching, and loss of fertility. The delicate balances which have evolved in natural ecosystems are disrupted by inappropriate agricultural systems that rapidly consume available nutrients. Reduction of soil fertility results in decreasing crop yields, and the economic return no longer compensates for costs of production. Land is abandoned, or converted to less intensive uses, and the cycle is repeated elsewhere with similar results. 23/

Some of the region's soil resources are renewable; they can be returned to a state of productivity by proper crop rotation methods, fertilization, and nutrient supplements. Rates at which soil can be revitalized, however, vary greatly. Tropical soils have notoriously low renewal capacity and can require decades or centuries for complete restoration. Data on soil recovery rates are sparse, methods of accelerating recovery have not been researched, and long-term studies are non-existent. 24/

In some parts of the region, soil revitalization is no longer an issue because the soil is gone. El Salvador's northern mountains,

once covered with dense forests, have been described more recently as "a rocky barren moonscape." 25/ An A.I.D. report on Haiti described circumstances that amount to ecological catastrophe:

The native forests are nearly all gone. Most of the deforested areas have suffered soil deterioration through erosion and loss of nutrients. The nation's rivers carry large sediment loads, a product of accelerated erosion which has seriously jeopardized not only agricultural productivity, but also irrigation works and the country's major hydroelectric project. 26/

The importance of crop selection and methods of cultivation, however, is increasingly understood throughout the region. Monocultures of numerous varieties have been attempted with little or no success on marginal soils, but have been moderately successful in areas of richer soils. Governments are exploring new techniques for agricultural development which include consideration of the complexities and limitations of the ecosystems. Rangeland management needs are also recognized. Latin American studies of techniques for increasing agricultural productivity while maintaining soil fertility and stability have already produced several encouraging developments that merit international support. 27/

#### c. Water Resources

In Latin America, dams are being built at a great rate in response to rapidly increasing demands for electricity, irrigation, industry, and resource exploitation. Increased deforestation and cultivation of steep slopes with resultant increased runoff, erosion, and sedimentation have reduced the anticipated useful life-span of these dams and resulted in the need for costly remedial dams and flood control projects. 28/

There are presently over 138 dams in the region with supporting reservoir systems and many more under construction or planned. 29/ The Itaipu Dam being constructed jointly by Brazil and Paraguay will be the world's largest dam with the capability of generating about six times the amount of electricity now produced by the Aswan High Dam. While dams provide electricity, water for irrigation, flood control, access roads, and tourism potential, they can also cause severe problems. The loss of homes and farms in rich floodplains and valleys has required resettlement programs, resulting in severe social disruption. The loss of valuable forests and riverine fisheries, and increases in various human diseases such as schistosomiasis, malaria, and encephalitis have been experienced throughout the region. 30/

#### d. Fisheries

Latin America has many river, lake, coastal, and deep water fisheries which have traditionally been an important food resource.

But over-fishing, water contamination and excessive silting have severely reduced fish populations.

Many of the high lakes and streams are severely contaminated by mining and pulp mill operations, sewage disposal, and runoff of agricultural chemicals which adversely affect the fish resource. Mine tailings dumped into the sea have decreased yields in the coastal waters of Chile and Peru, adversely affecting an economically important fish meal industry. 31/ Lake Titicaca was once a highly important source of salmon trout, an introduced species, as well as of indigenous fish. Its productivity has been markedly reduced as the result of over-fishing, the use of dynamite fishing to increase the fish catch, netting from spawning rivers and pollution of the waters. 32/ Extensive river basin development, especially in South America, has altered the ecological regime essential for continued fish propagation. Pollution of coastal wetlands, marshes and mangrove swamps poses a serious threat to estuarine, coastal, and deep water fisheries as these areas provide essential habitats and nutrients; their destruction prevents breeding of important commercial species of edible fish, shrimp and shellfish.

The highly important shrimp industry associated with Lake Maracaibo, Venezuela, has been virtually destroyed as a result of pollution from oil refining and petrochemical industries in the vicinity of the lake. Contamination by untreated sewage as well as depletion of the shrimp and fish resources in Panama Bay has affected the fishing industry which is dependent on this resource. 33/

e. Wildlife

Wildlife populations are dwindling rapidly in nearly every country in Latin America and many of the mammals (including the jaguar, puma, ocelot, and several monkey and deer species), as well as reptiles and birds once common to the tropical forests are now listed as rare or endangered species. 34/

Wildlife researchers often are unable to isolate primary reasons for declines in animal populations. There is no simple cause and effect relationship; multiple factors contribute but data are not available to place each factor in proper perspective. Estimates are based on declining yields or scattered field observations. Other than species listed on international lists for rare and endangered species, priorities for research on animal populations are not defined.

Destruction or degradation of habitat as a result of extensive deforestation, expanding agriculture, over-grazing by domestic animals, and spreading industrialization is probably the most significant contributing factor to declining animal populations.

Over-exploitation is common when animals bring high prices in the pet or skin trade, 35/ or when wildlife serves as an important food resource. A significant reason for preservation is the dependence of local people on wildlife as a source of animal protein. For example, in the Huallaga Central Region of Peru, new settlers and the indigenous population depend on wildlife for up to 80 percent of their animal protein. 36/

Programs to manage wildlife resources by selective harvest, protection of habitat or enforcement of wildlife regulations are not in evidence. Without integrated approaches to fishery and wildlife management, populations will continue to decline and at increasing rates. Some species such as the West Indian manatee face extinction in the very near future. In the next decade, many new species of animals will be added to international endangered species lists.

## 2. Problems Attributable to Pollution and Other Residuals

### a. Agricultural Chemicals

Agricultural chemicals have been the subject of a great deal of study and attention in this region. These studies have shown that pesticides have accumulated at hazardous levels in Latin America. The widespread use of fertilizers has resulted in nitrate and phosphate contamination of runoff waters, producing accelerated stream and lake eutrophication and groundwater pollution. DDT and other persistent pesticides have been used both for agricultural crop pest control and malaria control for over 25 years since they were perceived to be relatively cheap, effective, and persistent, and their use was promoted by developed countries. Residual traces of these pesticides have been found at dangerous levels in fish, shrimp, and animals in many areas and, in Central America, have also been detected at high levels in mothers' milk. 37 Pesticide contamination of foods has had adverse economic effects. For example, consignments of Central American beef exported to the U.S. have been rejected by the U.S. Department of Agriculture due to the presence of excessive levels of pesticide residue in the meat. In 1976, about 500,000 pounds of El Salvador beef were rejected when levels of up to 95 parts per million (ppm) of DDT were found; the U.S. threshold level is 5 ppm. 38/

Restrictions by developed countries on the amount of chemical residue on agricultural products have been enforced for years, yet these countries do not prohibit or control the sale of excessively toxic pesticides to developing countries.

Many insect pests have become resistant to DDT, requiring the use of newer and more toxic pesticides such as parathion, organic phosphates, and other compounds for their control. The use of pesticides for controlling insect damage to agricultural crops contributes to the development of resistance of insect vectors of human disease to chemical control.

The health hazard from malaria and other insect-borne human diseases, consequently, is increased.

Cases of poisonings and deaths from pesticides have been reported in many Latin American countries. From 1971 to 1976, 19,300 medically certified pesticide poisonings were reported in Central America, some 17,000 of those in El Salvador and Guatemala, or about 360 cases per year per 100,000 population. (In the U.S., there are about 100 poisonings per year per 60 million population.) 39/ Unfortunately, only the results of acute exposures are reported; no studies have been conducted to measure the effects or the extent of chronic, low-level exposures on the population-at-large who are exposed to pesticide contamination of their food and water supplies. 40/

While pesticide residues are the most studied residual in Latin American environments, more research seems needed and alternative methods for insect control must be developed and employed for agriculture and environmental health.

b. Industrial Pollution

Industrialization is progressing rapidly in Latin America, especially in Mexico, Venezuela, Brazil, and Argentina. Although less than 20 percent of the estimated potential industrial capacity of the region has been tapped, the pollution thus far generated poses major environmental problems. 41/ In urban areas of each country and at other scattered sites where resources, geographic conditions and manpower availability combine to make industrial development activities economically attractive, specific pollution problems have been identified. However, in general, government agencies reject proposed expenditures for pollution control devices in favor of expenditures supporting greater national productivity.

High levels of hazardous industrial air pollutants, dust or total suspended particulates (TSP) and sulfur dioxide have been detected or measured in many cities and scattered areas. The problems created by pollution by asbestos, toxic arsenic, lead and mercury are increasing. Arsenic is produced in smelting and found in mine tailings and wastes. While arsenic occurs naturally in water supplies in parts of Mexico, El Salvador, Chile, and Argentina any added amounts are believed to be detrimental. Lead is a significant pollutant from smelting operations. Mercury is a common pollutant from plants producing chlorine and certain types of plastics. Chromium is a serious pollutant in waters discharged from most leather tanning factories. 42/

In Venezuela, the growth of large petrochemical and steel complexes in the vicinity of Caracas, of oil production and handling facilities in the north coast bay of Maracaibo, and the processing of iron ore and generation of hydroelectric power in Ciudad Guayana in the last two

decades have benefitted the market economy and dramatically increased the country's GNP, but this growth has occurred at the expense of extensive environmental degradation and resource destruction.

High levels of sulfur dioxide have been reported as a result of thermoelectric power generation in Venezuela and from the metallurgical industries and petroleum refineries of Peru and Mexico. 43/

Mexico City, with its very large industrial complex and many small industries, has one of the highest levels of suspended particulate matter in Latin America. Foundries, metal processing, ceramic and paint manufacturing operations, cement production, smelting, and other small industrial operations contribute to the total pollution burden in the enclosed valley of the city. 44/

Smelter wastes pose a serious air and water pollution problem in Santiago, Chile. Reports from Central America and the Caribbean also indicate existence and recognition of environmental degradation as a result of industrialization. 45/ Special industries, such as fish meal processing in Peru, cause bad odor and irritation of lungs and eyes due to ammonia and hydrogen sulfide.

Most studies that have been instituted in the more industrialized countries to measure toxic pollutants have found them to exist at levels which exceed accepted health standards. It is likely that industrial pollution is more of a problem than has been documented. More monitoring and control are needed, particularly of water pollution.

### c. Mining

Geologic exploration and development of the region have uncovered a treasure chest of valuable mineral resources including petroleum, tin, iron, bauxite, cassiterite, lead, copper, and silver. The development of these resources has increased employment and improved national economics, but has also created additional environmental problems. It has been demonstrated that large extractive operations can be designed and planned to minimize negative environmental impacts. Some countries in Latin America have made efforts in this direction. 46/

Techniques to eliminate or reduce wastes from some mining operations are available, but they are infrequently used. The long-term benefits of control, such as reduced costs for health care, protection of fisheries and water resources, are ignored or not recognized; the short term consideration of maximizing profit while reducing direct costs of production takes precedence.

