

PN.ABI-209
71987

**THE ECONOMICS OF ENVIRONMENTAL DEGRADATION
PROBLEMS, CAUSES AND RESPONSES**

by

Theodore Panayotou

with the assistance of **Mona Yacoubian and Madeline Hirschland**

**Harvard Institute for International Development
One Eliot Street
Cambridge, Massachusetts, 02138
December 1989**

**Prepared for the United States Agency for
International Development (USAID) under
CAER Task Order #3.**

Contents

Abstract	i
1. The Magnitude of the Problem	2
1.1 Physical manifestations of environmental degradation	3
1.2 The economics of environmental degradation	4
1.3 Economic manifestations of environmental degradation	7
1.4 The Causes of Environmental Degradation	14
2. Market Failures Leading to Environmental Degradation	18
2.1 Insecurity of ownership over resources	20
2.2 Unpriced resources and thin markets	22
2.3 Externalities and spillover effects	24
2.4 Transaction costs	28
2.5 Public goods	29
2.6 Uncompetitive markets	32
2.7 Myopic planning horizons and high discount rates	34
2.8 Uncertainty and risk aversion	36
2.9 Irreversibility	38
3. Policy Failures Leading to Environmental Degradation	38
3.1 Project-related policy failures	43
3.2 Forest policy failures	47
3.3 Water policy failures	48
3.4 Land policy failures	52
3.5 Urban industrial environment; market and policy failures	53
3.6 Industrial and trade policies leading to environmental degradation	59
3.7 Effects of macroeconomic policies in environmental degradation	62
3.8 Effects of structural adjustment programs on environmental degradation	65
4. Policy Successes that Control Environmental Degradation	70
5. Needed Policy Reforms	72
5.1 Indicated forest policy reforms	76
5.2 Policies to conserve biological diversity	79
5.3 Indicated water policy reform	82
5.4 Policy options for dealing with urban and industrial environmental problems	84
6. The Role of AID	89
Annex I: Cases	
Case 1: Ranching for subsidies in Brazil's Amazon	97
Case 2: The costing and controlling of air pollution in Sao Paulo, Brazil	98
Case 3: Policy success: water pricing in China	99
Case 4: Irrigation water pricing in developing countries	100
Case 5: Policy success: removal of pesticide subsidies in Indonesia	101
Case 6: The Dumoga-Bone national park - Indonesia	102
Case 7: Experimenting with communal resource management: the Arabari experiment in India	103

Case 8:	Policy success: the role of women and local community groups in improved natural resource management in Katheka Kenya	104
Case 9:	Investing in conservation in northern Nigeria	105
Case 10:	Communal tenure in Papua New Guinea	106
Case 11:	Evaluating a tropical forest for multiple use: the Mishana forest in Peru	107
Case 12:	Fighting urban congestion with marginal cost pricing in Singapore	108
Case 13:	Costs of unplanned resettlement, Nam Pong Reservoir - Thailand	109
Case 14:	Policy failure: the logging ban in Thailand	110
Case 15:	Turning a market failure into a policy success: improving security of land ownership in Thailand	111
Case 16:	Macroeconomic policies fuel deforestation in Ghana	112
Annex II:	A Sample of Policy Failures and Successes Based on AID Field Experience	113
Annex III:	Tables	118
Annex IV:	Guidelines	129
References		132
Figures		
Figure 1		73

THE ECONOMICS OF ENVIRONMENTAL DEGRADATION: PROBLEMS, CAUSES AND RESPONSES

Abstract

Environmental degradation is a more common and pervasive problem than inflation, foreign debt and economic stagnation. Deforestation, watershed destruction, loss of biological diversity, fuelwood and water shortages, soil erosion and water contamination, overgrazing and overfishing, urban congestion and environmental pollution are as common to fast-growing Asia, as they are to stagnating Africa and heavily indebted Latin America. Yet focusing on such physical manifestations of environmental degradation tends to overstate the problem because it seems to suggest that all degradation is preventable or worth abating, when a certain degree of environmental degradation is an inevitable consequence of human activity. In our search for lasting solutions to the problem of environmental degradation, we should not be concerned as much with its physical symptoms as with economic manifestations which define the true dimensions of the problem, its causes and possible remedies.

Why are increasingly scarce resources being inefficiently used and wasted instead of economized and conserved? Why are renewable resources being mined rather than managed for a perpetual stream of benefits when the latter would generate more benefits? Why are highly profitable investments that enhance both current productivity and future sustainability not being undertaken while scarce funds are being wasted on marginal investments? Why is a larger amount of effort and cost expended when a smaller amount would generate more profits and less damage to the resource? Why are unique habitats and species going extinct without compelling economic reasons to counter the irreversible loss of uniqueness, diversity and future options? Why are communities and tribal groups that possess the knowledge, physical presence and vested interest to manage natural resources efficiently and sustainably deprived of their customary rights and replaced by disconcerted and inefficient bureaucracies or insecure extractive industries that have no stake in the sustainability of the resource?

The answers to these problems are to be found in the disassociation between scarcity and price, benefits and costs, rights and responsibilities, actions and consequences. This disassociation exists because of a combination of policy distortions and market failures. The prevailing configuration of markets and policies leaves many resources outside the domain of markets, often subsidizing their excessive use and destruction despite their growing scarcity and rising social cost. The end result is an incentive structure which induces people to maximize their profits by appropriating other peoples' resources and shifting their own costs onto others, rather than by economizing on scarce resources and investing in enhancing their productivity. Common and public property resources (e.g. forest, fisheries, public lands and the environment) are being appropriated without compensation; the cost of growing scarcity is diluted through subsidies financed by the general taxpayer, and the cost of ultimate depletion is borne by the poor who lack alternatives and by future generations whose interests are sacrificed to short-term political expediency. Preventing prices from rising in line with growing scarcities and rising social costs distorts the signals that in a well-functioning market would have brought about increased efficiency, substitution, conservation and innovation to restore the balance between supply and demand.

While policy and market failures are often intertwined and mutually reinforcing, for both analytical and policy reform purposes, it is important to unravel these failures and distinguish between them as clearly as possible. Policy failures or market distortions are cases of misguided intervention in a fairly well-functioning market or unsuccessful attempts to mitigate market failures that result in worse outcomes. Market failures are institutional failures partially attributable to the nature of certain resources and partially to a failure of the government to (a) establish the fundamental conditions (secure property rights, enforcement of contracts, etc.) for markets to function efficiently; and (b) to use instruments in its disposal (e.g. taxation, regulation, public investment and macro policy) to bring into the domain of markets inputs and outputs (costs and benefits) that the institutional framework fails to internalize.

The paper proposes a number of policy reforms on both the sectoral (e.g. land, forestry, biological diversity, water, and urban/industrial environment) and macroeconomic levels. These policy reforms aim to increase the efficiency of resource allocation and use, thus

generating both economic and environmental benefits. Suggested policies include the elimination of interest rate ceilings and capital subsidies, inclusion of environmental considerations in structural adjustment programs, and environmental assessment for all major public and private projects. Sectoral level policies range from reduction of agricultural taxation and industrial protection to the establishment of secure property rights to land and other natural resources; from elimination of pesticide subsidies to irrigation water pricing; from longer and more competitive forest concessions to simplified but effective taxation of timber rents; from communal management of certain rural resources to pollution and congestion charges to preserve the quality of the urban environment.

AID has an important role to play in helping to bring about such policy reforms. Policy reform is by no means easy; among the obstacles are: (a) vested interests created by existing policies; (b) pressing day-to-day issues which often overshadow long-term problems; and (c) the difficulty of forging a consensus in non-crisis times. AID can be most effective as a catalyst and a facilitator that helps create an environment conducive to change and assists the process of change through (a) human resource development in environmental management and policy sciences; (b) a policy dialogue with policy makers on current and emerging problems of natural resource management; (c) support of research and policy analyses; (d) strategically targeted natural resource projects; (e) technical assistance in natural resource management; and (f) dissemination of factual information on the state, management and potential of natural resources.

- 1 -

**ECONOMICS OF ENVIRONMENTAL DEGRADATION:
PROBLEMS, CAUSES AND RESPONSES**

Environmental degradation is a more common and pervasive problem than rapid inflation, excessive foreign debt or economic stagnation. Rapid deforestation, watershed degradation, loss of biological diversity, fuelwood and water shortages, water contamination, excessive soil erosion, land degradation, overgrazing and overfishing, air pollution and urban congestion are as common to Asia as they are to Africa and Latin America. It is striking that rapidly growing Southeast Asia has similar environmental problems as stagnating sub-Saharan Africa or heavily indebted Latin America. And, while economic growth enables countries to better deal with environmental problems, there is an abundance of failures and a scarcity of successes in dealing with environmental problems. These observations imply that (a) there are underlying causes of environmental degradation that are common to countries in different geographical locations with different cultures and at different levels of development, (b) economic growth by itself neither causes nor remedies environmental degradation, the connections being far more subtle and complex; and (c) environmental problems are insidious and refractory or at least poorly understood, resulting in either failure to deal with them or to interventions that tend to treat the symptoms rather than the underlying root causes with consequent failure.

The purpose of this paper is to analyze the economics of policy issues associated with environmental degradation, both from a causal and curative perspective. Special attention is paid to (a) the connection between economic growth, poverty, and environmental degradation, (b) the role that government policies play, often unwittingly and unintentionally, in causing and promoting environmental degradation and (c) the role of market failures and the implications for public policy. The study deals with these theoretical issues in their practical manifestations by drawing heavily on illustrations of actual cases of policy and market failures as well as policy successes in dealing with environmental degradation. Alternative corrective mechanisms are discussed and guidelines for AID project design and policy dialogue are provided.

The study is organized into six sections. In the first section, the magnitude of the problem is outlined and its different manifestations described. Section two and three distinguish between symptoms, causes and consequences and analyzes in detail policy and market failures as root causes of environmental degradation. Section four reviews some policy successes that help contain environmental degradation. In section five alternative interventions and corrective mechanisms are reviewed with emphasis on their effectiveness in dealing with the underlying causes rather than the symptoms of environmental degradation. Finally, section six examines the current and potential role of AID as a catalyst for policy reforms that would reduce environmental degradation and promote sustainable development. Sixteen cases, included in Annex I, are referred to throughout the paper to concretely illustrate its conclusions. A sample of cases based on AID field experience is included in Annex II. Annex III contains a set of data tables, while a set of guidelines for policies and projects is included in Annex IV.

1. The Magnitude of the Problem

There are few problems that are as common to all countries regardless of economic system and level of development as environmental degradation. The underlying causes of environmental degradation, as we will discuss in the next section, are fundamentally similar. Yet, its manifestations, dimensions, and implications differ depending on history, geography and level of development, among others. Even within the same country, environmental degradation evolves over time with population growth, migration, urbanization, industrialization, structural change and economic growth. For example, with rural-urban migration, many of the rural environmental problems such as forest encroachment and degradation of marginal land resurface as urban problems in the form of slums, congestion and pollution.

The objective of this section is to define the magnitude of the problem in both its spatial and temporal dimensions and to provide a sense of relative importance and priority. An attempt is also made to group problems in typologies that might help target AID project design and policy dialogue activities.

1.1 Physical Manifestations of Environmental Problems

The term "environment" covers both the quantity and quality of natural resources, renewable and non-renewable, as well as the ambient environment which is an essential element of the quality of life. As such, environment is a critical determinant of the quantity, quality and sustainability of human activities and life in general. Environmental degradation then is the diminution of the environment in quantity and its deterioration in quality. Correspondingly, environmental problems have both a quantity and a quality dimension. Water-related problems include water shortages as well as deterioration of water quality through pollution and contamination. Forest-related problems include both deforestation in the sense of forest cover loss and forest degradation in the sense of reduction of forest productivity, loss of diversity and replacement of primary by secondary forest. Land-related problems include growing land scarcity as well as soil erosion, nutrient leaching, waterlogging, and salinization. Fishery-related problems include overfishing as well as changes in species composition to less valuable species, increasing share of trashfish in the catch and fish contamination. Urban environmental problems include congestion and thereby less open space available per person, as well as air, water, and noise pollution, and hence a lower-quality environment.

Quality problems at the extreme become quantity problems. For example, water may become completely unusable because of heavy pollution. Land may become unsuitable for cultivation because of severe erosion. A forest area may completely lose its forest cover because of severe degradation as it happens when shortening of the fallow cycle in shifting cultivation results in replacement of forest by imperata grass. Certain urban areas (e.g., slums, residential areas near dumpsites, chemical or nuclear plants, etc.) may become unlivable because of excessive pollution and contamination. Quality problems also become quantity problems because quantity is defined for a given quality. For example, shortages of drinking water, or prime farmland, and of primary forests may coexist with abundance of low-quality water, marginal land and secondary forests.

Finally, diversity has value; expanding the supply of one resource or environment at the expense of another (known as substitution) may be beneficial up to a point, but as any given resource is driven to depletion or extinction, diversity is lost, and with it an option and an element of the quality of life. Diversity of species and environments is essential to long-term productivity and sustainability. Its preservation is a form of investment for the future or insurance against future uncertainties. Its diminution constitutes environmental degradation even if its loss as a factor of production or a source of consumption has been fully compensated via substitution for an equally productive asset. In conclusion, when we speak of environmental degradation, we should keep in mind its three dimensions, quantity, quality and diversity and their interdependence.

1.2 The Economics of Environmental Degradation

A certain level of environmental degradation is an inevitable consequence of human activity. Any exploitation and use of non-renewable resources inevitably results in their partial or total depletion, as well as the degradation of the landscape and the generation of waste. Industrialization leads to increased consumption of minerals and energy and the generation of air, water and noise pollution and hazardous wastes. Agricultural extensification leads to deforestation, cultivation of marginal lands, and soil erosion while agricultural intensification leads to pesticide and fertilizer runoffs, waterlogging, soil salinity, etc. Even the use of renewable resources on a sustainable basis presupposes the mining of the stock down to a level that would generate a maximum annual growth (maximum sustainable yield). Virgin fisheries and undisturbed forests reach a natural equilibrium stock where net growth is zero; unless the stock is reduced and there is no sustainable yield to harvest. Therefore, some environmental degradation is inevitable.

The question is not how to prevent or eliminate environmental degradation altogether but how to minimize it or at least to keep it to a level consistent with society's objectives. When environmental degradation is seen in the context of the society's development objectives, not all deforestation, soil erosion or water pollution is bad or worth preventing. Some

deforestation is necessary and beneficial when the forest land is put to a superior use which maybe agricultural, industrial or residential. As long as all costs involved, including those arising from diminished quantity, deteriorated quality and lost diversity of forests have been accounted for; as long as both the productivity and the sustainability of the alternative uses have been considered with a due margin of error; and, as long as any side effects of the forest conversion have been internalized and paid for, deforestation should not be something we would like to prevent. The problem is that usually only the short-term benefits of forest conversion and none of its long-term costs are considered. As a result, too much conversion takes place in areas where no conversion should have been taking place because the present value of costs outweighs any short-term benefits. Even worse, forests are converted to wastelands with little current benefit and enormous current and future costs. It is unfortunate and renders a disservice to conservation when such wasteful forest destruction is lumped together with socially optimal forest conversion into a single deforestation figure. Considering, however, the rate at which tropical forests have been disappearing in recent years, it is understandable that all deforestation is considered undesirable, no matter what the economic justification. Nevertheless, this emphasis on the symptoms rather than the underlying causes, and the disregard of the costs and benefits involved prevents the formulation of effective policies to deal with the problem while it antagonizes developing countries that depend on forest resources for development.

A similar case can be made for soil erosion and water pollution. Not all soil erosion is worth preventing. In deep fertile soils, erosion has little or no effect on land productivity, while it enhances considerably the productivity of downstream land where it is deposited. Still there may be other negative offsite effects such as sedimentation and eutrofication of waterways and reservoirs that should be taken into account in determining how much soil erosion to allow. In other areas, such as in much of the tropical rainforests, where the fertile soil is very superficial consisting basically of the humus formed by degrading matter, any soil loss may make the difference between lush growth and desertification. Again the tendency is

to lump together all soil erosion and express it in tons per hectare without regard to the depth of soil, fertility, natural replenishment and deposition.

Similarly, air and water pollution are excessive not in any absolute sense but in relation to the assimilative capacity of these media and in reference to their use and the society's constraints and objectives. To attempt to prevent all forms and levels of pollution in all water resources is to leave a flow resource of little opportunity cost unused with consequent reduction of social welfare or use of resources of higher opportunity cost for the same purpose. This does not imply that individuals should be allowed to use the assimilative capacity of the environment free of charge. If they do, not only will excessive pollution be generated but the resource itself, i.e., the assimilative capacity of the environment will be diminished as a result. Moreover, as the disposal of waste increases and the assimilative capacity is reduced, there is a definite opportunity cost that should be paid by individual users, consisting of two elements, (a) the use of a scarce resource to the exclusion of others, and (b) the damage to the productivity of the resource as waste disposal increases beyond a threshold. A charge for the use of the resource can be set at a high enough level to limit effluents to a level that can be assimilated without damage to its assimilative capacity.

Prevention is often far more cost-effective than rehabilitation ("an ounce of prevention is worth a pound of cure"). Once excessive environmental degradation takes place, it is not worthwhile to attempt to reduce it back to the level that would have been optimal with prevention because costs are higher, effectiveness is lower and vested interests stronger. Not only is a 100% abatement technically difficult and economically out of the question, but the optimal level of abatement would leave us with more pollution than we would have liked had we had the option of a fresh start. Because of this economic irreversibility (which sets in much before the physical irreversibility), prompt internalization of environmental costs is both economically and environmentally preferable.

To sum up, physical manifestations of environmental degradation, such as rates of deforestation, rates of soil erosion, level of water pollution and densities of urban congestion tend to overstate the problem because they seem to suggest that all degradation is preventable

or worth abating. Because they are based on observed symptoms rather than underlying causes, they tend to be devoid of analytical insight as to how to deal with the problem other than banning the activities that appear to be responsible. For example, if logging leads to deforestation, it is common sense that banning logging will solve the problem. As Thailand is gradually discovering, a logging "ban" does not stop logging (let alone deforestation), any more than Prohibition in the United States several decades ago stopped drinking.

1.3 Economic Manifestations of Environmental Degradation

The first step for understanding the root causes of environmental degradation is to look for its economic manifestations, help define the true dimension of the problem and suggest the scope and opportunity for cost-effective intervention. Economic manifestations are counterintuitive observations or contradictions (puzzles); their very identification calls for an analytical explanation (why?) and a policy implication (what and how?). The following is a representative list of such economic manifestations of environmental degradation:

1. **Overuse, waste and inefficiency coexist with growing resource scarcity (shortages).**
For example, increasingly scarce irrigation water in many parts of Asia is used wastefully and excessively by some farmers to the point of causing waterlogging and salinization of soils, while other farmers in the same irrigation system suffer from water shortages and unreliable supplies. This is true of most irrigation systems in Thailand, Indonesia, Philippines, India and Pakistan to mention only a few (see Case 4). The net loss consists of current production loss by those who receive inadequate water and future production loss by those who suffer from waterlogging as well as general degradation of the resource.
2. **An increasingly scarce resource is put to inferior, low-return and unsustainable uses, when superior, high-return and sustainable uses exist.** For example, in Thailand, uplands suitable for fruit trees or other perennials are often planted with maize or cassava, for a few years and abandoned as yields decline when perennials would yield

both higher return (in present value terms) and be more sustainable. A second example comes from Morocco where scarce irrigation water is used to grow sugarcane in an arid environment when vegetables, orchards and other higher-value crops would have produced a higher return and fewer soil salinity problems. In Brazil, valuable forests have been converted to ranches that generate negative economic returns (see Case 1).

3. **A renewable resource capable of sustainable management is exploited as an extractive resource (it is mined).**

For example, tropical forests are being mined without concern for regeneration and future harvests as evidenced by the damage to the remaining stand, even when future harvests have a positive net present value at the market rate of interest (see Cases 1 and 11). While some forest land conversion to other uses is economically justifiable, the fact that the rate of deforestation is 100 times the rate of reforestation alone suggests that tropical forests are mined not managed. There are indeed very few sustainable alternatives that would justify failure to regenerate a renewable resource capable of yielding a perpetual stream of income.

4. **A resource is put to a single use when multiple uses would generate a larger net benefit.**

For example, many tropical forests are managed for timber production alone when management for multiple uses such as non-timber goods, water and soil conservation, biological diversity and a host of other environmental services would generate a higher return (see Case 11). While not all uses are mutually compatible, the relevant question is which combination of uses would produce the highest net present value for a given forest.

5. **Investments in the protection and enhancement of the resource base are not undertaken even though they would generate a positive net present value by increasing productivity and enhancing sustainability.**

Examples include the failure of many farmers throughout Asia and Africa to invest in on-farm land development and soil conservation to reduce erosion and improve irrigation. Another example is the failure of many forest concessionaires to regenerate

or replant their concessions or even to protect them from encroachment. A third example is the failure of irrigation authorities to invest in watershed protection, to protect reservoirs from sedimentation and in maintenance and rehabilitation of deteriorating irrigation systems, to increase their efficiency and prolong their economic life.

6. A larger amount of effort and cost is incurred when a smaller amount of effort and cost would have generated a higher level of output, more profit and less damage to the resource.

Examples include capture fisheries and common pastures throughout the developing and parts of the developed world. Most fisheries employ twice as much labor and capital as needed to obtain less than the maximum sustainable yield and virtually no economic surplus. Any profit that the fishery is capable of generating is dissipated by excessive fishing cost. Fishermen tend to be among the lowest income groups in most countries. In the long run, overfishing results in decreased productivity of the stocks, lower output and a compositional change towards lower value species (see Panayotou 1982). Nor is the excessive employment a benefit in itself since fishermen are earning no more than their opportunity costs (what they could earn in alternative employment). If they do, additional entry would nullify any income differential between the fishermen and comparable socioeconomic groups in the country. A reduction in fishing effort would reduce fishing cost and increase profits in the short run, and help the stock and catch recover over the long run leading to further increases in profits. The economic surplus so generated can be used to compensate, retrain and reemploy the surplus number of fishermen. Despite these obvious gains, no such reform takes place.

The situation with common (open access) pastures¹ is very similar. More animals are being grazed than the pastures can support with the result that total output is less than

¹ Common property and open access are used here interchangeably. Communal property is distinguished from common property by exclusion of other communities and by customary rules of access and management. Unlike common or open access resources, communal resources are often well managed (see Case 10).

it could be, incomes are low and the pastures deteriorate. Incomes and output can be raised and pastures be improved with a reduction of the number of animals but this does not happen, despite the obvious gains. It is as if the society is subsidizing the degradation of its resource base by raising and grazing an excessive number of animals. Of course, the problem arises from the fact that the sum of individual actions does not lead to socially desirable outcomes, under the prevailing institutional arrangements. Since the pasture is a common property, and livestock is viewed as a transformer of common property into private property, the more animals each individual has the larger his share of the common property, assuming that others do not also expand their herds. But since the other common owners would not sit and watch their share fall, they also increase their herds. The end result is neither efficient nor equitable. The productivity of the pasture declines and the largest share goes to those that can afford the largest number of animals, that is, those who are initially better off. The poor suffer in what appears to be an equitable arrangement: property that is freely accessible to all.

7. **Local communities and other tribal groups such as women are displaced and deprived of their customary rights of access to resources regardless of the fact that by their very presence or specialized knowledge, tradition and self-interest, they may be the most cost-effective managers of the resource.**

Many tropical resources, particularly the rainforests, are so complex and vulnerable that their sustainable management requires specialized knowledge of plants and animals and their interaction in such an environment. It also requires a physical presence to prevent encroachment or other interference by those less knowledgeable or less interested in the continued productivity and sustainability of the resource. Managers that combine such specialized knowledge with personal commitment to the long-term sustainability of the resource and willingness to live in the rainforest, far from the city lights, are hard to find. Even if they existed, employing an adequate number of them with all the necessary support would be prohibitively expensive.

Fortunately, there are people who do live in the forest, depend on it for survival, have the specialized knowledge of the ecosystem necessary for sustainable management and even have a tradition of doing so. By any criterion, such as cost effectiveness, present value maximization or equity, many local communities and tribal groups ought to be given the responsibility of managing the resource and vested with sufficient authority, protection and security of tenure to do so effectively. Yet, in most cases, central governments have assumed the ownership and management of tropical forests despite their lack of specialized knowledge and management skills, their absenteeism, and often their lack of interest in the sustainability of the resource. The rights of exploitation have been subsequently awarded to equally distant logging companies, with little knowledge of the rainforest environment and no interest or stake in its long-term productivity and sustainability. Short-term concessions and perverse taxation did not help either. In the meanwhile, local communities have been deprived of their customary rights of access or displaced altogether. Under these circumstances, it is no wonder that tropical forests are being destroyed by the combined actions of logging firms that seek short-term profits and local communities that seek a livelihood without a secure resource base. Neither group has an assurance of a share in the future of the resource. For example, African women who have the responsibility for managing resources but lack access to secure property rights, extension and credit, have no choice, but to overuse land and to farm areas that should not be cultivated. The encroachment of the resource by farmers and ranchers in search of land for agriculture and cattle ranching further compounds the uncertainty and effectively reduces state ownership into open access land. Unlike most developing country governments that declared state ownership over all forest resources with little consideration of local customary rights, the government of Papua New Guinea recognizes and defends communal and tribal tenure over land and forest resources (see Case 10).

8. **Public projects are undertaken that do not make adequate provisions or generate sufficient benefits to compensate all those affected (including the environment) to a level that they are decidedly better off with than without the project.**

Public projects aim to increase total welfare or to promote economic development not to effect a redistribution of income, although other things being equal, projects that benefit more the poor than the rich ought to be preferred. Therefore, public projects should fully compensate all those affected, including future generations. If indeed the project is as beneficial as its proponents maintain, the project ought to generate sufficient benefits to make all those involved or affected better off with the project than without the project through actual not hypothetical compensation. This should be especially so since those affected more severely are usually the poor that lack the political and economic power to avoid the damages. The analysis of who is affected by public projects should be broken down by location, income level, profession and gender. This will help ensure that the effects on disadvantaged segments of society are not neglected, as is often the case.

In addition, the expected benefits from the project ought to be sufficient to mitigate or compensate the project's environmental impacts to a level that the country's environment is not decidedly worse off with the project than without the project. For example, if a forest area is inundated by the construction of a dam, an equivalent area of forest must be created elsewhere (e.g., by purchasing logging rights from concession companies or through extensive replanting with similar species).

Many irrigation projects fail to meet these conditions and thus create social tensions and long delays that result in cost overruns and forgone benefits, if indeed they are overall beneficial. Examples abound. The Narmada project in India which has been delayed for some thirty years, is a case in point. If such projects do go through without meeting these conditions, they run into problems of watershed encroachment by the displaced population, sedimentation and loss of capacity. A case in point is the Nam Pong reservoir in Northeast Thailand (see Case 13). The Dumoga irrigation system cum

national park in Sulawesi, Indonesia is a counterexample that has met the conditions for a socially beneficial and sustainable project (see Case 6).

9. Failure to recycle resources and byproducts when recycling would generate both economic and environmental benefits.

With the exception of energy, the consumption of natural resource commodities such as minerals, wood products and other fibers generates recyclable materials. While not all recyclable materials can be economically recycled at the current levels of technology and costs, many could be profitably recycled except for the fact that material from primary sources is underpriced or subsidized and the fact that unrecycled waste can often be disposed of free of charge. Inadequate recycling means more exploitation of natural resources, more pollution and loss of salvageable economic value. Recycling is implicitly taxed by depletion allowances and exploration subsidies pertaining to primary resource extraction, but not to recycling. Even when recycling is more costly than primary production, the environmental benefits from recycling (less waste disposal, less degradation of the environment by primary production) could help tip the balance if appropriately internalized.

A good example is palm oil processing in Sumatra, Indonesia. The residuals from palm oil production could be economically converted into fertilizer if the averted damage to the aquatic life and other uses of water were taken into account. However, because factories are free to dispose their waste in the rivers free of charge, a profitable economic activity is foregone and, as a result, palm oil waste is today Sumatra's single most severe form of water pollution. Related losses include damage to the riverine and coastal fisheries and reduced water quality for household use.

10. Unique sites and habitats are lost and animal and plant species go extinct without compelling economic reasons which counter the value of uniqueness and diversity and the cost of irreversible loss.

As a resource becomes increasingly scarce, its social value rises regardless of whether it is traded in the market or not. The value of resources with no close substitutes, such as natural habitats and animal and plant species, approaches infinity as their numbers are reduced to levels that threaten their continued existence. Both uniqueness and the marginal contribution of threatened environments and species to diversity is of such "great" value that their irreversible loss and the associated loss of future options cannot be justified except in very special cases when survival is at stake, as in the case of famine or when enormous and indisputable economic benefits are expected. Yet unique sites and habitats and threatened species are often driven to extinction by public projects or with the help of government subsidies, without compelling economic reasons to counter such enormous loss. The burden of proof that such resources have a lower value than the proposed projects or policies ought to be with those who advocate these interventions.

1.4 The Causes of Environmental Degradation

Unlike physical manifestations and symptoms that are devoid of analytical insight, the economic manifestations of environmental degradation raise analytical questions as to cause and effect. Why are increasingly scarce resources being inefficiently used and wasted instead of economized and conserved? Why are valuable resources being put to inferior uses when superior uses exist? Why are renewable resources being mined rather than managed for a perpetual stream of benefits when the latter would generate a higher net present value? Why are resources that generate a multitude of products and services being put to a single use when multiple use management would generate more benefits? Why are highly profitable investments that enhance both current productivity and future sustainability not being undertaken while scarce funds are being wasted on marginal investments? Why is a larger amount of effort and cost expended when a smaller amount would generate more profits and less damage to the resource? Why are resources and byproducts not recycled when recycling would generate both economic and environmental benefits? Why are local communities and tribal groups displaced and deprived of their customary rights to resources when by virtue of their physical presence and intimate knowledge they would be the most cost effective managers of the resource? Why

are unique habitats and species going extinct without compelling economic reasons to counter the irreversible loss of uniqueness, diversity and future options?

