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POLICY RESEARCH WORKING PAPER 1757

Using Economic Policy to Improve Environmental Protection in Pakistan

Rashid Faruqee

Pakistan has introduced market-oriented economic reforms — its vigorous implementation and extension will help both economic growth and the environment.

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Summary findings

Faruqee studies Pakistan's major environmental problems, both green and brown, and assesses the extent to which economic policies affect incentives to protect the environment. Experience in other countries shows that nondistortionary economic policies that promote economic growth by improving the allocation of resources also create appropriate incentives for protecting the environment.

Sound economic policies alone are not enough, of course. Environmental policies designed to correct market failures are also necessary. Pakistan, like many countries, has relied mostly on command-and-control environmental policies, which have often failed because its regulatory institutions lack the resources to monitor compliance. Pakistan would be better off using incentive- or market-based policies, which use prices to encourage pollution abatement and the appropriate use of resources.

Failures in economic policy contribute significantly to Pakistan's "brown" environmental problems, which include industrial and domestic wastewater pollution, as well as air pollution (especially from motor vehicle emissions). Pollution problems exist both in urban and industrial areas, as well as in marine and coastal zone waters.

Failures in economic policy also contribute to "green" environmental problems, affecting behavior in forests, rangelands, and both rainfed and irrigated agriculture. Subsidies for irrigation water, for example, encourage farmers to overuse water, exacerbating the problems of waterlogging and salinity that plague irrigated agriculture. Lack of property rights in communal forests and the failure to give local communities incentives to participate in forest-management decisions have contributed to the problems of deforestation and the degradation of Pakistan's rangeland.

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Rashid Faruqee

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I. Economic Policies and the Environment

Like most developing countries, Pakistan faces serious environmental problems. Rapid population growth (averaged about 3 percent a year since the early 1970s) and impressive GDP growth (of about 6 percent a year) have put enormous pressure on the country's natural resource base and have significantly increased levels of pollution. Between the mid-1960s and the mid-1990s, for example, the availability of water for agriculture more than doubled and the cultivated land area expanded by almost 50 percent. Because few idle natural resources now remain untapped, future economic and population expansion portends increased pressure on the country's natural resource base and worsening environmental problems, some of which have already reached critical levels. Rapid expansion in industrial production and urbanization have led to increased levels of waste water pollution, solid waste, and vehicle emissions that have resulted in serious health problems in many areas of the country.

Soil erosion and salinity have caused crop yields to decline in some areas on what were previously some of the most productive soils in Pakistan. Forests are being depleted, especially in the Northern areas, as land is cleared for livestock fodder and fuelwood. Rangelands are increasingly becoming degraded, some irreversibly, as a result of uncontrolled grazing of livestock, and the marine environment has been affected by industrial pollutants and increasing levels of salinity as a result of upstream irrigation. The country's rich flora and fauna species are being depleted, with some species in danger of extinction. Meanwhile, about 60 percent of infant mortality is caused by waterborne diseases, a consequence of an unclean domestic water supply. A recent study (Brandon 1995) attempts to value environmental costs in Pakistan and puts the estimate of environmental damage at $1 billion to 2.1 billion per year, or 2.6 to 5.0% of GDP in 1992 values.

In response to environmental concerns, the government of Pakistan prepared its National Conservation Strategy (NCS) in March 1992. That report sets forth goals for natural resource conservation and use, and includes a ten-year investment plan for addressing environmental issues. The government has also formulated a Plan of Action, covering the period 1993—98, and is about to enact a new national environmental law, which will revise the 1983 Pakistan Environmental Protection Ordinance (PEPO), the dominant piece of environmental legislation. Development of this legislation is being coordinated by the federal Environmental Protection Agency (EPA), which is consulting with the government, the provinces, industry groups, and other relevant professionals. Although the current draft law is seen as a significant improvement over the existing legislation, many local experts indicate that it covers only some environmental problems facing the country and should be expanded.

