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**Environment,  
Growth,  
and Development**

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and Development*

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Joint Ministerial Committee  
of the Boards of Governors  
of the World Bank and the International Monetary Fund  
on the  
Transfer of Real Resources to Developing Countries  
(Development Committee)  
Washington, D.C., U.S.A.

Established in October 1974, the Development Committee is known formally as the Joint Ministerial Committee of the Boards of Governors of the World Bank and the International Monetary Fund on the Transfer of Real Resources to Developing Countries. The Committee's members, usually Ministers of Finance, are appointed in turn for successive periods of two years by one of the countries or groups of countries represented on the Bank's or the Fund's Board of Executive Directors. The Committee is required to advise and report to the Boards of Governors of the Bank and the Fund on all aspects of the broad questions of the transfer of real resources to developing countries, and to make suggestions for consideration by those concerned regarding the implementation of its conclusions.

The International Bank for Reconstruction and Development (IBRD) and its affiliate, the International Development Association (IDA), together constitute the World Bank. The International Finance Corporation (IFC) is another affiliate of the IBRD.

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# Contents

The Environmental Problem	1
Environmental Degradation	2
Economic Growth, Poverty, and the Environment	5
Lessons from Development Projects	10
Linking Economic and Environmental Objectives	10
Considering Technical Interactions	12
Considering Behavioral and Sociological Factors	14
Overcoming Problems of Implementation	15
Looking beyond Individual Projects	16
National Policies and Instruments for Environmental Management	17
National Planning and Environmental Management	17
Pricing of Agricultural Output	19
Pricing of Agricultural and Forestry Inputs	20
When Governments Should Intervene	22
Regulatory and Legal Mechanisms	24
Coordination of Policy Instruments	26
An Agenda for Action	28
Country Policies	28
Collaboration in the Development Community	30
World Bank Actions	31

The framing of environmental strategies for sustainable development has become one of the most important challenges of our time. On the basis of a paper prepared by the World Bank on environment, growth, and development, the Committee at its April 1987 meeting emphasized the importance of protecting the environment while pursuing economic growth and development. It intends to return to this subject at a future meeting. In April 1987 the Committee noted the early publication of the report of the World Commission on Environment and Development and hoped to benefit from its findings. In view of the abiding interest in the subject, the Bank report is being made available for a wider audience.

FRITZ FISCHER  
Executive Secretary  
Development Committee

*August 1987*

## The Environmental Problem

Attitudes toward environmental matters have changed greatly over the past two decades in both industrial and developing countries. Concern about air and water pollution began in the industrial countries in the 1960s. The developing countries, apart from their concern with such immediate problems as unsanitary living conditions, generally regarded environmental issues as a luxury that only the rich nations could afford. And they resented the efforts of interest groups in the industrial countries to persuade them otherwise.

This general difference of opinion characterized the 1972 Stockholm Conference, a milestone in the development of international environmental policy that led to the establishment of the United Nations Environment Programme (UNEP). That conference was also a forum for discussing a wider range of environmental issues. In the years that followed, resource degradation from large development projects, such as irrigation and hydroelectric schemes, became a matter of increasing concern. Today the developing countries—faced with conspicuous evidence of soil erosion and deforestation and increasingly concerned about rapid population growth—recognize that environmental issues are as relevant to them as to the industrial countries. Particularly in land and water management for agriculture, environmental protection is now generally recognized as necessary for sustainable economic development, not as an alternative to it. And countries now realize that environmental interdependence is as important as economic and financial interdependence. The effects of tropical deforestation and industrial emissions on the global climate, and the effects of overfishing and agricultural and industrial

*Note:* This paper was prepared by Jeremy J. Warford, Environment Department, World Bank.

pollution on the productivity of the oceans, have spawned a host of international institutions and legal arrangements.

### Environmental Degradation

Today's wide-ranging environmental issues include deforestation, biodiversity, soil erosion, climatic change, pesticide buildup, threats to indigenous peoples, and industrial and municipal pollution. These issues arise in both industrial and developing countries, but their importance varies considerably, depending on a country's stage of development, its geographic location, and its industrial or agricultural base. In many instances the differences are more in degree than in kind. Industrial pollution is worse in industrial countries, but it is nevertheless a major problem in many cities in the developing world. Soil erosion and deforestation are worse in developing countries, most of which have tropical environments that are more fragile and complicated than temperate environments.

Among the most urgent environmental problems facing the developing countries are those relating to the use of land. Of particular concern are deforestation, devegetation, and (in the extreme) desertification—the outcomes of many interrelated activities. Overgrazing, land clearing, commercial logging, and slash-and-burn agriculture rob soil of its cover and fertility and reduce agricultural yields. They also increase flooding, sedimentation, and the silting up of dams and reservoirs. The problems are worse where the inadequacy of fuelwood compels rural families to burn agricultural residues and dung, thus further depleting the fertility of the soil and accelerating erosion. Such deforestation deprives people of other essential products for their daily survival and threatens wildlife reserves and fragile ecosystems. Resources that in principle are renewable are rapidly disappearing as a result of overexploitation. And the extinction of plant and animal species, which is proceeding all too rapidly, may have serious and as yet unknown consequences for the future of mankind.

Environmental pollution, although typically associated with industrialization, is a great and growing concern in developing countries. Air and water pollution in such cities as Calcutta, Lagos,

Mexico City, and São Paulo are at least as bad as in most developed countries, and, as demonstrated by the Bhopal disaster, industrial catastrophes are not confined to the industrial world. Moreover, one aspect of the environmental problem—unsanitary living conditions because of inadequate water supply and waste disposal—is observed almost exclusively in the poorer countries. Throughout the developing world, water polluted by pesticides and by municipal and industrial wastes causes disease, malnutrition, and death.

Over the past few years air pollution has been seen increasingly as a regional or global problem, not a local one. Acid rain may fall to earth thousands of miles from the emissions of sulfur dioxide and nitrogen oxides that cause it. The destruction of forests in northern Europe is perhaps the clearest consequence. Other global phenomena include damage to the ozone layer by chlorofluorocarbons and the “greenhouse” effect—the warming of the planet because of carbon dioxide emissions and tropical deforestation. The consequences of these phenomena for climate and health are highly uncertain but potentially catastrophic. Responsibility for this is shared: industrial countries tend to be the main culprits in industrial emissions, but some of the larger developing countries, with their lower emission standards, are adding much to the problem.