Public support for pollution control is slowly developing. The government of Peru has reimbursed campesinos along the Rio Mantaro for damages to crops from mine-polluted irrigation waters. 47/

d. Coastal Zone Problems

Marine and coastal pollution is increasing. The concentration of Latin American cities and industry along coastal areas creates enormous problems with coastal pollution. Sewage from towns and resort hotels is usually local but causes problems on tourist beaches. Dredging, coastal erosion, and turbid water at the mouths of rivers also cause contamination. Coastal pollution attributable to oil spills from tankers, from tanker loading, and from flushing bilges with sea water is a particularly severe problem in the Caribbean, where beaches are the principal attraction for tourism and the population is dependent on fisheries. Aerial observation of the seas into which the Amazon and Orinoco Rivers empty corroborates the extent of the problem: brown turbid areas, only partially a result of natural silt runoff, extend far out from the deltas. Sedimentation and pollution destroy the coral reef and mangrove coastal habitats which serve as essential breeding areas for marine fish and shellfish. Although monitoring activities have not been adequate, the effects of pollution are seen in the alarming reduction of coastal fish catches and by observations of reliable indicator plant and animal species. Both indicate dramatic changes in the region's marine and coastal environment. 48/

3. Problem Affecting Urban Areas

The very large cities of Latin America are rapidly increasing in population due to a high birth rate, improved longevity, and migration from the rural areas. The largest cities (1979 estimates) are:

|                |                        |
|----------------|------------------------|
| Mexico City    | 14.1 million           |
| Sao Paulo      | 13.7 million           |
| Buenos Aires   | 10.6 million           |
| Rio de Janeiro | 10.6 million           |
| Lima           | 5.4 million            |
| Caracas        | 4.2 million <u>49/</u> |

Thirty-three Latin American cities have populations of more than half a million. It is estimated that, by the year 2000, Mexico City and Sao Paulo will each have 30 million inhabitants. 50/

Because of the enormous influx of migrants from rural areas and villages, squalid shanty towns can generally be found at the edges of most large Latin American and Caribbean cities. The increase in urban population puts a severe strain on water supplies, sewage and solid waste disposal facilities and medical resources for disease prevention and control. 51/ Attempts have been made to solve these problems with varying degrees of success. Governments have not been able to provide services to the new

"overnight suburbs" which have appeared on the outskirts of major cities. The extremely high human densities, coupled with inadequate or nonexistent sanitary facilities, increase the threat of major epidemics and are of great concern to international health agencies. Immunization programs, improved quality of medical care, and advances in medical technology have helped reduce the occurrence of health crises.

a. Water Supply, Sewage Disposal and Solid Waste Collection

Water supply and quality are critical problems in every urban area in Latin America. Water supply problems range from the lack of adequate delivery systems to the lack of sufficient water for domestic and industrial use. Solutions include appeals for voluntary restraints, water shut-offs during periods of the day, and the construction of elaborate and costly pipelines or reservoirs for transport of water to the cities. Despite significant investments in the expansion of water supply facilities during the last two decades, approximately one fourth of urban residents have no direct water supply. 52/

Water quality problems result from inadequate sewerage and waste disposal systems, 53/ and contamination of large bodies of water which supply urban areas. Water treatment facilities capable of treating beyond preliminary stages are rare; many facilities do not operate efficiently and experience frequent and lengthy breakdowns. Treatment plants rely on foreign parts for repair and maintenance which are not readily available. 54/ This reliance on foreign equipment and technology impedes the development of an indigenous environmental control industry to protect the public health and provide new job opportunities.

An estimated 60 percent of the population of Bolivia do not have access to potable drinking water and 89 percent do not have access to sanitary disposal of sewage resulting in a full range of gastroenteric disorders and lowered resistance to other diseases. 55/ In Haiti only 3 percent of the country's population has piped water, and in Paraguay raw sewage is dumped into streams without treatment. 56/

To reduce dysentery and related diseases caused by water and food sources, the Pan American Health Organization, the governments of Latin American countries, and other agencies have established a program designed to provide potable water to homes.

The solid waste problem in Latin American cities is increasing not only because of the explosive population growth but to a lesser degree from greater consumer product use and increased use of packaging materials. Since the amounts of solid waste will increase exponentially in the future, there will be even greater problems of collection and disposal. 57/

Solid waste disposal programs for the most part are still in the planning and design stages. Disposal techniques have not improved appreciably in the past decades. Solid wastes typically are dumped into rivers, streams or open dumps. In most cases, waste disposal sites are not selected or supervised by any governmental unit. Wastes are merely dumped in nearby convenient locations until those sites are filled or wastes slide down the hillside. The dumps provide feeding areas for disease-carrying rat populations and provide breeding habitats for disease vector insects. In addition, they lead to the leaching and seepage of toxic and noxious materials into water supplies with a consequent adverse effect upon public health.

Since dysentery and other gastroenteric diseases are endemic in many of the countries in Latin America, in some places a special effort has been made to construct sewerage systems. The Pan American Health Organization, together with national governments and other agencies, established a 1980 goal to provide sewerage services for 70 percent of urban and 50 percent of the rural population. 58/ However, it will be extremely difficult to meet this goal, which requires an investment of \$9.2. 59/

It is estimated that less than 10 percent of municipal sewage is treated to primary levels. 60/ Improper disposal of human waste and lack of treated water are major sources of enteric diseases and intestinal parasites. This is an important problem in many of the countries of the region, especially among the rural and small town populations. 61/

#### b. Air Pollution

Air pollution is a problem in the major cities of Latin America, notably Mexico City, Caracas, Lima, Santiago, Sao Paulo, Rio de Janeiro and Buenos Aires. Pollution problems in these cities far exceed similar problems in the U.S. Motor vehicle emissions, burning of solid wastes, and use of incinerators in buildings, combined with air pollution from industry, cause very high air pollution levels, especially in those cities like Mexico City which suffer from thermal inversions and lack of air circulation. Some cities are built in valleys or at the foot of mountains, and pollution persists. Abundant solar radiation catalyzes nitrogen oxides with organic compounds producing photochemical oxidants and ozone which have adverse effects on public health and the economy. Coastal cities, particularly on the Pacific coast, experience daily high pollutant concentrations generated by motor vehicles. 62/

A regional air pollution monitoring network has been established by the Pan American Health Organization jointly with member countries. In 1977 it consisted of some 95 stations in 40 cities in 16 countries. This network is continuing to expand and is currently supplying data on the levels of suspended particulates and sulfur dioxide. 63/ Measurements show that in some cases levels are three to four times greater than WHO recommended limits. More than a third of the stations with two years of data show an alarming increase in concentrations of measured pollutants. 64/

The goals of the ten-year Health Plan for the Americas include the initiation of programs for prevention and control of air pollution in the some 87 cities of more than 500,000 inhabitants, and in others where problems may exist. 65/

Disease from air pollution is becoming more serious each year. 66/ Respiratory ailments are among the major causes of death in many countries. Long-term exposure to industrial residuals has not been widely studied, but may be causing undetected health hazards in industrial urban areas.

c. Land Use Planning

Cities are expanding so rapidly and populations are growing so quickly that proper land use planning is difficult. Many city services and utilities are already overloaded. With limited budgets, expansion of these essential facilities is difficult. There are a few examples of advanced city land use planning but they have had varied results. 67/ Frequently, slum areas are located on river margins outside of the cities, or near floodplains, hillsides, or garbage dumps where essential services are difficult to provide. The migration to the cities may be reduced by providing some basic services to rural communities and by providing rural dwellers stabilizing incentives such as land ownership and access to markets for agricultural crops. Some countries are attempting to disperse industry, government agencies, and artisan craft production to areas beyond the capital cities. Together with tax incentives and development projects, this not only relieves congestion but also reduces the urban air, water, and solid waste pollution problems. Assistance in land use planning is critical not only for city development but also for national development as a whole.

d. Noise

Noise is a serious problem in urban areas although it is not generally so perceived. Citizens have gradually become accustomed to high noise levels and are not aware of potential health hazards and to the one psychological stress of excessive noise. Automobiles, buses, and trucks, especially in highly congested areas, contribute to high noise levels as do extensive construction and rebuilding projects, industry, and airplane traffic. Noise is also an occupational and health hazard in foundries and other industrial plants and jetports. Some cities have legislation to restrict noise, especially from vehicle horns, but this is only partially effective. Noise is a pollutant which can be reduced by means of transportation controls and urban planning with provision for open space and park development.

e. Energy Supply

The production of oil has benefitted the economies and energy-producing capabilities of countries such as Mexico, Venezuela, Ecuador, and Peru. As noted elsewhere in the text the production of hydropower by the construction

of dams is occurring rapidly. The lag between energy generation and energy demand is being reduced as most countries have embarked on major energy projects. Yet energy will continue to be a problem because cities are expanding at such rapid rates. Unfortunately, new energy must be transported longer distances because nearby energy sources are fully utilized. Longer transportation distances frequently require extensive improvements in delivery systems, either new roads or higher transmission voltages. Each new system extracts environmental and economic costs that can produce environmental shortcomings in other areas. 68/

#### 4. Environmental Health

Major diseases of Latin America are carried by insects and rodents. Therefore, environmental health programs focus on vector control. Any decrease in the effectiveness of chemicals used to eliminate disease vectors may result in greater outbreaks and prolonged epidemics. There is some disturbing evidence that vector-control chemicals have lost effectiveness in the region. 69/

Schistosomiasis and malaria are spread in part by project developments such as dams, reservoirs, and irrigation schemes, which provide breeding habitats for disease vectors. 70/ Schistosomiasis (also called bilharzia or snail fever) is a disease of humans caused by contact with water infected by an aquatic worm that uses certain species of aquatic snails as a host. It is spread by movement of infected people and snails to new areas without proper sewerage and water facilities. The prevention and control of this disease is so difficult that it is spreading throughout South America and the West Indies. It is also endemic in the Dominican Republic.

Malaria, however, is the most important disease vector in Latin America. Large-scale DDT spraying programs during the 1960's resulted in a decrease of the malaria-transmitting anopheles mosquito in all countries and elimination in some. The Anopheles mosquito developed resistance to DDT, however, and other more expensive and less persistent pesticides were required. Because funds and effective controls are decreasing, malaria appears now to be increasing even in countries which were once free of it. Drug resistant strains of the parasite are also found in Central America.

Other diseases of concern in the region are: leishmaniasis; leptospirosis (a protozoan disease in humans transmitted by rats); and chagas (also a fairly common protozoan disease which has infected 3 million people in South America alone). Chagas is transmitted by blood-sucking triatome bugs which are resistant to DDT but can be controlled with lindane. Encephalitis and yellow fever are transmitted by certain species of mosquitoes, especially in jungle areas. While there are few human cases except during occasional outbreaks, the diseases are particularly dangerous for those without specific immunity to them. Vaccination against yellow fever is highly effective. Dengue fever

is a virus transmitted by the Aedes aegypti yellow fever mosquito formerly responsible for urban epidemics. Although the disease had been successfully eliminated from many countries, strains of the mosquito have now evolved which are resistant to insecticides. <sup>71/</sup> Onchocerciasis is endemic in Central America, causing eye problems similar to those problems caused by the disease in Africa.