The NCS has been useful, especially in raising awareness of environmental problems among government institutions. Following the release of the report several institutional improvements were made, among them the establishment of an NCS implementation unit in the Environment and Urban Affairs Division (EUAD) and the creation of an Environmental Section, mandated to integrate environmental concerns in economic development planning, in the Planning Commission. The Sustainable Development Policy Institute (SDPI) was set up on the basis of NCS recommendations to provide economic and policy analysis for sustainable economic development, and most of the provinces have created environmental cells in their Planning and Development (P&D) Departments in order to screen investment projects for their effects on the environment.

Following early successes in implementing the NCS, however, progress now appears to be faltering because of several major factors. First, not enough attention has been given to government policies that provide incentives for individuals to pollute the environment and exploit natural resources in an unsustainable manner. The NCS focused on investment projects but did not suggest specific policies for creating economic incentives for individuals to behave in ways that are supportive of the natural resource base. Moreover, many of the recommendations of the NCS are very broad, and include no evaluation of costs and benefits or recommendations on implementation. Second, institutions set up for managing the environment, such as the EPAs, appear to be weak and incapable of implementing an appropriate environmental strategy or coordinating the actions of donors to help protect the environment. This institutional failure is largely the result of the lack of technical expertise within the institutions, which was recognized but underestimated by the NCS. Third, the goals set by the NCS may have been overambitious given technical, economic, and institutional constraints Pakistan faces. Fourth, the role of the private and nongovernmental (NGO) sectors has not been defined. Finally, many attributed slow progress to a lack of political commitment to sustainable environmental improvement. Delayed or deferred decisions have led to disconcertingly slow implementation of donor-funded projects, including the World Bank project on Environmental Protection and Natural Resource Conservation.

Broadly speaking, there are two ways of protecting (improving) the environment—policies and regulations. Policies can be general (economywide) with impacts on the environment, or specific, directed policies to aimed at environmental protection. This paper assesses how economic policies (and in some cases the absence of economic policies) have affected the environment in Pakistan. This should help in assessing what policies or areas warrant special attention to improve environmental protection.

The paper focuses on both brown and green issues, examining problems affecting water pollution (domestic and human waste water, industrial waste water discharge); air pollution (vehicle emissions, urban air pollution, industrial emissions); and marine and coastal zones; irrigated and rainfed agriculture; forests; and rangeland. For each of these issues, the paper describes the major problems; evaluates the role of economic incentives in creating these problems. This helps us to understand how environmental management can be improved through creating appropriate policies in addition to enforcing regulations.

Economic and Demographic Causes of Environmental Problems

Environmental problems are caused by a variety of economic and demographic factors, including market failures, policy failures, poverty, and population growth, all of which have been important in Pakistan.

Policy and Market Failures

Environmental problems are often caused or exacerbated by inappropriate policies that provide incentives for practices detrimental to the country's natural resource base. In Pakistan, for example, subsidies on some agricultural inputs have caused damage to the environment. Especially damaging has been the provision of irrigation water at prices substantially below the cost of delivery, a policy that has increased waterlogging, led to the loss of many mangrove forests in the coastal areas, and diminished biodiversity (NCS). The former policy of subsidizing

agricultural chemicals led to excessive use of pesticides. The policy of providing energy (such as electricity and diesel) at below-market price provides incentives to individuals to overuse the natural resource base.

Environmental problems often arise because decisions about natural resource use and pollution are made without taking into account the full costs of environmental damage to society at large. Market mechanisms sometimes fail to allocate natural resources efficiently or to reflect the social value of the environment. Many of the green environmental problems in Pakistan reflect market failures associated with open access or common property resources. In Balochistan, for example, the rangeland, which is common property, has become severely degraded over time. Because the costs of the degradation are shared among all users, there are no private incentives to conserve the land for the future, unless strong community organizations are able to enforce sustainable practices.

Markets also fail when there is a market for some but not other uses for a resource. Deforestation in some areas of Pakistan, for example, has occurred because the nonmarket benefits of soil conservation have frequently been ignored. Markets may also fail to reflect the social value of the environment when decision-makers lack access to information about environmental effects or low-cost ways of avoiding environmental degradation (such as the use of Integrated Pest Management).

Poverty and Population Growth

Poverty and population growth have contributed to the degradation of the environment in Pakistan, where they have caused soil degradation, deforestation, rangeland degradation, marine and coastal zone damage, and many forms of urban and industrial pollution. People dealing with day-to-day survival tend to have short time horizons and favor consumption today over consumption tomorrow. Poor people also find it more difficult to make investments in natural resource conservation that provide positive returns in the future. Short time horizons are not innate characteristics, however, but are the outcome of policy and institutional and social failures (Mink 1993).