The causes of environmental degradation are as many and varied as its manifestations. But at the heart of the problem is the rapid rate of population growth in many developing countries. This growth, particularly critical in the poorest countries, puts direct pressure on environmental resources through the depletion of fuelwood and the cultivation of increasingly unsuitable land. With agricultural productivity falling, “ecological refugees” flood into urban areas which often lack the economic and environmental capacity to absorb them. In 1980 three-fifths of the people in developing countries did not have safe drinking water, and three-quarters had no sanitary facilities—not even a pit or bucket latrine. But rapid population growth is rarely the sole culprit. Rather, it typically exacerbates the problems caused by inadequate environmental policies.

The effects of environmental degradation are difficult to establish with precision, but physical indicators alone give grounds for concern. For example, desertification worldwide is proceeding at 6 million hectares—almost the size of Ireland—a year, and tropical

deforestation at 10 million hectares a year. Every year 20 million hectares of agricultural land are lost to soil erosion. And over the next twenty years a fifth of the world's plant and animal species may become extinct.

Countries and continents do not share the burden of environmental degradation evenly. Two-fifths of Africa's nondesert land risks being turned into desert, as does a third of the nondesert land in Asia and a fifth in Latin America. Tropical deforestation is massive in Southeast Asia, Africa, and the Amazon Basin. In Haiti and Nepal deforestation and soil erosion have taken most of the productive land. Not all soil erosion involves a loss, but in Turkey more than three-quarters of the land has been adversely affected, in India one-quarter.

Degradation of land and water, even under the most optimistic assumptions about technical progress and the ability to adapt to depleted resources, clearly threatens economic development in many countries. The evidence for this is fragmentary but telling. Because of the scarcity of fuelwood an estimated 400 million tons of dung are burned each year. That robs the soil of its fertility and depresses each year's grain harvest by 20 million tons. This lost grain—enough to feed 100 million people for a year—would cost about \$3,000 million at international prices<sup>1</sup>. The alternatives to burning crop residues and dung are to travel farther and farther afield to obtain fuelwood or to pay more for it. But in Gambia and Tanzania households already spend 250 to 300 days of labor a year gathering wood. In Addis Ababa fuelwood costs up to a fifth of a household's income. And in the Sahel of West Africa the consumption of fuelwood far exceeds the capacity to regenerate it. Nor can the mining of forest resources for short-term gain go on indefinitely. Between now and the end of the century the number of developing countries that are net exporters of forest products will fall from over thirty to fewer than ten, and developing country exports of industrial forest products will drop from \$7,000 million to less than \$2,000 million.

Soil erosion in India removes nutrients worth \$6,000 million a year in chemical fertilizer replacements. In parts of Mexico erosion reduces maize yields from 3.8 tons a hectare to 0.6 tons, and in parts

1. Current U.S. dollars are used throughout this report.

of Nigeria from 6.5 tons a hectare to 1 ton. Other sectors pay for soil erosion as well. The flood-prone area in India doubled from 20 million to 40 million hectares between 1970 and 1980, and in the Ganges Valley alone the annual cost of flood damage to crops and other property averages about \$1,000 million. Reduction of sedimentation in hydroelectric facilities will cost the developing countries about \$3,000 million over the next fifteen years. And the disruption of major water flows because of deforestation threatens water supply systems throughout the world—a grim prospect, because acute water shortages combined with pollution now cause 25,000 deaths a day.

Water pollution, in addition to its impact on health, may have more readily quantifiable economic consequences. Pollution of the Rimac River, the water source for Lima, has increased the cost of chemicals and disinfectants by almost 30 percent. Pollution of the Isser in Algiers and the Han in Seoul has substantially increased water supply costs because of the need to move water intakes upstream. A similar situation in Shanghai, where a water intake for the public water supply system had to be moved more than 40 kilometers upstream, cost about \$300 million.

### Economic Growth, Poverty, and the Environment

Promoting growth, alleviating poverty, and protecting the environment are mutually supportive objectives in the long run. Rather than address environmental issues in isolation, decisionmakers in governments and international institutions should consider the preservation of the environment along with other issues central to the formulation of development policy. In so doing, they should take maximum advantage of the complementarities in order to help the poor, promote better resource management, and contribute to sustainable development. In the short run, however, the objectives are not always compatible, and decisionmakers often confront difficult choices in pursuing them simultaneously. It is important to consider the implications of competing claims and to determine the approaches that will help achieve the most appropriate balance.

The evidence in the preceding section substantiates the view that

environmental degradation threatens sustained economic growth in many countries. Even today's per capita income may be difficult to maintain, especially in the poorest countries, many of which depend heavily on a declining natural resource base and have rapidly growing populations. In these countries, such as those in the Sahel, the search for projects and policies that satisfy the objectives of environmental protection and economic growth must be rigorously pursued.

Because the problems of many developing countries are so extreme and urgent, real tradeoffs often arise between protecting the environment and satisfying basic short-term needs. For example, given the high rates of population growth in many countries, it is hard in the short run to find alternative fuels to stem the rapid depletion of fuelwood stocks or the burning of dung. Similarly, levels of air and water pollution that would be intolerable in industrial countries persist in many cities in the developing world, in part because the immediate costs of abatement are deemed to outweigh immediate improvements in health and the quality of life and in part because long-term benefits are heavily discounted.

Those affected most adversely by environmental degradation are the disadvantaged—the poorer, less educated, and politically less powerful elements of society. The urban poor live in unsanitary conditions without safe drinking water. They are hurt most by noise, flooding, and water pollution and cannot afford to pay for better services or to defend themselves against damage. Similarly, the rural poor farm flood-prone valleys and swiftly eroding hillsides. They cannot afford to invest in conservation measures or to grow crops which take a long time to mature; they cannot move to more productive land; and they must immediately spend any income on consumption goods.

This urgency among the poor, implying the heavy discounting of future costs and benefits, is paralleled by the need for governments of poor countries to deal first with short-term budgetary and balance of payments problems. For them, immediate needs preempt adequate provisions for the future—even the near future. Poverty—of people and of countries—is thus a major cause of environmental degradation. That makes it essential, if environmental degradation is not to become completely unmanageable, to devise policies oriented

toward economic growth, with special emphasis on improving the incomes of the poor.