An important task to be performed by international assistance groups is to point out health problems which result from environmental conditions: air, water, and soil pollution. The experiences of highly industrialized countries can be presented to decision makers so that they are clearly informed of past results, available options, and environmental health costs. Informed decisions can then be made with knowledge of future environmental and health effects, in addition to economic benefits and short-term gains.

## B. Institutional Framework

### 1. Government Commitment

The awareness of many governments in the region of environmental problems associated with development was heightened first by the 1972 United Nations Conference on Human Environment and later by environmental conditions attached to financial assistance from some bilateral funding agencies, including A.I.D., and international funding agencies such as the World Bank.

In the early 1970's, several governments acknowledged that their continued economic development would have significant impact upon the continuing viability of their environmental resources. Governments have attempted to increase commitments to environmental planning since then. <sup>72/</sup> This acknowledgment however, is unevenly distributed throughout society. Traditionally, academics and professionals are most responsive, but have limited influence on government policy.

Government commitment in the form of new legislation, however, is inadequate evidence of resource management or environmental conservation. The effectiveness of legislation is dependent on financial support, governmental motivation, social concern, and implementation mechanisms in the form of meaningful regulations and enforcement authority. In Latin America, as in other regions discussed in this report, institutional capability for implementation of appropriate national goals is still inadequate.

Various measures have been employed to assess the different national levels of environmental concern. Legislation does not reflect the actual degree of commitment since many environmental laws are not enforced. Commitment to natural resource management can be measured to a relative degree by determining the proportion of a national budget that is allocated to it. However, many agencies have multiple functions, some of which are exploitive to the point of being detrimental to resource management objectives, making it difficult to assess which part of the funding

is for management and which part is purely for development. At present, the best assessment can be made through field observations that distinguish between government rhetoric and action. 73/ Those observations indicate that environmental management capabilities are lagging.

The long range value of sound ecological practices on socioeconomic development is yet to be effectively recognized by most countries in Latin America. This is especially important because of the great market value of the natural resources of the countries in the region. Environmental resource commitment and ecological processes must be reconciled with socioeconomic needs in order to meet the basic needs of the population now and in the future.

## 2. Government Agency Structure and Decision-Making Procedures

Countries of the area have evolved several different kinds of organizations and structures to manage developmental planning, environmental management and health protection. 74/ There appears to be a close correlation between rate of development and the infrastructure's capability to respond to environmental concerns. Fundamental issues of political orientation and development policy have dictated the locus of decision making authority in environmental protection.

The more developed countries of Latin America have designated agencies and established institutions for dealing with environmental problems. They have financial resources, technical expertise and infrastructure not available in the less developed countries. Yet, even the most industrialized countries do not have model control programs and their institutions are still in early developmental stages. 75/

Three countries have comprehensive national laws and dominant institutions for environmental management. By presidential decree Venezuela established a Ministry of the Environment and Renewable Natural Resources in 1977 which combined several existing agencies into a single environmental management and protection organization. It is the only Latin American environmental agency at the cabinet level. Colombia adopted a wide ranging code in 1974 establishing an Institute for Development of Renewable Natural Resources and Environmental Protection within the Ministry of Agriculture. Its code defines an integrated policy including the treatment of atmosphere and natural resources, protection of flora and fauna, energy resource development and conservation, urban and industrial development, and land use planning and conservation. 76/ Mexico enacted a federal law for prevention and control of environmental contamination and established a Subsecretary of Environmental Protection within the Health Secretariat in 1972, and in 1977 created an Intersecretarial Commission for Environmental Health. The Mexican Environmental Protection Agency was assigned responsibility for air and water pollution, effluent emissions, industrial pollution, soil conservation, and land use. 77/

In other countries, environmental units have been established with-

in existing ministries with a major interdepartmental coordinating unit. Argentina created an environmental agency in 1973 within the Ministry of Economy, and Brazil, a special secretariat for the Environment within the Interior Ministry. In 1976, Ecuador created an Agency for Prevention and Control of Environmental Pollution within the Health Ministry.

In Peru, the national Office for the Evaluation of Natural Resources, created in 1962, was restructured with broader functions and powers in 1969. The Office, which was originally in the natural resources ministry, broadened its capacity and became a national organ that acts as an advisor to the government in all environmental matters, conducts integrated studies of the country's resources for economic and social development, and collaborates in the formulation of policies for use and conservation of natural resources.

Other countries have a similar structure but the coordinating units have minimal power. These units evolved from the commissions originally created to prepare for their country's participation in the Stockholm Conference. Countries in this category include Cuba, Puerto Rico, Bolivia, and Chile. In Central American countries, the environmental unit is usually housed in the agricultural ministry. 78/ Central American countries have expressed their concerns about environmental issues and have participated in regional meetings and seminars to address particular issues. Guatemala's 1976 law, or environmental protection created an inter-agency committee composed of the ministries of health, natural resources, agriculture, defense and industries, but institutional constraints have limited the ability of the committee and the agencies to respond to the problem. The forthcoming 1979-1982 development plan is expected to place a high priority on environmental issues. 79/

Little or no recognition of environmental management is seen in the legislation of Haiti, Guyana, the Dominican Republic and the Lesser Antilles. There are laws relating to narrow issues of sanitation, health and disease reduction, vesting implementation responsibility in the health ministries, and occasionally minor environmental regulations are assigned to housing and agricultural agencies, or local governments.

A problem in many countries is that ministries are assigned dual functions, one to regulate and the other to promote resource development. The dual charge presents two serious problems. First, while criteria to evaluate the success of conservation programs are lacking, economic gains attributed to resource development are easily measured. Ministries can show immediate economic gains for development projects, but must await the results of long-term studies to demonstrate successes of regulatory activities. Second, it is impossible for a government agency to maximize economic benefits of a resource base, and, at the same time, impose regulations to protect or preserve the resource. 80/

Latin American governments continue to subordinate environmental protection concerns to economic growth. The private sector has not shown an interest in contributing to environmental protection and governments continue to give priority to the private sector's developmental goals. In some isolated instances, governments have made reparation payments to those directly and adversely affected by the contaminating activities of industrial activity instead of requiring more effective wastewater treatment. 81/

Tropical forests are viewed in terms of economic development rather than in terms of ecosystem stability, genetic repositories, or watershed protection. Rivers have tended to attract attention as potential hydroelectric sites, not because of their value for fisheries development, recreation, or transportation, unless these have been seen as appropriate parts of a hydro development project. For each resource, considerations of development potential seem to outweigh concerns for the long-term stability of natural ecosystems.

The decision-making process is less varied from country to country than agency structure. Public participation in resource decisions is nearly non-existent. Governments rarely establish channels of communication to get public opinions on decisions. The very active press in countries like Brazil and Mexico contributes to public awareness, and provides the best channel for communication between government and the public. The press commonly takes pro-environmental stands on environmental issues; however, as in all regions, publicity is often a substitute for action. 82/

A complex factor in the decision-making process in Latin America is the variability of the relative strengths of the various branches of government. 83/ Ministries regulating natural resources are a part of the executive structure and Latin American governments are characteristically dominated by strong executive branches, to the point, in some states, that virtually all regulation and development is controlled by the executive body. Only in a few countries do the legislative and judicial branches form a power base independent of the executive. In countries with a strong executive branch, environmental decision-making merely reflects the desires of those exercising the executive function. Even in governments with more active legislatures, decision-making is heavily influenced by executive powers. 84/

In a number of countries, quasi-governmental institutions playing a significant role in development. National corporations or other public authorities have been given responsibility for particular development projects. The infrastructure thus created is basically used to identify and offer investment incentives. The same infrastructures have as yet unused potential for introducing environmental considerations into new development projects. 85/

### 3. Laws and Regulations

Most Latin American countries have laws and regulations designed

to protect and preserve the environment and natural resources, including forest and wildlife preservation, watershed management, national park protection, and pesticide usage. Examples include the Forestry Law of Guatemala (1974), the Forest, Soil, Water and Fisheries Law of Bolivia (1974), the Urban Planning Law of Bolivia (1973), the Water Codes of Nicaragua and Ecuador (1972), the Health Law of Costa Rica and the Forest Law of Paraguay (1972). Governments in countries with tropical forest resources have laws requiring reforestation by logging companies. Costa Rica's law is the oldest -- adopted in 1942. Nicaragua did not adopt a reforestation law until 1976. Government officials, however, say the laws are "unenforceable." Guatemala forestry officials for example admit that national and foreign logging companies ignore the laws and that the government has little control due to inadequate budgets for enforcement or personnel. 86/

The conclusion is that, as in other regions, the existence of the many laws is meaningless unless mechanisms are established for their implementation. In most cases this has not been done because of inadequate budgetary support or lack of trained personnel. In other cases, the laws and regulations are irrelevant to the variety of problems within a country or are so stringent that people must violate them in order to subsist, or laws have been adopted to give the appearance of environmental concern, with knowledge that they are unenforceable. Poachers continue to decimate wildlife; the many national parks that have been established are not protected; watershed protection and forest management laws are ignored. 87/

The fact that protective legislation exists is nonetheless a positive factor. It is sometimes used selectively to protect critical areas or projects. Further, it represents public acknowledgment of the need to address environmental concerns.

The need for environmental impact assessment similar to that required by the U.S. National Environmental Policy Act is not yet widely recognized. The importance of such analyses will become more apparent as national and international funding agencies require consideration of environmental impact as a condition to loans or grants for developmental projects.

#### 4. Availability of Qualified Manpower

A.I.D. Missions report that lack of qualified personnel continues to be a significant problem in all but the most developed countries. 88/

The more developed countries have an apparently adequate supply of professionally trained environmental scientists in such fields as chemistry, biology, and physics. The demands for their services and the disparity in salaries between private industry and government pose a problem. However, at the present time about one-fourth of the countries feel they have as many trained professionals as needed. Other countries routinely depend on specialists from other countries or international agencies, including A.I.D., FAO, PAHO, and OAS. 89/

The most notable lack of personnel is at the paraprofessional and technician levels. As a result, professionals must use valuable time on tasks which could and should be performed by a trained cadre of technicians. Whereas the countries may have professionals to analyze data or operate sophisticated electronic equipment, there is a significant lack of personnel capable of collecting data or for maintenance of the laboratory equipment. In addition, government agencies do not include budget items for positions between professional scientists and the general labor force, nor for training programs for supervisors.

Administrators, lawyers, and economists cognizant of environmental problems and developmental needs are essential for program planning, management, and implementation. While Latin America has a larger pool of trained personnel to meet these needs than other developing regions, it is still inadequate. The importance of environmental administrators, lawyers, and economists has been described in an earlier section of this report. Expertise in natural resource economics is a particularly critical need in Latin America. Countries in the region are moving forward with public sector support for industrial, agricultural, and commercial programs without benefit of sound economic appraisal of the natural resource commitments involved. Major development and re-colonization projects are frequently instituted with only superficial cost-benefit analyses, disregarding the economic significance of natural resource assets. 90/

#### Training Programs

Most Latin American countries have made serious efforts to establish training programs designed to ensure availability of qualified manpower, and to upgrade professional levels in environmental sciences by instituting environmental curricula in the university systems. Many countries have also designed environmental education programs for elementary and secondary school levels to stimulate interest in the environmental sciences. Mexico has had notable success with its programs for professional training in environmental health, watershed management and watershed modelling. Venezuela, with UNEP support, includes environmental science in its engineering curricula. Brazil has assigned environmental research responsibility for each different ecosystem to regional universities. 91/

Governments have obtained technical and financial support from international agencies such as PAHO, UNEP, FAO, UNESCO for seminars and workshops addressing various aspects of problems related to pesticide usage, forestry, coastal zone management, river basin planning, and tropical wildlife. The seminar-workshop training programs have proven valuable in solving specific manpower training needs, but their principal value is public education.