Poverty and environmental degradation are closely connected because poor farmers face very high production and financial risks, often the result of misguided policy interventions in factor and product markets or insecure land tenure. Many poor farmers are unable to afford the mechanisms available for coping with risks, such as selling stored crops, credit, and crop insurance, and have limited access to extension and market information. In many cases, producers have no choice but to overexploit the available natural resources.

Of course, the cause and effect relationship between poverty and the environment works in both directions. A poor and fragile environment can be a major cause of poverty. Agricultural productivity on severely eroded or waterlogged soils is generally low; as forests become depleted, labor productivity declines as more time is spent collecting fuelwood. In addition, environmentally induced health problems, such as intestinal diseases from unsafe drinking water, disproportionally reduce the working capacity and productivity of poor laborers. Health expenditures increase as a result of environmentally induced diseases, and the costs of cleaning up and preserving environmentally damaged areas can be substantial.

Population growth can also contribute to environmental degradation. Since Independence in 1947, Pakistan's population has risen from 30 million to about 130 million, an increase of an average 3 percent a year. Construction of housing and infrastructure to support this growing population has had a significant effect on the environment, and migration to urban areas has increased urban pollution. Moreover, as the population increases, greater demands are placed on the productive agricultural land to meet food needs. Greater use of productivity enhancing technology and management practices can mitigate the environmental problems of population growth. Yield improvements from excessive use of chemical fertilizers, pesticides, and irrigation water create environmental problems of their own, however.

To prevent environmental degradation, appropriate policies and institutions must be put in place so that the true costs (both private and social) of economic activities are borne by decision-makers. Such policies and institutions include those that correct market failures, help define property rights, and provide for strong and consistent enforcement of regulations. Institutions must be flexible, because improvements in technology, changes in tastes, and new environmental investments mean that the relationship between development and economic growth and natural resources is constantly changing.

Economywide Policies and the Environment

Policymakers in many developing countries are increasingly concerned with the effects of economywide policies on incentives that affect natural resources and the environment[1]. Box 1 describes the relationships between economywide policies and the environment experienced by other countries. It shows that market reforms are good for growth and generally good for the environment. There may, however, be unintended side effects of economywide policies that are bad for the environment and require additional corrective policies.

What has been Pakistan's experience? Table 1 describes some of the economic and environmental effects of both past and present economic policies in Pakistan. The table looks at the present and past policies without making any judgment on their appropriateness. Some of these policies have been distortionary, and have adversely affected both overall economic growth and the environment.

Despite terms of trade that have heavily favored industry, Pakistani agricultural production has increased as a result of an increase in both crop yields and area under cultivation. But some of the policies that spurred this growth have been damaging to the environment, either because they were not economically appropriate (the pricing of water, for example), or not accompanied with corrective policies for environmental protection. Irrigation of the Indus Basin, for example, has increased salinity and sodicity of the soil, and destroyed many of the riverine forests and associated flora and fauna species. The system has also led to the loss of many mangrove forests in the coastal areas and to an associated decline in biodiversity and the fishing economy. Agricultural run-off from fields to which chemicals have been applied incorrectly or inappropriately has raised the levels of toxics in the waterways. Had appropriate policies been adopted, agricultural growth could have been achieved with less damage to the environment.

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[1] Munasinghe (1993) distinguished two types of economic policies that affect the environment: economywide policies (whose effects on the environment are often indirect or unintended) and targeted environmental policies that deal directly with environmental problems and natural resource use.

Box 1. The Effect of Economywide Policies on the Environment: Findings from a Cross-Country Study

A recent World Bank report (1994a) investigating the ways in which economywide policies interact with the environment drew the following conclusions:

1. The removal of price distortions and the promotion of market incentives are generally good for both economic growth and the environment.

2. Economywide policy reforms may cause unintended side effects when other policy, market, or institutional distortions persist.

3. Economywide policies aimed at stability are generally good for the environment, because instability undermines sustainable resource use.