Without growth, all other things suffer in developing countries. Nevertheless economic growth may also destroy the environment and further jeopardize the already tenuous lives of the poor. For example, agricultural development that further concentrates landholdings may drive the poor onto increasingly marginal land, unchecked urban commercial growth may create shantytowns, and roads may pave over the small properties of the poor. Thus, although growth is imperative for alleviating poverty, it may also adversely affect the poor and the environment if inadequate attention is paid to the poor and their needs.

As noted earlier, environmental problems vary from country to country. In some countries the greatest concern is urban air and water pollution, in others upland watershed management, and in yet others desertification. In many countries, especially in Africa, sustained growth is likely to depend for some time on increasing productivity in agriculture. Other countries, such as the Republic of Korea, have reduced their reliance on agriculture and have switched to an increasingly industrial base. For them, adequate savings, an educated labor force, and the ability to adapt to changes in resource endowments have been critical factors in sustaining growth. Differences in factor endowments and in the prospects for industrial or agricultural growth suggest that no simple model of environmental policy applies equally to all circumstances.

In principle, however, policies and investment decisions involving natural resources should be subjected to a comparison of the probable benefits and costs. This holds true even where there are choices between economic and other values. Major differences of opinion may arise, however, because of the uncertainties: the long-term consequences of air and water pollution are imperfectly understood; the losses from the extinction of species may never be known; and opinions about technical relationships vary greatly, as do attitudes toward risk.

Uncertainties aside, decisionmakers tacitly make important value judgments about what alternative patterns of resource use mean for the distribution of income, the impact on vulnerable indigenous peoples, the preservation of cultural property, the worth of genetic

diversity, and the welfare of future generations. Economic analysis can and should help in making such judgments. The consequences of decisions related to the environment should be estimated as far as possible in economic terms to make the choices explicit. Although monetary values alone are typically inadequate as criteria for decisions, the benefit-cost approach, which systematically sets out the good and bad consequences of alternative courses of action, is generally applicable.

It is sometimes claimed that conventional benefit-cost analysis fails because it uses discount rates that are too high, thereby giving inadequate weight to the costs of resource depletion or the benefits to future generations of conservation measures. In practice, however, intertemporal choices can typically be satisfactorily made by using discount rates that reflect the returns to capital in alternative uses on the basis of fairly short-run market criteria. This applies where there is no reason to expect one generation to be much worse off or better off than another, or where effects are not irreversible. The gains from projects or activities that pass standard economic tests could, if future societies so choose, be reinvested for the benefit of generations still further in the future. In these circumstances economic costs alone (where market-based discount rates are used to estimate present values) may be an adequate benchmark for evaluating policies or investments.

Where the effects are irreversible (an ambiguous term that certainly includes the extinction of species and probably includes desertification) or where future societies are expected to be significantly richer or poorer than the present one, economic cost calculations should be supplemented by analysis—possibly quantitative and certainly rigorous—of the likely physical and distributional consequences. The tremendous uncertainties in predicting events that will occur many years hence should not deter governments from serious consideration of the results of such analysis.

Even where the objectives of environmental protection and sustainable economic growth coincide, governments face politically difficult choices. Public interventions to address environmental issues are likely to have costs for some parties and benefits for others. For example, as is implied by the tendency of the poor to suffer most from environmental degradation, policy reform might have distribu-

tional consequences that powerful interests might resist. The urgency of current needs, the uncertainty about the future, the legitimate differences in value judgments, and the short-term perspective of many decisionmakers make it clear that a major political commitment is required to improve substantially the management of natural resources. But such a commitment will be only the first step in a long process. Capacity for analysis and implementation in this area is weak in most countries, and both human resources and the institutional framework will have to be built or substantially strengthened. If the political commitment is to be translated into effective action, it will need to be nurtured through broader public understanding of the urgency of the problem and the need for remedial action.

## Lessons from Development Projects

The experience of governments and development agencies over the past two decades provides several important lessons on the environmental aspects of development projects. The lessons relate to the potential of projects to satisfy the multiple criteria of sustainable growth, poverty alleviation, and sound environmental management. They also relate to the importance of technical links and sociological and cultural factors, to the inherent difficulties of implementation, and to the need to supplement the project-by-project approach with more pervasive policy measures. These lessons are informing the policies of governments, international financial institutions, and other parts of the development assistance community.

### Linking Economic and Environmental Objectives

There is ample evidence in a variety of sectors that development projects can be designed to ensure that economic and environmental objectives coincide. Improved water supply and sanitation projects can typically be shown to be economically justified on the basis of consumers' willingness to pay for them. For example, safe drinking water can be supplied through appropriately designed community systems in low-income urban neighborhoods at one-tenth the cost that slum dwellers without such systems now pay to water carriers and vendors for inferior supplies. Moreover, sanitation systems that reduce water pollution and facilitate resource recovery have been installed in developing country cities at one-twentieth the cost of conventional sewerage systems. The relationship between such environmental projects and economic growth is direct: improvements in health from such investments are likely to show up in improved labor productivity.

Further evidence that the economic and environmental objectives of projects can coincide comes from a review of environmentally oriented projects that the World Bank has financed since 1968. The review shows that economic rates of return were between 10 and 30 percent for twenty-three social forestry projects and between 15 and 21 percent for five watershed rehabilitation projects.

Population is another area where the economic and environmental objectives of projects tend to coincide. Population projects, which are typically intensive in labor and low in foreign exchange costs, can have an extensive impact by stimulating the demand for family planning services. But these projects are not alone in stimulating such demand. Education projects, which increasingly emphasize opportunities for women, can do the same. So can health and water supply projects, which by reducing infant mortality also reduce the cultural imperative for large families. Although the economic rates of return of such projects are difficult to assess, there is little doubt about the complementarities between economic and environmental objectives.

Economic and environmental objectives typically are mutually reinforcing in agriculture as well. But some types of projects, particularly irrigation schemes, would no longer be economically viable if project analysis were to take environmental damage fully into account. Such tradeoffs between economic and environmental objectives are much more common with regard to pollution, but sometimes even pollution control projects can be economically justified by the savings that may accrue to parties damaged by the discharge of industrial and domestic wastes. (The pollution control projects for Sarajevo, Yugoslavia, and the Lake of Tunis are examples.) There also are cases in which industrial pollution and occupational hazards arise from inefficiency. Leakages of hazardous materials may be reduced by investments and improved operating procedures that are financially profitable and economically justified. This is especially true of small-scale industries, and technical and financial support to them may be the only way to control pollution. Monitoring their activities would be costly, and improving their operational efficiency may to some extent substitute for monitoring.