The answers to these problems are to be found in the disassociation between scarcity and price, benefits and costs, rights and responsibilities, actions and consequences. This disassociation exists because of a combination of market and policy failures. The prevailing configuration of markets and policies leaves many resources outside the domain of markets, unowned, unpriced and unaccounted for and more often than not, it subsidizes their excessive use and destruction despite their growing scarcity and rising social cost. This results in an incentive structure that induces people to maximize their profits not by being efficient and innovative but by appropriating other peoples' resources and shifting their own costs onto others. Common and public property resources (e.g., forests, fisheries) are being appropriated without compensation; the cost of growing scarcity is diluted through subsidies paid by the general taxpayer and the cost of ultimate depletion is borne by the poor who lack alternatives and by future generations whose interests are sacrificed to short-term political expediency. Preventing prices from rising in line with growing scarcities and rising social costs distorts the signals that in a well-functioning market would have brought about increased efficiency, substitution, conservation and innovation to restore the balance between supply and demand (see Figure 1).

While policy and market failures are often intertwined and mutually reinforcing, for both analytical and policy reform purposes it is important to distinguish between them as clearly as possible. Policy failures or market distortions are cases of misguided intervention in a fairly well-functioning market or unsuccessful attempts to mitigate market failures that result in worse outcomes. Market failures are institutional failures partially attributable to the nature of certain resources and partially to a failure of the government to (a) establish the fundamental conditions (secure property rights, enforcement of contracts, etc.) for markets to function efficiently; and to (b) use instruments at its disposal (e.g., taxation, regulation, public investment and macropolicy) to bring into the domain of markets inputs and outputs (costs and benefits) that the institutional framework fails to internalize.

We will first review market failures not because they are more important, but because they outline a potential role for government policy against which current policies can be viewed to identify areas of policy failure and policy success. Policy failure, as used here, is defined as a government intervention that distorts a well-functioning market, exacerbates an existing market failure, or fails to establish the foundations for the market to function efficiently. Policy success on the other hand is the successful mitigation of market failures; success is defined in terms of improvement in the allocation of resources among sectors and over time.

Before discussing market failures in detail, however, it is important to clarify a number of points that have often led to misunderstanding and advocacy of market replacement by government institutions. First of all, as we have seen, only a part of environmental degradation in developing countries is due to genuine market failure; much of it is due to misguided government interventions (such as tax distortions, subsidies, quotas, interest rate ceilings, inefficient public enterprises, etc.), which distort an otherwise well-functioning market (see Cases 1-16 in Annex I). Second, a good deal of genuine market failure, such as the failure arising from open access, insecure tenure, unpriced resources, and to some extent uncertainty and high transaction costs comes about because of government failure to establish the legal foundations of markets, such as secure property rights and enforcement of contracts.

Third, the mere existence of a market failure does not justify government intervention much less abandonment of the market as a mechanism for allocating resources; government intervention must lead to improved allocation outcomes over those of the free market and the ensuing benefits should exceed the costs of such intervention including those of enforcement and side effects (distortions). Fourth, experience suggests that the most cost effective intervention for mitigating market failures is the improvement of the functioning of the market through elimination of policy-induced distortions, the establishment of secure property rights over resources, the internalization of externalities through pricing and fiscal instruments, the encouragement of competition, the free flow of information and the reduction of uncertainty through more stable and predictable policies and politics.

Therefore, it is a misconception that the presence of market failures justifies the reduction in the role of the market in resource allocation and an increase in the role of government. To the contrary, mitigation of market failures through secure property rights, internalization of externalities, increased competition and reduced uncertainty will enhance the role of markets in allocating resources such as water, land, fisheries, forests and environmental services and would make unnecessary the establishment of cumbersome and often inefficient public institutions for resource management and conservation. The government need only provide the initial institutional and policy reform necessary to allow the markets to function efficiently.

The first priority under the prevailing circumstances in developing countries is to eliminate policies that have significant environmental cost or which create perverse incentives that encourage the depletion of resources and environmental degradation beyond the free-market level. Reforming policies that distort incentives for efficient resource use is a priority because unless perverse incentives are removed, project investments aiming at improved utilization and conservation of resources are unlikely to succeed and when they do, their impact would be unsustainable, lasting only as long as the project lasts.

Reforming policies that are detrimental to both the economy and the environment is an easier point at which to start because no difficult development-environment tradeoffs or budget outlays are involved. If anything, eliminating policy distortions usually reduces government expenditures and may even generate additional budget revenues. The distributional implications are also in the right direction since many of these distortions (e.g., interest rate ceilings, capital subsidies, untaxed resource rents, monopolies, input subsidies, price supports, etc.) are not only sources of inefficiency but also of inequity and perpetuation of poverty. Finally, eliminating policy distortions can be done by adjusting prices, taxes, subsidies, interest rates, and exchange rates which is easier than introducing new instruments or developing new institutions to deal with market failures.

This is not to say that market failures need not be mitigated but that both the priority and the acid test of successful policy interventions is the elimination of policy-induced market distortions. Only then can market failures be seen in the right perspective and cost-effective

interventions for improving the functioning of the market be formulated and effectively implemented. For example, there is little rationale for trying to internalize the benefits from conserving biological diversity when the wholesale conversion of tropical forests into cattle ranches or pine plantations is heavily subsidized.

In what follows we analyze first market failures and their sources, then policy failures and their impacts, and finally policy successes and the need for further policy reforms. We conclude with the potential role of AID in bringing about such reforms. Additional documentation is provided in the form of sixteen case studies and eleven data tables.

2. Market Failures Leading to Environmental Degradation

Well-functioning markets are normally efficient mechanisms for allocating resources among uses and over time. Markets function efficiently when certain fundamental conditions are met. Property rights over all resources must be clear and secure; all scarce resources must enter active markets that price them according to supply and demand; there are no significant externalities; competition prevails; public goods are minor exceptions, and issues of myopia, uncertainty and irreversibility do not arise. If these conditions are not met, the free market fails to allocate resources efficiently among uses and over time. It wastes too many resources today and leaves too little for the future.

Much of the mismanagement and inefficient utilization of natural resources and the environment can be traced to such malfunctioning, distorted or totally absent markets. Prices generated by such markets do not reflect the true social costs and benefits from resource use. Such prices convey misleading information about resource scarcity and provide inadequate incentives for management, efficient utilization and enhancement of natural resources.

The most important market failures affecting resource use and management are:

- (1) Ill-defined or totally absent property rights which are essential for the efficient operation of markets.**
- (2) Unpriced resources and absent or thin markets.**

- (3) Pervasive yet unaccounted externalities, spillover effects or intersectoral linkages which are kept outside the domain of markets.
- (4) High transaction costs which discourage otherwise beneficial exchanges that would conserve resources and improve social welfare. Transaction costs include information, negotiating, monitoring and enforcement costs.
- (5) Public goods that cannot and/or should not be provided by the private sector through the market because of either inability to exclude free-riders and recover the cost of provision of these goods or because exclusion, though technically possible, reduces social welfare.
- (6) Market imperfections, particularly lack of competition in the form of local monopolies, oligopolies and segmented markets. Especially critical for resource conservation and management are the imperfections of the capital market.
- (7) Myopia in the sense of "too short" planning horizons or "too high" discount rates arising from poverty, impatience, and risk or uncertainty which affect individuals but not the society as a whole.
- (8) Uncertainty and risk aversion which may lead not only to high discount rates but also to unwillingness to undertake investments which are otherwise profitable but have a large variance of returns.
- (9) Irreversibility: when market decisions under uncertainty lead to irreversible results the market may fail to allocate resources prudently.

These market failures or rather sources of market failures are not unique either to natural resources or to developing countries. For instance, a good part of investment in education and human capital has public good aspects and so do investments in science and technology. Uncertainty and market imperfections permeate all sectors of the economy. However, no other sector can claim as many and as pervasive market failures as the natural resource sectors. Not only are these market failures intertwined with each other, but they are also intertwined with socioeconomic and sociocultural factors such as poverty, customs, and perceptions. For historical and sociocultural reasons, many of these market failures are more pervasive and refractory in some countries than others. Below we discuss how each of these market failures

contributes to the mismanagement of natural resources in general and the degradation of the environment.

2.1 Insecurity of Ownership Over Resources

A fundamental condition for the efficient operation of markets is that there exist well-defined, exclusive, secure, transferable and enforceable property rights over all resources, goods and services. Property rights are a precondition to efficient use, trade, investment, conservation, and management of resources. No one in his right mind would economize on, pay for, invest in, or conserve a resource without an assurance that he has secure and exclusive rights over it, and that he can recover his costs through use, lease, or sale, and that such rights can and will be enforced. Property rights must be well-defined. Otherwise they give rise to competing claims and conflicts that cause uncertainty of ownership and discourage investment, conservation, and management. The rights that accompany ownership must be fully specified along with restrictions that apply to owners and the corresponding rights of non-owners.

Property rights need also to be exclusive in the sense that others do not have similar or competing rights to the same piece of the resource. Multiple ownership, however secure, has detrimental effects on investment, conservation and management. No single joint owner has sufficient incentive to invest in land improvements when he or she knows that all the other co-owners have a right to the benefits that accrue from this investment. Joint investment is a solution provided that the joint owners can agree on the type, scale, and financing of the investment (or conservation). The larger the number of owners and the higher the transaction (or negotiation) cost, the smaller the likelihood that they will reach a stable agreement. This has implications for communal management of resources, a subject which we will discuss later.

Property rights need to be secure. If there is a challenge to ownership, risk of expropriation (without adequate compensation), or extreme political or economic uncertainty, well-defined and exclusive property rights provide little security for long-term investments such as land improvements, tree planting, and resource conservation. If long-term investments are to be

encouraged, property rights must not only be secure but also indefinite. Usufruct certificates or land titles for a specified period of time after which property rights expire do not provide the right incentives for investment and conservation. Only investments that can yield sufficient benefits within the given time framework of the right will be undertaken, and exploitative behavior will ensue as the expiration date approaches unless there is a high probability that the property right will be renewed or extended.

Property rights must be enforceable. Even if property rights are well defined, exclusive and secure, they will have little impact on resource use and management if they cannot (or will not) be enforced. An unenforced right is effectively no right at all. This holds for both private and public property. For example, the declaration of forest as public or state property by most tropical countries, did little to prevent deforestation and, in fact, it may have accelerated it for the very reason that public ownership over vast areas has been proven unenforceable. Effective enforcement is the discovery of violations, the apprehension of violators, and the imposition of penalties. For penalties to be effective their expected or certainty-equivalent value (fine multiplied by probability of apprehension) must exceed the benefit obtainable from violations. When it is difficult to enforce property rights through penalties because of sociocultural or other constraints, incentives for self-enforcement could be provided. For example, the government may rely on peer group pressure and community leadership to enforce communal and private property rights within a community that has a cohesive social organization.

Finally, property rights must be legally transferable, through lease, sale, or bequest. If they are not, the incentives for investment and conservation are considerably reduced and the efficiency of resource allocation is compromised. Owners of resources who are not allowed to transfer them are discouraged from making long-term investments because they cannot recover such investments were they to change occupation or residence. For example, a logging concessionaire has no incentive to invest in reforestation or conservation because his concession is not transferable and his investments accumulate no equity. Moreover, for markets to work efficiently in allocating scarce resources between competing uses, property rights must gravitate

to the highest-value use. Restrictions on transferability of property rights are sources of inefficiency. Where there is a justification for such restrictions it should be imposed on the use not on the transfer of ownership.

For historical and sociocultural reasons, property rights over many natural resources are ill-defined, insecure, and unenforceable, and in a number of cases totally absent. Insecurely held resources include (a) private agricultural land, (b) public forest land and forest resources, (c) irrigation systems and water resources, (d) coastal zone and fishery resources, and (e) environmental resources. Resources over which property rights do not exist and therefore everybody has free access are known as open access or common property resources, or in layman's terms "no man's land". Common property must be distinguished from communal property, which is well-defined and enforceable.

2.2 Unpriced Resources and Thin Markets

There is no market and therefore no price for open access resources since there is no secure and exclusive owner who should demand such a price and in its absence deny access. Moreover, prospective buyers would be unwilling to pay such a price as long as they have free access to the same resource elsewhere. With no sellers and no buyers, a market for open access resources does not develop and their price remains at zero even as they become increasingly scarce. True, there are markets for natural resource commodities such as fish, crops and fuelwood produced from open access resources, but the price that such commodities command reflects only the opportunity cost of labor and capital used in their production, not the opportunity cost of scarce natural resources used in their production. The implicit rent or user cost for the fishing ground, the newly opened forest land and the forest itself is still taken to be zero, regardless of scarcity and social opportunity cost.

With prices of zero (that is, available for free) and no market to register scarcity, that natural resources are depleted at rapid rates is not surprising, since demand is very high and supply (conservation) very low (zero) at a zero price. In a market economy, the only gauge of

scarcity is price. Price is also the mechanism through which scarcity is managed and mitigated through demand and supply adjustments. In the case of natural resources, supply is limited by nature and adjustments can be made only through conservation and substitution: both are costly processes that need to be paid for by rising resource prices. Rising prices require working markets and working markets require secure property rights over resources.

However, the absence of markets and prices is not limited to open access resources such as fisheries and the environment. As we have seen earlier, even state property such as forests and forest lands are in effect open access resources since the state's ownership is unenforceable, or deliberately not enforced. For this reason, the market in forest properties is a very thin, that is, one with very little competition, which is itself another market failure.

A more obvious case of an unpriced resource is irrigation water. Here, the state has made a deliberate decision to provide farmers with irrigation water free of charge or at a nominal fee. In this case, it is not only the water, a scarce natural resource of positive opportunity cost, which is left unpriced (or zero-priced), it is also the scarce capital invested in the irrigation systems that is left unpriced. The consequences are many and far reaching: (a) water is inefficiently and wastefully used without any attempt to conserve it even when its scarcity is obvious to the user; (b) the state is unable to recover capital, operation and maintenance costs with the result that watersheds remain unprotected and the irrigation system is poorly maintained; (c) serious environmental problems such as sedimentation, soil salinization and waterlogging result from watershed degradation and from overirrigation while other potentially irrigable areas receive insufficient quantities of water to grow dry season crops; and (d) better-off farmers near the irrigation canals are indirectly subsidized by worse-off farmers who pay taxes but have little or no access to irrigation water.

True, water pricing is neither technically nor politically easy to introduce especially in societies in which water has traditionally been regarded as a God-given and therefore free good. Yet, the potential gains justify some form of water pricing in the face of increasing scarcity. The alternatives range from volumetric pricing, to water rights, land taxation, contributions in kind and self-management through water users associations.

Efficiency pricing is at the heart of natural resource policy and management. Almost all resource problems can be traced to discrepancies between private and social valuation of resource commodities and resource stocks. In the case of irrigation water the private cost of both the commodity water and the resource water is constant at zero, while the social cost of both is positive and rising. Similarly, the cost to the private sector of using the environment (waste, land, and air) for waste disposal is zero, while the cost to the society is positive and rising. Rapid deforestation and slow reforestation, even in securely owned forest land, is partly the consequence of the failure of the market to price forest products to capture the externalities of watershed and wildlife protection, and of other non-marketed services of the forest.

In general, the overexploitation, inefficient utilization, inadequate conservation and lack of investment in regeneration of natural resources can be attributed to undervaluation of resources arising from failure of either the market or the government to efficiently price natural resources according to their social scarcity. The key to optimal pricing of natural resources is to identify and measure correctly the external social cost² and the intertemporal use cost³ of resource exploitation and to internalize them or charge them to the current generation of consumers through appropriate pricing or taxation. This leads us to the discussion of external costs or externalities on spillover effects in the following section.

2.3 Externalities or Spillover Effects

A major factor that drives a wedge between private and social valuation of resources and leads to inefficient pricing is the presence of external costs or spillover effects known as externalities. An externality is an effect of one firm's or individual's actions on other firms or individuals who are not parties in those actions. Externalities might be positive or negative. An example of a positive externality is the benefit that upstream forest owners provide to

² Spillover effects damaging other activities which are ignored in private benefit-cost calculations.

³ The effect of current resource use on future resource availability: the more a resource is used today the less it is available for use in the future.

downstream farmers in the form of a steady water supply made possible by a forested watershed. It is to the society's (and the farmer's) benefit that more of such positive externalities are provided, but since the forest owners receive no payment for their watershed service they have no incentive to provide more of this service by logging less and planting more. The result is that more logging and less planting than is socially optimal takes place. Looked at from another angle, logging has negative externalities (or spillover effects) on downstream activities such as farming, irrigation, transport and industry, in the form of flooding, sedimentation, and irregular water supply. These are real costs to downstream activities and to the society as a whole, but not to upstream loggers or shifting cultivators who have no cause or incentive to consider them as they do not affect the profitability of logging or shifting cultivation. In fact, taking such costs into account voluntarily amounts to a conscious decision to lower one's profit and price oneself out of the market. Unless every logger and every shifting cultivator takes such external costs into account, those who do are certain to lose to competitors who do not. This is exactly why government intervention is necessary to establish and enforce similar standards and incentives or disincentives for all competitors.

Another example of a negative externality is the damage that an upstream rice farmer's use of pesticides causes to a downstream fish farmer that uses the same water source. The society as a whole (not only the fish farmer) would be better off if less of this negative externality is produced, but again there is no market (or other) incentive for the upstream farmer to take the downstream farmers interest into account. The government may react to this problem by banning the use of pesticides altogether. This however may reduce social welfare if the loss from rice production outweighs the gain from fish production (and if no other environmental effects are involved). The ideal solution would be for pesticide use to be reduced exactly to the level where the combined value of rice and fish is maximized. This level is obtained where the marginal benefit from pesticide use equals its marginal cost, where this cost is understood to include both the production cost of the pesticide and its environmental cost (effect on fish production). There are two ways in which this could happen: (a) the price of

pesticide that the rice farmer pays includes a surcharge above production cost to account for the pesticide's environmental cost, or (b) if the same decision maker owns both the rice farm and the fish farm.

Will a free market produce either of these outcomes? The answer is no, except under very special circumstances. Environmental costs are outside the domain of markets because these costs arise from a technological rather than a market interdependence between economic activities. It is a fundamental premise for an efficiently functioning market that economic units interact only through their effect on prices; technological interdependence is ruled out. However, the market will stretch itself to handle a technological interdependence if it is a private externality. If there is only one rice farmer and one fish farmer, one of the two (or both) will recognize that one could buy off the other, combine the two operations and end up with a profit because as we have seen combined profits exceeds the sum of individual profits. Alternatively, the fish farmer may offer to "bribe" the rice farmer to reduce the use of the pesticide if the latter has the right to pollute. Or, if the fish farmer has the right to clean water, the rice farmer may offer to bribe him to accept more water pollution. In either case the result will be an improvement in social welfare through internalization of the externality accomplished by a free market.

However, as the number of polluters and affected parties (say rice and fish farmers, or upstream loggers and downstream farmers) increases, the market becomes less and less able to internalize externalities. First, the damage is spread over so many decision makers that it is not perceived as important enough by any individual decision maker to induce action although its aggregate effect might be enormous. Second, it is difficult to unscramble the cause and effect or who damages whom and by how much. Third, and more detrimentally, another market failure comes into play: as the number of parties involved rises, so do information and transaction costs, bringing people together and obtaining an agreement becomes prohibitively expensive. A smooth functioning of markets assumes that information and transaction costs are zero or insignificant. In the case of public externalities, transaction costs may be so high that they will eat up all benefit from their internalization. Government intervention is justified

provided that the government can bring about a more cost-effective internalization of externalities than the market. For example, a surcharge on the price of pesticides or wood to reflect respectively environmental costs of pesticide use and logging is a policy option which is likely to generate net social benefits if appropriately set and administered.

To sum up, the market mechanism may work out a solution as long as the externality is private or at least concentrated and important enough for the internalization benefits to be apparent to all parties involved. Or, at least one of the parties involved should have such a high stake as to be induced to act despite the free-riding by other beneficiaries. When the external effects are too widely spread, as is usually the case, the correction of the externality is a public good, in which case, the market does not function effectively and government intervention might be necessary if the externality is worth rectifying. Not all externalities are worth correcting and few, if any, are worth eliminating entirely. The guiding principle should be that the gains in social welfare from correcting an externality should outweigh the costs of the intervention including any distortions in the rest of the economy that such intervention might introduce.

It may be useful at this point to relate externalities to common property and insecurity of ownership. Common property or open access creates externalities, and externalities create insecurity of ownership. Common owners impose externalities on each other which they ignore to everybody's detriment. The larger the catch of one fisherman, the higher the fishing cost of all other fishermen. Since this cost is ignored, everybody's catch and costs are higher than necessary leading to economic and biological overfishing and ultimate social loss. In analogous fashion, pervasive externalities may lead to insecurity of ownership with the same devastating overexploitation results as those obtained under open access. A farmer with a secure and exclusive title to a piece of land subject to increasing erosion or flooding caused by upstream deforestation may decide to "mine" rather than farm his land before it is washed away ("make hay while the sun shines"), an outcome identical to that of common property or open access.

As we have already seen, the failure of the market to price externalities or to account for environmental costs is a major reason for the undervaluation of natural resources or

alternatively for the discrepancy between private and social benefits and the costs of their exploitation. The market fails to deal with externalities for two related reasons, themselves major market failures. Correction of public externalities: (a) involves prohibitively high transaction costs, and (b) is by itself a public good. We now turn to these two market failures.

2.4 Transaction Costs

Markets emerge to make possible beneficial exchanges or trade between parties with different resource endowments and different preferences. However, establishment and operation of markets is not costless. Transaction costs in the form of information, coordination, bargaining, and enforcement of contracts are involved. Usually such costs are trivial compared to the benefits from trade that such markets make possible. Markets fail to emerge if there are very high set-up costs, if the costs per unit transacted exceed the difference between the supply and demand price, or if there are only a small number of buyers and sellers. Absence of well defined property rights prevents markets from emerging, but well-defined property rights do not bring markets into existence if the coordination and marketing costs, necessary for the commodity in question to be traded voluntarily, are very high. Even if markets appear, they tend to be thin and inactive. The absence or paucity of futures markets and the high costs of rural credit market are usually attributed to high transaction costs.

Similarly, there are costs to establishing and enforcing property rights. If such transaction costs are high relative to the benefit from secure and exclusive ownership, property rights and the related markets will fail to be established. For example, the costs of parcelling out the sea to individual fishermen and enforcing property rights over a mobile resource are prohibitively high. Analogous is the case of externalities. There are costs to identifying the afflicted and generating parties and to negotiating a mutually agreeable solution. The more parties involved, the less likely that a bargaining solution will be arrived at voluntarily because the transactions cost tends to exceed the benefits from internalizing the externality. However, the government, either through its collective or coercive power, may be able to internalize externalities at a

lower transaction cost than the free market. According to Stiglitz (1986, p. 184), "The government may be looked upon as precisely the voluntary mechanism that individuals have set up to internalize externalities or to reduce the welfare losses from the externality in some other way." Another way to look at this is that the organizational services necessary to internalize the externality are public goods. Moreover, many externalities involve the provision of public goods such as clean air, clean water, watershed protection and biological diversity. Since it is very costly (and often detrimental to social welfare) to exclude anyone from enjoying the benefits from public goods, such goods cannot (or should not) be provided by the market. They can be best provided by the government and financed from general taxation. In some cases, public goods could be provided by non-governmental organizations (NGO's) through voluntary contributions by members or supplied by the private sector under contract with the government.

2.5 Public Goods

When several originators and recipients are involved, externalities such as water and air pollution, may be considered as public "bads" and their correction as a public good. In fact, a public good may be thought of as an extreme case of a good that has only externalities, that is, no part of it is private to any individual. Each individual's consumption of such a good depends on the total quantity of the good supplied in the economy. Unlike the case with private goods, the consumption of a public good by an individual does not diminish its availability to other individuals. Although the production of public goods involves an opportunity cost in terms of foregone quantities of private or other public goods, a zero opportunity cost is associated with its consumption.

A public good is characterized by jointness in supply, in that to produce the good for one consumer it is necessary to produce it for all consumers. In many cases, no individuals can be excluded from the enjoyment of a public good (e.g., national defense) whether they pay for it or not. However, even if exclusion is possible (e.g., a bridge across a river), to do so violates pareto optimality, which requires that no opportunity of making one person better off without making anyone else worse off is left unutilized. Because nobody can or should be excluded

from the benefits of a public good, consumers would not freely pay for it and, hence, no firm would be able to cover its production cost through the market; hence, the market mechanism would fail to supply a public good, although the good would contribute to social welfare. Thus, a free market will lead to underproduction of public goods and overproduction of private goods.

Because individual consumers cannot adjust the amount of the public good they consume, a market for it cannot exist or, when it exists, it does not provide the public good in sufficient quantities. This provides a rationale for many government activities aimed at providing public goods. For the government to provide a public good, it is necessary to know each individual's marginal rate of substitution between the public and private goods, which would determine the optimal level of the public good and (perhaps) each individual's share of the cost. However, because consumers may not reveal their true preferences for fear that they may be taxed on the basis of their willingness to pay, public goods are usually produced or contracted out by public agencies on the basis of collective decisions and financed from general taxation. Thus, although consumers consume the same amount of the public good, they pay different "prices", whereas in the case of the private good, consumers pay the same price but consume different quantities of the good.

Natural resources and the environment involve many public goods ranging from environmental quality and watershed protection to ecological balance and biological diversity. Public goods range in geographical scope from local or regional to national and global. For example, biological diversity is an international public good since it is not possible (or desirable) to exclude other nations from benefiting from its conservation. Therefore, it is unreasonable to expect such a good to be provided in sufficient quantity by an individual country, in a free market.

Certain goods are referred to as "publicly provided private goods" because of the large marginal cost associated with supplying additional individuals. The rationale for the public supply of such goods is their large set-up costs and the high (transaction) costs of running a market for these goods. When private goods are freely provided, they are overconsumed.

Since the consumer does not pay for the good, he demands and uses it up to the point where the marginal benefit he receives from the good is zero, although the marginal cost to the society is positive and often substantial. The social loss from overconsumption is the difference between the individual's willingness to pay and the marginal supply cost.⁶ A classic example of a publicly provided good is irrigation water, whose overconsumption involves a double loss: a direct welfare loss from excessive consumption and an indirect loss from waterlogging resulting from overconsumption. There is a need for a rationing system to control consumption. Three possible rationing devices are (a) uniform provision, (b) queuing, and (c) user charges. The problem with uniform provision is that everyone gets the same amount regardless of his needs and desires. The problem with queuing is that it requires payment in waiting time and rewards those whose opportunity cost is lowest. User charges are particularly suited to publicly provided private goods because users could be charged the marginal cost of providing the good which is often substantial though not sufficient to cover the total cost of the public good. User charges result in both improved efficiency of use and partial cost recovery. This is particularly relevant to irrigation water pricing. According to the World Bank (1985, p. 456),

True efficiency pricing requires accurate measurement of supplies by metering the volume of water delivered to individual users . . . Although true efficiency pricing may not be attainable, even a nominal charge for irrigation water would provide an incentive to use it more efficiently . . .

These complications notwithstanding, the pervasive shortage of public funds and the large income benefits derived from participants in irrigation schemes suggest that substantial cost recovery should be the goal in many instances. Most governments, however, have not attained anything like a full cost recovery from public irrigation schemes. A rule of thumb followed by some governments is to absorb the capital costs, but to establish water charges and benefit taxes at the level that in the aggregate will at least recover the operation and maintenance costs including repairs.

⁶ What it costs to supply one more unit of the good.

However, it must be noted that even when there is a marginal cost associated with each individual using a good, if the transaction costs of running a price system (that is the cost of collecting user charges) are very high, it may be more efficient for the government to provide the good and finance it from general taxation. However, raising revenues through taxes, such as the income tax, may introduce distortions (disincentives for work and investment) that raise the effective amount of private goods that individuals must give up to obtain an additional unit of the public good above the nominal cost.

2.6 Uncompetitive Markets

Even when markets do exist and are very active, there may be market failures in the form of insufficient competition. For markets to be efficient there should be a large number of buyers and sellers of a more or less homogeneous commodity or, at least, a lack of barriers to entry, and a large number of potential entrants as an insurance against monopolistic practices by existing firms. In reality, we observe economies ridden with monopolistic elements. A market is imperfectly competitive if the actions of one or a few sellers or buyers have a perceptible influence on the price. Market imperfections may arise for a variety of reasons. A major source of monopolistic tendencies, affecting some resource related sectors such as water and energy supply, is their decreasing industry cost feature. Because of the indivisibility of the necessary investment, the average cost of the service falls continuously as more and more customers are served until the whole market is dominated by a single firm (known as a natural monopoly). To prevent monopolistic practices, a government monopoly is usually established as is usually the case with utilities and the post service.

Other causes of limited competition may be institutional, legal, or political barriers to entry into certain professions or industries; high information costs; and the limited extent of the market, a common problem in developing countries which may result in oligopolies because only a few firms may supply the entire market. A usual monopolistic practice is to withhold supplies in order to raise prices. The monopolist's price is too high and his output too low for

social optimality which requires marginal cost pricing rather than the monopolist's average cost pricing.

Monopoly is not altogether bad for conservation. For the wrong reason, the monopolist may approximate the social optimum rate of resource extraction. Even though a monopolist is equally likely to ignore the environmental cost of his activities, his fear of depressing the price turns him into a conservationist. This is not to imply that monopoly is a solution to resource depletion: replacing one market failure by another does not usually improve welfare.

While monopolies are not uncommon, the natural resource sectors are not less competitive than other sectors of the economy. One market whose imperfections are likely to have more pronounced effects on natural resources than on the other sectors of the economy is the capital market. Ideally, economic activities and business ventures that promise to yield a net return higher than the going interest rate should be able to obtain funds for investment because they expect to earn enough to pay the cost of borrowed capital and still earn a profit. In reality, this does not always happen. Unless farmers already have sufficient property or capital assets to use as collateral, and unless they understand and are able to meet rigid repayment requirements, they cannot obtain institutional credit at the going rate of interest. Most farmers, being either subsistence or small-scale commercial farmers, have access only to non-institutional credit that comes with high interest rates, usually a multiple of the institutional rate and, more often than not, debilitating preemptive marketing arrangements. This means that even if a project is profitable at the institutional rate of interest (say 15%), it may be unprofitable at the much higher (usually above 50%) cost of informal credit, often the only source of funds for the small farmer. Thus, unless the government makes collateral-free credit available to small farmers at the institutional rate of interest, many privately and socially worthwhile projects would not be undertaken.

There are at least two reasons why farmers and other rural dwellers have no access to institutional credit. First, many farmers have no secure land title which they can use as collateral; semi-secure titles are not accepted for the long-term institutional credit required for long-term investments such as land improvement and tree planting. Second, interest rate

ceilings intended to help rural borrowers result in the drying up of rural credit because banks are unwilling to lend at a loss (rural credit involves higher transaction costs than urban credit), leaving the far more costly informal credit as the only recourse for rural borrowers. Since informal credit is both costly and short-term, rural investments are biased against natural resource activities such as tree planting and soil conservation.