Important contributions to training programs have been made by private organizations such as the Ford and Rockefeller Foundations and the World Wildlife Fund. 92/

A critical deficiency in the total education program is the lack of technician or sub-professional education curricula. Pilot efforts in technical education have been attempted in a few countries, such as Venezuela and Guatemala, but were not of sufficient duration to evaluate their success. Subprofessional training programs are plagued by their own success. Technicians successfully completing the programs usually continue training and education in order to gain positions at the higher salaried professional levels until they receive fairly high compensation in salaries or appropriate professional recognition. The rapidly developing industrial sectors in the region offer professionals and technicians employment at higher salary levels than the public sector is willing or able to offer.

### 5. Research Facilities and Data-Gathering Capability

Excellent research facilities can be found in the more affluent countries of the region, including Brazil, Venezuela, and Mexico. However, in spite of new expansions of research capacity, most countries cannot keep pace with environmental commitments.

Data-gathering capabilities have improved, although advances in information retrieval systems have not improved concurrently. At present, more data are collected than can be utilized in environmental management decisions simply because the data are not available to all potential users. Much of the data generated by a research group or facility is not distributed widely within the region or even in the country itself. In fact, the research data of one ministry may be unavailable or unknown to other ministries or even to different divisions in the same ministry. Improvements in data retrieval and distribution systems and improvements in data generating mechanisms are critically needed.

Comprehensive water and air monitoring systems have not been established even in the most scientifically advanced Latin American states. The methods and equipment required to identify the presence and levels of environmental residuals are expensive and sophisticated. Only a few research centers, often limited to one in each country, have the capability to perform complicated analyses required to identify specific residuals and to determine existing levels. Research laboratories are equipped and staffed at minimal levels and therefore can respond only to the most critical situations. As a result, there may very well be unusually high concentrations of dangerous environmental residuals that have not been studied or reported. In most cases, residuals are first noted when an effect has already been produced, such as a fish kill or the destruction of some indicator vegetation.

Another problem is the lack of available scientific journals for the publication of research reports. If more journals similar to the Venezuelan Interciencia were published, information might be more accessible to a wider audience of researchers and decision makers. 93/ A common frustration of Latin American researchers is that they must rely on low distribution, in-house publications that are not reviewed

or indexed by international publishers, or on the large international journals which are typically not in Spanish or Portuguese.

#### 6. Environmental Education for the Public

Countries in Latin America have established modest environmental education programs aimed at the general public. Efforts include comic book presentations, billboards, adult education courses and periodic messages in the media. Major newspapers carry educational articles on environmental issues initiated by either the newspaper or government agencies. International organizations such as UNESCO and UNEP and non-governmental conservation organizations have been helpful in designing educational programs and providing funds for their implementation.

Public awareness of the need for resource conservation has increased, largely as a result of government education programs and news coverage of environmentally oriented activities. Those segments of the population with high rates of illiteracy, especially in remote rural and underdeveloped areas, are least aware of environmental problems.

In spite of the lack of public participation in decision-making, public environmental education programs are valuable in developing public feeling which will support environmental planning. The programs will also encourage students to seek careers in environmental management as well as increase sensitivity to the environment in daily activities. These public programs should continue to receive government support.

#### 7. Participation in Bilateral and Multiilateral Arrangements

The increase in bilateral and multilateral arrangements to deal with transnational environmental resources in Latin America is an encouraging sign for environmental management. International groups studying river basin development, such as the Comision Tecnica Mixta de Salto Grande and the Rio Parana Commission Study Group, are most common, and deal with a variety of transnational environmental issues associated with hydroelectric development. The bilateral and multilateral commissions are staffed with top scientists and planners from the ministries of each country and receive substantial support from their respective governments and international organizations. The commissions operate outside the bureaucratic constraints of their sponsoring governments and are better able to cope with problems. In most cases, the commissions are able to establish standards and guidelines more effective than the regulations of each country involved. For example, the recently signed Amazon Cooperation Treaty for development of the Amazon Basin emphasizes environmental concerns in the development process. 94/

The United Nations Conference on Science and Technology for Development, to be held in Vienna in August 1979, has sparked interest throughout Latin America. Several regional conferences have been held to discuss mutual concerns that should be presented at the conference. As a result of this increasing multilateral interest, Central American scientists have taken steps to create a Central American organization for natural resource scientists.

International agencies have demonstrated considerable interest in assisting governments of Latin America to develop the institutional infrastructure needed for environmental protection. The Pan American Health Organization (PAHO) is the oldest, focusing its programs on problems of health and sanitary engineering. Its Pan American Center for Sanitary Engineering and Atmospheric Sciences in Lima, Peru, supervises an air monitoring network (REDPANAIRE) which consists of stations in 14 countries. The UNDP has been active in environmental projects in Argentina, Brazil, and Venezuela. In the state of Sao Paulo and in Guanabara Bay in Brazil, and in Mexico and Paraguay, it is participating in major environmental sanitation projects. The FAO studies renewable natural resources in its Environment and Development group located in the Regional Office in Santiago, Chile. UNESCO, principally through its Man and the Biosphere Program, supports several projects while the OAS has a regional development program which deals specifically with management of natural resources and the environment.<sup>95/</sup> Financial organizations like the Inter-American Development Bank and the World Bank have expressed repeated interest in the subject and have the capacity to take part in projects linked in the environment. World Bank projects approved for fiscal 1978 include water supply and sewerage projects for Brazil, Colombia, Haiti, Nicaragua and Paraguay.<sup>96/</sup> The Caribbean Sea area, including the West Indies, the Greater and Lesser Antilles, and adjacent countries of Mexico, Central and South America, is at present the object of a joint UNEP/ECLA Caribbean Environmental Project (CEP). Plans for project direction were described at an August 1978 meeting. At present there is lack of defined environmental policy objectives at national levels, minimal data base, minimal regional cooperation and communication, and minimal technology transfer. Eight targeted areas for the CEP plan are marine pollution, coastal zone management, natural disaster preparation, environmental health, tourism, human settlements, industry, technology, energy, and natural resources.

In addition to defined multilateral arrangements, symposia and conferences on specific environmental topics have been convened and have heightened interest in cooperative studies. Established research centers in several countries have taken on an international flavor through scientific staff exchanges and a broader focus on environmental problems. Research centers in Brazil, Venezuela, Costa Rica, and Mexico have become international centers for tropical research.

The increasing exchange of development technologies between Latin American neighbors will foster the cooperative planning attitudes that are beginning to develop between countries. Cooperative development projects will mandate cooperative environmental analyses for international decision making. International funding agencies encourage cooperative studies and should continue to provide technical assistance to multinational ventures.

#### 8. Non-Governmental Organizations

Environmental organizations are active in Latin America, particularly in more developed countries. Argentina, Brazil, Venezuela, and Mexico have associations dedicated to the prevention of air pollution. Committees for the conservation of nature are found in most countries in the area. <sup>97/</sup> These organizations, although smaller and less well organized than those in developed nations, are increasingly pressuring national governments to respond to environmental concerns. An example of this was the 1978 Central American Regional Environmental Conservation Conference attended by non-governmental conservation organizations. The Conference, partially supported by A.I.D. funding, proposed the formation of a Central American and Panama conservation organization, established environmental concern priorities and initiated plans to influence national governments to respond to needs for environmental management. <sup>98/</sup>

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#### IV. NEAR EAST

SUMMARY: Major environmental resource problems of the Near East are depletion and pollution of water resources and desertification. Other problems, especially poor land use practices, deforestation, and high population growth, have disturbed the delicate balance of the region's ecosystem. Cultural and wildlife resources suffer as a result of pollution and soil erosion. The unavailability of safe water to many people has led to serious health problems. At times, the very solutions undertaken to correct water resource problems increase the incidence of water-associated disease.

Industrialization has increased the rate of environmental resource degradation. Wastes from mining and oil drilling, industrial discharges, and residues from agricultural chemicals pollute water supplies in the absence of adequate treatment facilities. Marine pollution damages protein sources.

Urbanization puts a severe strain on water supplies, sewerage and solid waste disposal services, and disease prevention programs. Because cities expand rapidly, proper land use planning is neglected, and water supply systems are inadequate. Without appropriate sewerage facilities, wastes mix with surface and ground water to cause severe health hazards. Air pollution, solid waste, and noise further contribute to urban decay.

The severe depletion of water and soil resources has forced some Near Eastern countries to create institutions to manage their remaining resources carefully. However, these institutions have not translated the official concern into effective resource management programs. Financial and manpower deficiencies and other pressures have impeded institutional improvements. Increased pressure to develop economically will further increase the drive toward industrialization at the expense of the environment. Efforts by international organizations have been welcomed but insufficiently utilized.

The Near East, for the purposes of this report, is that geographical portion of the world which extends from Morocco across North Africa into Asia, to Afghanistan in the east and the Arabian Peninsula in the south. The region consists of 22 countries 1/ with an area of almost 5 million square miles and a population of about 232 million people. With an average population increase of nearly 3 percent per year the population can be expected to nearly double by the year 2000 to over 413 million. 2/ Except for Israel and Lebanon, these countries share a single religion, Islam, although there are important religious minority groups within most. They share also a dramatic shortage of certain natural resources, notably water and cropland.

This is a region of arid and semiarid lands, characterized by a climate with low precipitation and warm temperatures for most of the year. Throughout the entire Near East, although climatic conditions have not changed, 3/ most existing ecological systems have been extensively modified by man; they would not revert to their natural state even if they were left undisturbed for years. 4/ The environment remains one of shifting zones of exploitation and settlement. Carrying capacity varies in response to natural environmental fluctuation, intensity of resource utilization, and governmental management schemes.

Traditionally, poor land use practices, especially overgrazing, excessive fuel gathering, deforestation and improper water management, have resulted in soil erosion, desertification and the salinization and waterlogging of irrigated land.

Recently environmental degradation has worsened, particularly as a result of high natural population growth, increased industrialization, migration to urban centers, and the abandonment of traditional land use and cultivation techniques. This section of the report will examine all of these problems, as well as efforts within the region to deal with them.

## A. Environmental and Natural Resource Problems

### 1. Productive Natural Resources

#### a. Water

Throughout the Near East, natural population growth and migration to urban areas have resulted in significant increases in the demand for severely limited water resources. Urbanization and modern technology have increased per capita use, and new industrial development has added to the demand. Some countries do not adequately capture the supply of water available to them. 5/ The expansion and intensification of irrigated agriculture has created basic water use conflicts between the allocation of water

for agricultural, domestic, and industrial use. At the same time, agricultural, industrial, and urban residuals have accumulated in amounts which serve to reduce the already scarce water supply.