4. In the short run, economywide adjustment programs can have negative effects on the environment.

5. *Economywide policies are likely to have longer-lasting effects on the environment through employment and income distribution changes.*

Policies favoring industrialization can have adverse effects on the environment unless measures are taken to protect the environment. This has been the case in Pakistan and, as further discussed later, industrial pollution is a serious problem in the country.

Freer international trade tends to increase investment in new technologies, which embody cleaner processes to meet higher environmental standards in countries to which Pakistan exports. This has not been significant so far, but is likely to become important in the future with trade liberalization and more vigorous implementation of the GATT's Uruguay Round agreements on sanitary and phytosanitary standards.[2] Exchange rate policies can affect the environment through the agricultural sector. Devaluation, for example, increases the prices of imported goods, and causes substitution away from imported products. In Pakistan, exchange rate devaluation led to higher prices for imported fertilizers and chemical inputs, which, together with changes in subsidy policies, led to changes in the pattern of input use. Making imports more expensive, however, could reduce access to the cleaner foreign technologies by making them more costly.

Policies aimed at reducing fiscal deficit balance can affect the environment through many direct and indirect channels. Spending cuts could also have both positive and negative effects on the environment. In Pakistan, the removal of some subsidies on energy provided financial incentives to increase the efficiency of energy use, and is generally beneficial to the environment. By contrast, cuts in spending on safety net programs for the poor will likely harm the environment, because consumption may be supplemented by increased exploitation of natural resources, including fish, rangeland, and forests.

Private sector development and policies aimed at privatizing government-owned industries may also affect the environment. During the early 1970s, many industries were nationalized in Pakistan. Nationalization was a disaster for the environment because it led to industrial

[2] Environmentalists often argue that trade liberalization can lead to the displacement of domestic industries, as polluting industries move across international borders to regions in which environmental regulations are less stringent. Environmentalists also claim that more open market access and international trade may force countries to reduce their production costs by lowering environmental standards. These arguments are not tenable because gains from liberalization are generally significantly higher than the associated environmental costs, and environmental protection costs are minor determinants of comparative advantage.

inefficiency, including the overuse of polluting technology, and provided few incentives to conserve. Reversal of this policy through privatization with strictly enforced standards for environmental protection should prove beneficial to the environment.

Redistribution of income and wealth has an effect on the environment. By giving ownership to farmers, land reform helps protect the environment because it enables the cost of land use to be fully borne by decisionmakers and eliminates the externality that leads to overexploitation. Because the laws in Pakistan were very lax and easy to circumvent, past land reforms did not bring about the desired change in land tenure and did not have any effect on environmental protection.

Table 1. Past and Present Economywide Policies and Their Effects on the Environment in Pakistan

Policy area	Policy instruments	Outcome	
		Economic	Environmental a/
Agricultural policies	Support prices Input subsidies Public expenditures on agricultural infrastructure	Increased cultivable area Increased crop yields Increased irrigation water use Increased fertilizer and chemical use	Change in soil quality Change in agricultural run-off Change in rate of deforestation
Industrial policies	Controls on industrial imports and exports of raw materials	Increased industrial output Increased energy use	Increased industrial emission Increased industrial waste water pollution
Trade and exchange rate policies	Removal of quantitative restrictions Lowering of tariffs Exchange rate devaluation	Higher returns to efficient sectors (cotton, for example) Changes in agricultural output pattern Change in energy cost	Change in use patterns of agricultural inputs Change in land use patterns Change in rate of deforestation
Fiscal balance	Broadened tax base Reduction in agricultural input subsidies Reduction in energy subsidies Reduction in rural development elimination of some poverty safety nets	Increased rate of economic activity Decreased agricultural input use Increased energy conservation Decreased research and extension Increased poverty levels	More efficient resource use Lower air and water pollution levels Decreased soil degradation and agricultural run-off
Private sector development	Sale of public enterprises Promotion of private sector promotion	Increased industrial production and efficiency	Change in industrial pollution
Redistribution of income and wealth	Land reform Labor protection laws Social and safety net programs	Changes in income and consumption patterns	Change in pattern of land use

a/ Some of these outcome assume that no corrective measures were taken.
Source: Based on Noman 1988, Shafik and Bandyopadhyay 1992, Munasinghe 1993, and World Bank 1994a.