Growth-oriented activities—such as large and small industrial projects, including those for rural nonfarm enterprises—can also

help achieve environmental objectives. By creating employment they take some of the pressure off the land. And energy projects (for oil, gas, coal, and electric power) reduce dependence on biological fuels. Frequently the cost of building environmental safeguards or ameliorative measures into such projects—typically up to 5 percent of total project costs—does not significantly affect their economic viability.

In other cases, however, the economic benefits of pollution control projects are difficult to demonstrate in economic terms, and sometimes even in physical terms. Long-term health and environmental effects are particularly hard to predict, and indirect benefits in addition to those expected are hard to track down. Sometimes the benefits of abating air and water pollution may be felt in countries other than those in which the pollution originates. Tradeoffs may therefore loom large in decisionmaking. Several developing countries face such issues where, owing to past neglect and the great costs of prevention, the pollution problem is assuming staggering proportions. This is true of air pollution in Beijing, Mexico City, and São Paulo and of water pollution and sewerage projects in rapidly growing urban areas throughout the developing world.

### Considering Technical Interactions

Project planners have often overlooked technical links in cases where they are fairly obvious. An example is the typical municipal water supply project. The increased water supply directly increases wastewater flows, yet water supply projects have frequently not been matched by provisions for the treatment and disposal of waste. Thus, as in the Bombay Water Supply and Sewerage Project, sewerage and sewage treatment facilities cannot keep up with increasing wastewater flows, and water pollution problems get worse, sometimes reaching intolerable levels.

In other cases the technical links are less direct. Because irrigation schemes can lead to salinization, waterlogging, and depletion of groundwater reserves, they require careful planning and investment in mitigating measures such as drainage. This has been demonstrated over many years in the Indus Basin, where the Pakistan Left Bank

Outfall Drain Project has been designed to alleviate the adverse impact of irrigation works. Sedimentation, another common problem, reduces the effectiveness and useful life of dams built for irrigation, water supply, or hydropower. Cases in point include the Sudan Roseires Irrigation Project and the Mangla and Tarbela dams in Pakistan.

Other problems with large dam projects include destruction of forests, increased erosion of streambeds, the drying of downstream lakes, threats to wildlife, increased salinization and reduced nutrient flows in estuaries, impaired water quality in reservoirs, and increased human disease (such as malaria and schistosomiasis). These problems have been known for many years, but they continue to cause concern, and sometimes criticism, in such projects as the Narmada Valley dams in India and the Mahaweli Ganga Development Scheme in Sri Lanka.

Forestry projects provide many illustrations of the complexity of technical links. For example, eucalyptus plantations are often economically important, but they cannot fulfill all of the functions of natural forests, which provide game, herbal medicines, natural fibers, and fodder and browse. Sometimes eucalyptus plantations do not even control erosion, which is usually a significant objective. In some eucalyptus plantations erosion has been accelerated on steep slopes because the trees alone do not retain enough soil, and they inhibit the growth of understory plants. Eucalyptus trees also deplete groundwater much faster than other species. Because of these problems, such projects as the Candi Watershed Project in India have had to shift to other species.

Livestock projects may also involve an unanticipated network of ecological events. The recent livestock projects in Botswana have been criticized for their adverse effects on the environment (from the overstocking or poor management of fragile areas) and on wildlife (from blocking migration routes and access to feeding areas and water sources). The more successful livestock projects, such as Uganda's First Beef Project, have shown that three prior measures are important. The first is to assess the resource base and the environment (soil, water, vegetation, topography, and pests and parasites). The second is to conduct small pilot projects to develop

livestock management systems that are appropriate and sustainable under local conditions. The third is to investigate economic and social factors, such as markets and cultural values for livestock, that will significantly influence the motivation and activities of project beneficiaries and the overall success of the project.

### Considering Behavioral and Sociological Factors

Behavioral and sociological factors influence the success of projects in many and varied ways. Issues of land tenure are frequently significant: providing groups or individuals with authority and security over land has improved conservation practices. For this reason determining landownership and, in some cases, promoting land reform are becoming increasingly important components of rural development projects.

Cultural values may influence the outcome of projects in unexpected ways. Well-planned livestock projects establish appropriate maximum stocking rates on the basis of the demonstrated carrying capacity of the land. But in some African cultures cattle are the main measure of wealth, and the size of the herd determines the status of individuals and families. Some pastoralists therefore have no desire to control the expansion of herds brought about by improved breeding, nutrition, and veterinary services, even when it is in their economic interest to do so.

Another issue is the distribution of project costs and benefits among ethnic and socioeconomic groups. In the extreme, indigenous people are displaced from their traditional areas by settlers drawn to regional development or highway projects, or their land is used for, say, a reservoir for an irrigation project. Well-known cases of such problems include the Polonoroeste project in Brazil and the transmigration projects in Indonesia.

These relationships among ecological, economic, political, and social factors—and their influence on the outcome of projects—are always more apparent in retrospect than during the design. But the more applicable links are now fairly well known and can be planned for early in the project cycle. Project preparation is also making

greater use of sociological and anthropological skills. It must continually be kept in mind that development projects bring changes both to people and to the environment and that unnecessary disruptions should be avoided.

### Overcoming Problems of Implementation

The unsatisfactory implementation of environmental projects and of their preventive and ameliorative components is apparent in sewerage projects. Poor maintenance and a lack of spare parts have rendered many municipal facilities inoperable or only partly operable. Similarly many problems of industrial pollution are attributable in great part to the improper operation and maintenance of pollution control equipment, as exemplified by the Las Truchas Steel Project in Mexico. This is true for dust collection equipment, gas cleanup systems, and almost all industrial wastewater treatment systems.

The damage resulting from faulty operation and poor maintenance of hazardous facilities can be catastrophic, as witness the recent Bhopal, Chernobyl, and Rhine River disasters. Some countries have laws to deal with these problems, but monitoring and enforcement are generally lacking. Few institutions charged with monitoring and enforcing pollution are well equipped, well staffed, and well trained.