2.7 Myopic Planning Horizon and High Discount Rates

Natural resource conservation and sustainable development ultimately involve a sacrifice of present consumption for the promise of future benefits. Because of time preference, such an exchange appears unattractive unless one dollar of sacrifice today yields more than one dollar of benefits tomorrow. Future benefits are discounted, and the more heavily they are discounted the less attractive they are. A high rate of discount may discourage conservation altogether. Clark (1973) has shown that a sufficiently high market rate of interest combined with a low natural growth rate may lead to the extinction of species. If the market rate of interest accurately reflects the society's rate of time preference, such extinction should not be worrisome except for another market failure that results from the combination of irreversibility and uncertainty which we will discuss later. Here we are concerned with the possibility that the market rate of interest (discount) fails to reflect the society's true rate of time preference. A combination of poverty, impatience, and risk, which either does not apply or applies to a smaller degree to the society as a whole than to individuals, drives a wedge between the private and social discount rate.

Environmental and market uncertainties (see below) coupled with a short and uncertain lifespan lead people to adopt myopic time horizons and discount rates which result in short-sighted decisions in pursuit of survival or quick profits at the expense of long-term sustainable benefits. At subsistence levels of living, when people's very survival is at stake, a "hand-to-mouth" economy prevails in which the future is infinitely discounted. The result of such "myopia" is over-exploitation of natural resources and underinvestment in their conservation and regeneration which ultimately leads to their depletion. The high cost of rural

credit from informal sources, in the absence of institutional credit, also leads to high rates of discount. Conservation projects that would have been profitable at 10% or 15% interest rates are not profitable at the 50% or even 100% rates charged by informal credit sources.⁵ Again, there is scope for government intervention to induce longer time horizons and lower discount rates (through increased savings), to regulate resource extraction and to invest in the conservation and regeneration of resources according to the society's true time preference. The society because of its continuity and risk pooling capacity tends to be less myopic than its individual members.

There is a clear relationship between this market failure and the ones discussed earlier. Common property or open access exploitation of resources is equivalent to the use of an infinite discount rate; that is, future benefits sacrificed by current resource use are infinitely discounted, effectively assigned a zero value by the common "owners", regardless of their value to society. This is understandable since, under open access, no one is assured of the benefits of his investments and conservation efforts since others have free access to the same resource. Under open access, there is no future: common property is transformed into private property through prompt capture and use. From the individual's point of view, conservation is meaningless and irrational under open access conditions.

Public externalities or environmental costs and benefits are also infinitely discounted by an unregulated market regardless of whether they occur at present or in the future. Discounting also relates to undervaluation and transaction costs through the absence of organized futures markets.

2.8 Uncertainty and Risk Aversion

Natural resource management and conservation is about the future, a future which is beset with uncertainties and risks. A situation is said to involve uncertainty if more than one outcome is (or is perceived to be) possible from any given action. Two types of uncertainty

⁵ High discount rates cut both ways: they discourage both conservation and exploitation projects which require major investments with future streams of benefits, but on balance conservation is more adversely affected because its benefits are more distant into the future.

may be distinguished: (1) environmental uncertainty arising from factors beyond the decision-maker's (farmer's) control, e.g., weather, epidemic disease, technological discoveries; and (2) market uncertainty arising from a market failure to provide information (prices) required for decisions affecting the future (absence of future markets). The longer the time horizon, the further into the future forecasts need to be made and the greater the uncertainties involved.

A distinction is sometimes made between uncertainty and risk. A situation is said to involve uncertainty if no objective probability of each of the many possible outcomes can be attached. In contrast, risk is a situation where the general level of probability of each outcome can be inferred, although known probabilities cannot be precisely assigned. In everyday use, a situation is said to be risky if one of the outcomes involves losses to the decision-maker. Thus, the risk of loss to a firm or a farm may be defined as the probability that profits will be less than zero, or the probability that returns will fall below some "disaster level" of income.

Risks may be reduced through diversification of activities with negatively correlated outcomes, ("putting all one's eggs in one basket" is rarely a good policy). Risks in one activity may also be reduced by pooling them with risks from other independent activities. Where risks are of a given type (e.g., independent of the actions of the decision-maker), risk-pooling or insurance markets have often emerged to exploit these possibilities. Individuals transfer their risks to an insurance company by paying an insurance premium which in a perfect insurance market would equal the administrative costs of the company plus the cost of any remaining risk.

However, not all risks are insurable. Insurance markets fail to appear when the outcome is not external to the policyholder, the risk affects all policyholders in a similar way, or the probabilities of the various outcomes are difficult to assess. For example, a farm cannot insure itself against the risk of losses because profitability is as much a function of the farmer's actions as it is of environmental uncertainty (e.g., weather). Similarly, a fish farm cannot insure itself against the risk of an epidemic because such risk would affect all farms in a similar way, which reduces the benefits from risk-pooling.

Risks may be objective or subjective. Objective risks are calculated on the basis of the probability of occurrence of the adverse outcome. Attitudes towards risk differ among individuals based on sociocultural and economic factors. In general, risk aversion tends to be stronger among lower socioeconomic groups because survival is at stake.

While uncertainty affects all sectors of the economy, natural resource sectors are more seriously affected for a variety of reasons. First, there are more uncertainties about ownership and access to natural resources. Second, there are more potential spillovers from other activities. Third, natural resource investments such as tree planting tend to have much longer gestation periods than investments in agriculture or industry and, the longer the gestation the more the uncertainties and risks involved. Fourth, natural resource commodity prices are subject to more violent fluctuations than other commodities and as such they are difficult to forecast. Last, most resource commodities are under the constant threat of substitution from cheaper substitutes developed by continuous but unpredictable technological change.

Uncertainty about the future should make people more conservative in natural resource exploitation, and therefore it should work in favor of conservation of at least those resources, such as biological diversity, which are less likely to be substituted by technology. After all, one reason why people save is to provide themselves with a cushion against future uncertainty. However, insecurity of tenure and pervasive externalities create uncertainty about the benefits from conservation as compared to the benefits from current exploitation. For the individual, it makes good economic sense to cut down the forest and mine the land to generate income which he can then consume or invest in more secure assets. From the society's point of view, it makes more sense to preserve the long-term productivity of the resource base both as a source of income in perpetuity and as insurance against uncertainty. Liquidating the resource base on the basis of short-term economics makes less sense in the face of uncertainty (than under certainty) if such action is also irreversible.

2.9 Irreversibility

Market decisions about the future (such as consumption vs. investment) are made with the best available, yet incomplete information about future developments, on the assumption that such decisions can be reversed if they are proved to be unwise in the light of new information. This assumption of reversibility does not hold in many decisions involving natural resources. Consider the choice between preserving a tropical rainforest with some unique features and developing the site for logging and mining concessions. If the social benefits from development exceed the social benefits from conservation even marginally, we should choose logging and mining except for the fact that conservation is reversible, while logging and mining are not. Choosing logging and mining forecloses our options; if we or future generations were to have a change of mind there would be no way to reproduce the uniqueness and authenticity of the original tropical forests and any species that became extinct. In contrast, choosing conservation preserves our option to reverse our decision. Clearly, there is a social value or shadow price for the preservation of options, though it is difficult to estimate. However, there are reasons to favor a "high" value. On the one hand, technical change is asymmetric: it expands our ability to produce ordinary goods, the products of development, but does little to improve our ability to produce natural environments, the products of conservation. On the other hand, consumer preferences tend to shift in favor of environmental services relative to ordinary goods. In conclusion, "Where economic decisions have an impact on the natural environment that is both uncertain and irreversible, there is a value to retaining an option to avoid the impact" (Fisher and Krutilla, 1965).

3. Policy Failures Leading to Environmental Degradation

The tendency of free markets to fail in the allocation and efficient use of natural resources and the environment opens an opportunity and provides a rationale for government intervention. But it is a necessary condition, not a sufficient one. The sufficient conditions are that (a) the government intervention outperforms the market or improves its function, and (b) the benefits from such intervention exceed the costs of planning, implementation and

enforcement as well as any indirect and unintended cost of distortions introduced to other sectors of the economy by such interventions.

Ideally, government intervention aims at correcting or, at last, mitigating market failures through taxation, regulation, private incentives, public projects, macroeconomic management and institutional reform. For example, if the market fails to allocate land to its best possible use because of insecurity of land ownership, the indicated government intervention ought to be the issuance of secure land titles through cadastral surveys, land registration, etc., provided the ensuing benefits exceed the costs. If on the other hand, the market fails to allocate land to its best possible use because of severe flooding due to upstream deforestation, the government ought to explore the costs and benefits of taxation on upstream logging and/or downstream agriculture and the use of the proceeds to subsidize upstream reforestation. If economic analysis that considers all costs and benefits involved concludes that such an intervention can make both upstream loggers/shifting cultivators and downstream farmers better off, and no one else worse off (including the government treasury), it would be a policy failure not to act. Such an intervention is not a distortion, but a mitigation or correction of a distortion introduced by a failing market.⁶

In practice, however, government policies tend to introduce additional distortions in the market for natural resources rather than correct existing ones. The reasons are many and varied. First, correction of market failure is rarely the sole or even the primary objective of government intervention; other objectives such as national security, social equity, macroeconomic management and political expediency may dominate. Second, government intervention often has unintended consequences and unforeseen or underestimated side effects. Third, policies such as subsidies and protection against imports or competition, often outlive their usefulness because they become capitalized into peoples' expectations and property values, creating vested interests that make their removal politically difficult. Fourth, policy interventions tend to accumulate and interact with each other in subtle but profound ways to distort private incentives away from socially beneficial activities. Finally, policies that are

⁶ Here, as in all policy analysis, we assume away "second best" problems.

seemingly unrelated to natural resources and the environment may have more pronounced effects on the environment than environmental and resource policies; for example, capital subsidies, tax and tariff exceptions for equipment, and minimum wage laws that displace labor lead to increased pressures on forest, marginal lands, coastal areas and urban slums. For example, in Ghana, a grossly overvalued exchange rate resulting from macroeconomic mismanagement has a) nullified what otherwise was an efficient forest policy, b) accelerated deforestation by exacerbating poverty, and c) foiled reforestation by making reforestation incentives irrelevant (see Case 16).

Thus, environmental degradation results not only from overreliance on a free market that fails to function efficiently (market failure), but also from government policies that intentionally or unwittingly distort incentives in favor of overexploitation and against conservation of valuable and scarce resources (policy failure).

Policy failures may be classified into four basic types:

- (a) Distortions of otherwise well-functioning markets through taxes, subsidies, quotas, regulations, inefficient state enterprises, and public projects of low economic return and high environmental impact. This is a case of "fixing what is not broken."
- (b) Failures to consider and internalize significant environmental externalities (side effects) of otherwise warranted policy interventions. For example, fertilizer and pesticide subsidies may have a useful role to play in encouraging farmers to adopt new high-yielding crop varieties. In selecting the types of fertilizers and pesticides to subsidize and in setting the level and duration of the subsidy the effect on farmers' choice of other inputs (manure, soil conservation, weeding, irrigation, etc) and on long-term productivity should be factored in. Moreover, the potential offsite damage from contamination and eutrophication of water resources from overuse and runoff should be considered and mitigated by setting a lower subsidy for a shorter period and promoting soil conservation, organic fertilizers and integrated pest management (IPM). For example, Indonesia in its drive for rice self-sufficiency has provided generous subsidies (82% of the retail price) for a variety of pesticides. Subsidies led to overuse which, in turn, led to severe reduction of the predators

of the brown blanhopper which threatened the country's achieved self-sufficiency in rice. In a dramatic move, the government turned what was threatening to be a policy failure into a policy success by abolishing the subsidy and promoting IPM at lower cost (see Case 5).

- (c) Policy interventions that aim to correct or mitigate a market failure but end up generating a worse outcome than a free and failing market would have produced. It must be recognized that market failure does not mandate government intervention; it merely suggests the possibility that such intervention might prove beneficial. In some cases, doing nothing might be the best policy if intervening would make matters worse. However, in most cases the problem is not that no action is indicated, but that the wrong action is being taken. For example, if the free market fails to contain deforestation because the forests are open access resources and the negative externalities of deforestation are not internalized (paid by the parties responsible), a government intervention in the form of a logging ban is unlikely to be effective since (a) higher prices are likely to stimulate illegal logging, and (b) concessionaires may log illegally to recover sunk costs or they may abandon their conservation to encroachment and slash-and-burn activities, as Thailand is discovering following the January 1989 logging ban in response to the catastrophic landslides of November 1988 (see Case 14).
- (d) Failures to intervene in failing markets when such interventions are clearly needed to improve the functioning of the market and could be made at costs fully justified by the expected benefits. For example, it would have been a policy failure for the government of Thailand not to undertake to issue secure land titles to its farmers, when it was established that the cost of titling was only a small percentage (less than 10%) of the potential benefits (see Case 15). By intervening in the land market to establish secure property rights, a precondition for well-functioning markets, the government has turned a market failure into a policy success. In contrast, the issuance of 25-year "usufruct" or "stewardship" rights to squatters on public lands in Thailand and the Philippines is a half measure that does not go to the root of the problem. It is likely to stimulate continued encroachment without

significantly improving farmers security of ownership, access to credit and incentives to invest. Such half measures risk turning a market failure into a policy failure of possibly greater dimensions.

To sum up, policy failures include both the failure to intervene when necessary and beneficial and the failure to refrain from intervention when unnecessary and detrimental. The policy failures which lead to environmental degradation range from poorly designed public projects that fail to account for their environmental impacts to structural adjustment programs that fail to internalize or at least cushion their environmental repercussions. Policy failures are not the exclusive domain of governments. Development assistance agencies, through their project and program lending and policy dialogue, may introduce or exacerbate a policy failure. For example, liberalization as part of a structural or sectoral adjustment loan, in the absence of secure property rights and other legal foundations of markets, may simply transform a policy failure into a market failure, an outcome not uncommon with African liberalization programs.

Policy failures may be classified into three groups:

- (a) Project-related policy failures, especially project selection on the basis of financial appraisal or narrow economic analysis that does not internalize environmental externalities.
- (b) Sectoral policies that ignore long-term costs and intersectoral linkages and spillovers.
Sectoral policies may in turn be divided into agricultural and industrial policies or even more narrowly into land policy, water resource policy, forest policy, fisheries policy, urban development policy, industrial location policy, etc.
- (c) Macroeconomic policies that either lack microfoundations (e.g., liberalization in the absence of functioning markets) or ignore significant environmental consequences (e.g., the effect of high interest rates, overvalued exchange rates or excessive borrowing on natural resource depletion).

3.1 Project-Related Policy Failures

Project policies refer to both public and private projects. We will discuss public projects first. Public projects are a potent instrument of government intervention for mitigating market

failures (e.g., provision of public goods such as roads, utilities, parks, etc.), but if used inappropriately, can become a major source of market distortion. First, since most public projects are financed directly or indirectly from general taxation, they tend to crowd out private investment as well as to redistribute resources. This is justified and beneficial only to the extent that public projects generate higher economic/social returns than private projects. Second, public projects, especially in developing countries, tend to be very large both by comparison to private projects and to the size of the economy. Because of their sheer size and their infrastructural nature, public projects tend to have non-marginal impacts on both the economy and the environment. Therefore, taking prices as given and ignoring environmental and social impacts is not appropriate.

Infrastructure projects such as roads and irrigation systems often have environmental impacts that extend far beyond the physical displacement of natural environments and any associated spillovers. For example, the environmental impact of road construction through an undisturbed forest is not simply the forest cut to make room for the road, or even the damage to the environment from road traffic and air pollution. The single largest environmental impact comes from the increased encroachment or colonization of the forest facilitated by the road, as the Trans-Amazon Highway through Acree and Rondonia amply demonstrated.

Two other examples come from Thailand. Only fifteen years ago the lower Northeast region of Thailand was covered with undisturbed forest. Then the area was made accessible by the construction of a major highway. According to Thailand's National Economic and Social Development Board (1982, p. 233): "Landless farmers... from around the area and elsewhere have moved in and cleared the land for cultivation, resulting in the destruction of forest land (and watersheds) of 5.28 million rai (one million ha) between 1973 and 1977. The sporadic immigration to clear new land for cultivation has given birth to 318 villages in the past nine years." Today, the area is totally devastated by salinization and soil erosion that make both forestry and agriculture unsustainable. Had private and communal property rights been issued before the opening up of the area, both agriculture and forestry could be sustainable. Another example comes from the Nam Pong multipurpose reservoir-irrigation system

constructed in 1966 in Northeast Thailand. In a strikingly similar fashion to the highway, the watershed area of the reservoir has been subjected to very high population increases both from people who were displaced from the reservoir area and from people attracted from other areas to the reservoir, which unexpectedly developed a productive fishery with more than 70 edible species. The influx of people into the area led to rapid deforestation of the open access watershed, increased soil erosion and sedimentation of the reservoir with adverse effects on the reservoir fishery and reduction in the outputs and benefits from power generation irrigation and flood control (for further details see case 13).

It is easy here to blame population growth, the proximate not the ultimate cause of deforestation, and prescribe population control. But this would amount to little more than treatment of symptoms, since in both the case of the dam and the case of the highway, the influx of population would have not taken place to the degree it did in the absence of the project. Prescribing population control as a remedy to a problem caused by poor project planning, by failure to establish secure property rights over agricultural and forest lands, and by failure to recognize externalities and internalize the environmental cost of the project is tantamount to arguing that no matter what the market and policy failures involved, without people there would have been no problem! In any case, Thailand over the past 20 years has undergone the most spectacular reduction in population growth of any country, from over 3% in the late 1960s to under 1.5% today through voluntary incentives, education, and economic growth. It is true that Northeast Thailand continues to be relatively densely populated and poor, but this is not because of high population growth but because of skewed economic growth (centered in the Central Region), barriers to mobility (insecure land ownership, inappropriate education policy) and distorted sector markets that favor capital intensity in industry at the expense of labor employment.

An econometric study of the causes of deforestation in Northeast Thailand has found that population density (as distinct from population growth), poverty, and infrastructure (both dams and roads) as well as economic incentives (wood and crop prices) played a significant role in deforestation (Panayotou and Sungswan 1989).

Public projects are usually justified economically through cost-benefit analysis, which in principle should consider all social benefits and costs, monetary or not, quantifiable or not. Project level distortions or biases against efficient resource use, environmental quality and sustainable development arise for one of the following reasons: (a) projects are selected based on financial appraisal (cash flows) or narrow economic analysis (shadow pricing some inputs and not others); (b) the social benefits and costs are too narrowly defined in space (excluding externalities) and in time (excluding long-term effects); (c) the environmental effects are unforeseen at the design stage of the project; (d) the environmental costs are foreseen and appreciated, but it is difficult to measure and evaluate them; (e) an unduly high social discount rate is used; and (f) the irreversibility of project-induced changes in the environment is ignored or not properly handled.

While difficulties remain, sophisticated evaluation techniques have been developed in recent years for evaluating environmental externalities and incorporating them into cost-benefit analysis. Similarly, methods, such as the "safe minimum standard" (SMS) approach, have been developed for dealing with irreversibility. As to the discount rate, two points need to be made here: (1) the discount rate does not discriminate against environmental benefits per se but against long-term benefits which may be development benefits; and (2) the discount rate is a public policy parameter which can be chosen to promote a longer-term perspective as long as it is used consistently and with full appreciation of the fact that the lower the social discount rate, compared to the market discount rate, the more private investment will be crowded out by public projects. (For more details on analytical approaches to be used under various circumstances in the economic analysis of projects, see AID Manual for Project Economic Analysis, PPC, October 1987).

A major policy distortion is the very emphasis on projects as opposed to policies and strategies. The emphasis is on choosing between projects rather than on asking whether anything needs to be done in a given resource area. Similarly, the emphasis is on designing and implementing new projects rather than on evaluating how well projects have fared in the past. Rogers (1986, p. 7) describes this bias in the case of water resource policies very aptly:

In most countries the framework for interrelating national economic policies with water resources policies has been collapsed down to an accounting framework whereby the possible investments in the water sector are analyzed project by project. These projects are added together to make a portfolio of investments offered by the technical agencies to the planning commission as the investment policy. The planning commission then responds by checking to see if the overall resources demanded can be met from the available current, or projected, economic resources. The planning commission then either recommends changes or passes the portfolio on to the executive for approval. Depending upon the country, and the time and resources available to it, the planning commission may, or may not, check for consistency between the water sector and the other sectors of the economy.

Planning paradigms such as the above can be quite effective if the planners have sufficient time to go back and forth between the sectors two or three times before stopping the process. In practical planning situations, however, sufficient time is not available and one is left with a one-sided, one-directional analysis -- the impacts of a sector (or parts of it) on the economic policies are assessed but the reverse is typically not done. Therefore, real assessments of the value of investments in the water sector are never effectively compared with those in other sectors. The enormous investments in irrigation systems were not seen in the context of a national development policy, or even an agricultural or water policy. Otherwise, the protection of the watersheds and the provision for system maintenance, water distribution, and drainage would not have been neglected. Similarly, seen in the context of a national or rural development policy, the construction of road infrastructure through forests without prior clarification of land rights should not have taken place.

The bias for or against projects as opposed to policies is not unique to government agencies. Environmental groups have focused on the environmental damage caused by projects such as Nam Choan Dam in Thailand, the Narmada project in India, and the Tucurui Dam in Brazil, rather than the massive market failures and policy distortions that lead to wholesale destruction of natural resources and degradation of the environment. When projects are seen as part of an overall development policy, many of what are now unaccounted externalities would be internalized and much of the development-environment conflict resolved. Many developing economies are far from their efficient production frontier. It is possible and feasible to produce more development and better environment at the same time by correcting market

failures and eliminating policy distortions. It is in this context that public projects should be planned, designed, and evaluated.

3.2 Forest Policy Failures

Forest policy is an excellent example of a resource-specific policy that needs to be overhauled if the link between scarcity and prices is to be reestablished. If indeed we are facing a growing scarcity of forests, forest product prices should be rising to slow down deforestation and accelerate reforestation. At present, not only are most forest products and services not priced, but even timber which is an internationally tradeable commodity is priced below its true scarcity value due to implicit and explicit subsidies and institutional failures. Uncollected resource rents, subsidized logging on marginal and fragile forest lands, and volume-based taxes on timber removal encourage high grading and destructive logging. Forest concessions are typically too short to provide incentives for conservation and replanting. Failure to value non-timber goods and services results in excessive deforestation, conflicts with local communities, loss of economic value and environmental damage. Promotion of local processing of timber often leads to inefficient plywood mills, excess capacity, waste of valuable tropical timber and loss of government revenues. Replanting subsidies often end up subsidizing the conversion of a valuable natural forest to inferior mono-species plantations, with the associated loss of the value of both tropical hardwoods and biological diversity.

Concerns over rapid rates of deforestation and slow rates of replanting have given rise to export bans on unprocessed timber by tropical timber producers such as Thailand, the Philippines and Indonesia. The primary motivation in Thailand has been the conservation of forest resources and, in Indonesia, an increase in value-added through domestic processing and, by implication, forest conservation. The log export bans have largely failed to slow deforestation in all three countries. In Thailand and the Philippines, illegal logging and clearing of land for permanent and shifting cultivation continued unabated. In Indonesia, the inefficient and excessive processing capacity stimulated by the log export ban has led to logging rates above the pre-ban levels.

Following the catastrophic landslides and floods of last November that have been attributed to deforestation, the Thai government introduced an indefinite logging ban. This is a well-meant and popular action. However, unless it is supplemented with effective enforcement and forest management, it is unlikely to succeed in stemming the rate of deforestation. Illegal logging, encroachment and shifting cultivation are likely to continue and even intensify in the absence of the logging concessions, because population pressures, poverty, and incentives for opening land for agriculture have not changed. Nor has the enforcement capability of the Department of Forestry, which is the legal owner of these forests. Already, there have been (controversial) reports in the local press that the rate of deforestation increased following the imposition of the ban last January (see Case 14).

3.3 Land Policy Failures

Insecurity of land ownership is the single most severe market cum policy failure in developing countries. It prevents the optimal use of land and leads to the degradation of land, water and forest resources. Insecurity of land ownership takes many forms: (a) totally untitled land, the result of forest encroachment and squatting; (b) land under unclear, disputed or multiple ownership; (c) land under short-term lease or tenancy; (d) land under uncertainty of imminent or likely land reform or appropriation; (e) land under usufruct or stewardship certificates that are not indefinite and transferable; and (f) land ownership that is tied to compulsory state trading, price controls, and forced cooperatives through which the "owner" is forced to buy inputs at higher than market prices and to sell outputs at lower than market prices.

Untitled or insecurely-held land is commonly found in the Philippines and Thailand (the result of swidden cultivation), in Indonesia (the result of spontaneous migration), in Burma (in areas outside the control of the central government), in Nepal (as a result of migration from the hills to the Terai), and in Africa (tribal lands). However, the quantitatively most significant form of insecurity of tenure in the Philippines and South Asia is tenancy. While owners and tenants with reasonable security do not seem to differ in their willingness to adopt innovations, such as new varieties, fertilizers and pesticides for annual crops, they may have

different attitudes towards long-term investments that enhance land productivity and sustainability over the long-run such as irrigation and drainage structures, land terracing, tree crops, etc. (World Bank, 1985, p. 98).

A classic example of multiple or unclear ownership is provided by some 500,000 tanks and ponds covering 70,000 ha in land-scarce Bangladesh that remain largely unused despite an apparent high potential for fish culture (Khan, 1989). Widespread multiple ownership aggravated by inheritance is suspected to be a major constraint (FAO/UNDP 1977). Similarly, open access pastures are clearly an extreme case of multiple ownership but communally managed lands or pastures are not if the community has sufficient cohesion, social organization, and leadership to make decisions about optimal use. This is why communal and tribal land in Papua New Guinea (see Case 10) and in parts of Africa does not suffer from insecurity of ownership while in other parts of Africa insecurity is pervasive. In fact, there are examples from Northern Thailand, India and Kenya and several other African countries where tribal land in one village is managed almost as if it is owned by a single individual, while in a neighboring village tribal land is exploited as no man's land, with the known consequences of the "tragedy of the commons."

The lack of security of ownership over land constitutes a serious obstacle to farm investments necessary for diversification, intensification, and increased productivity. Untitled land is not accepted by financial institutions as collateral for credit forcing farmers into the high interest rate informal credit market, which makes farm investments unprofitable (Feder et al 1986). The risk of eviction, however small, adds an element of uncertainty that further discourages investments in land improvements and soil conservation. Uncertainty, lack of access to institutional credit, and easy access to public forest land combine to bias agricultural development against intensification on existing lands and in favor of expansion into new lands. This leads to encroachment of forest resources thereby depleting forest resources and increasing the amount of land under cultivation. Moreover, insecurity of land tenure and the consequent lack of access to credit biases the cropping system in favor of annual crops such as corn and cassava that generate a quick return at the expense of long-term productivity. Tree crops

which may be more profitable over the long run and are certainly more protective of the soil and, therefore, more sustainable are discouraged by insecurity of ownership, uncertainty and lack of credit because of their long gestation.

The importance of security of ownership for investment, long-term productivity, and conservation cannot be overemphasized. The World Bank (1985), based on its 40 years of experience in lending for agricultural development around the world, has concluded that:

"How farmers use land is greatly affected by the degree of security of land-tenure -- with respect to such matters as duration of user rights, clarity of land rights, ability to sell these rights or to pass them on to succeeding generations, and ability to obtain compensation for investments. A farmer with unclear, insecure, or short-term tenure is more likely to "mine" the land, that is, to seek maximum short-run production gains through crop rotations and other practices that may degrade the biological and physical qualities of the soil."

The large percentage of agricultural land under insecure tenure in Thailand, the Philippines, Indonesia and parts of South Asia and Africa is partly due to the open access status of public forest lands. In the absence of enforcement of state ownership, forest land has been effectively made available for agricultural expansion free of charge. As an unpriced resource, forest land for agricultural expansion is in high demand and increasingly short supply as the limits of the land frontier are being approached. Yet, in the absence of secure and transferable titles, an efficient land market for encroached land failed to develop, and consequently, increasing land scarcity did not lead to higher prices and increased land conservation. Thus, we have a dual failure of the market to bring about the efficient allocation and use of land resources. First, an excessive acreage of forest land is being cleared even when its best use is in forestry rather than in agriculture. Second, cleared land is not used efficiently because of the insecurity of ownership discussed earlier. Moreover, the availability of free land discourages land investment even on securely owned lands because it biases relative prices in favor of extensification and against intensification.

Insecurity of land tenure and lack of access to credit have both on-farm and off-farm environmental consequences that result in further reduction of productivity. The on-farm environmental effects are soil erosion, nutrient leaching and waterlogging resulting from inadequate incentives (and funds) to invest in drainage and soil conservation practices. The off-farm effects are further encroachment of marginal lands and watersheds because of

inability to maintain yields on existing agricultural lands. This results not only in loss of valuable forest resources but also in soil erosion and sedimentation of downstream irrigation systems.

Given these detrimental consequences of insecurity of land ownership on land productivity, on the owners income and wealth, and the quality of the environment, governments have a critical role to play in improving security of ownership. Empirical evidence (see Feder et al.) suggests that the benefits of providing secure titles far exceed the costs. Unfortunately, well-intentioned governments have been exacerbating uncertainty and insecurity by talking about land reform rather than effectively carrying it out while ignoring other politically more acceptable and economically more efficient means of improving land distribution (e.g., land taxation). Graduated, progressive land taxation has been effectively used in Japan to effect a land reform without creating the kind of uncertainty that paralyzes long-term investments in the Philippines today. Moreover, since much of the wealth in developing countries is held in the form of land, and land value benefits from rural infrastructure, such as roads and irrigation, it is possible and appropriate to use land taxation as the principal source of financing of the operation and maintenance of rural infrastructure. At present, land taxes are nominal and little or no tax revenue is derived from land, partly because of the lack or inadequacy of land cadastre, lack of enforcement and very low tax rates.

Well-meant government policies that limit property rights to fixed-term use rights, and prohibit their transferability or tie the land granted through land reform to state trading, price controls or forced cooperatives create unnecessary uncertainty and diminish the value of these rights. Such land is not likely to be put to its best use. Concerns about land purchase and accumulation by land speculators can be dealt with through a land sales tax and a progressive property tax.