At present in the Near East at least half of the urban population and the majority of the rural population are without an adequate, safe water supply. 6/ Without sources of pure water, inhabitants turn to available and often unsafe supplies. All the countries of the Near East suffer from this problem to a large extent, some -- Afghanistan, 7/ Tunisia, 8/ and Jordan 9/ -- perhaps more than others, although exact figures are unavailable. 10/

Although they contribute to an increased water supply, water resource developments, particularly reservoirs and irrigation systems, have also expanded the habitats which breed schistosomiasis. Within the last twenty years the reported incidence of this debilitating parasitic disease has increased dramatically throughout the region. 11/ Schistosomiasis presents a particularly significant environmental health problem in that it is difficult to control and impossible to treat victims successfully.

Sound planning can reduce the adverse impacts of water resource projects, including the incidence of schistosomiasis. In Egypt, for example, although epidemic levels of schistosomiasis were predicted at the inception of the Aswan High Dam project, recent studies suggest that those fears were exaggerated. Other predictions were that more water would be lost than gained from Lake Nasser through surface evaporation and underground seepage, that the dam would trap silt needed downstream for essential nutrients, and that slowing down the rate of water flow would cause waterlogging and soil salinity. 12/ These consequences do not appear to have materialized to the extent anticipated. 13/

Because of Egypt's progressive government programs, 14/ water quality and supply have generally increased over the last forty years. 15/ Moreover, while recent reports of a 50 percent decline in the incidence of schistosomiasis in the rural population during the same period should be viewed with caution, 16/ -- 20 to 30 percent of the population continues to suffer from the disease -- the threat of substantial new outbreaks does appear to have been reduced. Other countries however, have not fared so well. In Morocco, for example, malaria and schistosomiasis have increased. 17/

Other common development-related diseases occurring within the region include gastrointestinal illnesses, often the result of high levels of contamination in water, milk, or food and localized malnutrition, caused by food shortages, associated with flooding, drought insect destruction of crops, and general crop failure. In addition, there are localized health problems associated with high level exposures to toxins and particulates in some agricultural and industrial work sites. 18/

In general, introduction of modern water exploitation technologies, such as powerful diesel well pumping systems, often create increased strains on limited water resources by increasing depletion rates ("water mining") and concentrating water distribution in a more restricted area. These modern wells frequently reduce water levels or dry up traditional wells, driving localized migrations to the captive water source. Such resettlement activities, in addition to causing local political problems, intensify cultivation and grazing in a smaller area, and thus often exceed the land's carrying capacity. 19/

Water mining often results in surface subsidence, with associated problems of canal gradient disruption, salinization, and structural damage. Another potential consequence is salt water intrusion, which pollutes aquifers in coastal areas.

Because of the increased urban and industrial demands, as well as the consequent degradation of water quality, the supply of water for agriculture may well be falling. This could depress future food supplies with obvious and serious implications for the Near East's inhabitants. 20/ Whether or not such shortfalls are averted depends heavily on the success of national and international water use plans, laws, and regulations, as well as on the pace of economic development and population growth.

b. Forests

Although, in ancient times, extensive forests existed throughout the upland areas of the Near East, they have been largely destroyed through cutting for both fuel and timber. 21/ The region's remaining forest resources are restricted to moderate stands in Algeria, Iran, Morocco, and Turkey, with small forests in Afghanistan, Israel, Iraq, Lebanon, Libya, Syria and Tunisia. These forests are threatened by a continuing demand for local lumber (especially for house lintels, rafters, doors, and window frames) and for wood for rural energy, frequently in the form of charcoal. Some reforestation programs -- focusing on watershed management-- have been initiated in Israel, Lebanon, Iraq, and Iran.

c. Fisheries

The Near East has a moderately developed fishing industry which concentrates on the small scale harvesting of marine life through a variety of methods. Principal marine fishing areas include the Aegean Sea, Caspian Sea, Eastern Mediterranean, Gulf of Oman (the Ras al Hadd area), coast of Morocco, Nile Delta, Sea of Marmara, Shatt al Arab (at the head of the Arab/Persian Gulf) and the Red Sea (the Babel Mandeb area). There is limited exploitation of fresh water species along the Euphrates, Nile, and Tigris Rivers, and a highly lucrative industry in the recovery of sturgeon eggs (caviar) from the Caspian Sea.

Fisheries are adversely affected by coastal and marine pollution, especially in the Eastern Mediterranean and the Caspian Sea. Destruction and pollution of coastal wetlands, marshes and mangrove swamps (Gulf of Aqaba) also threaten estuarine and coastal fisheries, areas providing essential living space and nutrients, by preventing breeding of important commercial species of edible fish, shrimp and shellfish.

One unfortunate result of the Aswan High Dam in Egypt is that fishing at the mouth of the Nile has been reduced because the water carries less organic matter and nutrients. 22/ Egyptian losses are being partially offset, however, by the development of a fishing industry in Lake Nasser. 23/

d. Croplands and Grasslands

Because the livelihood of most rural populations is substantially dependent upon the land, the desertification and abandonment of croplands are among the most pressing problems the Near East faces. Even careful management and irrigation of soil produce their own hazards which some countries have already encountered. 24/

Several factors influence the continued health of cropland. First, the fragile ecology of semiarid regions makes the habitat vulnerable to deterioration. 25/ The forms of land use such as shifting cultivation, nomadism, and seasonal grazing, which were maintained for centuries, no longer hold deterioration in check. Even under optimum conditions, land use in the Near East today necessitates the intensive exploitation of the limited areas of irrigable croplands, large areas of arid and semiarid rangelands, and the moderate exploitation of rainfed croplands.

Due to the breakdown in tribal authority and population growth, economic pressures have compelled cultivators to shorten fallow cycles and use the land more intensively. 26/ These pressures are exacerbated by poor land preparation, lack of mulching, farming of steep slopes, lack of contour plowing, and the transfer of inappropriate modern agricultural methods such as deep-plowing (at least 10 inches deeper than traditional methods).

Overgrazing of annual grasses, brush, shrubs, and low trees by cattle, goats, sheep, and camels detracts from the land's carrying capacity by destroying vegetative cover; 27/ the soil then is either blown or washed away. Once the soil has gone, the land loses its

ability to support vegetation. Under such pressure, grasslands rapidly deteriorate to desert-like conditions.

Soil erosion is further advanced because in many areas the increased population continues to forage further and further for fuel, stripping roadside stubble, weeds, brush, shrubs, and trees. Once the land is stripped, inhabitants move on, usually to urban areas. In Afghanistan's Helmand River Valley local farmers now find it more profitable to cross the borders to work in Iran than to resurrect their denuded cropland. 28/

In at least one place traditional land-use has been altered for the better by government intervention. The Jordanian government successfully attempted to control soil erosion by reestablishing a former livestock management scheme in which an area was designated for the use of a specific owner. This had the effect of preventing livestock owners from allowing their herds to graze on lands owned by others even if their own were insufficient. This policy encouraged the retention, rather than sale, of livestock on the hoof since the amount of land an individual received depended on how many livestock he owned, and therefore depressed the protein supply. Such policies do, however, encourage individual owners to prevent erosion. 29/

Most governments have not fared so well. In Iran, land reforms displaced traditional patterns which provide for 'contracting out' by the owner of all tasks, such as plowing, supplying fertilizer, water and seeds. After the land reform, the new and uninitiated owners attempted to perform all tasks themselves, and frequently failed from lack of knowledge, leaving the land to erode. 30/

The terrace systems in the Jubal Nafousa in Libya and in Tunisia have experienced productivity decreases and maintenance difficulties because the labor required for their success has been attracted to urban and industrial activities. In Yemen, as well, where most of the cultivated land is terraced on steep slopes to prevent erosion, more than one million Yemenese have left to work in Saudi Arabia, and very few able-bodied men are left to till the land and maintain the terraces. Some have returned with enough money to buy tractors, necessitating destruction of terraces so that the farmers can use the new motorized equipment. 31/

Another major soil problem in semi-arid and arid regions especially in irrigated areas, is the accumulation of salts. Waterlogging occurs in areas where water is applied without proper drainage. Both waterlogging and salinization are often the cumulative results over time of large-scale irrigation development schemes, as well as naturally-occurring waterlogged areas.

Extensive areas in the Near East -- the Helmand Basin in

Afghanistan and the Mesopotamian Plain of Iraq, for example. -- suffer from severe salination. The increasing salinity of the soil and resulting lower productivity may be due in some more developed areas, such as Israel, to the use of too-efficient irrigation schemes. <sup>32/</sup> If drainage is inadequate in water-efficient irrigation schemes, salts remain and build up in aquifers. Thus, highly refined techniques like drip irrigation, (water applied through small plastic tubes supplying exactly the right amount to the root zone) may result in increased salinization, because there is no excess to carry away the salt.

Two major marshland areas, in the Nile Delta and Hor al Hamara (at the confluence of the Tigris and Euphrates), have also been threatened. In keeping with traditional practice, the marsh is periodically burned to improve pasturage. Diversion and reallocation of drainage water in the basins have also resulted in local dessication of the areas.

e. Wildlife and Natural Areas

In the Near East, except for Israel, there is a limited governmental commitment to the protection of wildlife and the management of natural areas. The principal pressures to exploit wildlife and natural areas come from uncontrolled sport hunting and agricultural development, deforestation, over-grazing, and water pollution. Use of wildlife as a source of food is marginal due to the historical decimation of animal population levels and the isolation of remaining wildlife habitat.

Due to the lack of basic inventory data it is difficult to assess the current status of specific species. Wildlife research has been directed more by individual interests than by national priorities. Lack of reliable wildlife data has forced governments to focus on preservationist legislation in place of management techniques.

An encouraging sign is the current interest of a number of countries, notably Egypt, Jordan, Iran and Saudi Arabia, in the development of natural areas. <sup>33/</sup> Many national tourist boards recognize the potential visitor interest in seeing wildlife and have encouraged the development of such areas. In Tunisia, for example, there is a migratory bird sanctuary which has drawn moderate numbers of European birdwatchers. <sup>34/</sup>

f. Cultural Resources

Throughout the Near East, large and small scale development activities are resulting in the unprecedented disturbance and direct physical destruction of archaeological and historical sites of significance to world and regional cultural history. <sup>35/</sup>

Cultural values are often inadequately considered in the planning process as the benefits of these resources are difficult to assess in monetary terms. Thus, in Iran, a decision was made to develop a large steel complex at Esfahan, despite the findings of an environmental impact assessment that the rapid industrialization and population growth threatened culturally important historical monuments, and that alternative locations were therefore more suitable. 36/ In spite of strong protective legislation, Iraq constructed a major road which destroyed archaeologically significant portions of Babylon. 37/

The long tradition of reusing archaeological and historical building materials is a widespread cause of damage and destruction to these resources. In Yemen, for example, the remains of ancient structures are commonly pulled out of place, transported by truck, and used as building materials for new dwellings.