One big constraint in project implementation is the institutional or political weakness of the responsible authorities. A project may require much cooperation, but this is often hampered by the narrowly defined sectoral objectives of the ministries of agriculture, forestry, energy, and health. A project may also affect a wide range of special interest groups, some of which may carry significant political weight. Great efforts are therefore needed to bring various parties—political, community, business, and religious leaders, as well as nongovernmental organizations (NGOs) and the relevant government agencies—into all phases of decisionmaking. Sound implementation thus depends heavily on the commitment of governments to environmental management and on their institutional capability to ensure that monitoring and control are carried out conscientiously over extended periods.

## Looking beyond Individual Projects

In recent years recognition of the need to incorporate environmental safeguards in individual projects has been growing, and the methods of doing so are constantly improving. Environmental impact analyses are frequently applied to large development projects. Ameliorative measures (installing pollution abatement equipment or lining irrigation canals) and associated activities (environmental training) are often built into projects. (More than 1,500 projects financed by the World Bank include ameliorative or preventive components.) Moreover, all countries invest in projects that have direct environmental objectives, such as sanitation, reforestation, water supply, and watershed management.

Although such attention to individual projects is an important element of any environmental program, recent experience clearly indicates that the project-by-project approach, taken alone, is inadequate. Most of the environmental degradation that is taking place is caused not by a large development project but by the combined effects of countless relatively small activities that use natural resources. Applying benefit-cost analysis and environmental impact assessments to each of these activities and exercising public control over each is impossible. Needed instead are general policy instruments to influence the behavior of natural resource users in ways that are environmentally benign and conducive to sustainable development. Education and appeals to social conscience have an important role for individual projects, and they are crucial for getting and then sustaining the political and public compliance needed for environmental protection. But this is not enough. Economic incentives, backed by investment programs and wide-ranging regulatory and institutional mechanisms, are indispensable for achieving major improvements in the way development activities influence the environment.

## National Policies and Instruments for Environmental Management

Numerous interdependent physical and behavioral factors complicate the environmental problem. The underlying causes of resource degradation often are activities that at first sight are remote from the observed effects. If project and policy measures are to succeed, they must originate in a sound understanding of both the physical links between events and the equally complex social, economic, financial, and institutional links that parallel them. And that understanding must be refined to determine where project and policy interventions are required. An essential element that is relevant to a wide range of environmental problems is to identify the environmental degradation that stems from natural events. Such degradation, particularly when compounded by human activities, may dwarf the degradation from human activities alone.

### National Planning and Environmental Management

The inadequacy of physical data has frustrated the identification of links between economic analysis—particularly macroeconomic analysis—and environmental considerations. That situation is changing rapidly. Recent developments in geographic information systems permit increasingly refined assessments of current natural resource endowments and trends. They also permit better projections of future resource endowments under various scenarios of economic growth and sectoral output. In assessing physical links and long-term trends, remote sensing from space may offer the benefit

of a broad view, repetitive coverage, and uniformity in the way information is collected. Integration of such information with socioeconomic data (on population, transport systems, land use, and so forth) will make systematic linking of macroeconomic and resource planning increasingly feasible. Economic planners therefore have an important role in ensuring that the collection and analysis of technical and behavioral information are well focused and geared to policy or operational requirements.

To a large degree, environmental management should be seen as a means of attaining the wider objectives of sustained economic growth and poverty alleviation. Environmentally related behavior and policies toward that behavior should thus be a part of social, sectoral, and macroeconomic policies. And planning at all levels should be sensitive to the intersectoral consequences of activities. Governments should use the tools at their disposal to search rigorously for policy and project interventions that address economic growth and poverty alleviation in an environmentally benign way. Investment programming to accommodate the physical interdependence between sectors is important here. Regional planning, based on natural rather than purely political boundaries, should increasingly become the basis for investment programs, to allow for intersectoral links and to improve environmental management. Projects for watershed management and regional pollution control could benefit from such an approach.

The most powerful tools available to governments to accompany multisectoral investment programming are price and regulatory interventions, the effects of which may be felt throughout an economy or region. These interventions influence resource use (and the sustainability of growth) in various and often unanticipated ways. Frequently governments do not consider the link between the primary objective of such policies and their environmental consequences. Good or bad environmental effects may be by-products of investment programs or of policies that apparently are aimed at totally unrelated objectives. Many such policies are incorrect, according to not only environmental but also standard economic criteria. Examples abound in policies for agriculture, forestry, and pollution control.

## Pricing of Agricultural Output

Governments throughout the world intervene strongly in agricultural markets to change agricultural prices in relation to one another and to the prices of nonagricultural goods. Some of these interventions are direct, through taxes, price controls, price supports, and supply restrictions. But perhaps the most important intervention stems from the widespread tendency in developing countries to turn the internal terms of trade against agriculture and to depress agricultural prices. This is done by overvaluing exchange rates, providing high levels of protection to nonagricultural industries, and effectively taxing farm output.

In general, depressed farm profitability reduces the demand for farmland, farm labor, and other inputs not supported by government subsidies. Agricultural land prices tend to be lower than otherwise since farmland is a factor of production that cannot easily be shifted to other uses. Therefore the returns on investments in farmland development or conservation are also depressed, which reduces both the farmers' ability and their incentive to invest in leveling, terracing, drainage, irrigation, and other land improvements. The resulting loss of land productivity through erosion, salinization, and depletion of nutrients compounds the problem of rural poverty, even in the short term.

In the agricultural sector different rates of implicit taxation for different commodities can strongly influence cropping patterns and land use. Many countries severely discriminate against export crops and favor such domestic food crops as cereals, primarily to keep food prices low. The environmental consequences of such discrimination can be severe, for export crops often are less damaging to soils than basic food crops. True, some export crops—such as cotton, groundnuts, and sometimes livestock—tend not to be environmentally benign, but others—coffee, cocoa, rubber, bananas, tea, spices, and so on—grow on trees and bushes that provide continuous root structure and canopy cover. These crops are suitable for the hilly terrain where they are often grown, and they leave soil much less susceptible to erosion than do such crops as yams, maize, sorghum, millet, and cassava.