3.4 Water Policy Failures

A third example of a resource-specific policy that needs to be reformed to reestablish the broken link between scarcity and prices is water policy. Virtually all countries, regardless of

the degree of scarcity of water, subsidize water for irrigation (and other uses) and, in many cases, they supply it free of charge. Take the example of Thailand. Both seasonally and spatially, Thailand experiences droughts and floods. Northeast Thailand suffers from perennial water shortages. The Central Region is inundated in the rainy season and imports water from the Northern Region in the dry season. Only 30 percent of the irrigable area covered by the Greater Chao Phraya Project has adequate irrigation in the dry season. Yet this profound and growing water scarcity does not register. According to the National Resources Profile (TDRI, 1987), "many farmers continue to think of water as a free, virtually unlimited resource whereas the facts increasingly suggest otherwise." Irrigation water is provided free of charge without any attempt to recover cost or to charge a price reflecting the scarcity value or opportunity cost of water. The result is overirrigation with consequent salinization and waterlogging in some areas and inadequate water in others. This gross waste of water limits the efficiency of irrigation systems to about 15 percent of a potential of 60 to 70 percent (ADB, 1984), while the failure to achieve any degree of cost recovery deprives the system of operation and maintenance funds.

Similar problems of growing water scarcity are also found in Indonesia which ranks second in the Asia/Near East (ANE) region in terms of freshwater endowment. Densely populated Java faces increasing water shortages that are being addressed through supply rather than demand management. But the area that is facing the most critical water scarcity is the Near East. According to Elias Saleh, a hydrologist with Jordan University, "In the mid 1990s farmers in the high plains and in the swelter of the Jordan Valley will face a crisis because the growing population will lay claim to water for drinking, and irrigation will be curtailed.... Water is the future of the whole area...It is very critical" (New York Times, April 16, 1989, p. 1). Virtually all Near East countries but particularly Egypt, Yemen, Jordan and Tunisia face severe water shortages, yet water continues to be subsidized throughout the region, and water efficiency is unacceptably low. In Egypt, where 30 percent of the irrigated lands suffer from salinization and waterlogging due to overirrigation (FAO, 1980), "efficiency ratings will have to increase by 60 percent over the next 11 years to meet the needs of the population, projected to

reach 70 million in the year 2000" (New York Times, April 16, 1989, p. 1). According to the same source, "Jordan is expecting a water crisis within a decade and dearth of new water resources by the year 2005."

3.5 Urban-Industrial Environment: Market cum Policy Failures

Industrial development and urbanization are highly correlated. Industries in many developing countries (and some developed ones) are often located in or near urban centers because of the skewed distribution of public infrastructure (roads, electricity, telephones, government offices, etc). About half of the industrial value added of countries as diverse as Brazil, Thailand, and Egypt comes from industries located in their largest urban centers (see Case 2). Correspondingly, industrial pollution is concentrated in and around urban centers such as Mexico City, Sao Paulo, Cairo, Bombay, Bangkok, and Manila. Thus, it is often difficult to determine what part of observed environmental degradation is caused by industrialization and what part by urbanization.

Increased urbanization (and industrialization) in the 1990s will exacerbate already serious problems of crowding and water and air pollution in cities such as Manila, Bangkok, Jakarta, Delhi, Calcutta, Cairo, Casablanca, Mexico City and Sao Paulo. This means that more emphasis and resources must be devoted to addressing urban environmental problems than have been the case in the past.

Regardless of urbanization, to employ the additional labor force in the 1990s more emphasis will be placed on industrial development, thus increasing the production and disposal of hazardous toxic chemicals and wastes. This is already a major problem in India, Thailand, the Philippines, Egypt, Mexico, and Brazil. Similarly, the intensification of agriculture to accommodate larger numbers on the same land will inevitably lead to increased use of toxic agricultural chemicals, which presents a new set of problems for policy makers. Indonesia has already had a dramatic experience with agricultural pesticides, as has India with industrial hazardous chemicals.

Industrialization is certain to have environmental implications not only for the urban centers but also for the rural areas. The impact of industrialization on the rural environment will depend on labor intensity, location and type of industry. Labor-intensive industry if combined with appropriate location and educational policy is likely to attract labor out of the marginal and fragile areas and thus reduce the pressure on natural resources. Capital-intensive industry would have little or negative impact on the rural environment.

Urban and industrial environmental quality is clearly an area of massive market failures. The urban environment is an unpriced common property resource; environmental pollution is a public externality whose internalization involves prohibitively high transaction costs because of the millions of polluters and affected parties involved. Pollution abatement and its product, environmental quality, are public goods that cannot be provided by a free market because of inability to exclude and hence inability to finance.

While there is an increasing recognition of environmental problems in urban centers around the world as evidenced by increasing regulation of industrial pollution, the environment is still treated by both households and industries as an open access space for free disposal of wastes. In many countries, large industries are required to submit environmental impact studies before their establishment and meet certain emission standards during their operation, but effective enforcement is lacking. Moreover, the far more numerous small industries and millions of households continue to enjoy free disposal of waste into the environment. Urban centers in developing countries lack sewage treatment facilities. Unrestricted air and noise pollution from public and private automobiles is another example of the use of the environment as a free and open access resource. Similar is the perception and use of the environment by farmers who release water contaminated with toxic fertilizers and pesticides into the main water source. Free disposal of wastes is tantamount to a lack of property rights over the environment or use of the scarce assimilative capacity of the environment free of charge. Unpriced or open access resources are commonly overused, underconserved, and mismanaged.

Environmental pollution is a classic case of a public externality. It originates from a variety of sources including discharges of domestic wastewater, community solid wastes, industrial

waste effluents and wastes from agricultural activities such as runoff of excess pesticides and fertilizers. It affects a variety of economic activities including industry, fisheries, tourism, and urban development, as well as the general quality of life. Thus, excessive environmental pollution constitutes both a misuse of an unpriced or open access resource and a negative externality on sectors and individuals who may or may not be parties to the pollution-generating activity. This is so because the environment serves both as the recipient of the residuals of economic activity and the medium which transmits offsite effects to second and the third parties. Externalities created by economic activity in one area proliferate and become widespread via the environment. As countries become increasingly industrialized and urbanized, the environment is used beyond its assimilative capacity to dispose of the byproducts of economic activity, and, as a consequence, environmental quality deteriorates. Even agriculture, usually thought of as more benign to the environment than industry, is becoming a major source of pollution as it becomes more intensified through the use of mechanical and chemical inputs (toxic fertilizers, pesticides, fossil fuels, etc.). At the same time, as the supply of clean environment declines, the demand for environmental quality rises as a result of income growth. Thus, while the significance of forests, land, and water as inputs into the production process may decline somewhat with industrialization, urbanization, and agricultural intensification, their significance as assimilators of industrial, urban, and agricultural waste and as sources of environmental amenities is certain to rise.

Further industrialization and agricultural intensification, however, will not necessarily cause further environmental degradation. It depends on the type of the new or expanded industries, their spatial distribution, their input mix and technology and the incentive structure and environmental regulations introduced by the government.

Under the direct regulatory approach, the government sets maximum permissible levels of discharge of each pollutant from each source (effluent or emission standards) and relies on administrative agencies and the judicial system to enforce them. An alternative (or supplementary) type of standard is the ambient standard which sets the minimum acceptable level of environmental quality for a receiving water source or airshed. In the US, both

standards are used in water pollution in combination with heavy subsidies for construction of waste treatment facilities.

Incentives, such as tax writeoffs, accelerated depreciation, low interest loans or outright subsidies for the adoption of "clean" production technologies or the construction of waste treatment facilities are similarly inefficient and ineffective. They do not make waste reduction or waste treatment any more profitable; they simply subsidize the producers and consumers of the products of these industries. Waste treatment is not always the most efficient means of reducing wastes; in many cases changing production processes, the type and quality of raw materials or the rate of output is more efficient. In some instances, rearrangement of the production process results in both reduction of waste and recovery of valuable by-products such as fertilizer from palm oil extraction and syrup from fruit canning. Tax breaks, credits, depreciation allowances, and subsidies are a drain on the government budget and a disincentive to industries which might have otherwise developed more efficient methods for reducing emissions.

This direct regulation and subsidization suffers from many weaknesses: (a) it relies on centralized setting and enforcement of standards which is both costly and ineffective; (b) it promotes inefficiency since it requires similar reduction of pollution of all sources regardless of costs; (c) it emphasizes subsidized end-of-the pipe, capital-intensive solutions (such as waste treatment plants); (d) it results in large bureaucracies and costly subsidies; (e) it requires that the environmental agency masters the technologies of both production and pollution control for hundreds of different types of industries and all their technological alternatives, a monumental task that detracts from the agency's principal monitoring functions; (f) compliance is very limited because the certainty-equivalent amount of the fine (fine times the probability of detection times the probability of conviction) for non-compliance is only a fraction of the cost of compliance in terms of expensive abatement equipment and loss of competitive position; (g) the environmental agency is engaged in endless negotiations with the polluters over the type of equipment to be installed resulting in long delays and compromise of the agency's standards; (h) the moral hazards of "regulatory capture" (the regulators are coopted by the regulated) and

bribing of enforcement officials is higher than in any other pollution control system because of the protracted negotiations and ambiguity of compliance to the set standards; and (j) direct regulation provides ample opportunity for rent-seeking behavior.

Urban congestion and pollution increasingly dominates the life of large urban centers. Bangkok's commuters spent an average of 2.5 hours in crowded buses and congested roads, while school children in Mexico City start school late to avoid the morning smog (Economist, February 18, 1989). The policy response to congestion problems range from supply management (build more roads, introduce one way traffic, etc.) to rationing the use of scarce roads by doing nothing. Supply management works only temporarily: to the extent that congestion and traffic jams are relaxed by new roads, the benefits from driving increase inducing car-owners to drive more and non-owners tend to purchase cars. As long as open access to city roads prevails, any rents from using them will be driven to zero. And, this is the basis of rationing by doing nothing; delays are left to become long enough to discourage any further increase in driving. However, this is a very inefficient solution. Costs include: (a) loss of productive time, (b) increased use of fossil fuels, (c) increased air pollution (with all the associated health problems, medical bills, and cleaning costs), and (d) increased noise pollution, not to mention the frustration and psychological costs. Ultimately those who are left using the roads are those who value least their time (low opportunity cost). A rough calculation of the lost time and increased use of gasoline for Bangkok produced an estimated loss of \$1 billion a year. Medical bills and lost days of work due to pollution-related ailments, cleaning costs, damage to infrastructure and buildings from increased pollution and the extra cost that consumers incur for noise insulation, air conditioning of cars and houses that would not have taken place otherwise may double this figure. If we conservatively put the total annual costs of congestion at \$1.5 billion and capitalized this figures at a 10% interest rate, we obtain a present value of congestion cum added pollution cost of \$15 billion. Only a fraction of this amount would suffice to provide Bangkok with a clean and efficient public transport. Charges for the use of city center roads and surcharges on gasoline can be set high enough to hold traffic down to levels that permit it to move freely, and the proceeds can be used to improve

public transportation. Singapore has introduced a road pricing system whereby drivers purchase a permit to enter the city center during rush hours; buses and car pools are excluded, making the system not only efficient but also equitable (see Case 12).

3.6 Industrial and Trade Policy Failures Leading to Environmental Degradation

Industrial and trade policies may seem only remotely related to natural resource use and management, but they are in fact critical, because they affect: (a) the terms of trade between agriculture and industry and therefore the relative profitability of agriculture and other resource sectors; (b) the use of natural resources as an input in industry; (c) the level of industrial employment and hence the residual rural labor that exerts pressure on natural resources; and (d) the level of industrial pollution.

Agriculture's terms of trade in the ANE region have deteriorated over the years because of heavy protection of industry through import tariffs and investment incentives which reinforced the adverse effects of agricultural taxation. Adverse terms of trade for agriculture appear to be conducive to natural resource conservation since the less profitable agriculture is, the less intensively and extensively land and water resources are used and the less agricultural chemicals are applied. However, this may not be the case in labor-abundant economies, dependent on agriculture for employment of the majority of the labor force.

For the pressure on the agricultural resource base to be reduced the number of people depending on agriculture must be reduced through labor movement into other sectors. Unfortunately, the increased relative profitability of industry often fails to attract much labor out of agriculture and other resource sectors because of the capital intensity and the urban bias of the promoted industries. Subsistence farmers and landless unskilled laborers faced with sliding real incomes, due to increasing land shortages (diminishing average holdings) and labor surpluses (low real wages), are in a constant search for supplementary and/or alternative sources of income. Open access natural resources such as forests and forest land, inland and coastal fishing grounds, mineral-bearing lands and offshore areas, and the natural environment are the most conveniently accessible sources of supplementary or alternative employment and income. Additional income is earned through the gathering of fuelwood and other forest products, fishing and the collecting of minerals by underemployed members of the household. Illegal logging and poaching of logs or working for illegal loggers often yields substantially higher income than legal employment, if such can be found. The size of land holdings is

maintained and sometimes increased by clearing additional forest land. Thus, the availability of open access resources helps halt the drop in incomes resulting from rapid population growth and slow rural development. When open-access resources in the vicinity of a rural community run out, migration to other areas where open access resources are found takes place. One of the major destinations of migration are the main urban centers where it results in squatting on public property, creation of slums, crowding, hawking and general environmental degradation.

The reduced profitability of agriculture as a result of industrial protection also results in reduced incentives for investment in farmland development and soil conservation both because of reduced returns to such investments and because of reduced savings. Moreover, the promotion of industry at the expense of agriculture does not necessarily reduce the use of natural resources. Many industries are indirectly resource-based, e.g., agroprocessing, furniture production, and mineral processing including cement, fertilizer, and gas separation. Industrialization certainly increases energy use both in absolute terms and relative to other inputs, as well as increasing the output of industrial waste. The type of urban-based, capital incentive industry promoted by industrial and trade policies is more resource-intensive (creating more air, water, and noise pollution) at the margin than the low input agriculture that is being displaced, (not considering forest land clearing which tends to be exacerbated rather than discouraged by industrial policies that limit industrial employment).

To date, environmental considerations have played little role in the formulation and implementation of industrial and trade policies partly because the connection has not been obvious and partly because policy changes are made in response to crises or immediate political pressures which do not afford consideration of long-term consequences. However, in the context of sustainable development, ignoring the impact of sectoral and trade policies on resource use and management can be self-defeating. For example, protection and credit subsidies for urban-based capital-intensive industries, combined with agricultural taxation to squeeze increasing surpluses out of agriculture and speed up industrialization, may backfire. Because the industry in its early stages depends heavily on agriculture for food, materials capital, foreign exchange and markets for its products, policies that promote industrialization

too heavily, at the expense of agriculture, undermine the country's industrial base. Equally important, such policies promote inequality, underemployment and scarcity of rural credit, thereby discouraging investments in land conservation and encouraging encroachment of forest lands. Moreover, the consequent social tensions do not constitute a sound basis for sustainable development.

The most important industrial policy reform necessary is the restoration of the comparative advantage of labor-intensive industry vis-a-vis the highly protected and promoted urban based capital-intensive manufacturing. The best solution would be a sweeping reform of biased industrial and trade policies. For political reasons such reform may not always be feasible. Given the dimensions and the urgency of the employment, poverty and resource mismanagement problems and the untapped potential of rural industry, a pragmatic second-best policy would be development assistance to rural, labor-intensive industries to create off-farm employment opportunities as an alternative to encroachment and destructive resource exploitation.

To be successful the promotion of rural industries should build upon the basic features of the rural areas: availability of raw materials, seasonality of labor supply and dispersion of markets. The emphasis should be on restoring a competitive environment between the rural and urban areas by improving infrastructure, making credit available at competitive rates, providing technical assistance and market information, and assisting in skill development.

Three other industrial policies that need reconsideration in the light of their environmental costs are: (1) depreciation allowances, tax rebates and tariff exemptions on equipment and materials which might be a major source of pollution; (2) energy subsidies that may favor more polluting sources of energy over less polluting ones; and (3) the criteria for approving direct foreign investment (prior screening based on the record of particular firms or industries elsewhere may be more effective than after-the-fact environmental impact assessments).

3.7 The Effects of Macroeconomic Policies on Environmental Degradation

Monetary, fiscal and foreign exchange policies seem even further removed from natural resource management than industrial and trade policies. Yet, they may have more powerful effects on how resources are being allocated and used than micro or sectoral policies. For example, other things constant, the higher the costs of inputs of capital and labor used in resource extraction or in polluting industries, relative to the price of outputs, the lower the rate of resource depletion and the amount of pollution. If capital-intensive technologies are more polluting than labor-intensive technologies, the lower the price of capital relative to labor the more pollution will result.

The rate of interest is an important macroeconomic parameter with microeconomic implications for resource allocation because it links the present with the future. The higher the interest rate (or discount rate) the higher the cost of waiting and, therefore, the faster the rate of resource depletion and the lower the investment in resource conservation. However, this effect may be mitigated somewhat by the fact that a higher interest rate means a higher cost of capital, which tends to reduce capital-intensive resource depletion and environmental degradation. Interest rate ceilings and implicit interest rate subsidies for promoted industries have been the main interest rate distortions affecting the agricultural sector and the rural economy in general. Credit policy has relied mainly on mandates, quotas, interest rate ceilings and constrained use of loan proceeds. Yet, there is growing evidence that farmers would prefer more flexible terms and increased credit availability even if they had to pay higher interest rates. The liberalization of the capital market is critical to land improvements, reforestation investments, resource conservation, agricultural intensification and the growth of the rural industry.

As most of the resource-based commodities produced in developing countries are internationally tradable (e.g. copper, oil, jute, cotton, tin, fish, rice, beef, rubber, timber) or are substitutes for tradable commodities (e.g. natural gas, lignite, hydropower), an overvalued exchange rate would reduce their depletion by reducing their price relative to non-tradable goods (e.g. transport, services, construction). An overvalued exchange rate and export taxes

have similar effects in that they discourage exports (and encourage imports) of resource-based commodities, thereby reducing the pressure on the domestic resource base.

Minimum wage laws (which also encourage capital intensity) reduce labor employment and depress real non-manufacturing wage rates. This, under conditions of labor abundance, leads to a) increased use of low-cost labor in depleting natural resources, and b) encroachment of resource sectors by unemployed or underemployed labor.

Therefore, even if the issues of open access and externalities are satisfactorily resolved, resource depletion and environmental deterioration may continue unless the macroeconomic policies responsible for price distortions in the economy are reformed. The unintended but pronounced effects of fiscal, monetary and trade policies on natural resources and the environment must enter the assessment and formulation of these policies. The effects of minimum wage rates, subsidized credit, interest rate ceilings, and exchange rate adjustments (along with those of export taxes, investment incentives, and import tariffs) on the rate of resource depletion in a resource-based economy cannot be ignored without endangering the long-term viability of the economy.

It would be outright unrealistic, however, to expect macroeconomic policies to be tailored to meet environmental objectives because of the many other overriding considerations, such as growth stabilization and macroeconomic management, which determine these policies. What can be expected, at best, is that environmental implications are somehow taken into account when these policies are being formulated and implemented. Consideration of the resource and environmental implications of macroeconomic policies could result in one of the following consequences: (a) environmental costs may tip the scale against marginal policies by raising their social costs above their social benefits; the reverse may happen with policies that have positive environmental effects; (b) macroeconomic policy interventions might be scaled up or down on account of their environmental implications; and, (c) provisions might be made for cushioning the negative environmental effect of policies when such policies cannot be scaled down sufficiently to reduce their environmental cost to acceptable levels.

On the other hand, macroeconomic mismanagement is as detrimental to natural resource management and environmental quality as it is to the other sectors of the economy. Mounting foreign debt, widening balance of trade deficits, hyperinflation, rising interest rates, low savings, negative growth of investments and growing budget deficits work their way through economic stagnation, increased poverty, structural reversal and shortening of the planning horizon (increase in the discount rate) to encourage environmental degradation. Environmental degradation arising from macroeconomic mismanagement is more common in Africa and Latin America than in Asia.

To help governments restructure their economies to better deal with the emerging problems, the World Bank, the International Monetary Fund (IMF) and other international development agencies have been financing structural adjustment loans (SALs) and sectoral adjustment loans (SECALs). For several reasons it is important to consider the impact of these structural and sectoral adjustment programs and loans on resource management and sustainable development: (a) these adjustment programs more or less define the macroeconomic and sectoral policies to be followed for a good part of the 1990s and, as we have seen, macroeconomic and sectoral policies affect resource allocation and use; (b) since these programs aim to restructure the economies of the region, their impact will extend far beyond the expiration of the programs and loans; and (c) for the first time, environmental concerns have been raised by several countries and development assistance agencies in the context of macroeconomic and development policies and some provisions relating to natural resources and the environment have been included in the loan agreements. Regardless of the adequacy or effectiveness of these provisions, the mere recognition of the implications of macroeconomic, trade, and development policies on the resource base and the environment is a significant step in the right direction. Yet, questions have been raised as to the overall impact of structural adjustment policies on the environment.

3.8 The Effects of Structural Adjustment Programs on Environmental Degradation

The impact of sectoral and structural adjustment loans on environmental degradation is a substantial topic that cannot be addressed fully in this study. However, because of its importance we will consider for illustration the possible effects of trade, industrial and agricultural reforms on the environment.

Overall, trade and industrial policy reforms amount to promotion of exports, liberalization of imports and encouragement of foreign investment. This is done by reducing absolute and differential protection, lowering production and transactions cost of exports and imports and promoting competition through institutional reform.

The environmental effect of these policies operates at several different levels. To the extent that these policies generate economic growth, create additional employment and reduce poverty, they help improve environmental conditions in the country. Increased exports of primary commodities may have the reverse effect unless the prices of inputs and outputs involved fully reflect the true scarcity of resources being used and the environmental costs incurred. Similarly increased industrialization and foreign investments are not detrimental to the environment as long as all environmental costs have been accounted for (internalized) and no major irreversible changes to the environment take place. Countries could use tariff reform as an opportunity to favor import or manufacture of environmentally benign technologies and machinery and discriminate against highly polluting technologies. Similarly environmental conditions should be specified as part of any foreign investment project at the time of application and monitored as part of regular performance evaluation. Environmental conditions include industrial location, waste disposal, pollution control, accident prevention and site rehabilitation. Environmental regulations may also be supplemented by emission standards, effluent taxes, or pollution permits. However, there is a limit to how restrictive a developing country can be and still attract the desired level of foreign investment since foreign investment is likely to gravitate to where environmental controls are less restrictive.

To ensure that industrial and trade policy reforms result in relative if not absolute environmental improvement, the import tariff structure should be used to internalize environmental costs into the pricing of technologies and products.

The environmental effects of industrial and policy reforms taken by themselves are rather ambiguous. On the one hand, to the extent that these policies generate economic growth, create employment and alleviate poverty, they help improve the environmental conditions in the country. On the other hand, to the extent that they lead to intensified exploitation and export of natural resources at prices which do not reflect the true resource cost to the country, they lead to deterioration of environmental conditions (timber exports from Indonesia and cassava exports from Thailand are cases in point). Similarly the environmental effect of accelerated industrialization and foreign investment depends on the type of new industries, their capital and energy intensity, their location and the enforcement of environmental regulation in the country. In the absence of such regulations and effective enforcement, promotion of low-cost manufactures and encouragement of foreign investment leads to increased industrial pollution. Examples abound but the cases of Bangkok, Manila and Cairo will suffice.

Acceptance of increased levels of pollution and other environmental costs in exchange for economic growth, employment, foreign exchange and government revenues is a legitimate tradeoff as long as all environmental costs are internalized. Where environmental costs cannot be adequately internalized into the economic costs and benefits of, for example, foreign investment there should be explicit determination of the relevant tradeoffs. We know of no structural adjustment program that attempts to either internalize environmental costs or determine these important tradeoffs.

Agricultural policy reforms involve: (a) increases in producer prices and reduction of taxes on agricultural exports to improve incentives for agricultural production; (b) changes in relative prices by reducing price support for certain crops (e.g., sugarcane in Morocco) or reducing taxes for others (rice and rubber in Thailand); and (c) reduction in agricultural input subsidies to reduce the drain on the budget, save foreign exchange (where inputs are imported) and

improve the efficiency of resource use (e.g., Philippines, Nepal and Morocco). The environmental impact of such reforms depends on the crops and inputs that are promoted or discouraged by these policies, and the institutional context in which they are implemented. If land is securely owned and forests are effectively protected and managed better prices for agricultural crops in general would lead to increased investment in land improvement, soil conservation and agricultural intensification. Otherwise, the very same policies may lead to increased forest land clearing, cultivation of marginal lands and agricultural extensification. On the other hand, changes in relative crop prices could benefit or damage the environment depending on the affected crops and the environmental conditions in which they are grown.

For example, the reduction of the price support for sugarcane in Morocco has a positive environmental impact because sugarcane is a soil-damaging and water-intensive crop in a water-scarce country. Thus, less price support for sugarcane stipulated by Morocco's SAL results not only in less drain on the budget, but also in less drain on soil and water resources. The market is, thus, more free to respond to market signals and shift resources (land and water) to more profitable crops, making a better use of limited natural resources with less damage to the environment.

Reduction of export taxes on certain crops such as tree crops helps diversify the economy away from soil-eroding crops such as maize, wheat or cassava and towards high value perennial export crops with positive environmental side effects. The irony in the case of Thailand is that high rubber prices and free forest land have encouraged overexpansion of rubber onto steep and fragile slopes contributing to the catastrophic landslides and floods of 1988 that claimed 350 lives and caused nearly half a billion US dollars in short and long-term damages. This case clearly demonstrates that economic incentives that have positive environmental effects under certain conditions, may be environmentally destructive under a different set of circumstances. Increased incentives for perennial crops (coffee, cocoa, rubber) vis-a-vis annual field crops such as cotton, ground nuts, or row crops such as maize and sorghum can help protect the soil on gentle slopes but are not a substitute for natural forest

cover on steep or fragile slopes. Countries such as Nepal, Thailand and Morocco have introduced programs as part of (or parallel to) their structural adjustment programs.

Reduction of agricultural input subsidies, also an integral part of structural adjustment policies, generally has a positive impact on the environment. The Philippines, Nepal, Pakistan, Morocco, and Tunisia have all agreed to substantially reduce pesticide and fertilizer subsidies. Judicial use of both pesticides and chemical fertilizers has helped countries increase their crop yield on existing land substantially (Pakistan, Indonesia, Philippines), thereby limiting encroachment of forest lands. However, the excessive and indiscriminate use of pesticides encouraged by generous subsidies has proved counterproductive by eliminating the pests' natural predators or promoting the emergence of pesticide-resistant strains of pests. Similarly, overapplication of chemical fertilizers over a prolonged period of time, to the total exclusion of organic fertilizers (manure), damages the structure of the soil. Heavy use of pesticides and chemical fertilizers also leads to water pollution and poisoning of aquatic life through runoff into the water systems. It does not matter that chemical subsidies have been cut to reduce the drain on the budget; their reduction also reduces the drain on the environment. Ideally, however, environmentally destructive inputs (pesticides, chemical fertilizers) should be taxed in proportion to their negative externalities, and environmentally beneficial inputs (IPM, organic fertilizers, soil conservation) should be subsidized in proportion to their positive externalities. However, there is no such provision in structural adjustment programs; any positive environmental effects of such policies are incidental rather than integral to these programs.

To the extent that structural adjustment programs require water pricing to improve efficiency in resource allocation or cost recovery to reduce budget deficits, water resources are being conserved and environmental costs are being reduced. Not only is salinization and waterlogging contained but more importantly the solution of water shortages through demand management averts the environmental problems of constructing new irrigation systems (supply management).

Structural adjustment programs also call for reductions in subsidies (or import duty exemptions) for farm equipment and land clearing machinery, again as part of their objective

of reducing budget and trade deficits and eliminating policy-induced distortions. This policy reform has several positive effects on resource use and the state of the environment because subsidized land clearing machinery: (a) encourages deforestation and the clearing of marginal lands for agriculture; (b) compacts and damages the structure of fragile tropical soils; (c) increases the use of fossil fuels; and (d) distorts the farmer's labor-capital choice in favor of capital and against labor in countries with abundant labor. Aside from the economic inefficiency and misallocation of scarce capital that the latter entails, it also reduces agricultural employment thereby promoting encroachment of forest lands or undue urban migration.

Structural adjustment policies also require reduction of agricultural credit subsidies as in the case of the Philippines and Tunisia. The impact of this measure is somewhat ambiguous. If credit subsidies are benefiting large farmers and ranchers engaged in large scale land clearing (as is more the case in Latin America than in Asia or Africa) reduction of these subsidies clearly reduces environmental degradation. If, on the other hand, credit subsidies are benefiting small farmers who have inadequate funds for intensification on existing lands, and investment in land improvement and soil conservation, any reduction of these subsidies will induce more soil "mining" and forest land encroachment than is currently the case. However, even in the case of the small farmer, there are superior policies to outright credit subsidies, which are in any case fungible and can be used for other purposes. Removal of interest rate ceilings, issue of secure land titles that can be used as collateral, and increased credit availability at competitive rates are better for the farmer, the budget and the environment than credit subsidies, because they optimize the use of both capital and land. Credit subsidies are an incentive to borrow but not an incentive to invest in soil conservation or tree planting if the farmer has no security of land ownership.

4. Policy Successes that Control Environmental Degradation

Policy success is defined as a government intervention, or elimination of one, that improves the allocation of resources and reduces the degradation of the environment. Policy successes may be classified into three groups:

- (a) Reduction and eventual elimination of policies (taxes, subsidies, quotas, public projects) that distort well-functioning markets or exacerbate market failures. Cases in point are the elimination of the pesticide subsidies in Indonesia and the ranching subsidies in Brazil (see Cases 5 and 1).
- (b) Correction or mitigation of market failures through interventions that improve the functioning of the market or result in outcomes superior to those of the free market. Examples include the introduction of water pricing in China and road pricing in Singapore (see Cases 3 and 12).
- (c) Consideration and internalization of environmental, social and other side effects of public projects and sectoral and macroeconomic policies. Examples include the Dumoga irrigation case cum national park project in Indonesia and the inclusion of environmental provisions in several structural adjustment programs (see Case 6).

Governments around the world are increasingly recognizing the growing threats to the sustainability of the growth process arising from environmental degradation. Concerns have been raised in international forums and structural adjustment negotiations with development assistance agencies about environmental problems and the implications of macroeconomic policies for the environment.