## 2. Problems Attributable To Pollution and Other Residuals

### a. Industrial Pollution

Industrialization is progressing rapidly in the Near East, especially in Algeria, Egypt, Israel, Iraq, Iran, Saudi Arabia, and Turkey. 38/ At present, industrial pollution is confined to large cities, ports, and resource processing areas such as oil fields and mines. Although most countries recognize the need to combat pollution, controls are generally inadequate.

The adverse impacts of Near Eastern industrial pollution are felt at the local, regional, and international levels. The production of cement, a widespread industry, has adversely affected air and water quality, vegetative growth and palatability, and human health. In Egypt, the Nile has become seriously polluted between Cairo and Alexandria as a result of rapid industrial growth. The potential for safe water reuse has diminished accordingly. The current plan to supplement the water supply of Amman, Jordan, with water from the King Talal reservoir is threatened by combined urban and industrial pollutants, principally fecal matter and heavy metals from the Zarqa Basin, which are collecting in the reservoir. 39/ Urban and industrial wastes in the Mediterranean Sea have severely degraded local, regional, and international environmental quality due to their magnitude and toxic nature. 40/

### b. Agricultural Chemicals

Agricultural chemicals have been used for over forty years in the Near East, especially to control pests on the valuable Egyptian cotton crop. Throughout the region there is a general trend toward the overuse and misapplication of agricultural chemicals due to poor education and training.

Agricultural chemical wastes have already polluted the Near East's water supplies, further aggravating a range of water quality problems. With agricultural crops like cotton, the process of irrigation itself ensures that there will be a prolonged residual presence of the applied pesticide in the ecosystem. Egypt, however, has developed an integrated pest control program aimed at the cotton leaf worm, demonstrating that for some species effective control is possible with a reduced use of pesticides. 41/

The improper application of pesticides can result in unanticipated direct and indirect effects on non-target plant and animal populations. During the early 1970's the massive use in Egypt of Leptophos resulted in widespread livestock and some human deaths. 42/ The widespread use of DDT and other pesticides in the Caspian Sea area of Iran has resulted in chemically attributed kills of as many as three million fish. In addition both the Soviets and Iranians are detecting high levels of chemical residual traces in the sturgeon eggs harvested from the Caspian Sea.

c. Mining and Drilling

Oil and gas production is the principal extraction industry in the Near East. In addition, there is a substantial phosphate mining industry in Morocco, and recovery of the following minerals in minor amounts: chromium (Iran, Turkey), coal (Afghanistan, Algeria, Iran, Morocco, Turkey), cobalt (Morocco), copper (Iran, Morocco), iron (Egypt, Turkey), lead (Iran, Morocco, Turkey), manganese (Egypt, Iran, Morocco, Turkey), molybdenum (Turkey), phosphates (Egypt, Jordan, Morocco, Tunisia), potash (Israel, Jordan) and zinc (Iran, Morocco, Turkey). There also exists a future possibility of mining oil shale in Morocco and the exploitation of metal deposits in the Saharan uplift and Oman.

The petrochemical industry in the Near East region focuses on the recovery of oil and gas through onshore and offshore wells, its transport by tankers and pipelines, and newly developed refining and processing facilities. Most environmental risks are associated with oil spills, pipeline rupture, local air pollution, local disruption of aquifers and water tables, and localized surface subsidence. As gas and oil exploration is the mainstay of most producing nations, limited concern has been given to associated environmental problems, with the exception of oil spills. 43/

Open pit hard rock mining with its attendant problems of post-mining land reclamation, disruption of aquifers, and habitat destruction is increasing throughout the region. These problems are particularly associated with the mining of phosphate rock. Currently Morocco is the world's third largest phosphate producer, while new phosphate industries are developing in Jordan and Tunisia. It is reported that phosphate dusts released during ship loading are causing damage to the fragile coastal reefs of the Gulf of Aqaba

by coating them with fine dust. 44/ Mining of sulfates creates the potential risk of leaching newly freed toxic chemicals from tailings and making water unfit for human and agricultural use.

Recovery of potash from the Dead Sea by both Israel and Jordan has resulted in the development of extensive systems of dikes at its shores and reduction in touristic value in the mining zones.

d. Marine and Coastal Pollution

Marine and coastal pollution is a widespread and rapidly increasing problem in the Near East. 45/ Principal contributors to the pollution problem are dredge spoils from the Suez Canal and ports, off-shore drilling, oil tanker traffic, and urban/ industrial sewage. This situation is complicated by the slow and weak currents in the Arab/Persian Gulf, Mediterranean Sea, and Red Sea which are unable to rapidly mix and disperse pollutants. 46/

The numerous activities associated with oil recovery, transportation, and disposal pose a major threat to the regional marine environment. There is already international concern about the potential for spills and discharges in the region, particularly in the Arab/Persian Gulf and the Mediterranean Sea. 47/ Oil transportation operations present an increasingly serious problem since many areas with high traffic levels, such as the Arab/Persian Gulf, Gulf of Oman, Red Sea, and Straits of Gibraltar, are located in regionally important fishing grounds.

Among the greatest threats to the coastal zone are increasing urbanization and industrialization. The capital cities of most countries in the Mediterranean area are located in the coastal zone and these, together with port facilities and smaller urban areas, are rapidly growing as the result of high normal population growth and the influx of rural inhabitants. 48/ These cities are not institutionally or financially able to meet the needs of the new residents. Because many services, including water supply, solid waste disposal and sewerage are not available, local coastal areas suffer from significant health hazards.

The concentration of regional oil port facilities along coastal areas also creates enormous problems with coastal pollution. The impact on tourism in beach resort areas has been severe. 49/

e. Toxic Substances

Problems attributable to the presence of toxic substances have not been adequately assessed in the Near East. The principal focus of the limited research to date has been the extent of toxic metal contamination in fish and marine life. The existing monitoring capabilities within the Near East, with the exception of Israel, are not sufficient to determine the extent and level of

toxic substances within the immediate environment.

### 3. Urban Environmental Problems

#### a. Land use

The urban areas of the Near East are growing rapidly due to the combination of high population growth rates and rural migration to urban centers.

The peculiar geology of the Near East dictates that only a small part of the whole region is inhabitable. For example, the Nile Valley, which comprises 2.5 percent of the country's area, contains a population density of 2400 persons per square mile, one of the highest in the world. <sup>50/</sup> Thus, whenever calamity strikes a delicate man-made system in an outlying region, the damage is usually irreversible, and the population moves to the nearest urban area. Because the agricultural return from the land is continuing to deteriorate, the tide turning toward the cities is swelling.

The enormous increase in population puts a severe strain on water supplies, sewage and solid waste disposal, disease prevention and control, electricity, and all other services. Moreover, haphazard expansion of cities into adjacent areas is taking up for urban purposes land that might better be used as cropland.

Cities are expanding so rapidly and populations are growing so quickly that proper land use planning is difficult. Projections show, for example, that by the year 2000 Cairo's population will have increased dramatically to at least twice its present size. <sup>51/</sup> Amman, the capital of Jordan, is growing by 11 percent per year. <sup>52/</sup> The urban migration of the rural poor has created a large pool of unskilled labor in all urban areas. At the same time, there is a shortage of administrative and technical workers.

Evidence shows that people who are crowded into urban centers have built increasingly in areas which are geologically hazardous in terms of earthquakes, land slides, and flooding. <sup>53/</sup> Baghdad, for example, is built on a large flood plain. Many of its suburban expansions are routinely threatened by flooding every few years. Iranian and Turkish cities are notable for their earthquake hazards.

The extremely high human densities, coupled with substandard sanitary conditions, increase the threat of major epidemics and are of great concern to international health agencies. Fortunately, the quality of epidemic emergency medical care has improved significantly in most urban areas and advances in medicine have kept potential health disasters in check.

b. Water Supply and Sewage Treatment

For urban dwellers of the Near East, water supply and sewage treatment are critical problems. At the present time, most countries lack the resources to manage water pollution from primary human and industrial wastes or to offset these effects by providing an adequately safe water supply. 54/

Water supply problems range from the lack of adequate delivery systems to the lack of sufficient water resources for the cities to tap. The inadequacy of sanitary services and inadequate water supply aggravate health problems in the area. Without appropriate sewage and sanitation facilities, the accumulated wastes mix with the surface and ground water resources, seriously degrading them. Since dysentery and other related diseases are of such great importance in many Near Eastern countries, a special effort has been made by host governments and donors to construct sewerage systems. 55/

Because of frequent flash rainfalls, storm water runoff is also a cause of pollution in the Near East. Where drainage is inadequate, abandoned lots create small reservoirs which become breeding habitats for disease-carrying pests.

Because water is in critically short supply throughout the Near East, there is fierce competition within a country between urban and agricultural demands. This competition has a qualitative as well as quantitative effect on the water supply. Agricultural use of the water before it reaches the city results in salinity and nitrate residues. Urban use of water before it reaches farms can result in a heavy concentration of urban and industrial and toxic pollution. The increased per capita use of water by urban dwellers, moreover, exacerbates the supply problem.

c. Air pollution

Throughout the Near East, urban transportation is recognized as a major impediment to maintaining urban environmental quality. Existing public transportation systems are seriously overtaxed and in many cases poorly maintained. Increasing numbers of private automobiles combined with traditional transportation vehicles in cities create spectacular traffic snarls in every Near Eastern city during peak traffic hours. The construction of new routes and upgraded roads has helped, but the problem remains an issue that attracts considerable public pressure. Systematic and comprehensive data on air pollution levels are sparse, and not particularly reliable. 56/ But available information and visual inspection indicate serious violations of internationally accepted ambient air quality standards, especially in industrialized areas. There are extreme air pollution problems in Tehran, Cairo, and Ankara. Automobiles, buses, and trucks, combined with air pollution from industry, burning of home cooking and heating fuels, burning of solid waste, and the use of incinerators in buildings, cause very

high pollution levels, especially in those cities with thermal inversions and lack of air circulation. Abundant solar radiation also intensifies the photochemical smog problem, resulting in adverse effects on public health and the economy.

d. Solid Waste Management

The solid waste problem in the Near East is increasing from both population growth and greater consumer purchasing power. Although substantial recycling is done of metal and glass, common packaging materials (paper, plastic, and cardboard) combined with household and kitchen wastes pose a significant urban disposal problem. Solid waste management programs are only beginning to be developed and focus on the provision of adequate removal service. Disposal techniques have received little attention with solid wastes typically being dumped into excavation pits, canal/river banks, and open dumps. In most cases waste disposal sites have been selected principally for convenience and are not supervised. In urban neighborhoods solid wastes are commonly piled informally in close and convenient locations such as alleys, gutters, open lots, or construction sites with materials accumulating until removed by the government or property owner.