Overall, bringing agricultural prices into line with international prices stimulates production and increases rural incomes. This policy tends to be in accord with the alleviation of poverty and with longer-term environmental objectives. But market forces cannot be relied on entirely to satisfy what sometimes are inconsistent objectives, and when conflicts arise, some public intervention is required. Unfortunately there are numerous instances in which public intervention works in precisely the wrong direction, subsidization of certain agricultural inputs and of forestry activities being examples.

### Pricing of Agricultural and Forestry Inputs

Many direct government subsidies are unsound in both environmental and economic terms. They add to a country's fiscal burden, encourage wasteful use of scarce resources, and frequently benefit the larger landowners. For example, a variety of subsidies, including tax and tariff concessions, low-interest loans, and incentives for local manufacturers, encourage the use of pesticides in many developing countries. The subsidies are often large. In nine developing countries in Asia, Africa, and Latin America the subsidy rates range from 15 to 90 percent of full retail cost, with a median of 44 percent. In Egypt the subsidy is \$4.70 per capita and in Honduras \$3.00. Overuse of pesticides has increased people's exposure to toxic substances and fostered more resistant strains of mosquitoes and other insects, causing a resurgence of malaria. Pesticides also poison fish in ponds and irrigation channels. The overuse of pesticides may therefore reduce their net economic benefits, and the result may be net economic losses, even in the short term.

Inappropriate incentives also adversely influence the use of irrigation schemes, which represent an investment in the developing world of \$250,000 million so far and a further \$100,000 million by the end of the century. The increased agricultural yields from these investments have come at the expense of significant environmental costs, which are exacerbated by large subsidies. When, as usually happens, water charges do not vary with use, the results of such subsidies are almost entirely adverse. The resulting excessive use of water can create the need for more dams and introduce problems

downstream, including shortages. Overall, the subsidies typically reduce the net economic benefits from irrigation projects.

Governments also subsidize livestock production, frequently with unfortunate consequences. The provision of infrastructure and livestock services at little or no cost has greatly expanded livestock production in many parts of the world. In Africa such support, often without adequate control over herd sizes, has encouraged stocking rates to climb well above range carrying capacity in years of low rainfall. Land concessions, tax holidays, and low-interest loans have also been instrumental in encouraging livestock production. Projects so encouraged, while showing healthy profits to private investors, have often yielded negative economic returns to the economy as a whole. The need for grazing land often leads to forest clearing, soil erosion, and potential losses in agricultural productivity elsewhere. The consequences for income distribution may also be adverse: tax and credit subsidies typically benefit the larger landowners, and in combination with the skewed distribution of landownership in many countries they have tended to encourage livestock production at the expense of food crops, thus reducing employment and damaging the environment.

Agricultural mechanization is another target for subsidies. When machinery and equipment are imported at overvalued exchange rates, financed by subsidized credit, and lightly taxed domestically, the result may be undue reliance on mechanization and inefficient patterns of agricultural production. The displacement of labor may reduce rural incomes and exacerbate rural poverty. In addition, the environmental impact may be negative. For example, clearing forests manually or with winches tends to be ecologically superior to clearing with bulldozers. Although mechanization does not automatically bring adverse environmental effects, these often follow owing to lack of the technical knowledge and institutional arrangements to ensure appropriate use of machinery.

Many countries have rapidly depleted their forest resources by handing over much of their worth to logging interests on contractual terms that encourage shortsighted exploitation. The tax systems leave the timber industry with large profits and provide little incentive for sustainable long-term forestry practices. The profits result from a variety of subsidies and tax concessions, including

cheap leases, free access roads and port facilities, reduced export taxes on processed wood, subsidized credit and export finance, and tax holidays.

Control over the exploitation of woodlands is an even more urgent need in semiarid Africa, where license fees, stumpage fees, and other charges for harvesting wood from government-managed forests cover only a small fraction of the costs of planting new stocks and tending them to maturity. Official stumpage fees (which probably overstate the revenues collected) are less than 1 percent of forest replacement costs in Nigeria, 2 percent in Senegal, and 12 percent in Sudan.

### When Governments Should Intervene

Recent policy reform in agriculture and industry has stressed greater reliance on market forces to provide correct signals to producers and consumers. In general, such policies are also conducive to sound environmental management. But often, because of externalities or adverse effects on income distribution, unregulated market mechanisms cannot automatically resolve environmental problems in an efficient or equitable manner. In such cases, public intervention is required. For example, because of the external damage described above, some activities, such as livestock and forestry, should on occasion be taxed more heavily rather than subsidized.

Public intervention may also be warranted in other important instances. For example, in what is termed the "tragedy of the commons," exploitation of a resource may continue to appear profitable for additional users but is actually disastrous for all. Common ownership, of, say, grazing land is not necessarily a problem, for tribal ownership of property is frequently characterized by sustainable methods. The more serious problems tend to be associated with the use of land and other resources for which ownership is not clearly defined. For such communal resources measures to induce prudent management may include physical restrictions, price policies, property rights, and leasing arrangements. The financial and technical assistance and the water rights given to private pastoralist

associations in some West African countries exemplify public interventions to relieve the commons problem.

Public intervention may also be required to manage or ameliorate the effects of natural degradation from catastrophes and more gradual natural events, which may be exacerbated by inappropriate human activities. Governments should design measures in light of the costs and benefits of the ameliorative action. What is needed is to disentangle damage by natural forces and by human activity and to design the set of incentives or other policies accordingly. For example, measures to avoid flooding caused by natural soil erosion and sedimentation might include incentives for industrial or residential location in less damage-prone areas. But if commercial logging is partly responsible the focus should be on incentives to improve the management of forest resources.

Developing countries almost invariably subsidize industrial pollution, in that polluters typically do not have to pay for damages caused. Efficiency, equity, and fiscal considerations argue against subsidization of treatment works, however, and subsidies are in any case difficult to administer. Because of the difficulty of unambiguously determining whether changes in plant design are for pollution abatement or for productive purposes, only "end-of-the-pipe" works can in practice qualify for subsidy, but that encourages inefficient plant design.

In general, the principle that the polluter pays should be followed. Taxes based on the costs of damage to others may be applied either on polluting activities or on relevant equipment. Correctly designed charges for effluents may be the cheapest way of improving air and water quality. Led by self-interest, each enterprise will maximize profits by investing in process changes or effluent treatment to the point where the cost of a unit reduction in effluents is equal to the amount of the charge. Enterprises with different cost characteristics are therefore likely to respond differently. Because their absorptive or regenerative capacities, and therefore the harm caused, will vary for different watersheds or airsheds, effluent charges should be set regionally.