Issues of deforestation, watershed destruction, soil erosion, insecure land use, excessive pesticide application, and inefficient water use have been raised in virtually every country. Issues of more localized interest include shifting cultivation in Southeast Asia, overgrazing in Africa and the Near East, waterlogging in South Asia (Pakistan) and the Near East (especially Egypt), and cattle ranching subsidies in Latin America (Brazil), and desertification in the arid lands of India, the Middle East and Africa.

In response to these concerns governments have introduced changes in existing policies as well as new policies and programs to deal with growing environmental problems. Particularly encouraging is a growing shift towards reduction and gradual elimination of pesticide and fertilizer subsidies that have been responsible for both misallocation of resources and environmental pollution. The radical change in Indonesian policy towards pesticides in recent years is a case in point. Following economic analysis that showed negative returns from insecticides and agroecological research that confirmed the link between insecticide use and the surge of brown planthopper that threatened 70 percent of Java's rice, a Presidential decree (INPRES 3, 1985) banned 57 registered brands of broad spectrum insecticides, 20 of which were heavily subsidized by the government. The same decree declared integrated pest management as the national pest control strategy for rice (see Case 5 for details).

More recently, there has been a shift towards reducing subsidies in the Philippines, Pakistan, Tunisia and Morocco. In many cases, the pressure comes more from a need to reduce the burden on the budget rather than the burden on the environment, although the latter is increasingly an added dimension as pesticide and fertilizer subsidies are brought out in macroeconomic and trade policy reform discussions and SAL negotiations. Sebastian and Alicbusan (1989) report that the Philippines, Nepal, Morocco and Tunisia have agreed to reduce their fertilizer subsidies as part of SAL packages.

In a parallel move, Brazil has recently reduced or eliminated most of the credit subsidies and tax breaks for the conversion of natural forests in the Amazon to privately lucrative but socially unprofitable ranches (see Case 1). Tunisia, Morocco, Nepal and Thailand have recently accelerated their land titling programs to improve security of land ownership (see Case 15).

Increasingly, policy successes, though still far fewer than policy failures, are easier to find. Papua New Guinea recognizes and protects customary communal tenure over land and forest resources (see Case 10). Indonesia, with assistance from the World Bank, uses water pricing to improve irrigation efficiency and to fund the management of a watershed area which has been declared a National Park (see Case 6). Singapore uses marginal cost pricing to control urban

congestion (see Case 12), while China has introduced water pricing to deal with water shortages (see Case 3).

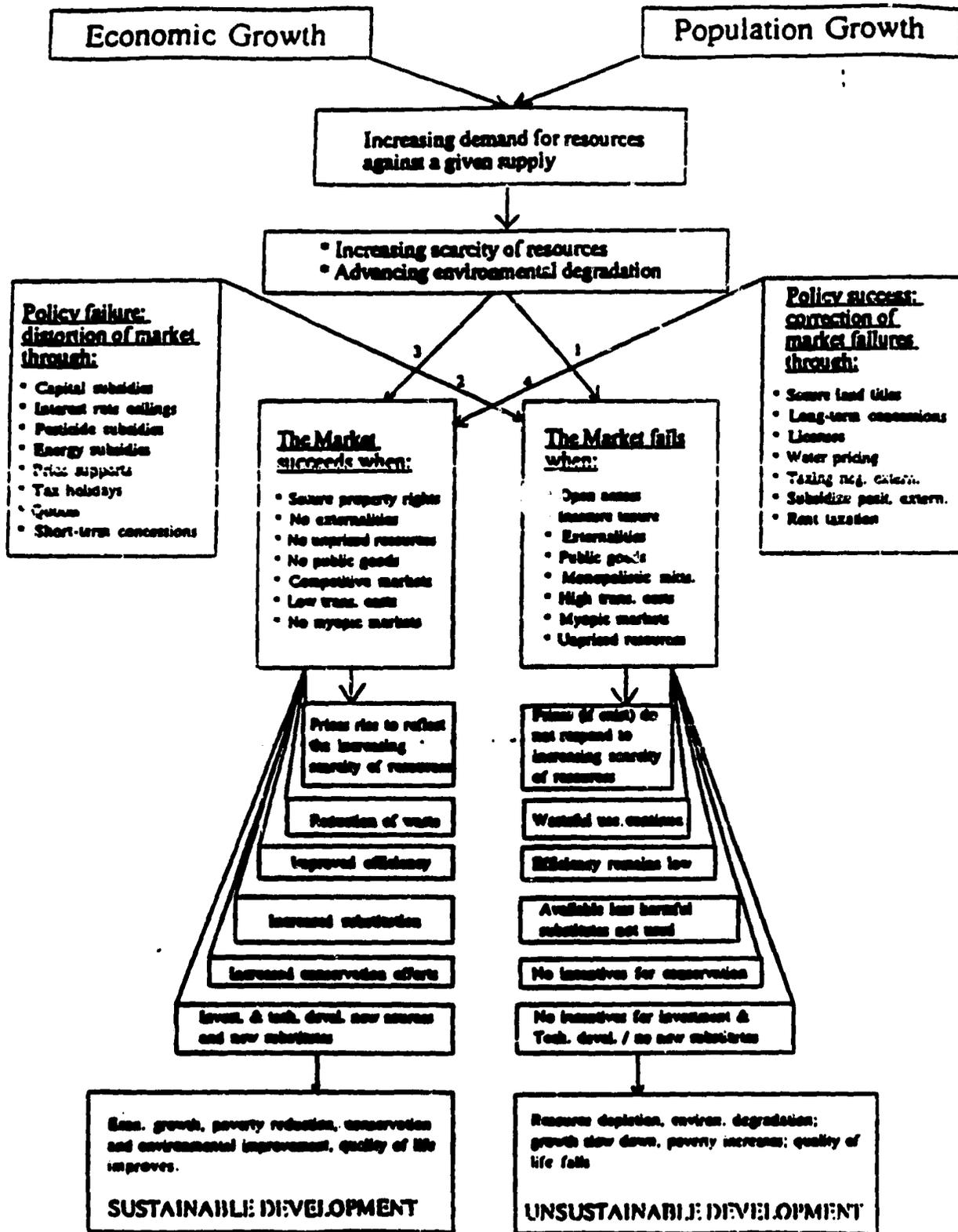
5. Needed Policy Reforms

Policy reform is simply the restructuring of government interventions from areas of policy failure to areas of policy success (see Figure 1). The absolute level of government intervention may not change and may in fact decrease depending on the relative magnitude of market distortions to be eliminated relative to market failures to be corrected or mitigated.

Our analysis of environmental degradation reveals three root causes of natural resource depletion and environmental degradation: policy distortions, market failures, and inadequate investment in human resource development and employment alternatives. These root causes also point towards the type of policy overhaul that is necessary to improve resource management and make the development process more sustainable. A comprehensive policy reform would have five components:

- 1) elimination or at least reduction of policy distortions that favor environmentally unsound practices, at the same time as they discriminate against the poor, reduce economic efficiency and waste budgetary resources;
- 2) correction or at least mitigation of market failures such as externalities, insecurity of ownership, and absent or imperfect markets that result in overexploitation of resources, through a system of institutions, incentives, regulation and fiscal measures;
- 3) investment in human resource development and rural industry to provide alternative employment to disadvantaged groups such as shifting cultivators, landless farmers, and underemployed workers, to lessen the pressure on natural resources and their use as a last resort activity;
- 4) application of a broad social cost-benefit analysis to all public projects by: (a) casting them in the overall sectoral and macropolicy context; (b) taking into account all benefits and costs, whether near or distant, whether economic, social, or environmental, and whether

Figure 1. Policy and Market Successes and Failures in Responding to Increasing Resource Scarcity and Environmental Degradation



quantitative or qualitative; and (c) avoiding projects that lead to irreversible changes of the environment or foreclosure of options; and

5) building of analytical capability and institutional capacity for analyzing, formulating and implementing policies and projects that have environmental dimensions.

While this is a tall order to follow and requires considerable political will, a movement in this direction is both necessary and feasible. It is necessary because the current situation is clearly untenable: the current trends of resource depletion and environmental degradation are not only unsustainable, but if continued will undermine otherwise successful development strategies. Policy reform is feasible, because the proposed policy reform would promote several national objectives with minimal trade-offs and budgetary costs: increased economic efficiency and growth, resource conservation and environmental protection, reductions in income inequalities, and, in some cases, savings in or additional sources of government revenues. Policy reforms in other areas such as taxation, the exchange rate, and general macroeconomic policy suggest that the political will for change does exist among policy makers.

The first priority here is to eliminate, reduce, or cushion policies that have significant environmental costs or perverse incentives that encourage the expansion of resource depletion and environmental degradation beyond the level that is even privately optimal. Reforming policies that distort incentives for efficient resource use is a priority because unless perverse incentives are removed, project investments aimed at improved utilization and conservation of natural resources are unlikely to succeed, and when they do, their impact will be unsustainable, lasting only as long as the project. Reforming policies that are detrimental to both the economy and the environment is also an easier point to start because no difficult development-environment trade-offs or budget outlays are involved. If anything, eliminating policy distortions usually reduces budget outlays, in many cases reduces government expenditures, and may even generate additional budget revenues. The distributional implications are also in the right direction since many of these distortions are not only sources of inefficiency and resource depletion, but are also sources of inequity. Finally, eliminating policy distortions can be done

by adjusting prices, taxes and subsidies which is easier than introducing new instruments or developing new institutions to deal with market failures. Therefore, eliminating policy distortions is the place to start but not to finish because without correction or at least mitigation of market failures, efficient use and conservation of resources cannot be secured.

The overall objective of policy reform is to reestablish the link between resource scarcity and resource prices that has been severed by a constellation of subsidies, perverse incentives, and unmitigated market and institutional failures such as insecure land tenure, open access fisheries and forests, and unaccounted environmental externalities. Reestablishing the link between resource scarcity and resource prices is critical to improving resource management and sustainable development. Population growth, economic growth and improvement in the quality of life, are all putting additional pressures on (increase the demand for) a dwindling supply of natural resources and environmental amenities. This pressure, if not allowed to be reflected in higher resource prices or if cushioned through subsidies, will result in accelerated resource depletion and environmental degradation, culminating in unsustainable development, as shown in Figure 1. If, on the other hand, the growing resource scarcity were allowed to be reflected in increasing resource prices, it would stimulate (a) efforts to reduce the growth of demand through resource conservation, improved efficiency and substitution, (b) efforts to expand supply through recycling, exploration, imports and development of substitutes, and (c) structural change that restructures the use of natural resources from sources of materials and dumpsites for waste disposal to sources of environmental amenities and improved quality of life, consistent with growing incomes and expanding material wealth. This very response to growing resource prices results in both economic growth and environmental conservation through increased efficiency in resource use, increased substitution of lower cost, more abundant sources of supply, increased investment in human capital and technological development.

5.1 Indicated Forest Policy Reforms

Log export bans and logging bans are well-intentioned responses to the need to increase value added from a wasting asset (Indonesia), to the growing scarcity of forest resources (Philippines) and to ecological disasters (Thailand) but they often accomplish the reverse of the intended result. The reason is a fundamental one. These policies depress rather than increase the value of the resource, thereby inducing more waste and less conservation. Making a resource less valuable is usually not an effective way of saving it. What is needed is a reform of current forest policies to encourage efficient harvesting and processing and to promote investments in forest regeneration and conservation. A forest policy reform might include the following elements, most of which can be done by the countries themselves without outside interference and with minimal external support:

- 1) Reclassify forest lands into (a) land disposable to individuals, (b) land disposable to groups of individuals or communities, and (c) non-disposable land over which the state retains ownership and control. The criterion for this classification should be the extent of externalities in terms of both intensity and spatial distribution: (a) forest lands with no significant externalities can be safely distributed and securely titled to the dispossessed; e.g., landless farmers, chronically idle laborers, shifting cultivators; (b) forest lands with localized externalities, such as local watersheds, can be made communal property provided that a community small and cohesive enough to manage them effectively can be defined; and (c) forest lands with regional or national externalities such as major watersheds or nature reserves should stay under state ownership which would be more likely to be effective over a limited area with reduced outside pressure.
- 2) Change the procedure for awarding concessions, from negotiations with the concessionaires and licensing with nominal fees, to competitive bidding in order to maximize the government's share of the resource rents, to keep logging out of marginal lands and to reduce the perceived risk of renegotiation of concession agreements; concessionaires should be provided with financial instruments for accumulating equity through forest investments which are transferable and marketable to encourage them to invest in conservation and reforestation.

- 3) Increase the duration and scope of the exploitation leases sufficiently to internalize non-timber forest products and services and to encourage forest regeneration for subsequent felling cycles.
- 4) Protect the concession area from encroachment and enforce the terms of the concession agreement.
- 5) Reform the taxation system to eliminate incentives for destructive logging; e.g. change the tax base from the volume of timber removed to the volume of merchantable timber on the site to eliminate the incentive for high grading and forest "mining."
- 6) Determine whether any harvesting of timber, fuelwood, and non-timber goods should be allowed in protective forests, and if so specify the areas, set the conditions and restrictions, define who should be allowed to harvest, and devise an enforceable cost-effective system of incentives and penalties that would regulate access and use without unacceptable trade-offs between the primary "protective" function and the secondary "productive" function. This would require research and experimentation in assessing trade-offs between competing uses, predicting behavior in response to penalties and incentives, and evaluating the cost-effectiveness of alternative policy instruments.
- 7) Invest in the protection, management and enhancement of the state-owned productive forests based on strict criteria of social profitability.
- 8) Devise an enforceable, cost-effective, and efficient system of laws and institutions to stimulate innovative approaches to the protection and management of national parks and biological reserves set aside for the conservation of genetic resources, the preservation of wilderness and recreation values.
- 9) Promote private forest investments through an appropriate incentive structure and financial mechanisms, such as co-financing of long-term loans; longer grace, disbursement, and repayment periods; establishment of guarantee funds to reduce risk; and insurance against pest outbreaks and forest fires.
- 10) With regard to public benefits generated by private forest investments, such as downstream irrigation benefits, provide commensurate incentives such as tax exceptions and subsidies

linked to these benefits to bring forest investments to a level consistent with long-term economic and social profitability. For instance, the tax structure should favor natural forest management over plantations, mixed-species plantations over single-species plantations, and single-species plantations over erosive crops such as corn and cassava. Eucalyptus and pine plantations should be taxed or promoted in proportion to their net social and environmental impact on water table, soil erosion, nutrient depletion, etc. Logging companies could be provided with incentives to set aside part of their concessions as nature reserves (for conservation purposes) and extractive reserves (for social purposes) and to manage the rest on a sustainable basis.

- 11) Recognize and accommodate the customary rights of access and land use of forests by local communities; their physical presence in the forest and their intimate knowledge of the local ecology can be of immense value in the protection and regeneration of the forest and the harvesting and use of non-timber products.

These reforms should be strongly supported by both commercial forestry (producers and consumers) and developing country government because they will ensure sustainable supplies of tropical hardwoods and will transform tropical commercial forestry from an extractive industry into a sustainable economic activity with considerable private and social net benefits. While higher hardwood prices may be perceived as running against the short-term interests of commercial forestry (especially by the importers and consumers), the long-term benefits appropriately discounted exceed any short-term costs. Unless higher prices are paid for tropical hardwoods, there can be no conservation and without conservation there can be no sustainable supplies. Currently, the waste, inefficiency, and damage to regeneration are so great that it is possible, by instituting these reforms, to make every party involved better off. Alternatives such as export bans, logging bans, import bans or other similar prohibitions or trade restrictions are misguided and counter-productive, as the experience of countries such as Thailand, Indonesia and the Philippines demonstrates.

5.2 Policies to Conserve Biological Diversity

Any reduction in natural forests inevitably leads to some extinction, some attrition of genetic diversity. The aim of conservation must therefore be to optimize, rather than to preserve everything, which in practice is impossible. Specialized animals and plants can, as a rule, survive in relatively small areas which are maintained in a completely unexploited, unmodified state. Generalized species often require larger areas, but cyclical selective exploitation is not usually harmful to them.

A system of carefully selected preserves with a minimum individual size for each habitat of at least 5,000 hectares, connected with corridors of managed natural production forest which together comprise a total conservation area of at least 100,000 hectares, may suffice in many cases to preserve the great majority of both specialized and generalized species. They would, of course, have to be environmentally heterogeneous to ensure adequate representation of genetic resources. In principle, a few large environmentally heterogeneous preserves are preferable to many small environmentally uniform preserves, and have the added advantage of preserving wilderness and aesthetic values. Selectively logged corridors connecting strict preserves must be managed so that keystone food plants such as figs are preserved. Finally, the full range of sites in each climatic zone must have adequate representation of the zone's genetic resources, with highest priority given to areas of high species endemism and high species richness (for further details see Ashton and Panayotou/ITTO, 1988).

The above principles would help determine the minimum size necessary to maintain biological diversity in a tropical forest. For ecological and social reasons, however, the size of the reserve may not be stable or sustainable. Preliminary results of experiments in Brazil show that the "the smallest plots gradually become overrun by encroaching growth, usually by a single species of tree, leading credence to the idea of having buffer zones surrounding parks of pristine forest" (U.S. News and World Report, April 25, 1988).

Setting up nature reserves and buffer zones, whatever the ecological and social justification, involves considerable costs. First, there is the opportunity cost of the forest and land resources that are taken out of intensive use; this cost is roughly the foregone value of timber and crops

that could be produced in the absence of the reserve and its buffer zone. Second, there is the cost of actually identifying, demarcating, protecting and managing the area to be conserved (core reserve). Third, there is the cost of issuing and enforcing communal (or private) rights over the buffer zone and providing adequate incentive for sustainable resource use.

The substantial cost involved in setting up reserves raises three questions: (a) What is the socially optimal level of biological conservation, that is, how much should a country invest in setting up nature reserves and buffer zones and designing appropriate incentives and enforcement mechanisms? (b) What form should the incentives, monitoring and enforcement take? (c) How can the government or other local authorities and communities generate revenues from nature reserves to pay for protection, monitoring and management of the reserves?

Answering these questions requires research beyond the scope of this paper. Nevertheless some guidelines for both policy and research can be given here. With regard to the first question, the government should be prepared to spend an amount up to the total social benefit derived from conservation, which includes a variety of use values such as scientific, educational, aesthetic, recreational, medicinal, climatic, hydraulic and commercial values. In addition to these use values, there are non-use values such as existence, option and bequest values as well as social and cultural values. Existence value is derived from the fact that people derive pleasure (utility) from knowing that a resource of unique characteristics exists, even though they have no plans of using it in any way. Option value derives from the fact that people would prefer to keep their options open to use a resource at some point in the future, if they so desire, although they have no such plans now. Bequest value exists because people derive a pleasure from passing on to their children part of the natural environment that they themselves have inherited from previous generations. Socio-cultural values derive from the value that a certain culture or religion puts on preserving the natural environment.

Experience indicates that reserve forests and national parks are constantly being encroached upon by surrounding populations in search of land, food, fuelwood, and building materials, as well as by illegal loggers. Buffer zones between areas of intensive land use (logging, farming) and areas of strict conservation may help control encroachment if they offer employment

opportunities that are more attractive than encroachment. For example, the buffer zones may be exploited for non-timber goods on a sustainable basis and/or be developed into areas for recreation and tourism. The critical elements here are that: (a) the people currently living in the forest or its perimeter (squatters, shifting cultivators) should benefit from the new activities; and (b) the open access status of the buffer zones should be terminated to prevent new entrants from dissipating any benefits that the buffer zones would generate.

The most cost-effective means of accomplishing both elements is likely to be the granting of secure and exclusive territorial rights over the buffer zone to the local communities that are currently depending on the forest for their livelihood. What is proposed here is communal property rights analogous to those in effect in Papua New Guinea (see Case 10). As long as the incentive structure is designed to favor sustainable use over logging and slash-and-burn farming, and the property rights are allocated to communities with a functioning social organization, self-enforcement can be relied on to protect the buffer zone and the core area of the reserve from encroachment. However, when a large number of communities are involved, a higher local authority or the government may need to play a more active role in enforcing communal rights, arbitrating conflicts between communities, and providing additional protection to the core nature reserve.

While all these use and non-use values are known to exist and to vary depending on the type of the resource and the population concerned, assigning a dollar value to them is not an easy task although it is by no means impossible. In recent years, methods have been developed for valuing commodities and services which are not exchanged in the market. There are three categories of such methods: (a) those which assign value from observable market behavior (e.g. travel cost method); (b) those that attempt to imitate market valuation by creating surrogate markets; and (c) those that solicit a direct valuation from the relevant population (contingent valuation method). The purpose of all these methods is to derive a proximate estimate of people's willingness to pay for biological conservation.

Since biological conservation is an international public good, the relevant population is not limited to the local or national population but includes the rest of the world as well, especially

people living in the developed countries who are the main consumers of biological conservation, through scientific and recreational tourism and medical research, and of environmental amenities including conservation for its own sake. This is not to say that the local populations derive no benefits, but given their low level of income their main benefit comes from their ability to convert biological conservation into direct economic benefits such as a) the harvesting of non-timber goods, b) employment as forest guards or tour guides, c) access fees for scientists and tourists, d) and secure and stable water supply from watershed protection etc. This raises questions about the appropriate form of conservation incentives for local populations and mechanisms for cost recovery. Costa Rica's experience with scientific and nature-oriented tourism, Indonesia's experience with the Dumoga Irrigation-National Park Project, India's experience with economic incentives for rural communities adjacent to wildlife reserves, and Brazil's experience with the rubber tappers movement are very relevant in this respect. Of considerable value is also an IUCN manual currently under preparation entitled "Biological Diversity and Human Economy: Guidelines for Using Economic Incentives to Provide Conservation of Biological Resources."

5.3 Indicated Water Policy Reform

A resource-specific policy reform in the area of water management calls for overhauling irrigation policy to provide incentives for efficient water use, to increase cost recovery and to generate funds for rehabilitation, maintenance, and improvement of existing irrigation systems. The first step in such reform should be to strengthen water-user associations and to make structural modifications to existing irrigation systems such as intermediate storage at the head of distributors and installation of meters in secondary channels. Such modifications would make possible "bulk water sales through contract with water-user associations and cooperatives as irrigation agencies do in Mexico, India, China and other countries" (Repetto, 1986, p. 34). A second step would be to develop cost recovery mechanisms such as user charges indexed to the value of crops, land taxes, water rights, provisions for water trading, etc. which would encourage farmers to value water at its marginal opportunity cost.

Bulk water sales to water user associations could help reduce the metering and collection costs by leaving water distribution to local organizations which can best monitor water use and prevent meter manipulation or damage through peer group pressure. Repetto (1986, p. 33) reports that "in Gujurat State in India, the irrigation agency sells water volumetrically in bulk to cooperatives, which distribute and collect fees from their members." A similar system operates in Sri Lanka. Ross (1986) reports that the introduction of volumetric irrigation fees in areas of China has induced farmers to use water more efficiently and has generated revenues for maintenance of the irrigation systems (see Case 3).

When volumetric (marginal cost) pricing is not feasible or prohibitively costly, low-cost approximations such as area-based irrigation charges and land taxes could be introduced. The sacrifice of efficiency in this case may be justified by the savings in metering and collection costs. The evidence worldwide suggests that farmers are prepared to pay for reliable irrigation services. Availability and reliability of supply is far more important than cost in this case.

The same principles that apply to irrigation water should apply to all other uses of water, including industry, energy and household use. Water consumers in all sectors in most developing (and many developed countries) pay a flat charge for water, which is well below the real cost of delivery let alone its opportunity cost or scarcity value. Thus consumers are encouraged and in many cases explicitly subsidized to overuse and waste water, often on account of "equity": water is too essential to deprive the poor of its use through pricing. Yet both equity and efficiency objectives could be served by progressive water charges that reflect long-run supply costs. It is the current system which is inequitable because it taxes the general public including the poor (who often bear a disproportionate tax burden because of inability to evade it, e.g., wage earners) to subsidize wasteful water uses by the wealthy (e.g., large lawns and gardens, golf courses, etc.).

Water is also demanded for use as a receptacle for waste water by industry, municipalities and households. In many countries, this use of water for waste disposal is free, and, as expected, water resources near industries, urban centers and tourist towns become overpolluted and degraded. In other countries, especially those at a higher level of development, waste

disposal in water resources is regulated by permit, by requirements for water treatment before disposal, or by effluent standards. However, compliance is poorly monitored, the penalties are too low and they are not strictly enforced. Such standards and regulations often work better as incentives for rent-seeking behavior than as regulation of waste disposal. Again, water pricing for waste disposal is a more effective instrument because it manages demand and suggests lower-cost alternatives other than bribing enforcement officials, for example switching to less polluting inputs and technologies, installing treatment facilities, changing location, etc.

In conclusion, the water user should pay fully for the costs of supply, delivery, depletion and pollution (treatment costs) attributable to his/her use. The payment should be linked to the quantity and quality of use and the link should be transparent enough to channel the user's efforts towards efficient use, conservation and minimization of waste generation and disposal. As long as there is a divergence between those who use (agriculture, industry, households) and those who pay (taxpayers), there is no built-in conservation mechanism. If there is such a mechanism, it is a perverse one because it encourages internalization of the benefits from water use and externalization of the costs. The government, in its attempt to correct one market failure (public goods), has generated another (externalities).

5.4 Policy Options for Dealing with Urban and Industrial Environmental Problems

The causes of environmental problems have been described as massive market failures and policy distortions. Environmental resources (air, water, landscape, atmosphere) are common property, unpriced resources outside the domain of markets. While the use of other resources such as capital and labor is subject to prices and other constraints, the use of environmental resources is not. Urban consumers and industrial producers dump raw wastes into the air and water without regard to the high costs they impose on others and the society at large, precisely because it is economically advantageous for them to do so: waste disposal is free; waste reduction or treatment is costly.

If environmental resources could be brought into the market and priced, their prices would indicate their true scarcity and the opportunity costs of their use. Users would have to pay to

use environmental resources and such payments would force them to economize on their use. The entire spectrum of industrial decisions would be affected: the design of industrial processes and technologies, the types and quantities of raw materials used and the nature of products produced. Therefore, the ideal solution would be to establish a market for environmental resources by defining property rights by governmental action, since transaction costs prevent the spontaneous emergence of such a market. Pollution rights (or pollution permits) could be issued and allocated to current industrial producers in a "grandfather system." Pollution permits could be either bought back by the government or gradually reduced in "value" (allowable pollution) until the desirable level of environmental quality is reached. Pollution permits should be marketable and transferable so that (a) they will gravitate to the most efficient producers, and (b) their prices will reflect the true scarcity of environmental resources being used.

Despite its many merits, the system of pollution permits has not yet been extensively used elsewhere and its details have not been fully worked out. The concept of marketable pollution permits is a relatively recent idea which is currently being experimentally tried in the US. What we propose here is research into the feasibility of such a system in developing countries. In some sense, it might be easier to introduce such a system in a country which is not yet fully industrialized. In industrialized countries, vested interests, sunk investments and damage already done militate against pollution permits.

However, there are alternatives that approximate the workings of a market for environmental resources, which have been tried successfully elsewhere. Instead of relying on the market to set prices for environmental resources, the government sets charges for the use of these resources through legislative or executive decision. If these charges are properly set, the external costs will be internalized and environmental resources will be optimally used.

Ideally, charges for destructive uses of the environment such as disposal of wastes should be set equal to the damage or external cost that these activities generate. In practice, it is very difficult to estimate the full extent of environmental damage because they are widespread, often not easily quantifiable and take a long time to accumulate. A more workable system of

setting charges is one based on ambient standards. This is done in two stages. First, technical experts describe the consequences of different levels of ambient quality: for example, fish survival at different levels of dissolved oxygen or human health at different levels of carbon monoxide. Then, a target level of ambient quality (e.g. a target level of dissolved oxygen or a maximum acceptable level of carbon monoxide) is politically or administratively chosen, and a charge for emissions is set at the level necessary to attain this target. The level of the charge for each area that would accomplish the target level of air or water quality is obtained by estimating the relationship between different charge levels and the emissions from different sources based on the average marginal costs of these sources. The effect of different levels of emissions on ambient quality can be determined through mathematical models of river basins or air pollution regions. These two relationships (between charges and emissions and between emissions and ambient quality) provide the link between charges and ambient quality and determine the level of the charges that will bring about the desired (target) ambient quality.

A system of charges, thus designed, will not result in polluters paying a price equal to the external costs or damages created by their activities, unless the charges vary according to the location of the source of pollution. Such fine-tuning may prove to be prohibitively costly. However, even in its crudest form, a system of pollution charges has advantages over the current system of direct regulation through effluent or ambient standards.

Emission charges are efficient means for achieving the desired level of environmental quality because they minimize the costs of pollution control by leaving the level of individual pollution control and the choice of technology to the polluter. Depending on his own control costs a polluter faced with a charge on emissions may choose to reduce his output, change his input mix or production process, treat the waste or simply pay the charge. Industries with high control costs would control less and pay more in charges while industries with low control costs will control more and pay less in charges. Overall, the desired reduction in pollution will be attained at the minimum cost, and the industry will be under constant pressure to develop more cost efficient ways of reducing or abating pollution in order to reduce its control costs or payment of charges. Enforcement is easier and simpler because charges require no knowledge

of the production and abatement technologies of different industries and no bargaining; the incentive structure facing the polluter is such that it promotes self-enforcement; the onus of finding or developing the most efficient approach to reduction of emissions is on the polluters themselves not on the regulatory agency.

The system of pollution charges has been used with considerable success in several countries. Japan has instituted a system of air and water charges to compensate the victims of pollution-related ailments. The Japanese compensation program uses statistics and epidemiology to allocate social responsibility for ailments to specific toxic substances. For example, sulfur oxides have been linked to respiratory diseases and the compensation cost was allocated 20% to automobiles (to be paid out of an automobile tax), and 80% to all other sources of airborne sulfur oxides. The automobile tax varies according to car weight and the charge on industry varies according to location in relation to the pollution zone. If an industry is identified as the only source of a particular toxic substance in the area it is held responsible for all the compensation costs related to that substance regardless of the level of emissions. It is important to note that the national industrial association participated in the structuring of the program and its implementation, thus minimizing monitoring and collection costs (Anderson *et al.* 1977).

Variants of emission and effluent charges have been implemented with varying success in several countries. In the United States, towns receiving federal grants for construction of sewer systems are required by the Water Pollution Control Act to recover their operating costs and parts of the capital costs from their users, through municipal sewage treatment user charges. In West Germany, the private association of discharges into the Ruhr Valley has levied charges on its members in proportion to their discharge levels and toxicity in order to finance collective control measures; again, the process works smoothly because the charges are levied and collected by the representatives of the dischargers not by the government. There is no reason why a similar system to the Japanese and the German ones cannot work in developing countries with appropriate industry leadership and some government encouragement.