These local and municipal dumps provide areas for excessive rat populations and provide breeding habitats for numerous disease vectors. They also lead to the leaching and seepage of toxic wastes into water supplies with consequent adverse effects upon public health. In addition, the unrestricted disposal of garbage is interfering with the development of tourism, with a resulting loss in foreign currency revenues.

e. Noise

Noise is a serious problem though it is not generally perceived as such in most urban areas. Citizens have gradually become accustomed to high noise levels and are not aware of the potential hazards of exposure to excessive noise. Automobiles, buses, and trucks, especially when heavily congested in narrow streets, result in high decibel levels. Extensive construction and rebuilding, noise from industry, and aircraft add to exposure levels. Noise is also an occupational hazard in oil refineries and other industries.

B. Institutional Capability of Near East Countries to Respond to Environmental and Natural Resource Problems

1. Policy and Agency Structure

Although there is little detailed information on the institutional frameworks of many Near Eastern countries, it appears that many of these nations are aware, at least to a limited degree of

their environmental and natural resource problems. With rare exceptions, however, this awareness has yet to be translated into effective programs for the management of threatened resources. In general, the difficulty appears to be an institutional one: the management of environmental resources calls for the establishment of coordinated planning and regulatory mechanisms which are not easily accommodated by the traditional arrangements which still characterize most government organizations in the Near East.

On one level, the problem is unfamiliarity with the structures and procedures essential to effective resource management. On another level, personnel employed by newly established environmental agencies are not equipped to function according to the administrative norms essential to the efficient performance of such organizations. Given the relative novelty of environmental planning and management, as opposed to more familiar economic development activities, these institutions also suffer considerably from inter-agency pressures designed to reduce whatever influence they might otherwise have.

Six countries in the Near East appear to have initiated unified environmental management plans: Tunisia, Iran, Israel, Saudi Arabia, Morocco and Kuwait. The extent to which these plans have been implemented, however, varies widely. The failure of institutions in this area can be attributed to several critical factors. The absence of a clear mandate from the highest levels of government, inadequate professional and technical support, lack of university-level courses designed to train young professionals, and inadequate legislation are among the most important reasons for poor performance.

Tunisia, although it does not have a formal statement of policy on the environment, does have an overall environmental quality plan. Tunisia's concern about environmental degradation has resulted in several projects aimed at combatting water pollution and soil loss. Several years ago, for example, a project for the cleanup of Lake Tunis was supervised by the Ministry of Agriculture's Civil Engineering Department. A new department, the National Purification Bureau, was created at the end of 1974 and was responsible for the final phase of the project.

Israel created an Environmental Protection Service in 1973 under the Prime Minister's Office, which was transferred in 1976 to the Ministry of the Interior. Its role is to advise and educate, but not to enforce; the enforcement function is reserved to individual municipalities. Because municipal budgets are generally low and pollution controls are expensive, however enforcement is sometimes problematical. Technically, if the municipalities do not adequately control pollution, the central government may intervene, but as a practical matter it rarely does so. 57/

Kuwait has a separate environmental agency, and has created a Human Environment Council in the Ministry of Public Health and a Department of Environmental Planning in the Ministry of Planning. 58/ These agencies, with assistance from the World Health Organization and the International Labor Organization, supervised the Kuwait Regional Conference to Combat Pollution in Gulf Waters. 59/

Despite Kuwait's creation of a unified Department of Environmental Planning, many other governmental agencies have some jurisdiction over natural resources. For example, the Ministry of Commerce is empowered to combat pollution in industry, while regional councils are responsible for controlling air pollution. The inevitable result is that efforts of these agencies are generally uncoordinated. 60/

Saudi Arabia has enacted an environmental quality plan which deals specifically with urban sewage, collection and treatment. 61/ In furtherance of the plan the Saudi government recently decided to establish an Environmental Protection Agency which will incorporate and expand the present Office of Meteorology. The new agency will be responsible for pollution control and environmental protection. 62/

Saudi Arabia is also planning systems to monitor pollution at Jubail and Yanbu. The two responsible agencies will be the Meteorological Department of the Ministry of Defense and Aviation, and the Royal Commission for Jubail and Yanbu. These systems will be designed to mitigate the harmful effects of industrial waste. The Meteorological Department also has an ongoing joint program with the University of Petroleum and Minerals in Dhahran. 63/

Morocco created a Ministry of the Environment in 1972 with responsibility for urban affairs, the environment, and tourism. 64/ This ministry coordinates all matters concerning the environment. In addition, appointed members of a National Committee on the Environment (Comite National de L'Environnement) act as consultants to organize studies.

Iran's Department of the Environment, established by the Environmental Protection and Enhancement Act of 1974, is beleaguered by several gaps in its statutory authority. Other major problems have been the Department's newness and the general lack of inter-agency coordination throughout the government. The Department is authorized to monitor the construction and operation of development projects as they affect the environment and to monitor and control pollution. Fines and orders of the Department are subject to judicial review. The Environmental Protection and Enhancement Act also established the Environmental High Council, which inherited the powers of the former Game and Fish Protection High Council and has expanded authority to create and manage protected areas. 65/

Forest management in Iran is the responsibility of the Forest and Rang. Section of the Ministry of Agriculture and Natural Resources. Enforcement of controls is included in the agency's authority, but its main function remains the allocation of forest resources for economic exploitation. 66/

Some countries, although they do not have comprehensive environmental agencies, have addressed the problem by creating an oversight post on the environment within the cabinet. Jordan, for example, created a Council for Human Environment Affairs in 1973. 67/ Turkey has established a new office of undersecretary of state in charge of environmental affairs. It is responsible to the Prime Minister and is intended to coordinate the activities of departments dealing with the environment, to originate research and to direct policy.

The creation of Turkey's environmental affairs undersecretary is a recognition of the serious and rapidly increasing environmental hazards particularly in the industrialized areas of Izmit and the Golden Horn in Istanbul, and the Bay of Izmir. Fish are no longer found in the Bay of Izmir; in other parts of the Marmara Sea the number of fish species have declined from 14 to 5. The penalties for violation of current pollution laws are minimal.

Turkey has recognized that legislation and close cooperation between relevant branches of government is essential, and the government intends to study existing legislation in industrialized countries, in part due to urging from private groups such as the Foundation for Turkey's Environmental Problems. 68/

Other governmental responses to environmental pressures have been to give new authority for environmental affairs to previously existing agencies, albeit with potentially conflicting aims.

The Algerian Ministry of State created a National Environment Committee in July, 1974. The Committee membership is drawn from the ranks of several ministries, and has the authority to develop a code of laws on protection of the environment, in addition to ensuring much needed liaison among various interested agencies. 69/

Libya and Qatar have also vested new responsibility for environmental problems in previously existing agencies. 70/ Their effectiveness is impeded, however, by rapid sociocultural change, industrialization, and inadequate agency support structures. One observer has termed the lack of coordination, "the balkanization of responsibilities." 71/ A Jordanian study concluded that "[t]he more limited the resources of experienced management available the more important it is to avoid dispersing it among departments with narrow constituencies and conflicting aims." 72/

## 2. Environmental Law

Most Near Eastern countries have at least some legislation on their books authorizing officials or agencies to respond to environmental concerns. And, as noted above, some have unified departments of the environment. It is fair to comment, however, that those countries with either unified agencies or merely isolated laws which address only one or two environmental problems have met with little success in implementation. In general, effective environmental sanctions do not appear to be in force. 73/

For example, Egypt, although it does not have a unified environmental agency, does have pesticide and pollution control legislation. In at least one view, however, this legislation is "almost universally ignored." 74/

Egypt's pollution legislation came about in 1969 because of rapid industrial expansion and increased energy use. An executive order established a Committee on the Prevention of Air Pollution, and in 1971 the Ministry of Health issued a regulation setting criteria for air pollution limits at industrial installations and for outside air generally. This regulation provides for shutdowns of polluters who exceed certain limits, yet it is "apparent that this regulation is not enforced." 75/

Similarly, Egypt's pesticide legislation, passed in 1951 and amended in 1967, requires registration of pesticides and authorizes sale only upon a written affidavit that the compound in question has undergone certain tests. But, the facilities for testing appear to be inadequate. 76/

Iranian legislation, on the whole, is general and leaves most of the details of regulation to the implementing agencies. Iran's National Clear Air Act of 1975 invested the Department of the Environment with specific authority to regulate emissions affecting air quality. The act also authorizes the Department to promulgate air quality standards which provide an upper limit for identified pollutants and which vary according to the needs of particular regions. The Department may also prescribe the use of certain fuels, and regulations for their use, although the National Iranian Oil Company and the Ministry of Energy have overlapping jurisdiction in this regard. The maximum fine for violating the Act's regulations is approximately US \$700. 77/

Pesticides are apparently subject to the regulatory authority of two separate agencies, the Department of the Environment and the Plant Protection Organization of the Ministry of Agriculture. As a practical matter, however, the Department of the Environment has had little influence on the Iranian Government's pesticide management program. 78/

Jordan, Tunisia and Israel have all passed stringent laws giving a central water authority power to control water supply and quality. Jordan passed the Water Supply Corporation Law in 1973. 79/ It authorizes the Water Supply Corporation to eliminate polluted water through a network of water councils and to cooperate with the Ministry of Health and others in all matters relating to the health aspects of water use. 80/ The jurisdiction of the regional water councils covers the whole country except the Jordan Valley, for which a special corporation was created in 1977.

Also in 1973, the Jordanian Government created the Amman Water and Sewage Authority to control pollution in the Jordanian capital's water supply. The Authority is a corporation administered by a Board of Directors chaired by the Mayor of Amman. 81/

While existing water legislation is undoubtedly a step in the right direction, some Jordanians maintain that even the five-year plan (1979-1980) fails to articulate a consistent national water policy. 82/ The Jordanian Government is said to be characterized by an over-centralization of administrative authority, and often gives insufficient attention to problems in outlying regions. Frequent conflicts between ministries over development policies and an outflow of trained personnel are other obstacles to effective resource management. 83/

Tunisia passed new water legislation in August 1975, providing for distribution of water on the basis of set priorities among competing users and prescribing sanctions against water pollution. 84/ Tunisia's Master Water Plan is intended to mobilize three-quarters of the water resources of Northern Tunisia by building four dams and interconnecting canals. This will open up newly irrigated areas, and provide increased supplies of water to the Tunis and Sousse regions. Despite this legislation, the Tunisian government cites three major deficiencies in its institutional framework: lack of quality control, lack of enforcement, and lack of continuity between agencies and legislation. 85/

The Water Law of 1959 is the basis for water resource management in Israel. There, as in neighboring states, water resources, including surface and ground water, and matters dealing with sewerage and drainage come under national government control. Principal authority over water supply is vested in a Water Commissioner, technically within the Ministry of Agriculture but directly responsible to the Prime Minister. No one may use water from any source except under an annual license issued by the Water Commissioner. In 1971, the Water Commissioner was empowered to control pollution as well as supply. 86/

Several countries have passed 'spot' legislation designed to ameliorate specific hazards. Iraq, Morocco, and Turkey have set maximum limits for excessive levels of radiation, enforced by

existing agencies. Iraq, for example, has created a Department for Radiation Control, made up of members from the Ministry of Health and the Atomic Energy Commission. 87/