The public ownership and operation of utilities has potential for reconciling economic and environmental objectives, but this potential is rarely achieved. The pricing of electric power shows why.

Governments usually require consumers of electricity to pay charges that cover the utility's financial costs, but these costs frequently underestimate economic and social costs. Financial costs tend to be lower than economic costs, for example, if the future exploitation of resources costs more than previous schemes (as is typically true of hydropower systems) or if other costs, including those of pollution or of resettling displaced people, are not fully borne by the utility. It will therefore often be the case that increasing prices beyond those required to meet the financial objectives of power utilities will improve the efficiency of resource use and support environmental objectives. The same is true for municipal water supply: prices rarely cover the economic costs of supplying water, let alone the costs of wastewater disposal. Government policies therefore typically encourage excessive consumption of both power and water.

### Regulatory and Legal Mechanisms

As noted, the cost of dealing with widespread environmental degradation on a project-by-project basis, subjecting each activity to individual inspection, is likely to be excessive. But the design and implementation of incentive systems also have costs because they too involve monitoring, policing, and regulating. A system of stumpage fees, for example, may require extensive monitoring. Irrigation water charges may require some kind of metering. And the administrative and legal costs of implementing land reform schemes may be overwhelming.

In general, economic incentives and educational campaigns are the most efficient ways of encouraging sound environmental behavior and ensuring the use of appropriate technologies. Environmental regulations, an alternative, are immensely difficult to enforce—witness the ineffectiveness of government efforts to prohibit certain land uses on steep slopes, to proscribe logging in certain areas, to preserve forests along watercourses, or to restrict exploitation of designated national parks and wilderness areas. But regulatory (or legal) conditions can play a major role in conserving or degrading

the environment, often through their interaction with more overt economic incentives. Property rights are an example.

The evolution of permanent land rights of individuals and of enforcement mechanisms to implement and maintain such rights in rural areas is closely related to population density, advances in agricultural technology, and the emergence of product markets. As land becomes scarce, societies must adopt fertility-restoring technologies that will allow continuous exploitation of land. Such technologies require investments of capital and effort, and cultivators need an incentive to make those investments. The incentive is strengthened when the right to cultivate a given tract of land and the ability to transfer it by will or by sale are secured not only by social custom but also by an effective state-enforced legal system.

One aspect of this issue that deserves special attention is the role of women. In many developing societies women manage the household and perform most of the agricultural work. Without their involvement natural resource policies are unlikely to succeed. Especially in Africa women normally do not have title to land or adequate access to credit. They may therefore be in no position to protect the land and water resources under their control, and their generally poor schooling compounds the problem. If these decision-makers in households and small farms are to respond effectively to incentives, they need equal opportunity for education, landownership, and access to credit.

In contrast to environmental management for agriculture, industrial and municipal pollution control in most cases depends heavily on regulatory mechanisms. This is true even though, as noted above, systems of effluent charges (including fees for sewage disposal) are generally preferable. Regulations usually rely on licenses or permits that allow a given volume and concentration of effluent discharge per unit of time, that establish minimum standards of water or air quality, or that specify the treatment equipment to be used. Uniform regulations are the easiest to devise and, in theory, to enforce. But the advantage of administrative simplicity may be outweighed by the economic inefficiencies that can result. For example, uniform effluent standards do not permit enterprises to take advantage of local absorptive or regenerative capacity and variations in the

costs of pollution at different sites. Furthermore, uniform standards ignore the fact that the cost of adjusting the quantity or quality of effluents differs among enterprises. The design of appropriate regulations that adequately consider tradeoffs between economic efficiency, equity, and administrative considerations presents a formidable challenge to administrations that are already overburdened.

### Coordination of Policy Instruments

The tools that governments may use to address the goals of economic growth, poverty alleviation, and sound environmental management are likely to be more effective if they are designed to be mutually reinforcing. For example, efforts to preserve fragile ecosystems or areas that are environmentally important (tropical rainforests, wildlands, upland watersheds, and tribal areas) will be more effective under a concerted approach that involves a variety of interventions. These might include agricultural and forestry pricing policies, land use controls, incentives to locate elsewhere, and special taxes on property in the protected area. Similarly, pollution control measures may work best if they consist of a coordinated set of interventions, including effluent charges, land use controls, relocation incentives, investments in pollution control projects, and prohibition of activities deemed environmentally harmful.

In practice, however, different agencies, often with conflicting objectives, are responsible for planning and implementing policies that may have serious environmental consequences. For example, a power utility may not adequately take into account the costs of a hydroelectric scheme to farmers or indigenous peoples. Downstream flooding caused by a river development scheme may not be of great concern to a provincial government if the damage occurs outside its borders. Improved natural resource management may therefore depend on the creation of new agencies with wide-ranging authority over some aspects of the operations of functional ministries in a region or watershed area. In addition, it will also be necessary to devise institutional incentive systems that encourage better collaboration between existing line ministries and to foster activities that

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- improve natural resource management. In short, environmental concerns should be incorporated in planning for agriculture, cities, regions, industrial location, and transport. Achieving this—one of the most important challenges of public sector management in developing countries today—will not be easy for governments whose administrations are already overburdened by immediate concerns.

## An Agenda for Action

Central among the lessons from recent years is the importance of elevating concern about environmental matters to the highest levels of country planning and of developing the capacity to implement sound practices for environmental management. Both are needed to reconcile, and, where appropriate, make tradeoffs among the objectives of growth, poverty alleviation, and sound environmental management. And both can be assisted by an increased commitment of resources and a major collaborative effort by all members of the development community.

### Country Policies

Governments have at their disposal a wide array of project and policy interventions for addressing environmental and economic objectives. Some, such as investments in financially viable sanitation, water supply, and forestry projects, may involve few tradeoffs and be relatively uncontroversial. More powerful and wide-ranging interventions, such as those for agricultural pricing, are analytically and institutionally more complex; they affect a range of interests and may involve considerable redistribution of income. Even where environmental and economic objectives neatly coincide, governments may face politically difficult choices. Their problems are compounded when they have to make other value judgments, including those about the welfare of future generations or the benefits of biodiversity.