Charge systems are also found in Eastern Europe. East Germany has established emission

charges for over 100 different air pollutants; anyone whose emissions are above the national standard pays the charge and the proceeds are used to invest in environmental improvement and to compensate pollution victims. Similarly, Czechoslovakia has instituted effluent charges on biological oxygen demand (BOD) and suspended solids to attain a predetermined level of water quality.

A comprehensive review of the application of pollution charges is beyond our scope, but a few more examples of potential applicability to developing countries might be useful. These include a lead additive tax; a beverage container deposit; a recycling incentive tax; and product disposal, congestion, and noise charges. The US government taxes leaded gasoline to reduce its price advantage over unleaded gasoline in order to induce a shift to the latter which is less polluting. Many states in the US have instituted refundable deposits on beverage and beer containers to discourage their free disposal and encourage their collection and recycling. Singapore, London and Los Angeles use congestion charges during rush hours to reduce congestion and air pollution in the city center (see Case 12), while Japan and the Netherlands have been toying with noise charges for traffic and airport noise control.

It might be worthwhile for other countries to study the experience of countries with pollution charges and develop their own variants based on their special circumstances and enforcement difficulties. For example, beverage container deposits are likely to be effective in developing countries; even if they do not fully stem free disposal of wastes, they would stimulate the establishment of a new labor-intensive activity: the collection of containers and beer bottles which fits low-cost labor-abundant conditions in many developing countries.

6. The Role of AID

To reverse environmental degradation and attain the level of management of resources that leads to sustainable development, the described policy reform is indispensable. Yet policy reform, especially in the area of natural resources and the environment, is not an easy task. A

major obstacle for policy reform is the vested interests created by existing policies. A second obstacle is that long-term problems are overshadowed by pressing day-to-day issues. The demand for policy reform is not effective and the need for change is neither apparent nor pressing. Consensus for policy change emerges only at times of crisis, as exemplified by the introduction of a nationwide logging ban following the catastrophic landslides and floods in Southern Thailand, which have been attributed to deforestation. To respond ahead of a crisis by developing long term policies for on-going management of forest resources is clearly more desirable. To do so, it is necessary to build consensus and capacity for advancing policy options that would lead to efficient management of resources for sustainable development. The inadequacy of the existing analytical basis for policy formulation, and the lack of analytical capability and institutional capacity for policy research in the area of resource management is clearly a constraint to policy reform.

The lack of local consensus and dynamics for policy reform is equally critical. Waiting for a major environmental crisis to attain consensus would be disastrous for the resource base and possibly irreversible. Pushing forward with an outright policy reform would be equally disastrous in sociopolitical terms and could cause a backlash against similar efforts for years. External concern, while useful and legitimate, cannot by itself bring policy reform. Outside pressure or conditionality is rarely well-received and is often counterproductive. Already, the eight Amazon nations have denounced policies by groups outside the region to dictate their policies concerning the use and management of their rainforests. Policy change is not effective and sustainable unless understood, espoused and promoted indigenously. Ultimately each country will require its own capacity to determine the optimal use of its forest resources. Foreign assistance is most effective when it aims to create indigenous capacity and demand for policy change rather than to supply policy prescriptions. The analogy of pushing as opposed to pulling on a string is very apt in this case.

It is in the creation of indigenous demand for policy reform and the building of capacity to design and carry it out that AID can have its major impact despite (or rather because of) its relatively limited financial resources. The most acceptable, and in the long-run, the most

effective role for AID to play in effecting policy changes is that of a catalyst and a facilitator that helps create a conducive environment for and assists in the process of change. The most effective way of bringing about lasting policy changes is by building consensus and capacity for developing and advancing policy options. This can be done with limited resources in a few targeted areas in which AID has a comparative advantage based on prior experience and access to both analytical resources in the US and to policy makers and analysts in developing countries.

While the priorities will vary according to each country's level of development, resource endowment, critical environmental problems and existing analytical capability, the following general actions are recommended:

- (1) human resource development in environmental management and policy sciences with particular emphasis on natural resource economics and applied ecology;
- (2) policy dialogue with policy makers on current and emerging problems of natural resource management;
- (3) support of research and policy analysis in natural resource management through research grants and institutional development assistance to government agencies, universities and NGOs concerned with resource management;
- (4) strategically targeted projects on natural resource management;
- (5) technical assistance in natural resource management; and
- (6) dissemination of factual information and knowledge on the state, management and potential of natural resources, and their role in sustainable economic development and the quality of life to increase awareness and promote acceptance of the need for changes in private behavior and public policy.

The ultimate objective of these strategic activities is to build consensus and capacity for policy change that will improve the management of natural resources and the environment and,

thereby, ensure the sustainability of the development process underway. The intermediate or proximate objectives of the supported activities are:

- (1) to generate and disseminate factual information and analytical knowledge on the state, management and potential of natural resources in each country;
- (2) to increase public awareness of environmental issues and promote acceptance of the need for change in private behavior and public policy;
- (3) to build analytical capacity and hands-on experience in analyzing environmental problems and formulating policy solutions; and
- (4) to build the institutional strength of relevant government agencies, NGO's, educational and research institutions and the private sector and to generate commitment among decision makers and bureaucrats for policy change and implementation.

The strategic instruments may be grouped into five interconnected, partially overlapping and mutually reinforcing groups: (1) policy dialogue; (2) pilot projects, institutional support and technical assistance; (3) research support; (4) environmental awareness activities; and (5) education and training. Table 11 in Annex III lists the individual instruments in each group and their primary, secondary and incidental objectives. The instruments are self-explanatory, except for the pilot policy projects and the policy workshops, which constitute the closest and most apparent link between projects and policies. As indicated earlier, one of the obstacles to policy change is the lack of the necessary parameters and analytical basis for formulating alternative policies. For example, we cannot predict the consequences of privatization of forest lands or the establishment of communal ownership in a buffer zone around a national park. We have a priori hypotheses based on theory and experience in various countries but these hypotheses have not been tested in the countries concerned. It is far more difficult to effect a policy change when its consequences are unknown or highly uncertain.

The pilot policy projects would provide a testing ground for a number of policy options that are amenable to localized application. For example, with the support of local authorities,

communal ownership could be introduced in an estuary with a multiplicity of resources (fisheries, aquaculture potential, mangrove forest, tourism, etc.) in proximity of a community known to have a cohesive social organization. Such a pilot project can be reinforced with support for social science research and observation/study tours in countries such as Sri Lanka and Japan which have a long history of successful communal property systems. The results of such pilot projects can be used to make improvements and to replicate them in other sites with increased local participation. If successful, the knowledge and publicity generated from such experiments would encourage their extension to the national level.

Policy workshops (combined with research grants and the development of case studies) can aim at harnessing and enhancing existing analytical capacity and intellectual leadership in order to accelerate the process of environmentally critical policy reforms. While it is true that developing countries lack sufficient analytical capacity in the specialized area of natural resource management and policy analysis, they have no lack of well-trained natural and social scientists and intellectual leaders. It is both feasible and cost-effective to harness existing analytical capacity by giving support to the best in-country talent to become involved in applied work, seminars and workshops on issues that are both critical and can be dealt with in the relatively near-term within existing constraints. This is essential for (a) demonstrating the value of policy reform, (b) gathering momentum, (c) sustaining interest, and (d) building a constituency for policy reform.

The local intellectual and political leaders must understand policy reform to be in their constituencies' best interests, and must be able to defend it as such. The predominant view of environmental issues as luxuries of concern to the affluent developed countries must be replaced by accurate and informed discussions of their importance for the economic well-being, quality of life and future of the local people themselves.

The performance of such a strategy and its individual projects and instruments can be evaluated at two levels: at the level of the intermediate or proximate objectives or at the level of the ultimate objective, the inducement of a policy change that would improve resource management. Evaluation of performance at the intermediate (policy input) level is easier but

less satisfactory than at the final (policy output) level. For example, human resource development or training can be evaluated based on the number of persons who have successfully completed training; this is an easier but a less satisfactory evaluation than one based on the policy changes effected by those who have participated in the training. Similarly, research support may be evaluated based on the number and quality of research reports and publications, but more pertinent would be an evaluation of the impact of supported research on policy.

The contribution of the strategy to information and knowledge could be monitored and evaluated based on the number and quality of research reports, publications and statistical data banks, as well as the number of successfully completed, pilot policy projects, and the circulation of publications and journals established in connection with the strategy. The contribution to awareness and acceptance may be judged by polling a cross-section of the public or by observing a number of related indicators such as: the trend in press coverage of environmental issues; the reference to environmental issues in public statements by government officials, politicians and the private sector; public reaction to development projects with environmental implications; the acknowledged consideration of environment development trade-offs in policy decisions, etc.

The strategy's performance in terms of enhancement of analytical capacity and experience may be evaluated in terms of the number of trainees that have successfully completed training; the number of pilot projects and study tours; the amount and quality of research completed; and the degree of competition for research grants. Finally, the strategy's contribution to institutional strength and commitment may be inferred from: (a) increasing budget allocations to environment-related projects especially by government agencies and NGO's supported by the project; (b) spontaneous introduction of new projects by government agencies and NGO's patterned after the strategy; (c) increasing numbers of government scholarships earmarked for environment-related training; (d) increasing numbers of environment-related bills submitted to Parliament; and (e) increasing borrowing by governments for natural resource-related projects.

Recognizing that success in intermediate objectives (policy inputs) may not necessarily be translated into policy changes (policy outputs), it would be appropriate to monitor and evaluate the strategy in terms of its impact on policy formulation as well. While it would be difficult to attribute or even link policy changes directly to the strategy, since some policy changes would have taken place anyway, it is possible to infer the contribution of the strategy by observing the differential speed and ease of policy change in areas where the strategy has supported projects, workshops, study tours, conferences, policy research and training compared to other areas where the project had minimal involvement. Because of the slowness and incremental nature of policy change the indicators for monitoring and evaluation of the strategy's policy impact must be cast in terms of "movement in the right direction" or "progress towards" rather than "reversal of policies" or major "new initiatives." Here are some examples:

- progress towards issuing secure and transferable land titles to insecurely held land to provide access to credit and increased incentives for efficient use, planting of perennials and investment in land improvement and soil conservation.
- progress towards privatizing certain forest lands.
- progress towards reform of the current concession and forest taxation system to provide incentives for more efficient use and investment in sustainable production (longer, competitively-awarded concessions, and simpler but higher taxation of rents are indicators of improvement).
- increasing recognition of the importance of non-timber forest products and services, assessment of their value, and introduction of policies that favor multiple use management of tropical forests.
- increased public investment allocations to rehabilitation and protection of critical watersheds.
- shift of irrigation funds from construction to operations and management (O & M) for existing irrigation systems.

- progress towards the establishment of water user associations, water rights and water pricing to improve water use efficiency, reduce waterlogging and generate funds for O & M and watershed protection.
- reduction of agricultural taxation, elimination of agricultural chemical subsidies, and promotion of tree crops, ecologically sound farming systems and integrated pest management.
- movement towards recognition, rejuvenation and strengthening of communal property rights as a cost-effective means of managing coastal resources, village forests, and buffer zones around national parks.
- progress towards introduction of effective limitations on entry into fisheries such as licensing schemes, territorial use rights and artificial reefs.
- progress towards introduction of pollution charges to replace or at least supplement the ineffective emission standards currently in use.
- experimentation with refundable deposits for beverage containers and packaging material and with disposal charges and recycling incentives.
- consideration of the environmental costs of alternative sources of energy in energy pricing policy.
- legislation requiring environmental assessment for all major public and private sector projects with potential impact on the environment.
- progress towards reduction of protection and capital subsidies to large scale industries and increased allocation of resources to rural industry.
- a more active debate on environmental implications of macroeconomic and sectoral policies during policy formulation especially among economists and policy makers in the finance, planning and industry ministries.
- progress towards making natural resource pricing and environmental considerations an integral part of the structural and sectoral adjustment negotiations and loans.
- increasing use of extended economic analysis of projects with provisions for internalization and mitigation of environmental impacts.

One may go one step further and monitor actual changes in resource use and the state of the environment through leading resource indicators that should be developed for this purpose, (e.g. reduction in the rate of deforestation, increase in the rate of reforestation, reduction in soil erosion and sedimentation, reduction in biological oxygen demand in water systems) and then attempt to link these changes to the strategy. Of course, the ultimate test of the strategy's success is not the elimination of all symptoms and physical manifestations of environmental degradation but their containment to levels consistent with society's other objectives. In some cases, however, the linkage may be too indirect and tenuous to be meaningful. It is also important to note that in many cases the linkage between the strategy and policy changes can only be based on a "before and after" comparison, rather than on a "with or without" comparison most appropriate for performance evaluation. The acid test that progress is being made in this regard is the lessening and ultimate elimination of the economic manifestations of environmental degradation.

Annex I: Cases**CASE I****POLICY FAILURE: RANCHING FOR SUBSIDIES IN BRAZIL**

In the 1960's, the Brazilian government introduced extensive legislation aimed at developing the Amazon region. Over the next two decades, a combination of fiscal and financial incentives emerged which encouraged the conversion of forest to pasture land. During the 1970's, some 8000-10,000 square kilometers of forest were cleared for pasture each year. The proportion of land used for pasture in the Amazonian state of Rondonia increased from 2.5% in 1970 to 25.6% in 1985 (34). Without tree cover, the fragile Amazonian soil often loses its fertility and at least 20% of the pastures may be at some stage of deterioration (49). Indeed, cattle ranching is considered one of the foremost proximate causes of deforestation.

Furthermore, ranching provides few long-term employment opportunities. According to Mahar, livestock projects offer work only during the initial slash-and-burn phase. Negative employment effects have been observed when income-generating tree crops such as Brazil nuts are eradicated for pasture (34).

Operation Amazonia (1966-67) established the Superintendency for the Development of the Amazon (SUDAM) which administered the numerous fiscal incentives designed to attract ranching. Fiscal incentives included tax holidays of 10-15 years, investment tax credits (ITC) and export tax or import duty exemptions. ITC's allowed corporations to exempt 50% of tax liabilities by investing their savings in SUDAM approved projects.⁷ Projects were prioritized, and those with favorable ratings could be financed 75% by tax credit funds.

Starting in 1974, subsidized credit also played a crucial role in encouraging numerous ranching projects. The Program of Agricultural, Livestock and Mineral Poles in Amazonia (POLAMAZONIA) offered ranchers loans at 12% interest, while elsewhere interest rates were 45%. Subsidized loans of 49%-76% of face value were typical through the early 1980's (50). The program discriminated against poor tenant farmers who lacked the necessary collateral. Also, tax breaks and cheap money were capitalized into the land making property more expensive and even less accessible to the poor.⁸

The subsidies and tax breaks encouraged ranchers to undertake projects which would not otherwise have been profitable. Many projects were pursued solely for their fiscal benefits. A survey of SUDAM projects reveals five projects receiving tax credit funds without ever being implemented (34). Investments were often made in projects which would normally generate negative returns. A World Resources Institute study showed that the typical subsidized investment yielded an economic loss equal to 55% of the initial investment. However when including subsidies received by the private investor, the investment yielded a positive financial return equal to 250% of initial outlay. The fiscal and financial incentives masked what were intrinsically poor investments, and served to subsidize the conversion of a superior asset (tropical forest) into an inferior use (cattle ranching). (For the detailed calculation of financial and economic returns from government-assisted ranches in the Brazilian Amazon, see Table I in Annex III.)

⁷ After 1974, ITC's limited to 25% credit.

⁸ Subsidized credit was eliminated completely by mid-1987.

CASE 2

THE COSTS OF AIR POLLUTION IN SAO PAULO, BRAZIL

Known as the "Valley of Death" because of the effect of its air pollution on residents, the Greater Sao Paulo Area (GSPA) illustrates only too dramatically the possible outcome when the social costs of industrialization and vehicle use are ignored. With an area of 8,000 square kilometers, the GSPA is one of the largest metropolitan areas in the world. It produces over 40% of Brazil's industrial value-added. In 1981, its population of 11 million was growing at a rate of 5-6% (60).

This dense population and heavy industry have given rise to levels of air pollution often well above standards set as maximally "acceptable." Emissions for the entire GSPA are estimated at 7,000 tons per day, over half of which is carbon monoxide. Nearly three quarters of the air pollution, including almost all of the carbon monoxide, is caused by cars, with most of the rest created by industry. In 1978, daily air quality standards for carbon monoxide alone were exceeded 299 times, at times by a factor of nearly three. With air pollution and population densities varying widely from municipality to municipality, air pollution levels more frequently exceed standards by greater amounts in the most densely populated areas. Not unexpectedly, the residents in these areas also suffer more from pollution-related health problems (60).

Although the health effects in Sao Paulo are painfully visible, quantifying the costs of air pollution is difficult. In addition to the impact on humans, damage to property, equipment, farm animal and crops must be included. A number of studies have successfully correlated health damages from pollution with levels of industrial concentration and population density in the different GSPA municipalities. In one such study, Fernicola and Azevedo have linked average levels of lead in the blood of residents to the level of air pollution in different municipalities (60). Examining a two-week period in 1973, Rene Mendes found a close correlation between sulphur dioxide concentrations and deaths due to respiratory diseases in the GSPA (60). Upon studying the relationship between pollution and mortality in Sao Paulo, a World Bank report concluded that "an annual increase of 1 ton of particulates per km² in the GSPA from 1977 levels is associated with an increase in the mortality rate of 12 per million" (60).

Attempts to limit air pollution are in the fledgling stages at the federal, state and municipal levels. Using air quality standards delineated by the federal government to calculate necessary abatements, the states have set emission standards for different sources of air pollution. Both the federal and state governments are also using licensing and zoning to try to control existing and potential new sources of pollution. At the municipal level, the GSPA has employed land use policy to limit the location of new industries and the levels of allowable pollution in different areas.

In the GSPA, reducing air pollution to the federal standards will require abatements of 80%-90%. The World Bank and the state's environmental agency, CETESB, estimate the annual cost of a 55% reduction at \$6 million or \$1.10 to \$1.20 per resident affected by the pollution (10). Given its impact on health, the benefits are judged to more than justify this level of expenditure. However, the cost of abatement clearly depends on the efficiency of the controls levied. Pollution standards or taxes are more efficient than mandatory control equipment, fuel restrictions, or output restrictions because the former give polluters the flexibility to choose the most cost-effective method of abatement for their firm. In the case of taxes, firms also determine the value of their right to pollute and whether abatement is an efficient choice (60).

- In urban areas, industrial and vehicle emissions can have substantial costs, particularly on resident health.
- Where populations are dense and levels of pollution high, the benefits of air pollution control, although hard to quantify, are extremely likely to be justified by its costs.
- Some methods of pollution control, such as taxes and standards, are more efficient and therefore less costly than others, such as mandatory control equipment, fuel and output restrictions.

CASE 3

POLICY SUCCESS: WATER PRICING IN CHINA

For centuries irrigation has played a crucial role in Chinese agriculture. Since the Communist Revolution in 1949, the area of irrigated land has tripled, and 75% of national food production is on irrigated land, contributing to China's food self-sufficiency (7).

In July 1985, the People's Republic of China took an important first step toward promoting greater efficiency in irrigation water usage. The Chinese government instituted agricultural policy reforms which invested a greater degree of financial and managerial autonomy in provincial water management agencies. The policy emphasized "water as a commodity rather than a gift of nature and clearly attributed wasteful consumption and the imbalance between supply and demand to irrationally low water charges" (53): As a result, irrigation water is priced more closely to what it actually costs and problems associated with overuse and inefficient distribution have diminished.

Agency budgets now rely on irrigation service fees paid by water users and income generated by secondary irrigation agency projects such as fishing and livestock production. Irrigation service fees are charged at levels to cover operation, maintenance and amortization of capital costs. Beginning in 1980, the government switched from financing systems with grants to providing loans. The move provided an extra incentive for water management agencies to collect higher water fees. In general, water charges are determined by what the water actually costs for different uses. For example, charges may be varied according to season, and in very dry areas progressive water pricing schemes have been adopted to reflect scarcity. Likewise, irrigation for grain crops is priced according to supply costs without profit, while cash crops may be irrigated for slightly higher than cost.

The reforms also serve to decentralize authority, making water management agencies more closely tied to both the operation and distribution of irrigation water. As a result, water is often distributed more efficiently. In Hungxian County, for example, farmers reported more reliable water supply and were willing to pay more for the guaranteed supply (7). Management is often further decentralized when a local agency purchases water wholesale and sells in bulk to smaller water user associations responsible for distribution to farmers. These smaller groups strengthen the bond between the water user and the supplier who must recover costs.

Because of these policy reforms, revenues collected by the water management agencies have increased significantly. Farmers have begun to irrigate their crops more efficiently while water use per hectare has declined (7). Decentralized management has led to more efficient distribution through practices such as distributing water according to land area, levying water charges on a volumetric basis rather than a flat rate and preparing distribution plans in advance. Crop production has improved, with China producing twice as much as similarly irrigated crops in India (52).

CASE 4

**TREATING A SCARCE RESOURCE AS A FREE GOOD:
IRRIGATION WATER IN DEVELOPING COUNTRIES**

From India to Morocco to Botswana, free or heavily subsidized irrigation water obstructs market signals, encouraging farmers to use the resource beyond its economic (or agricultural) optimum and stifling incentives to invest in improvements and maintenance of existing dams which are often plagued by poor drainage and inefficient distribution systems. In Bangladesh, Nepal, and Thailand, total costs were at least 1000% of revenues collected. Even after a sixfold increase, Chinese farmers still pay less than 25% of average supply costs for irrigation water (51).

Cheap water often becomes a substitute for other inputs. Overirrigation by farmers nearest the water source leads to waterlogging, salinization and alkalization. Meanwhile those less conveniently located are forced to rely on sporadic and sparse water. A study of Pakistani irrigation systems found that 73% of farmers surveyed complained of insufficient water supplies while farmers close to the water source of the same system were overwatering. The consequences are reduced crop yields, loss of irrigated lands and increase salt loadings of return flows and aquifers. Downstream effects include the erosion and siltation of estuaries and deltas.

Water subsidies encourage farmers to treat water as an abundant resource when it is in fact scarce. With no water rights, and no effective water user associations or other mechanisms to allocate water efficiently, water scarcity does not register. Indeed, water charges do not reflect the increasing opportunity cost due to increasing scarcity. Beyond the less apparent economic costs, there is an absence of effective financial cost recovery mechanisms. Even at low maintenance levels, only a fraction of operation and maintenance costs is covered by the revenues collected by water users. For example, revenues cover 20% of costs in Bangladesh, 27% in Thailand and 60% in Nepal. If capital costs are included, water charges often cover only 10-20% of costs (51).

Underpricing of irrigation water also leads to both inefficient use and inadequate maintenance of irrigation systems resulting in problems such as poor drainage which in turn leads to salinization and waterlogging. The FAO estimates that 50% of all irrigated lands have been damaged from salinization, alkalization and waterlogging. In Pakistan, half the command area of the Indus Basin canal system is waterlogged, saline or both. The same is true for the lower Rafactain Euphrates Valley in Iraq. Maintenance problems often result in inefficient use, with as much as 75% of water seeping out or evaporating from unlined or obstructed canals and distributories.

The market failure inherent in unpriced water and the policy failure of irrigation subsidies and inefficient water use are inextricably linked. It is estimated that if Pakistan increased its efficiency by 10%, the water saved could irrigate another 2 million hectares (67). However as long as farmers do not bear the true cost of water, they will be unlikely to appreciate its scarcity or the problems which arise with overuse. Until they receive clear market signals indicating otherwise, they will continue to use water wastefully.

CASE 5

POLICY SUCCESS: REMOVAL OF PESTICIDE SUBSIDIES IN INDONESIA

In 1985, the Indonesian government was subsidizing pesticides at 82% of retail price at a total cost of \$128 million (49). These heavy subsidies encouraged intensive pesticide use by Indonesian farmers. Indeed, pesticide use witnessed a 76% increase between 1976 and 1985. The widespread use of the pesticide Sevin wiped out the natural predators of the rice brown planthopper, leading to significant losses in the annual rice crop. Millions of tons of rice were lost to the pest which five years earlier was not considered a threat (44). In 1976 alone, 364,500 tons of rice valued at \$100 million was lost (14).

Overuse of pesticides often leads to the evolution of resistant strains of some pests, while natural predators that help control pests are wiped out. Excessive pesticide use has in fact been linked to a reduction in productivity. In Northern Sumatra, brown planthopper population density rose directly with the number of pesticide applications (9). Meanwhile, research has shown that untreated fields had 75% lower planthopper populations and higher yields (44).

As with other market failures, subsidies obstruct important market signals which would otherwise prevent farmers from overusing pesticides. By paying artificially low prices for pesticides, farmers tend to use more than the economic optimum, the point at which the true cost of pesticide use begins to exceed the benefit of using more pesticide. As a result, farmers continue to use pesticides, perhaps as a substitute for other inputs such as weeding, despite increasing damage to crops and the environment. In Indonesia, insecticides were generously applied 4-5 times per season over millions of hectares of rice fields regardless of the need of individual fields (44).

By late 1985, 70% of Java's rice was threatened and numerous economic studies showed negative returns to heavy insecticide use. A policy which aimed to promote rice self-sufficiency had jeopardized the crop yields it had intended to bolster. Supposedly resistant varieties of rice were being attacked by the brown planthopper with increasingly intensive damage. Describing the damage the FAO reported, "Even extremely high dosages of insecticides could not stop these outbreaks. To the contrary, they seemed to make things worse" (25). In November 1986, President Suharto issued a decree banning 57 brands of subsidies, 20 of which were heavily subsidized by the government. The same decree declared integrated pest management (IPM) as the national pest control strategy for rice. Three planting seasons after the decree, FAO reported a 90% reduction of pesticide use. Also, average yields rose from 6.1 tons per hectare to 7.4 tons.

In October 1988, the Indonesian government cut pesticide subsidies from 55% to 40% of retail prices. Shortly after, in December, the government opted to eliminate pesticide subsidies altogether. While fiscal concerns played an important role, policy makers also hoped the cuts would increase farmers' efficiency with pesticide use (29). The government also issued provisions for raising the floor prices of unhusked rice, yellow corn, soybeans and mung beans increasing farmers' incomes so they could better cope with the policy change.

CASE 6

TURNING A MARKET FAILURE INTO A POLICY SUCCESS: THE DUMOGA-BONE NATIONAL PARK- INDONESIA

In 1980, the Indonesian Government with assistance from the World Bank established the Dumoga-Bone National Park in Sulawesi, Indonesia.⁹ The park serves the dual purpose of protecting a major irrigation area as well as conserving valuable wildlands. After construction of the Dumoga Valley highway, the once pristine area fell prey to rapid encroachment, especially via a government-sponsored transmigration scheme. Increasingly, forest in the catchment area was cleared, threatening the water flow from feeder rivers and increasing the likelihood of siltation. Given this steady deterioration, the Indonesian government and the World Bank agreed the watershed area of the Dumoga basin needed more effective management.

Their agreement led to the establishment of the 278,700 ha park which has allowed scientists to make important advances in conservation biology. For example, 160 researchers from 17 countries participated in Project Wallace which was implemented to catalog the insects of the area.

At the same time the park promotes the conservation of indigenous plant and animal species, it also insures the investment in the irrigation project by guaranteeing a well-protected watershed. Two alternative uses - an effective watershed for irrigation and conservation land - complement each other, resulting in a positive externality generating benefits for both uses and society at large. The project's provisions for wildland management also serve to enhance the irrigation system by reducing sedimentation (and related maintenance costs) and helping to ensure a steady and predictable flow of water. Water fees are collected to fund both services: provision of irrigation water and wildlife preservation. For the first time, the Indonesian government explicitly recognized and assigned a value to conservation efforts as part of development. (37)

Both economic and ecological benefits are gained. The free market would not have brought about this result because of prohibitive transaction costs of bringing together thousands of farmers to reach an agreement and enforce it. Government intervention has produced two public goods: watershed protection and biological conservation, neither of which could have been produced by a free market because of the inability to exclude free riders.

The Dumoga Park illustrates how an irrigation project can be planned to include provisions for watershed protection which simultaneously fulfill the requirements for conservation land. Both uses complement one another while generating both economic and environmental benefits. The conversion of the watershed area into park land establishes an important linkage between biological conservation and watershed management. The project can serve as a model for other irrigation projects where costs for protecting watersheds are automatically included and justified not only as a means to insure the irrigation investment but also for the inherent conservation value.

⁹ At a cost of \$1.2 million, the project constituted nearly 2% of a \$60 million irrigation project.

CASE 7

**EXPERIMENTING WITH COMMUNAL RESOURCE MANAGEMENT
THE ARABARI EXPERIMENT IN INDIA**

The Arabari experiment began in West Bengal in 1970. The objective of the experiment was to find out what it takes to get the villages to stop encroaching on the forest for illegal firewood cutting, an activity that was leading to rapid deforestation. Interviews with 1,300 people in eleven villages revealed the villagers were earning a good part of their income from illegally cutting and selling firewood. The experiment offered the villagers forest-related employment opportunities from which they could earn at least as much as they earned from forest encroachment. The villagers were employed in planting trees and grass on blank patches. Planting was scheduled to take place during the low-employment season. Fuelwood and construction poles were provided to the villagers at cost from outside sources. In addition, they were offered a revenue sharing agreement with the Forest Department whereby the villagers received 25% of the selling price of mature trees in cash. The villagers were also entrusted with the responsibility of protecting the forest from encroachment. Institutional arrangements were made for the election of rotating representatives from among the villagers to monitor the work and to collect and distribute payments.

Following these changes, the villagers enforced total protection of the forest and they themselves refrained from illegal cutting. They self-imposed and self-enforced a reduction of firewood cutting and introduced watching and patrolling by villagers. In 35 years, the degraded forests were rehabilitated, the villagers were markedly better off and their relations with the Forest Department improved. Gradually the experiment was expanded to more villages and by 1989 there were over 700 groups or Village Protection Committees protecting over 70,000 ha of degraded lands that were planted to forests in West Bengal. "The will to do so developed as these groups believed in the assurance of sustained benefits..." (Banerjee, 1989). Similar success with small user groups is reported in Nepal, Indonesia and Niger.