### 3. Manpower and Training

Several Near Eastern countries have substantial professional and technical communities which provide essential manpower resources. Egypt has a significant number of university and technical training centers, including Ain Shams University, the Academy of Scientific Research and Technology, Al-Azhar University, the Alexandria Institute of Oceanography and Fisheries, the Arab Engineering Union, Cairo University, the Desert Institute, the Egyptian Academy of Scientific and Research Technology, and the University of Alexandria. 88/

The Desert Research Institute of the Ministry of Agriculture is a leading institution in the field of appropriate technology for desert development. Its focus is on resource inventories and research on salt tolerance in crops. The American University of Cairo is establishing a Desert Development Demonstration and Training Program in Abees in the South Tahrir Province. This effort will focus attention on those technologies appropriate for land reclamation outside the Nile Valley, the traditional region of interest. 89/

Israel has a highly educated pool of university and technical staff. The Technion, the Hebrew University of Jerusalem, the Weizmann Institute of Science, Bar Ilan University, Tel Aviv University, Ben Gurion University of Haifa, and the University of the Negev in Beersheva all have significant programs which enable the Israeli government to rely heavily on its own citizens for expertise. 90/

Iran has training centers at Tehran University, and the Shiraz Center, and the Arid Lands Group. 91/

The Jordanian research community is organized and trained through such organizations as the Royal Scientific Society, the University of Jordan, and the Royal Scientific Society's Energy Station at Aqaba, although a large proportion of Jordanian professionals are trained abroad. 92/

Iraq has several centers for training. The principal two are the University of Baghdad (National Science Institute, Pollution Research Center) and the Foundation of Scientific Research. Other centers are the Department of Scientific and Industrial Research, Mosul University, Al-Mutansiriyah University and the University of Basrah. 93/

Kuwait has an Agricultural Experiment Station within the Ministry of Public Works, the Kuwait Institute for Scientific Research, and the University of Kuwait. 94/

Syria has an important center in Damascus, the Arab Center for the Studies of Arid Zones and Dry Lands, which publishes regional studies in Arab countries on water resources, soil and water problems, and soil conservation. The University of Aleppo is affiliated with the Agricultural Research Center and the Technical Institute for Agriculture. 95/

#### 4. Multinational Approaches to Environmental Problems

As noted, the Near Eastern countries, like those in other parts of the world, are beginning to give greater attention to the problems of environmental degradation than in previous years. This concern has increased significantly since the mid-seventies, due in part to the concern of international organizations such as the United Nations Environment Program, the Food and Agriculture Organization, and the World Health Organization. It is apparent, however, that this growing concern has yet to be translated into effective action in most Near Eastern countries.

The need for cooperation has increased, first, because huge aquifers in the region are shared by several countries. For example, the North African aquifer extends under Libya and Egypt, among others; the Arabian Peninsula aquifer crosses Saudi Arabia, Bahrain, Qatar, and the United Arab Emirates. The Northern Sahara Basin is shared by Algeria, Tunisia, and Libya. 96/

Pollution is a second point of common interest. The United Nations Environment Program has sponsored a series of conferences on the environment in the Near East. One of their principal focuses has been pollution in the Mediterranean. 97/ In 1975, UNEP invited 18 Mediterranean states to discuss common problems and propose a "Mediterranean Action Plan" in Barcelona. This plan included three legal agreements: a general convention for the protection of the sea against pollution; a protocol preventing pollution by dumping from ships or planes; and a protocol ensuring cooperation in dealing with emergency oil spills. Significantly, only 6 of the 18 states have signed, and those six are not major polluters.

The Barcelona Convention also established an oil spill control center in Malta in 1976. However, efforts to carry out this plan are not progressing rapidly. Most of the 18 countries bordering the Mediterranean, for example, have not yet instituted oil spill contingency programs. Of the Near Eastern countries on the Mediterranean, only Israel has a program to combat oil pollution. A

positive sign is that some countries in the Near East have asked for help: Tunisia, Lebanon, Morocco, Algeria and Libya. 98/

Also under UNEP auspices, the Gulf states met in Kuwait in April 1978 to adopt a plan for introducing environmental considerations into development. The Gulf states also set up an oil spill center in Bahrain and made Kuwait the headquarters of a Regional Organization for the Protection of the Marine Environment. Experts are optimistic about the chances for success, due to significant regional awareness of pollution problems.

Two other UNEP-sponsored meetings held by the Arab League Economic, Cultural and Scientific Organization (ALESCO) in Jiddah in 1974 and 1976 were not as successful because of political turmoil in the Horn of Africa. 99/

Transnational projects in Near Eastern countries. Iran and Afghanistan are participating in a project on Monitoring Desertification Processes and Related Natural Resources in South West Asia. 100/ Also, Iran and the USSR have signed a protocol on cooperation in the Caspian Sea. The two countries exchanged results from studies on pollution in the Caspian during 1977, and pledged to continue their cooperation through 1980. 101/

The wealthier Arab States are progressing more rapidly in solving problems. The First Gulf Conference for Marine Meteorology approved the establishment of a regional Marine Meteorological Center in Jiddah, Saudi Arabia, on Sept. 25, 1977. 102/ The new center will provide data on oil prospecting and meteorological forecasts and accelerate technological progress and protection of the Gulf against air and water pollution.

In April 1978, the Arab Center for the Study of Dry Regions and Barren Lands in Riyadh held a meeting to discuss special agreements to halt desertification. It was attended by delegates from Saudi Arabia, Egypt, Syria, Iraq, Libya, Sudan, Jordan, Lebanon, Oman, Algeria, Morocco, United Arab Emirates, and Mauritania. 103/

In 1976, Qatar and Iraq discussed the establishment of a center for protection of Gulf waters from pollution in Basrah, Iraq. 104/

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NOTE ON CONTRIBUTORS AND METHODOLOGY

Contributors

This report was prepared by a staff specially recruited by the Science and Technology Division of the Library of Congress pursuant to an interagency agreement with A.I.D. (A.I.D. Participating Agency Service Agreement No. ZA/DSB-000-i-79). The project was organized and directed by Jeffrey N. Shane. Principal staff members were Diana C. Middleton and Lenore S. Ostrowsky. Other major contributors to the project were Dale W. Jenkins, Barbara Lausche (Mittelholtz), Ralph A. Luken, Robert E. Stein, Lloyd V. Stover, and Gus Tillman.

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PREVIOUS PAGE LINK

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### Methodology

Given the relatively short period of time available for the preparation of this report, it was necessary to find a means of assembling, as efficiently as possible, a broad range of current information about the problems and capabilities to be examined. First, in early December 1978 A.I.D. Headquarters sent airgrams to over fifty overseas Missions requesting relevant information. The many cables received in response to that request are thoroughly reflected throughout the body of the report.

Second, four meetings were held in Washington in January 1979 for the purpose of examining the problems, respectively, of Africa, Asia, Latin America and the Caribbean, and the Near East. Each day-long meeting was attended by experts, both governmental and non-governmental, with extensive first-hand experience in the region under discussion. The experts were asked to comment on a detailed list of issues, and some were asked to submit further material in writing, all based on their personal knowledge. One expert at each meeting acted as rapporteur and, on the basis of the meeting, the written submissions of other participants, and further documentary research, prepared an overview of the region. The papers were subsequently amplified on the basis of information received from A.I.D. Missions in response to the earlier request for information and incorporated, together with introductory material, in the present document. A list of participants in the four workshops will be found at page 182.

Definition of issues. Critical to the success of this undertaking was an early identification and organization of the issues to be discussed. The legislative mandate listed two major categories: (1) the environmental and natural resource problems of developing countries; and (2) the institutional capabilities of developing countries to respond to those problems.

The environmental and natural resource challenges confronting the developing world have been classified in a variety of ways. Distinctions have been drawn, for example, between problems attributable to poverty and the lack of development, on the one hand, and problems attributable to the development process itself on the other. Similarly, the "natural" environment has been distinguished from the "man-made" environment; "renewable resources" and "non-renewable resources" are sometimes treated as separate categories.

Given the functional nature of the present task -- the ultimate objective was to relate the problems identified to the wherewithal of developing nations to respond effectively -- these traditional taxonomies seemed insufficiently instructive. Instead, the issues were arranged in a way that corresponds more readily to their institutional implications. That is, common to all institutional frameworks for environmental management are important differences in the mechanisms addressed, say, to the management of forests as opposed to the control of riverborne industrial pollution. Forests and rivers are both "renewable resources," but the human activities which threaten the integrity of each call for quite different responses. Comprehensive forest management may require the creation of reserves, the granting of carefully conditioned concessions, public education programs, the establishment of village reforestation programs, and other elements. Industrial pollution control, on the other hand, requires a more orthodox regulatory regime. It calls for technologically sophisticated monitoring, any may require the possible establishment of effluent charges, discharge limitations, stream standards, permits, or some combination of these mechanisms. Given their very different institutional ramifications, therefore, deforestation and industrial pollution of rivers and streams belong in separate categories.

For these reasons, problems examined at the workshops were addressed in four categories:

1. Problems associated with productive environmental resources (forests, fisheries, cropland, grasslands, genetic resources, etc.).
2. Problems attributable to pollution and other residuals (industrial and agro-industrial pollution, accumulation of agricultural chemicals, toxic substances, etc.).
3. Problems associated with urban areas (waste management automotive emissions, land use planning, etc.).
4. Environmentally-related diseases.

With respect to the institutional capability of the countries being examined, a lengthy series of issues was formulated. Among the more important questions were:

- To what extent have the governments of developing countries articulated firm policies with regard to environmental and natural resource management?

- What is the nature of government agency structures within developing countries in connection with environmental and natural resource management? Has clear regulatory authority been established with respect to those environmental and natural resource problems of significance to the countries in question? Is there adequate coordination of the activities of different agencies?
- Are qualified personnel available in adequate numbers in the environmental sciences and engineering? In environmental law? Planning? Economics? Have training programs been established locally to ensure the availability of adequate manpower resources? If not, are there plans to remedy this deficiency? Are government managers sufficiently familiar with the natural resource implications of program and project decisions?
- What is the prevalent attitude of the public toward environmental management within the developing countries? Has environmental education been added to public education curricula?
- Have developing country governments established effective programs for gathering data about environmental and natural resource trends? Are they able to evaluate data meaningfully?
- Have procedures been established for assessing the environmental consequences of proposed development projects? Do such assessments, where required, influence the decision-making process? Do they serve as a device for encouraging inter-agency coordination?
- What is the adequacy of the legal frameworks for environmental management in developing countries? Have laws regulating individual conduct been accompanied by government efforts to ameliorate resulting hardships?

- To what extent do developing countries participate in multilateral arrangements addressed to transnational environmental issues?
- Have developing countries acknowledged any deficiencies identified in response to these questions, and have they initiated remedial action?

It was understood from the outset that information on all of these issues would not be available in all cases; indeed, some of the institutional issues do not appear to have been the subject of any prior systematic assessment. To that extent, because the report is based exclusively on existing material, much of the resulting information is necessarily impressionistic and anecdotal.

It is hoped that the design of the present preliminary overview will serve as a useful point of departure for far more detailed and useful examinations of these crucial issues.

AID ENVIRONMENTAL SURVEY PROJECT

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