To address some of the major underlying causes of resource degradation, governments have to confront even more sensitive issues. Operating within existing social and economic structures, a country's projects and policies can achieve major improvements in natural

resource management. But more fundamental causes—among them, rapid population growth, the role and status of women, the distribution of land, income, and wealth, and existing institutional arrangements—need to be addressed if long-term growth is to be sustained. In general, governments should search for and implement the many project and policy interventions that can satisfy environmental and economic criteria relatively easily. At the same time, they should improve their understanding of natural resource management and make progress in addressing its more politically sensitive underpinnings. Each country should develop an action plan that incorporates the following steps:

- Assess the natural resource base, the trends and patterns in resource use, and the prospects for the future under various scenarios of economic growth .
- Estimate the economic and social consequences of major categories of resource use, making any tradeoffs between economic and environmental objectives as explicit as possible
- Identify the economic, sociological, and other determinants of environmentally related behavior
- On the basis of the first three steps, set priorities for investment programming and policy interventions, with a special emphasis on population policy
- Amend government interventions in the market that are economically and environmentally perverse
- Design and introduce interventions when market forces are inadequate
- Continue efforts to address the major underlying causes of natural resource degradation and to improve understanding of what affects the environment and how.

The ability of governments to take sometimes unpopular measures will largely determine whether the degradation of natural resources will continue to threaten economic growth. Systematically integrating natural resource management into country economic planning along these lines calls for a substantial commitment from governments. They must devote the additional resources required to implement lessons from project experience. They must also be will-

ing to make decisions that may adversely affect powerful interests. But if they are to overcome financial and institutional constraints, which are particularly binding for the poorest countries, they will also require substantial external assistance.

### Collaboration in the Development Community

Today's environmental concerns call for unprecedented cooperation among various development institutions. The World Bank stands ready to play a catalytic role in a collaborative effort to address environmental issues, drawing on its expertise in country, sector, and project analysis and expanding its normal practice of relying heavily on other disciplines and agencies to assist it.

The United Nations technical agencies, including the UNEP, the United Nations Fund for Population Activities (UNFPA), the United Nations Children's Fund (UNICEF), the Food and Agriculture Organization (FAO), the World Health Organization (WHO), and the World Meteorological Organization (WMO), are improving understanding of technical parameters, such as the extent and causes of resource degradation, its relationship to productivity, and the prospects for the future. The Bank can make an important contribution by helping to set priorities for data collection for resource assessment. For example, it can help focus remote-sensing efforts to ensure their operational usefulness and avoid duplication. Such collaboration is already taking place, but it should become more systematic.

Also needed is a better understanding of the legal, cultural, and institutional factors that determine environmentally related behavior. In this, the experience of both local and international NGOs at the community level can provide a sounder basis for policies to be introduced at a higher level.

Collaboration between the various agencies is required in policy development and research as much as in operations. Coordinating the activities of the many interested parties can help particularly in building bridges between conservationists and the development community. There is a need to demonstrate the importance of using economics to achieve environmental goals and to show that other

disciplines—the physical and behavioral sciences—are indispensable to economic analysis.

Even more complex issues lie ahead. Regional and global environmental degradation poses special problems for the international community—problems that will be extremely difficult to resolve. The adequacy of international institutions, the role of financial intermediaries, and the nature of international legal arrangements need to be reviewed in light of the prospects for addressing several major problems. Among these are marine pollution, acid rain, the greenhouse effect, changes in stratospheric ozone, and the possible climatic change and genetic impoverishment resulting from cutting down tropical rain forests. Because the global or regional interest in such problems may not coincide with the interest of the country generating the damage, new kinds of international arrangements may be needed that go beyond such legal agreements as the Law of the Sea, beyond the technical support or advice of such international agencies as the UNEP, and beyond unilateral domestic policies to reduce global pollutants. Some form of compensatory mechanism may be required to induce governments to curtail environmental degradation in the global interest.

### World Bank Actions

In general, the methods for addressing the environmental, poverty, and growth objectives of projects are reasonably well established. Benefit-cost analysis, for example, provides for the estimation of externalities and is useful in highlighting the ethical judgments that governments must make. General instructions to World Bank staff on project analysis are, subject to the inherent limitations of economics, adequate for dealing with environmental issues. Similarly, general instructions on environmental matters—supplemented by instructions on wildlands management, tribal peoples, resettlement, and so on—provide the correct framework for analyzing and conducting environmental projects. There is, however, a need to shift the traditional focus of environmental economics from benefit-cost analysis toward the use of economic instruments designed to reconcile environmental, growth, and poverty

alleviation objectives. The Bank will play a leading role in developing such methods.

The Bank will also increase its efforts to raise the consciousness of policymakers about the importance of integrating natural resource management into country economic planning and to help governments plan and implement the requisite measures. In interested countries that have developed action plans, the Bank will undertake pilot studies in cooperation with the United Nations Development Programme (UNDP), other financing agencies, and the countries concerned. Those studies will establish the link between natural resource policies and country economic planning and analyze the economic, institutional, and cultural constraints on the efficient management of natural resources. A major objective will be to assist in the design of appropriate policy instruments to overcome such constraints and to find out what can be done practically and at reasonable cost.

The cooperation between the Bank and NGOs will be expanded. The Bank has benefited from and sometimes has supported the policy work of environmental NGOs such as the World Resources Institute and the International Institute for Environment and Development. Such NGOs as the World Wildlife Fund and the International Union for the Conservation of Nature routinely provide the Bank with technical assistance on project design—notably surveys of species diversity and the identification of ecologically important wetlands and wildlands. NGOs are also expected to play a role in the Bank's growing program of social forestry. They have participated in the development of the Tropical Forest Action Plan, sponsored by the UNDP, the World Bank, the Rockefeller Foundation, the World Resources Institute, and the Canadian International Development Agency (CIDA). That plan is being refined and promoted through regional meetings involving NGOs, governments, and international agencies.

While special emphasis will be given to the pilot studies, the Bank will increase its efforts to integrate natural resource management into country economic and sector work. In so doing, the Bank will maintain its concern for the projects it finances and devote increased effort to their assessment and implementation to ensure that they

- follow appropriate environmental policies and include the necessary safeguards. In sum, the Bank will continue to invest in projects and encourage policies that meet the three criteria of economic growth, poverty alleviation, and environmental protection.

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