The lesson to be learned from these success stories is that for collective action to succeed, the following conditions must be met:

- (a) a link must be created between a well-defined small-group and a well-defined price of forest land,
- (b) the group members must perceive a clear correlation between their contributions and the returns they get,
- (c) both authority and benefits flowing from resource management must be restricted to the member of the group to the exclusion of outsiders and free riders (Cerne, 1989), and
- (d) adjustments and variations of the degree of group cooperation must be made according to the particular communities' degree of social cohesion and experience with collective action.

CASE 8

**POLICY SUCCESS: THE ROLE OF WOMEN AND LOCAL COMMUNITY GROUPS
IN IMPROVED NATURAL RESOURCE MANAGEMENT IN KATHEKA KENYA**

Over the past decade, volunteer self-help groups in the Kenyan village of Katheka have contributed significantly to controlling soil erosion, improving water catchment and increasing food production. Fifteen volunteer groups, including twelve women's groups, meet twice weekly and work on a group member's farm as well as carry out community projects (48). Projects, which are often self-funded, have included land terracing, digging cut-off drains and installing check dams.

In 1973, resource degradation had reached nearly intolerable levels in Katheka which has an annual rainfall of 400-600 mm. Soil loss and tree removal was rampant. Voluntary women's groups known as mwethya or self-help groups had been organized for centuries in times of need. During colonial times, however, the tradition had all but disappeared. For unknown reasons, the mwethya witnessed a resurgence in the mid-1970's and within a few years the groups, which were predominantly women¹⁰, were actively working and results beginning to show. The groups are organized with incentives for participation. If, for example, a member misses two or three work sessions, then the group skips over that person's farm during the course of the rotation (48).

The mwethya have led to increased environmental awareness among women. Respondents to a village survey almost unanimously commented that soil conservation increases water retention and consequently food production. They also agreed terracing is critical to sustaining and increasing yields (48). This awareness in turn leads to more efficient farming practices and sustainable food production. Decision-making and implementation are the sole responsibility of the groups with no outside interference. As a result the women are invested with a strong sense of leadership and responsibility. It is they who benefit from the more efficient practices they choose to adopt.

While Katheka residents have practiced effective resource management within the confines of the mwethya, they do not have the management capabilities, or access to economic resources to combat external forces. Indeed, whenever external forces do become involved, trouble seems to arise. For example, Nairobi businesses often send trucks to dig sand from the dry riverbeds. As a result of the sand removal, less water can be stored for the dry season; dams built by the mwethya are rendered useless, and the riverbed lining is removed increasing the rate of water flow during rainstorms and raising the rate of soil being carried away (48). Despite these problems, the mwethya of Katheka remain mobilized to institute effective resource management. When such groups are invested with the ultimate responsibility for success or failure, the results are often positive. As farmers witness sustainable increased yields due to more efficient practices, they learn the value of resource management and conservation.

¹⁰ As of July 1987, there were 12 groups with 400 members, all but 40 of whom were women (48).

CASE 9

INVESTING IN CONSERVATION IN NORTHERN NIGERIA

Investment projects in shelterbelts and farm forestry in arid zones in northern Nigeria demonstrate that the ecological benefits of rural afforestation programs can be translated into economic terms. Such programs are ecologically beneficial to the region as well as economically sound (6).

The planting of public shelterbelts and farm forestry practice can prevent soil erosion and loss of soil fertility resulting from deforestation and loss of trees on farmland. In the more denuded areas, planting may enhance soil fertility and in areas still being cleared for agriculture, the same ecological effect can be achieved at a fraction of the cost by leaving trees standing. The overall outcome would be an increase in farm income because of the higher output of the crops and livestock. The result would also be sustainable because the long-run threat to the soil's carrying capacity from erosion and from loss of nutrients and moisture would be reduced. In addition, there would be economically important bi-products such as firewood, fuel, fruit, mulch, and fodder.

The benefits of preventing declines in soil fertility are measured by taking the present value of all agricultural outcomes from land at the present level of soil fertility and subtracting the present value of the output, assuming a decline in soil fertility. Increases in soil fertility as a result of improved moisture retention and nutrient recycling are measured by the present value of the incremental effects of afforestation on crop yield, since farm forestry and shelterbelt programs not only prevent losses in soil fertility, but may actually improve fertility. Increases in the output of livestock products (as extra dry season fodder becomes available from the stover associated with larger crops and from trees and shrubs) are measured by the present value of the incremental livestock production. The value of the tree products such as firewood, poles, and fruit is estimated in the usual way by multiplying the amount produced by the price of the products and calculating the present value.

The net benefit of the project is the present value of the changes in net farm incomes from cropping and livestock activities and of the benefits of wood and fruit production, minus program costs. The estimated net benefit and rate of return to investment under several scenarios are shown in Table 2 of Annex III.

CASE 10

COMMUNAL TENURE IN PAPUA NEW GUINEA

Unlike most of the developing world, Papua New Guinea has maintained its communal tenure customs while adapting to the requirements of an increasingly market-oriented economy. While the latter requires clear land ownership, Papua New Guinea's experience has shown that converting land from communal to freehold may confuse rather than clarify the rights of ownership. On the other hand, absent has been the widespread land degradation encouraged by the insecure tenure, loss of entitlements, and open access characteristic of state-owned land elsewhere.

Most countries have responded to market pressures for clear ownership by imposing a new system of private or state ownership. In contrast, Papua New Guinea's land law builds upon the customs governing its communally held land. The country's Land Ordinance Act calls for local mediators and land courts to base settlements on existing principles of communal ownership. Consequently, 97% of the land remains communal, has been neither surveyed nor registered, and is governed by local custom (15).

This communal tenure seems to provide clearer ownership rights, with all their environmental and market implications, than private ownership. Settlements which convert communal land to freehold are often later disputed with reversion back to customary ownership a frequent outcome. Yet, unlike the reality of state-owned land in other developing countries, communal land in Papua New Guinea is neither unowned nor public. Rather, the bundle of rights deemed "ownership" in the West does not reside in one part. For example, individual families hold the right to farm plots of land indefinitely, but the right to trade them resides in the clan (15).

The island's communal systems have long resulted in the sustainable use of its more densely populated highlands. With a 9,000 year agricultural history, an overly wet climate, and a population growth of at least 2.3%, the highlands remain fertile. The population, which is primarily agricultural, enjoy a per capita income over twice that of El Salvador, Western Samoa and Nigeria (15). In marked contrast to much of the developing world, only 6 million of its 46 million hectares of forest land have been converted to other uses (8).

The lack of deforestation comes as no surprise since those who control the land have an interest in the sustainable, productive use of its forest. Rather than dealing with a distant government in need of quick revenues and foreign exchange, companies seeking logging rights must negotiate directly with those who have secure tenure and who use the land not only to farm, but to gather fruit, hunt and collect materials for clothing, buildings, and weapons (30, 8). Because the communal tenure patterns provide an entitlement to all clan members, individuals have little incentive to sacrifice future value for current use.

- Basing land law upon customary communal tenure patterns can be a viable adaptation to the requirements of a market economy.
- Communal tenure may prevent deforestation more effectively than either state or private ownership if it provides an entitlement and secure tenure to a group who benefits from a forest's sustainable use.

CASE 11

**EVALUATING A TROPICAL FOREST FOR MULTIPLE USE:
THE MISHANA FOREST IN PERU**

Tropical forests capable of generating a multitude of products and services are often exploited commercially for a single use such as timber production, or they are simply converted to plantation or ranching while management for multiple use would generate a higher net present value. A recent study (Peters et al. 1988) has calculated the net present value of forest products in a 1.0 hectare stand of the Mishana Forest on the Rio Nanay 20km southwest of Iquitos, Peru, and found that managing the forest for a combination of fruits, latex and timber would generate three times as high net present value as converting to an intensively managed single-species plantation.

A systematic inventory of a single hectare of forest showed 50 families, 275 species, and 842 individual trees of less than 10.0 cm in diameter of which 72 species (26.2%) and 350 individuals (41.6%) yielded products which have an actual market value in Iquitos. Edible fruits were produced by 7 tree species and 4 palm species, 60 species were commercial timber trees, and 2 species produced rubber.

The value of the forest resources including fruit, timber, and rubber was assessed at the actual market value. The yield of useful products per unit of time was determined for each resource. The net revenues generated by the sale of each resource were calculated based on current market values and the costs associated with harvest and transportation. Two different harvest scenarios were used. The first involved the selective removal of all existing timber of greater than 30.0 cm in diameter in year 0, year 20, and year 40, with a final cut of all remaining trees (projected to have a minimum diameter of 30 cm) in year 65. Annual collection of fruit and latex were conducted throughout the 65 year cutting cycle. The second scenario, that of sustainable yield, assumes selective timber removal (30 m³/harvest) on a 20 year cutting cycle with annual fruit and latex collections in perpetuity.

Using the criteria for the first scenario, the native plant resources on the site possessed a net present value (NPV) of \$9191.77 (fruit, \$7679.81; latex, \$428.39; timber, \$1083.57). Using the second scenario, the NPV comes to \$8610.13 (fruit, \$8002.60; latex, \$446.40; timber, \$161.13). It is important to note that in this latter scenario, fruit represents 88.2%, and fruit and latex together, the "minor forest products," 98.1% of the total NPV of the forest.

The NPV calculations for the Mishana forest demonstrate that natural forest utilization is economically competitive with other forms of land-use in the tropics. Using identical investment criteria, the NPV of the timber and pulpwood obtained from an intensively managed plantation of *Gmelina arborea* in Brazilian Amazonia is estimated at \$3,184.00, and gross revenues from fully-stocked cattle pastures in Brazil are reported to be \$148/ha/year, with an NPV of \$2960.00. Thus, even though multiple use management of this tropical forest could generate three times the net present value of a single species, single use plantation, large tract of forests in Peruvian and Brazilian Amazonia are converted to such plantations and ranches.

CASE 12

FIGHTING URBAN CONGESTION WITH MARGINAL PRICING IN SINGAPORE

Like many cities, Singapore has suffered from the environmental effects of an increasing car-driving population: congestion resulting in longer travel times for cars and public transport alike, air pollution, wear and tear on roads, and a lower quality of life for those living and working in heavily congested areas. Because car drivers do not naturally bear the substantial costs they impose on society, charging for urban road use is theoretically appealing. The success of Singapore's Area Licensing scheme demonstrates its practical appeal as well.

In 1975, cars represented half of Singapore's 280,000 registered vehicles and were owned at a rate of one per 16 people. In an attempt to reduce central city traffic by 25-30% during peak hours, the city implemented a scheme which charged drivers for using roads in the center city during these hours. Specifically, the city aimed to 1) reduce car use within certain areas during particular times, 2) leave economic activity unaffected, 3) enact a scheme which was easy to implement and enforce, and 4) provide those no longer driving into the inner city with attractive travel alternatives. The area pricing scheme required vehicles traveling through the center city at peak hours to purchase a daily or monthly license, raised daytime parking fees within this area, and instituted a park and ride service to facilitate easy non-car commuting. Cars with more than four passengers, buses and cycles were exempted from the licensing requirements (62).

The scheme had the following effects. Above all, it achieved a traffic reduction of 73% in the zone during peak hours. In addition, business seemed largely unaffected and, although the park and ride option was not heavily utilized, the city found the overall scheme easy to enforce and implement. Carpools increased from 10% to 40% of all traffic, while 13% of car-owning commuters into the zone switched to public transit and about the same number changed their commuting time to pre-peak hours. For those who did not change their habits to avoid the zone during peak hours, the monthly average commuting cost rose from US\$64 to US\$95. More significantly, all but one-tenth of "through zone" commuters changed their route or departure time to avoid licensing fees. Travel speeds decreased by 10% on incoming roads and by 20% on zone roads. Speeds on substitute "ring" roads increased by 20%. The only group experiencing an increase in travel time were converts to public transit, whose average travel time went up by only 9 minutes on a previously 29-minute trip (62).

The scheme had additional environmental benefits. Although other pollutants were difficult to measure, the level of carbon monoxide declined significantly during the hours the scheme was in effect. Central city residents and shoppers reported greater ease and safety in getting around, less fumes, and generally happier living and shopping conditions. Overall, all affected groups concurred that the impact on Singapore was positive, with motorists being the only ones to perceive themselves as worse off, although not badly so. Their perceptions were accurate since they were, in fact, shouldering more of the social costs of their car use. With an initial return on investment of 77%, which, with an increase in license fees, rose to 95%, the scheme achieved its goals without undue budgetary costs. Less quantifiable but more significant may be the long-run benefits, specifically, the road construction or future congestion which may be avoided due to changed habits and attitudes towards public transit and car use (62).

- By making drivers bear some of the costs their driving imposes on others, charging for road use can reduce traffic to a more efficient and environmentally sound level.
- Schemes which charge for road use can be cost-effective and easy to implement and enforce.

CASE 13

COSTS OF UNPLANNED RESETTLEMENT, NAM PONG RESERVOIR

The Nam Pong Water Resources Project in Northeast Thailand illustrates the potential of mismanaging the environmental impacts of water projects. The intensive resettlement of people displaced by the Nam Pong reservoir into areas within its watershed has resulted in widespread deforestation. This, in turn, has significantly increased the level of sedimentation in the reservoir, which has quantifiably and substantially reduced its economic value.

The Ubolratana dam, which created the Nam Pong reservoir, was constructed in 1966 to regulate flooding, generate hydropower, and irrigate surrounding areas. The reservoir's estimated life was 500 years (31). At that time, virtually all the better farmland in the surrounding area was under cultivation, 85% of the inhabitants were farmers, and the population growth rate was 3%. Most farmers displaced by the reservoir were resettled on land within its 11,500 km² of watershed. With a population density of 68 people/km², the watershed area supported 785,000 people in 1980. This number is expected to double by the year 2000 (58).

Not surprisingly, the character of watershed land use has changed dramatically. Between 1965 and 1982, over half of the forested land in the Nam Pong Basin had been converted to agricultural use, despite its poor soil and steep slopes. Previously largely forest, the watershed area, at current rates of conversion, will be totally deforested by 1990. Sedimentation, a direct function of the effectiveness of vegetation cover and anti-erosion practices, has increased dramatically. The average sediment inflow from the Nam Pong Watershed into the reservoir increased by 80% between 1969 and 1982. By 1990 the cumulative increase is expected to be 135%. Currently, over 2 million tons of sediment flow into the reservoir annually (31).

	<u>1962</u>	<u>1978</u>	<u>1982</u>
Agricultural land in Watershed, thousands of km ²	2.5	7.0	7.8
Forest land in watershed, thousands of km ²	10.0	5.3	4.5
Sediment inflow to reservoir, millions of tons	1.2	1.7	2.2

In turn, sedimentation in the river basin reduces the effective capacity of the reservoir, cutting its potential to irrigate, generate power, control floods, and support fish. In 1980, the reservoir's expected life had been reduced to 200 years from 500 years. To limit the sedimentation to 3 million tons per year, the government will have to preserve the 2,500 km² of national parks within the watershed. Without this maintenance, the life span of the reservoir is expected to decrease further to 157 years (31).

The Thai government's study of the reservoir has enabled researchers to estimate reservoir benefits foregone due to watershed deforestation and inadequate erosion management. The levels of sedimentation resulting from different types of land use and erosion management, and the consequent reductions in irrigation, power, flood control and fish catch have been calculated. Estimated foregone reservoir benefits due to sedimentation are given below. Because of sedimentation, the reservoir is expected to provide only half its initial benefits by year 50 (18).

<u>Year</u>	<u>5</u>	<u>10</u>	<u>15</u>	<u>20</u>	<u>25</u>	<u>30</u>	<u>35</u>	<u>40</u>	<u>45</u>	<u>50</u>
Foregone benefits due to sedimentation as a % of initial benefits	3	8	13	18	24	29	34	39	45	50

- Not considering the environmental implications of where persons displaced by a reservoir resettle can substantially and quantifiably reduce the reservoir's economic life and benefits.
- Preventing erosion in a reservoir's watershed can maintain the reservoir's economic value.

CASE 14

TREATING THE SYMPTOMS: THE LOGGING BAN IN THAILAND

In response to the catastrophic flooding and landslides in November 1988 which left 70,000 homeless and caused millions of dollars damage to farms and fisheries, the Thai Government banned all commercial logging nation-wide. While seemingly a natural disaster, the November floods are the result of both changes in land use patterns (where cash crops such as rubber have replaced less erosive ground cover) and rampant logging by villagers and large companies. Indeed, Thailand's forest cover is 20% today as compared with over 60% in the 1950's (35). The ban has largely failed to reduce deforestation due to a lack of effective enforcement and forest management. In fact there may have been an increase in deforestation since the ban. The local press in June 1989 reported more serious deforestation since the ban as documented by a Forestry Department survey. Aerial surveys recorded a 54% increase in deforested land between January and May 1989 as compared with the same period in 1988. Also, illegal logging was uncovered in 2500 forests as compared with 1300 forests a year earlier (17).

While the logging ban may appear to answer directly to the problem of deforestation¹¹ in Thailand, the underlying incentives for land clearing for agriculture remain firmly in place - which may be the reason the logging continues (21). These root causes include a fast-growing population which leads to social pressures such as increased rural poverty and lack of alternative employment opportunities. The agriculture minister admitted that logging violations were almost wholly committed by villagers as a way to supplement income. The Thai government's response to these pressures has been tacit encouragement of the landless peasants' squatting on forest lands. In some cases, the government's support has been more overt. For example, 1.2 million landless families have been resettled on "deteriorated" forest land in the last decade. However authorities did not allow the landless migrants to secure firm land ownership.

Indeed "half measures" such as the granting of 25 year "usufruct" rights to squatters on public forest lands encourage further encroachment without investing farmers with the long-term interests needed to stimulate more effective and sustainable land management. Depriving farmers of access to formal credit or other investment incentives leads to myopic planning or no planning at all. Insecure land tenure dominates more than 50% of Thailand, leaving farmers with few options other than to "mine" the land since more sustainable land management practices will not be rewarded (46). A logging ban does not answer these underlying causes of deforestation. Until issues of land tenure, employment opportunities and rural poverty are resolved, deforestation and subsequent flooding and landslides will continue to plague Thailand.

¹¹ Deforestation is estimated to be at 3% per year (39).

CASE 15

**TURNING A MARKET FAILURE INTO A POLICY SUCCESS:
IMPROVING SECURITY OF LAND OWNERSHIP IN THAILAND**

As a result of massive forest encroachment and land opening over the past two decades, 37% of the agricultural land in Thailand is undocumented and untitled while another 47% is covered by certificates of utilization (Nor Sor 3) which are not accepted as collateral for long-term credit. The lack of security of ownership over land constitutes a serious obstacle to farm investments necessary for diversification, intensification, and increased productivity. Untitled land is not accepted by financial institutions as collateral for credit forcing farmers into the high interest rate informal credit market, which makes farm investments unprofitable (Feder *et al* 1988). The risk of eviction, however small, adds an element of uncertainty that further discourages investments in land improvements and soil conservation. Uncertainty, lack of access to institutional credit, and easy access to public forest land combine to bias agricultural development against intensification on existing lands and in favor of expansion into new lands.

There is empirical evidence that insecurity of ownership has been a serious impediment to production growth in Thailand. According to Feder, *et al.* (1986), "Large numbers of farmers do not have legal ownership of the land which they operate even though they are perceived as de facto owners within the farming community." Through extensive surveys and rigorous econometric analysis, Feder *et al* (1988) found that (1) the value of insecurely-held land was only one-half to two-thirds the value of securely-owned comparable land; and, (2) the capital-land ratio in securely-owned lands was 60-250% higher than that of insecurely titled land. Finally, the authors found that the social benefits from providing land ownership security range between 25% and 80% of the market value of the squatters' land, and that the private benefits to the farmers were even higher (Feder *et al.* 1988). These are enormous benefits, if one considers that almost 40% of the agricultural land in Thailand is untitled. They amount to roughly 10-30% growth in Thailand's total agricultural productivity as well as to substantial soil and forest conservation. It is believed that 14% of the encroached forest in Northern Thailand is used to replace land that is seriously eroded and degraded (Attaviroj 1986).

With assistance from the World Bank, the government of Thailand is currently carrying out a major land titling program to improve farmers' security of land ownership. Unfortunately, squatters in reserved forest lands are given only rights to farm ranging 5-25 years which are not transferable because it is feared that granting them full titles might encourage them to sell their land for a song and continue opening new land in reserved forests. However, it is more likely that the half-measure of use rights would lead to further forest encroachment since the World Bank Study found that only full, secure, exclusive, transferable and indefinite titles to land could result in increased investment and higher productivity.

CASE 16

MACROECONOMIC POLICIES FUEL DEFORESTATION IN GHANA

In 1900, over one-third of Ghana was covered with natural forest. At present, little remains. Since the mid-sixties, the immediate causes of this deforestation have primarily been shifting cultivation and the harvesting of fuelwood, with logging and treecropping playing a marginal role. However, underlying these causes is the increasing rural and urban poverty which has resulted from the country's misguided macroeconomic policies (26).

Ghana has experienced such extreme rates of deforestation that in 1980, only 7% of the country remained forested. Poverty has resulted in the halving of forested area over the past twenty-five years as rural families, lacking other alternatives, turned to shifting cultivation for their energy needs. By 1980, nearly 40% of the country's land was being used for shifting cultivation. Poverty rates jumped in 1970, a condition reflected in a rapid growth in fuelwood consumption in the 1970's. By 1983, Ghana's rate of fuelwood use, 906 cubic meters per capita, ranked among the highest in the world (26).

The increasing poverty can be attributed to the country's macroeconomic policies. At its independence in 1957, Ghana was one of the wealthiest and most highly educated countries in Sub-Saharan Africa. Between 1965 and 1983, the country's real per capita GNP growth rate was -2.1%, 5.6 percentage points lower than the average for other oil-importing middle income developing countries. Economists concur in attributing this decline to the government's agricultural, industrial and trade policies (26).

On the other hand, logging and conversion to treecropping has dwindled as these same policies, in particular the highly overvalued exchange rate, have undermined export profitability and limited the foreign exchange available for necessary inputs. Between 1970 and 1985, the volume of the country's industrial logging was one-tenth that of its fuelwood harvesting. Ghana's export of cocoa, which had represented almost one-third of the world market in the early 1960's, had dropped to less than 15% by 1982 (26).

To the extent that logging has been profitable, Ghana's per tree, species-specific royalty system should have resulted in efficient logging with high utilization rates. By levying royalties according to trees cut rather than volume utilized, the system could have discouraged cutting young trees and leaving oversized ones, which would have ensured canopy openings for remaining saplings. However, these incentives have been irrelevant in the context of an exchange rate so overvalued that real fees for logging have been negligible. While officially high at the black market exchange rate, royalty rates have been the lowest in the world. Likening the charges per hectare to the cost of a "small stick of firewood," the World Bank concluded that Ghanaian forest wood could be considered a free good (26).

Similarly, the exchange rate has foiled reforestation efforts by eroding the value of their revenue sources. Before 1976, at the black market exchange rate, the reforestation charge on loggers was equal to only US\$0.02 per hectare. After 1986, it was still less than US\$0.05 per hectare. The Forestry Department's recent reforestation budget has been equivalent, at the black market rate, to approximately US\$125,000 per year (26).

- Misguided macroeconomic policies which result in increased poverty can be a primary cause of deforestation by leading to diminishing entitlements and consequent widespread reliance on fuelwood and shifting cultivation.
- The efficacy of environmentally sound microeconomic policies can be undermined by inefficient macroeconomic policies.

Annex II: A Sample of Policy Failures and Successes Based on AID Field Experience

POLICY FAILURE: DEFORESTATION IN HONDURAS

At current rates of deforestation, forestry resources in Honduras will be exhausted within a quarter of a century. More specifically, Honduras is witnessing large scale destruction of pine and broadleaf forests. As a result of this severe deforestation, an estimated 10,000 hectares of tillable soil is being lost annually. Furthermore, the resulting watershed destruction has imposed heavy social and economic costs in terms of siltation, flooding, shortening the useful life of reservoirs and loss of productive capacity.

Both insecure land tenure and inefficient forestry resource pricing have been implicated as root causes of Honduran deforestation. Policies of the public forest corporation (COHDEFOR) have encouraged excessive rates of extraction and dampened incentives for long-run investment in the forestry sector. Meanwhile, farmers who are denied access to fertile lands are increasingly turning to marginal areas for farming, leading to highly destructive slash-and-burn techniques. Contributing to the problem is a lack of secure land ownership, stifling any inclination for farmers to incorporate long-term considerations in their decision making.

MARKET FAILURE: AIR POLLUTION IN THE DOMINICAN REPUBLIC

Several sections of Santo Domingo suffer from severe air pollution due to emissions from a scrap iron foundry, a cement factory and electric power plants. Measures adopted by the Dominican Republic government have thus far been ineffective due to a combination of unenforceable zoning regulations and successful lobbying by industrial concerns to avoid relocation or installation of emission-controlling devices.

POLICY FAILURE: GOVERNMENT HANDS TIED IN FACE OF RAPID POPULATION GROWTH IN THE DOMINICAN REPUBLIC

Following the death of President Trujillo, who placed severe restrictions on rural-urban migration, Santo Domingo's slums are teeming and the quality of life there is rapidly deteriorating. Neither the private nor the public sector has been able to provide adequate housing, food, electrical power, water, education or employment opportunities.

The government *de facto* encourages migration since public works are concentrated in urban areas, while rural infrastructure is sorely lacking.

POLICY FAILURE: OVERUSE OF PESTICIDES IN THE DOMINICAN REPUBLIC

The Dominican government has been unable to regulate pesticide use resulting in excessive preventative spraying of pesticides. Consequently, much of the Dominican produce has been denied entry into the U.S. since the American government has detected excessive levels of pesticide residue.

Besides dampening the Dominican Republic's export revenues, the excessive use of pesticides has resulted in a decrease in crop yields. This decrease has been traced to the killing off of beneficial natural predators which had previously kept the pest level in check.

POLICY SUCCESS: INSTITUTIONAL CAPACITY IN TUNISIA

The Tunisian government has developed a highly skilled technical cadre to formulate environmental policies. In addition, legislation for protection of water, soil and forests is in place. Moreover, all of these efforts are bolstered by considerable statistical data which is available to policy makers.

POLICY FAILURE: INEFFICIENT IRRIGATION WATER PRICING IN PAKISTAN

Much of Pakistan's soils suffer from excessive salinity due to excessive use of irrigation water. Water tables rise, bringing sub-soil salts to the surface. The problem is further exacerbated by common access and common exposure of many farms to a single water table.

The root cause of overuse of irrigation water lies in the government's inefficient pricing policies. Water fees do not reflect the true cost of the water they are using, leading farmers to use far more than the economic optimum.

MARKET FAILURE: ADMINISTRATIVE CONTROLS AND RENT-SEEKING IN KENYA

Government attempts to combat environmental problems through administrative controls often lead to rent-seeking behavior by those who administer such measures. In the past, extensive government intervention has created entrenched bureaucracies with strong vested financial interests in perpetuating precisely the kinds of behavior they were supposed to prevent. In effect, the distortion created by administrative controls provides a powerful incentive for rent-seeking behavior.

Government actions can also have a widespread effect on both the economy and the environment, influencing farmers' cropping patterns and cultivation practices. For example, fertilizer and pesticide subsidies encourage overuse and misuse of these inputs resulting in adverse effects on downstream water supplies. Similarly, price and marketing controls on food grains, adopted for food security reasons, may lead to planting grains on marginal lands, such as steep hillsides, where tree crops would be both economically and environmentally more sound.

POLICY FAILURE: WASTE MANAGEMENT IN YEMEN

Some areas in Yemen, both rural and urban, are literally buried in plastic bottles. A tree covered with plastic bags is a frequent sight and is sometimes jokingly referred to as Yemen's "National Tree". Coastal areas also suffer from severe waste management problems. The dumping of plastic articles into the ocean undoubtedly has a harmful effect.

Toxic waste is yet another problem, often related to water contamination. The problem exists on different scales. Even small industrial plants, which often lie outside the purview of policymakers, can have a detrimental impact on the local level. Somewhat related, the storage and proper use of toxic pesticides and herbicides is definitely an issue in Yemen.

MARKET/POLICY FAILURE: A "TRAGEDY OF THE COMMONS" IN LESOTHO

The most striking examples of environmental degradation in Lesotho are the related problems of severe soil erosion and severe overgrazing of mountainous pasture lands. The root of the problem lies in a "tragedy of the commons" with respect to grazing rights as well as the accompanying cultivation and grazing practices. Because of the lack of secure and enforceable grazing rights, farmers rush to exploit pasture lands with little thought for the future. This insecure land tenure leads to drastic overexploitation and degradation of pasture land.

The problem is further exacerbated by overstocking of animals. Wage remittances from Basotho miners inject excess liquidity into the local economy. Because of a lack of attractive investment alternatives, additional investment is made in livestock.

**MATRIX OF ENVIRONMENTAL PROBLEMS & POLICIES
BASED ON AID FIELD EXPERIENCE**

	Irrigation Related Problems	Urban Degradation	Soil Erosion Land Degradation	Deforest- ation	Water Pollution
Pakistan	Saline soil: govt subsidi- zied irriga- tion water; inefficient cost recov- ery	Insecure property rights;govt controls in financial sec- tor	Overgrazing; soil erosion; desertifica- tion;reduced biological diversity	Lax enforce- ment;obso- lete legal sy- stem limited financial resources	
Mexico		Inadequate funding for effective remedies			
Tunisia		Overdevel- opment of tourist areas;limits on import of pollution control devices	Construction destroys marsh eco system,leads to tidal ero- sion;hotel & industrial construction in coastal zones	Lax enforcement; coordination problems	
Yemen	Excessive water use; use guided by tradition- al views;pol- itical con- straintintro of tubewells	Inefficient pricing of waste/water management; urban decay			Toxic waste; pesticide use;dumping plastics in ocean; over- all waste management
Saudi Arabia	Subsidized wheat leads to excessive water use, drains aquifers				
El Salvador		Polluting firms not bearing cost of pollution		Mining of forest re- sources; fu- ture costs not considered	
Guinea			Insecure land tenure	Exploitation of trees for charcoal	

	Irrigation Related Problems	Urban Degradation	Soil Erosion Land Degradation	Deforest- ation	Water Pollution
Dominican Republic		Externality of pollution costs not internalized	Dam con- struction on steep slopes leads to erosion		Inadequate disposal of tailings from gold mining, acid runoff
Honduras		Lack of attn to urban waste prob- lems; public health hazard and associated externalities ignored	Loss of till- able soils due to forest exploitation; watershed destruction; ranching	Insecure land tenure, slash and burn farming due to limited access to fer- tile land; lack of in- centive for long term investment	
Mauritania		Sudden increase in urban popu- lation due to loss of entitlements and drought		Harvesting of fuelwood	
Kenya			Food crop price and marketing controls led to hillside planting and consequent soil degrad- ation		Pesticide and fertilizer subsidies encourage excessive use and conse- quent water pollution
Caribbean			Subsidized cash crop production; external costs of tourism not inter- nalized	Subsidized cash crop production	External costs of tourism not internalized

	Irrigation Related Problems	Urban Degradation	Soil Erosion Land Degradation	Deforest- ation	Water Pollution
Lesotho			Communal tenure and lack of alternative investment opportunities leads to excessive cattle purchase, overgrazing, soil erosion	Underpricing of forested land leads to expansionist agricultural practices	Failure to internalize external costs of industrial waste
Mozambique		Increased in population due to loss of entitlements due to drought			
Indonesia			Subsidies to fertilizers and food crop cultivation; transmigration policies	Unenforced public ownership of forest lands combined with insecure tenure for indigenous people, short concessions, low rents inadequate to recover reforestation costs	Failure to internalize external costs of industrial waste; sectoral subsidies for water use

Annex III: Tables

TABLE I
ECONOMIC AND FINANCIAL ANALYSIS OF
GOVERNMENT-ASSISTED CATTLE RANCHES IN THE BRAZILIAN AMAZON

		Net Present Value (\$ mil.) investment outlay (\$mil.)	Total investment outlay	NPV
I.	<u>Economic Analysis</u>			
	A. Base case	-2,824,000	5,143,700	-0.55
	B. Sensitivity Analysis			
	1. Cattle prices assumed doubled	511,380	5,143,700	+0.10
	2. Land prices assumed rising 5%/year more than general infla- tion rate	-2,300,370	5,143,700	-0.45
II.	<u>Financial Analysis</u>			
	A. Reflecting all inves- tor incentives: tax credits, deductions, and subsidized loans	1,875,400	753,650	+2.49
	B. Sensitivity analysis			
	1. Interest rate sub- sidies eliminated	849,000	753,650	1.13
	2. Deductibility of losses against other taxable in- come eliminated	-658,500	753,650	-0.87

Source: Robert Repetto, "Economic Policy Reform for Natural Resource Conservation" (World Bank, Washington, D.C., May 1988), p. 42.

TABLE 2
RETURNS TO SHELTERBELTS AND FARM FORESTRY IN NIGERIA

Cases	Cost-Benefit Results			Assumptions		
	NPV Naira/ha farmed ¹	Benefits Cost Ratio	IRR (%)	Yield Effect (%)	Costs Relative to Base Case (%)	Rate of Soil Fertility Decline (%)
Shelterbelt						
Base Case	170	2.2	14.9	20	100	1
Low Yield/ High Costs	110	1.7	13.1	15	110	1
High Yield	221	2.6	16.2	25	100	1
Rapid Erosion	109	1.8	13.6	20	100	2
Farm Forestry						
Base Case	129	4.5	19.1	10	100	1
Low Yield/ High Costs	70	2.3	14.5	5	150	1
Rapid Erosion	60	2.5	15.5	10	100	2

1. The analysis employs a discount rate of 10% and is based on 1986 prices. In 1986, the official exchange was .25 naira/US\$.

Source: Anderson, Dennis, The Economics of Afforestation A Case Study in Africa (John Hopkins University Press, Baltimore, 1987) p.68

TABLE 3
COST-BENEFIT ANALYSIS OF CONSERVATION INVESTMENTS IN NORTHERN NIGERIA

Case	Yield effect (Percent)	Costs relative to base case (Percent)	Rate of decline of soil fertility (percent)	Cost-benefit results			Remarks
				NPV (naire per hectare farmed)	B/C	IRR (Percent)	
Shelterbelts							
1	20	100	1	170	2.2	14.9	Base case
2	15	110	1	110	1.7	13.1	Low yield/high cost case
3	25	100	1	221	2.6	16.2	High yield case
4	20	100	0	108	1.8	13.5	No erosion
5	20	100	2	109	1.8	13.6	More rapid erosion
6	20+	100	1	262	2.9	16.9	Soil restored to initial condition, plus yield jump
7	0	100	0	-95	0.3	4.7	Wood benefits only
Farm forestry							
1	10	100	1	129	4.5	19.1	Base case
2	5	150	1	70	2.3	14.5	Low case (no "high" case assumed)
3	10	100	0	75	2.9	16.6	No erosion
4	10	100	2	60	2.5	15.5	More rapid erosion
5	10+	100	1	203	6.1	21.8	Soil restored to initial condition, plus yield jump
6	0	100	0	-14	0.6	7.4	Wood and fruit benefits only

Note: B, benefits; C, costs; NPV, net present value; IRR, internal rate of return.

1. A 10 percent discount rate was used.

2. This increase corresponds to a three-to-four year lag in farmer response, plus a 10 percent cost.

Source: Anderson, 1987.

TABLE 4
NET SOCIAL BENEFITS OF OWNERSHIP SECURITY

Province	Gross social benefit as percentage of P_{nt}		Social cost as percentage of P_{nt} (2)	Net social benefit as percentage of P_{nt}		Mean price of untitled land (P_{nt}) (4)	Net social benefit in Baht per rai	
	Risk neutrality ^b (1)	Risk aversion ^b (1)		Risk neutrality (3)	Risk aversion (3)		Risk neutrality (5)	Risk aversion (5)
Udon-Ratchasini	82.9	38.6	3.3	79.6	35.3	3,448	2,745	1,217
Khon-Kaen	80.5	42.1	3.5	77.0	38.6	3,204	2,467	1,237
Chaiyaphum	41.3	25.3	5.6	35.7	19.7	2,014	719	397
Pooled northeast sample	68.2	35.1	4.1	64.1	31.0	2,889	1,852	896

- a. The opportunity cost of capital is assumed to be 12 percent. P_{nt} is the price of untitled land.
 b. Risk neutrality and risk aversion towards the risk of eviction from untitled land.

Source: Feder et al, 1988.

TABLE 5
HOW GOVERNMENTS SUBSIDIZE ENVIRONMENTAL DEGRADATION

**PUBLIC IRRIGATION SYSTEMS IN SELECTED DEVELOPING COUNTRIES:
COST RECOVERY RELATIVE TO TOTAL COSTS & ECONOMIC RENTS GENERATED**

Country	Revenues (\$US/ha.)	Total Costs (\$US/h)	Total Costs as % of Revenues	Charges as Percentage of Economic Benefits to Farmers
Indonesia	25.90	191.00	735%	8%
Korea	192.00	1057.00	550%	26%
Nepal	9.10	126.00	1388%	5%
Thailand	8.31	151.00	1818%	9%
Philippines	16.85	75.00	443%	10%

ESTIMATED AVERAGE RATE OF PESTICIDE SUBSIDIES

Country	Rate as % Full Retail Costs
Senegal	89%
Egypt	83%
Ghana	67%
Honduras	29%
Columbia	44%
Ecuador	41%
Indonesia	82%
Pakistan	negl.
China	19%

**GOVERNMENT RENT CAPTURE IN TROPICAL TIMBER PRODUCTION
(IN US\$ MILLIONS) (1979-82)**

Country	Potential Rent	Actual Rent	Official Govt Rent Captured	Rent Captured as % of Actual Rent	Govt Rent Captured as % of Potential
Indonesia	4958	4409	1654	37.5%	33.0%
Sabah	2065	2064	1703	82.5%	82.5%
Philippines	1504	1001	141	14.0%	9.4%

Source for above three tables Robert Repetto, "Economic Policy Reform for Natural Resource Conservation" (World Bank, Washington, D.C., May 1988)

TABLE 6
COMPARISON OF STUMPAGE FEES AND
REPLACEMENT COSTS PER CUBIC METER FOR SELECTED COUNTRIES

<u>Country (Currency)</u>	<u>Estimated Stumpage fees</u>	<u>Replacement Costs</u>	<u>Stumpage fees as a % of re- placement costs</u>
Ethiopia (Birr)	4.0	8.3-18.6	22-48
Kenya (KSh)		57.6	33
(deadwood collected by headload)	2.0-5.0		
(purchases by concessionaires)	19.2		
Malawi (MK)	2.88		16-58
(government plantations)		18.0	
(private plantations)		5.0	
Niger (CFAF)	85.00	13,610.0	0.6
Rwanda (FR)	160.00	600.0	27.0
Senegal (CFAF)	185.00	9,250.0	2.0
Sudan (LS)		10.2-46.2	
(Bushland)			
(Low rainfall savannah)		5.7-27.9	
(High rainfall savannah)		1.6-8.6	
Tanzania (TSh)			
(Plantation poles)	60-88	66.0	91-133
(Bush poles)	20-30	30.0	67-100
(Fuelwood plantation)	12.00	25.0	48.0
(Fuelwood brush)	6.0	9.0	67.0

Sources:

Ethiopia Forestry SAR, Report 6096-ET, May 29, 1986.

Kenya: Peri-Urban Charcoal/Fuelwood Study Phase I Report (ESMAP) Working Paper 2, World Bank, 1984.

Malawi Forestry Sub-Sector Study (A Review of Selected Issues) World Bank, 1984.

Senegal and Niger: Joseph Baah-Dwomoh, "Estimating Stumpage Value of Wood in the Sahel," mimeo, Washington: World Bank, n.d.

Rwanda Integrated Forestry and Livestock Development Project SAR, 1980.

Sudan Forestry Sector Review, World Bank, 1986.

Tanzania Mwanza/Shinyanga Rural Development Project Forestry Working Paper (Attachment 1, page 2).

Reproduced from Repetto (1988).

TABLE 7
INDEX OF DEFLATED PRICES OF WOODFUEL (\$1976)

<u>Country</u>	<u>1965</u>	<u>1976</u>	<u>1980</u>
Bangladesh	83.9	100	96.9
Burma	86.7 (1972)	100	170.0
Cameroon	112.9	100	203.2
Guatemala	88.3	100	66.6
India (Bombay)	78.5 (1971)	100	97.0
India (Hyderabad)	90.2 (1972)	100	101.8
Madagascar	93.2 (1971)	100	124.2
Malawi	108.6	100	157.9
Nepal (Kathmandu)		100	208.1
(Central Terai)		100 (1974/75)	103.2
Pakistan	85.6 (1966)	100	99.2
Philippines	117.0	100	132.0
Sri Lanka	56.1	100	168.2

Note: Dates in brackets give the year where it differs from that in the column heading.

Source: Leach, 1984; Nepal, adapted from World Bank data.

TABLE 8
POPULATION LIVING IN URBAN AREAS, 1950-2000
 (as a percentage)

Region	1950	1985	2000
World Total	29.2%	41.0%	46.6%
Africa	15.7%	29.7%	39.0%
Latin America	41.0%	69.0%	76.8%
(Temperate S. America)	64.8%	84.3%	88.6%
(Tropical S. America)	35.9%	70.4%	79.4%
Asia	16.4%	28.1%	35.0%
(China)	11.0%	20.6%	25.1%
(India)	17.3%	25.5%	34.2%

EXAMPLES OF RAPID POPULATION GROWTH IN THIRD WORLD CITIES
 (in millions)

City	1950	MOST RECENT	UN PROJECTION FOR 2000
Mexico City	3.05	16.0 (1982)	26.3
Sao Paulo	2.7	12.6 (1980)	24.0
Bombay	3.0	8.2 (1981)	16.0
Jakarta	1.45	6.2 (1977)	12.8
Cairo	2.5	8.5 (1979)	13.2
Delhi	1.4	5.8 (1981)	13.3
Manila	1.78	5.5 (1980)	11.1
Lagos	0.27	4.0 (1980)	8.3
Bogota	0.61	3.9 (1985)	9.6
Nairobi	0.14	0.83 (1979)	5.3
Dar Es Salaam	0.15	0.9 (1981)	4.6
Greater Khartoum	0.18	1.05 (1978)	4.1
Amkan	0.03	0.78 (1978)	1.5

Source for above two tables: World Commission on Environment and Development, "Our Common Future" (Oxford University Press, Oxford, 1987)

TABLE 9
DEFORESTATION IN SELECTED TROPICAL COUNTRIES

<u>Country</u>	<u>Closed Forest Area</u> <u>1980, (1000 Hectares)</u>	<u>Annual Rate of</u> <u>Deforestation</u> <u>1981-85, Percent</u>
Group 1		
Malaysia	20,996	1.2
Thailand	9,235	2.6
Philippines	9,510	1.0
Nepal	1,941	4.1
Nigeria	5,950	5.0
Ivory Coast	4,458	6.5
Ave (24 Countries)	222,415	2.3
Group 2		
Brazil	357,480	0.4
Indonesia	113,895	0.5
India	51,841	0.3
Ave (13 countries)	908,005	0.3
Group 3		
Kenya	1,105	1.0
Mozambique	935	1.1
Ave (10 countries)	6,529	2.2
Group 4		
Pakistan	2,185	0.0
Ethiopia	4,350	0.1
Central Af. Rep	3,590	0.1
Ave (15 Countries)	23,458	0.4

Group 1 countries: higher than average rates of deforestation, large areas affected.

Group 2 countries: relatively low rates but large areas affected

Group 3 countries: high rates and small areas of forests remaining

Group 4 countries: low or moderate rates and small areas affected

Source: Repetto (WRI, Table 1.2, 1988)

TABLE 10
WILDLIFE HABITAT LOSS IN ANE COUNTRIES OF THE
INDOMALAYAN REALM

	Original Wildlife Habitat (km ²)	Remaining Wildlife Habitat (km ²)	Habitat Loss (%)
Bangladesh	133,910	7,975	94
Burma	774,817	225,961	71
India	3,017,009	615,095	80
Indonesia	1,446,433	746,861	49
Nepal	117,075	53,855	54
Pakistan	165,900	39,816	76
Philippines	308,211	64,724	79
Sri Lanka	64,700	10,999	83
Thailand	507,267	130,039	74
TOTAL	6,535,322	1,895,345	71

Source: MacKinnon and MacKinnon, 1986

**TABLE II
STRATEGIC INSTRUMENTS FOR BUILDING CONSENSUS AND CAPACITY
FOR POLICY CHANGES THAT WILL IMPROVE THE MANAGEMENT OF
NATURAL RESOURCES AND ENVIRONMENT**

Project Instruments	Information and Knowledge	Awareness and Acceptance	Analytical Capacity and Experience	Institutional Strength & Commitment	Consensus & Capacity for Policy Change
PILOT PROJECTS, INSTIT. SUPPORT & TA					
Pilot Project & Micropolicy Tests	xxx	x	xxx	xx	xxx
Targeted Catalytic Technical Assistance	xx		xx	xxx	xxx
Institutional Support/Networking	x	x	xx	xxx	xxx
Leading Resource Indicators	xxx	x	xx	x	xxx
Environmental Accounts	xxx	x	xx	x	xxx
Monitoring Environmental Change	xxx	x	x	x	xxx
RESEARCH SUPPORT					
Research Support-Policy Analysis	xxx		xxx	xx	xxx
Research Support-Policy Research	xxx		xxx	xx	xxx
Competitive Research Grants	xx	x	xxx	x	xxx
Observation/Study Tours	xxx	x	x	x	xxx
Studies and Publications	xxx	x	xx	x	xxx
Natural Resources Journal	xxx	x	xx		xxx
Conferences, Seminars & Workshops	xxx	xxx	x	x	xxx
ENVIRONMENTAL AWARENESS					
Sustainable Development Forum	xx	xxx	x		xxx
Guest Speakers' Series	xx	xxx	x		xxx
Newsletters	xx	xxx	x	x	xxx
NGO Support	x	xxx		xxx	xxx
Environmental Awards	x	xxx	x	x	xxx
Environmental Awareness Activities		xxx		x	xxx
Audiovisual Productions	x	xxx	x		xxx
TRAINING					
Environmental Education/Curricula	xx	xxx	x	x	xxx
Degree Training/Thesis Support	xx	x	xxx	xxx	xxx
Non-Degree Training	xx	x	xx	xxx	xxx
In Service Training	xx	x	xx	xxx	xxx

xxx: Primary Objective
xx: Secondary Objective
x: Incidental

Annex IV: Guidelines**Guidelines for Policies**

- (a) **Ensure self-renewal of renewable resources by preventing overexploitation and mismanagement**
- (b) **Prevent unnecessary environmental damage from the extraction and processing of both renewable and non-renewable resources**
- (c) **Promote recycling where it is economically and environmentally beneficial**
- (d) **Avoid irreversible environmental effects**
- (e) **Undertake environmental protection measures that can be shown to have economic benefits that exceed their economic costs**
- (f) **Emphasize effective protection over rehabilitation on grounds of greater cost effectiveness**
- (g) **Adopt the principles "users and polluters pay" to internalize scarcity and environmental costs**
- (h) **Assess the environmental impacts of sectoral and macroeconomic policies and internalize them partly by adjustment of these policies and partly by mitigation of residual impacts**

Guidelines for Projects

- (a) **Projects affecting renewable resources should not result in rates of use that exceed the regenerative capacity of these resources or environments:**
 - e.g. - fisheries projects should not lead to overfishing
 - livestock projects should not lead to overgrazing
 - irrigation projects should not lead to destruction of watersheds
 - agricultural projects should not lead to mining of the soil, excessive soil erosion, overuse of pesticides, etc.
- (b) **No projects that lead to irreversible deterioration of the environment**
 - e.g.- species extinction
 - habitat destruction
 - loss of significant biological diversity
 - destruction of merit sites (natural and cultural)
- (c) **No projects that unduly compromise the public's health and safety**
 - e.g. - chemicals such as asbestos, etc.
 - hazardous wastes
 - reservoirs in areas of earthquakes or volcanic activity
- (d) **No projects that displace people or seriously disadvantage certain vulnerable groups, including tribal groups, without mitigatory and compensatory measures that leave them better off**
- (e) **No projects that contravene international environmental agreements (e.g. Montreal Protocol)**
- (f) **No projects which significantly modify natural areas designated as national parks, wildlife refuges, biosphere reserves, or World Heritage sites**
- (g) **Minimize unavoidable adverse consequences of projects through site selection, scale adjustment, timing, attenuation and mitigating measures**
- (h) **Balance short-term development gains against long-term environmental degradation or resource impairment (trade-offs) or internalize environmental damage through consideration of forgone long-term development benefits. Short-term development often leads to environmental degradation that constrains long-term sustainable development.**
- (i) **Avoid projects that involve unnecessary or irreversible damage to the natural resource base and the environment**
- (j) **Support environment-protecting, restoring and enhancing projects based on extended economic appraisal that fully internalize their benefits as well as their costs**
 - e.g. - reforestation and afforestation
 - forest and soil conservation

- management of rangelands and wildlands
 - watershed management
 - fisheries management
 - protection and management of parks, nature reserves and wildlife sanctuaries
 - land titling
 - irrigation maintenance, rehabilitation and management
 - solid waste management
 - efficient energy pricing
 - control of urban and industrial pollution
 - improvement of water quality and sanitation/ control of water pollution
 - prevention of desertification
 - water supply and sewage improvement
 - slum upgrading
 - projects in public health and education
 - preservation of genetic diversity
 - integrated pest management
 - safe disposal of hazardous wastes
 - coastal zone management
 - ecotourism
- (k) Integrate environmental impact in the appraisal of all public and large private projects by requiring extended economic analysis that considers a wider set of inputs and outputs than is traditionally considered; extends the relevant space dimension, the immediate site of the project to internalize spill-over effects; extends the relevant time horizon beyond the useful economic life of the project to internalize long-term effects and residual impacts; and includes indirect effects and intangibles usually left out of cost benefit analysis. Financial analysis and conventional narrow economic analysis lead to misallocation of resources when significant environmental impacts are involved.

REFERENCES

1. Agency for International Development (AID), Development and the National Interest: U.S. Economic Assistance into the 21st Century (AID, Washington, D.C., February 1989)
2. Agency for International Development (AID), Environmental and Natural Resource Management in Central America: A Strategy for AID Assistance (AID, Washington, D.C., 1988)
3. Agency for International Development (AID) "Safeguarding the Future: Restoration and Sustainable Development in the South of Thailand", USAID Team Report (AID, Bangkok, May 1989)
4. Agency for International Development (AID), Environmental and Natural Resource Management in the Asia and Near East Region: Strategies for AID in the 1990's (AID, Washington, D.C., September 22, 1989)
5. Ahmad, Yusuf J., Salah El Serafy and Ernst Lutz, Environmental Accounting for Sustainable Development (The World Bank, Washington, D.C., June 1989)
6. Anderson, Dennis, The Economics of Afforestation. A Case Study in Africa (John Hopkins University Press, Baltimore, 1987), p. 68
7. Asian Development Bank and International Irrigation Management Institute, Irrigation Service Fees Proceedings of the Regional Seminar on Irrigation Service Fees (Asian Development Bank, Manila, 1986)
8. Australian UNESCO Committee for Man and the Biosphere, Ecological Effects of Increasing Human Activities on Tropical and Sub-Tropical Forest Ecosystems (Australian Government Publishing Services, Canberra, 1976)
9. Barbier, Edward B., Economics, Natural Resource Scarcity & Development, (Earthscan Publications, London, 1989)
10. Binswanger, Hans P., "Brazilian Policies that Encourage Deforestation in the Amazon" (World Bank, Washington, D.C., April 1989)
11. Booth, Anne, Agricultural Development in Indonesia (ASAA Southeast Asia Publications Series, Sydney, 1988)
12. "City Lights", The Economist (February 18, 1989)
13. Clark University Program for International Development, Renewable Resource Trends in East Africa (Clark University, Worcester, Massachusetts, 1984)
14. Conway, Gordon R., Ibrahim Manwan and David S. McCauley, The Sustainability of Agricultural Intensification in Indonesia: A Report of Two Workshops of the Research Group on Agro-Ecosystems (Ford Foundation and Agency for Agricultural Research and Development, Ministry of Agriculture, Indonesia, December 1984)
15. Cooter, Robert D., "Inventing Property: Economic Theories of the Origins of Market Property Applied to Papua New Guinea",
16. Davis, Gloria, Indonesia Forest, Land and Water: Issues in Sustainable Development (World Bank, Washington, D.C., 1989)

17. Dhanasetthakarn, Apisak, "More Deforestation Since Logging Ban", The Nation, (June 29, 1989)
18. Dixon, John A. and Maynard M. Hufschmidt, eds., Economic Valuation Techniques for the Environment (Johns Hopkins University Press, Baltimore, 1986)
19. Dunkerly, Harold B., Alan A. Walters and John M. Courtney, Urban Land Policy Issues and Opportunities, Volume II, World Bank Staff Working Paper No. 283, (World Bank, Washington, D.C., May 1978)
20. "The Environment Survey", The Economist (September 2, 1989)
21. Erlanger, Steven, "Indonesia Takes Steps to Protect Rain Forests", New York Times (September 26, 1989)
22. "The Extended Family - A Survey of Indonesia", The Economist (August 15, 1987)
23. Falloux, F., "Land Information and Remote Sensing for Renewable Resource Management in Subsaharan Africa A Demand Driven Approach" (World Bank, Washington, D.C., June 26, 1989)
24. Feder, Gershon, Tongroj Onchan, Yongyuth Chalamwong, and Chira Hongladarom, Land Policies and Farm Productivity in Thailand (Johns Hopkins University Press, Baltimore, 1988)
25. Food and Agriculture Organization (FAO), Integrated Pest Management in Rice in Indonesia (FAO, Jakarta, May 1988)
26. Gillis, Malcolm, "West Africa: resource management policies and the tropical forest" in Robert Repetti and Malcolm Gillis, eds., Public Policies and the Misuse of Forest Resources (Cambridge University Press, New York, 1988)
27. Goodland, Robert and George Ledec, "Environmental Management in Sustainable Economic Development", International Association of Impact Assessment (Spring 1987)
28. Gorse, Jean Eugene and David R. Steeds, Desertification in the Sahelian and Sudanian Zones of West Africa (World Bank, Washington, D.C., 1987)
29. "Government to Abolish Subsidy for Utilization of Pesticide", The Jakarta Post, (December 2, 1988)
30. Harvard Institute for International Development, "The Case for Multiple-Use Management of Tropical Hardwood Forests" (Harvard Institute for International Development, Cambridge, MA, January 1988)
31. Johnson III, Sam H., Physical and Economic Impacts of Sedimentation on Fishing Activities: Nam Pong, Northeast, Thailand (University of Illinois, Urbana-Champaign, 1984)
32. Ledec, George and Robert Goodland, Wildlands Their Protection and Management in Economic Development (World Bank, Washington, D.C., 1988)
33. Leonard, H. Jeffrey, Natural Resources and Economic Development in Central America, (Transaction Books, New Brunswick, 1987)
34. Mahar, Dennis J., Government Policies Deforestation in Brazil's Amazon Region (World Bank, Washington, D.C., 1989)

35. McCoy-Thompson, Meri, "Sliding Slopes Break Thai Logjam", World Watch (September/October 1989)
36. McNeely, Jeffrey A., Economics and Biological Diversity: Developing and Using Economic Incentives to Conserve Biological Resources (International Union for Conservation of Nature and Natural Resources, Gland, Switzerland, 1988)
37. McNeely, Jeffrey A., "How Dams and Wildlife Can Coexist: Natural Habitats, Agriculture, and Major Water Resource Development Projects in Tropical Asia", Journal of Conservation Biology, Volume 1, No.3 (October 3, 1987)
38. McNeely, Jeffrey A., "Protected Areas and Human Ecology: How National Parks Can Contribute to Sustaining Societies of the Twenty-first Century" in David Western and Mary C. Pearl, eds., Conservation for the Twenty-first Century (Oxford University Press, Oxford, 1989)
39. Mirante, Edith, "A 'Teak War' Breaks Out in Burma", Earth Island Journal (Summer 1989)
40. National Research Council Panel on Common Property Resource Management Board on Science and Technology for International Development Office of International Affairs, Proceedings of the Conference on Common Property Resource Management, (National Academy Press, Washington, D.C., 1986)
41. Panayotou, Theodore, "An Econometric Study of the Causes of Tropical Deforestation: The Case of Northeast Thailand", Development Discussion Paper No. 284 (Harvard Institute for International Development, Cambridge, MA, March 1989)
42. Panayotou, Theodore, "Economics, Environment and Development", Development Discussion Paper No. 259 (Harvard Institute for International Development, Cambridge, MA, December 1987)
43. Panayotou, Theodore, "The Economics of Man-Made Natural Disasters: The Case of the 1988 Landslides in South Thailand" (Agency for International Development, Washington, D.C., August 1989)
44. Panayotou, Theodore, "Natural Resources and the Environment in the Economies of Asia and the Near East: Growth, Structural Change and Policy Reform" (Harvard Institute for International Development, Cambridge, MA, July 1989)
45. Panayotou, Theodore, "Natural Resource Management Strategies for Sustainable Asian Agriculture in the 1990's", (Harvard Institute for International Development, Cambridge, MA, September 1988)
46. Panayotou, Theodore, "Thailand Management of Natural Resources for Sustainable Development: Market Failures, Policy Distortions and Policy Options", (Harvard Institute for International Development, Cambridge, MA, May 1988)
47. Pezzey, John, "Economic Analysis of Sustainable Growth and Sustainable Development" (The World Bank, Washington, D.C. March 1989)
48. Program for International Development, Clark University in cooperation with National Environment Secretariat, Ministry of Environment and Natural Resources, Government of Kenya, Resources, Management Population and Local Institutions in Katheka. A Case Study of Effective Natural Resources Management in Machakos, Kenya (Clark University, Worcester, MA, October 1988)

49. Repetto, Robert, "Economic Policy Reform for Natural Resource Conservation" (World Bank, Washington, D.C., May 1988)
50. Repetto, Robert, The Forest For the Trees? Government Policies and the Misuse of Forest Resources. (World Resources Institute, Washington, D.C., May 1988)
51. Repetto, Robert, Skimming the Water: Rent-seeking and the Performance of Public Irrigation Systems (World Resources Institute, Washington, D.C., December 1986)
52. Rogers, Peter, "Fresh Water", in The Global Possible: Resources, Development and the New Century, Robert Repetto, ed. (Yale University Press, New Haven, 1985)
53. Ross, Lester. Environmental Policy in China (Indiana University Press, Bloomington, 1988)
54. Schramm, Gunter and Jeremy J. Warford, eds., Environmental Management and Economic Development (World Bank, Washington, D.C., 1989)
55. Southgate, David and David Pearce, "Agricultural Colonization and Environmental Degradation in Frontier Developing Economies" (World Bank, Washington, D.C., October 1988)
56. Spears, John, "Containing Tropical Deforestation A review of Priority Areas for Technological and Policy Research" (World Bank, Washington, D.C., October 1988)
57. Spears, John and Edward S. Ayensu, "Resources, Development and the New Century: Forestry" in The Global Possible: Resources, Development and the New Century, Robert Repetto, ed. (Yale University Press, New Haven, 1985)
58. Srivardhana, Ruandoj, The Nam Pong Case Study: Some Lessons to be Learned (Environment and Policy Institute, East-West Center, Honolulu, 1982)
59. Szulc, Tad, "Brazil's Amazonian Frontier" in Andrew Maguire and Janet Welsh Brown, eds., Bordering on Trouble Resources & Politics in Latin America (Adler & Adler Publishers, Bethesda, Maryland, 1986)
60. Thomas, Vinod, "Pollution Control in Sao Paulo, Brazil: Costs, Benefits and Effects on Industrial Location", World Bank Staff Working Paper No. 501 (World Bank, Washington, D.C., November 1981)
61. "Traffic Jams: The City, the Commuter and the Car", The Economist (February 18, 1989)
62. Watson, Peter L. and Edward P. Holland, "Relieving Traffic Congestion: The Singapore Area License Scheme" World Bank Staff Working Paper No. 281 (World Bank, Washington, D.C., June 1978)
63. "Win Some, Lose Some", Far Eastern Economic Review, (October 27, 1988)
64. World Commission on Environment and Development, Our Common Future (Oxford University Press, New York, 1987)
65. World Resources Institute, The World Bank and The United Nations Development Programme, Tropical Forests: A Call for Action, Parts I and II (World Resources Institute, Washington, D.C., October 1985)
66. World Resources Institute and International Institute for Environment and Development, World Resources 1986. (Basic Books, New York, 1986)

67. World Resources Institute and International Institute for Environment and Development.
World Resources 1987. (Basic Books, New York, 1987)

68. World Resources Institute and International Institute for Environment and Development.
World Resources 1988-89. (Basic Books, New York, 1988)