Incentive Policies and Institutions for Improving the Environment in Pakistan

As noted, non-distortionary economic policies that stimulate economic growth by improving the allocation of resources generally create appropriate incentives for the protection of the environment. Such policies are referred to as "win-win" policies in that economic and environmental objectives are jointly achieved with the use of the same policy instruments. Policies for sustained development thus can build on the positive links between development and the environment.

Economic Policies That Create Incentives for Improving the Environment

The scope for policy reforms that promote income growth, poverty alleviation, and environmental improvement is very large in Pakistan. Since the 1980s and particularly in recent years, Pakistan has carried out significant structural reform of the economy. Such reforms aim at altering the organization of the economy in order to achieve greater efficiency and economic growth, largely by moving toward a more open, market-orientated economy (World Bank 1995a). By providing economic agents with incentives to manage the natural resource base in ways that are more sustainable, market-orientated policies have generally had positive effects on the environment. These win-win policies—particularly the deregulation of prices, the privatization of State-owned enterprises, and trade reform—should be supported and strengthened.

The structural adjustment program eliminated many agricultural price subsidies. The subsidy on agricultural chemicals was removed, for example, and the subsidy on fertilizers is now very small. As a result, the markets for chemicals and fertilizers have become more efficient, private sector involvement in the production and distribution of these agricultural inputs has increased. At the same time, farmers face incentives to use less of these inputs, which in turn has led to slower rates of pollution resulting from less agricultural run-off into the groundwater aquifers (see section III).

Opportunities for other win-win price policies remain unexploited. Irrigation water charges do not cover the operation and maintenance of providing service, and farmers thus receive large subsidies on water. The cheap water has provided incentives for farmers to over irrigate, leading to water wastage and severe soil degradation as a result of the leaching of nutrients from the soil. The pricing of energy is another area in which win-win opportunities are being missed. Electricity prices charged for residential users remain below the long-run marginal cost, and agricultural users pay a flat tariff instead of being charged on the basis of use. Subsidies also remain in the gas sector, with residential users and some industrial users paying significantly less than production costs (World Bank 1995b).

Privatization is also a win-win policy because it can help reduce fiscal deficits—especially if proceeds from privatization are used to reduce the government debt—and it leads to more efficient use of inputs and to the introduction of new technologies that are generally cleaner than the old ones. Private firms must be required to comply with pollution control laws and regulations; the extent to which privatization benefits the environment thus depends on the government's monitoring and enforcement capacity. Although these capabilities are weak in Pakistan, private firms can nevertheless be encouraged to employ environment-friendly production practices through the use of market-based incentives, such as the proposed pollution tax, or through other forms of control, such as pressure from NGOs.

Rationalizing the trade regime and liberalizing external payments increases economy efficiency, speeds up economic growth, and reduces poverty. It is also likely to provide incentives for better natural resource management. These reforms have encouraged production of products in which Pakistan has a comparative advantage, such as cotton yarns and threads, textiles, and leather products. Although in some cases additional policies may be required to ensure that growth in these sectors does not cause additional pollution, for the most part trade policy in Pakistan has benefited the environment.

Focusing only on win-win policies will not ensure sustainable resource use. An economy in which resources are allocated efficiently is a necessary not a sufficient condition for creating appropriate environmental incentives. Environment-specific policies will be needed to ensure sustainable economic development.

Targeted Policies Directed at Improving the Environment

As mentioned above, win-win economic policies are necessary but not sufficient to achieve sustainable development. In many cases, targeted environmental policies are required and justified, often to cope with market failures that cause externalities and overexploitation of the natural resource base. This argument is supported by a recent study of economic reforms and the environment in Pakistan (AERC 1995), which developed economic models (both at the macro and sectoral level) in which levels of key economic variables were linked to indicators of resource degradation and pollution. The study showed that economic reforms reduce the number of people exposed to environmental risks associated with unsafe drinking water and inadequate sanitation, but increases urban population and the generation of municipal waste. Economic reforms also increase aggregate emissions of air pollution. The study argued that unless corrective measures are taken, the income, water, and sanitation benefits of economic reforms will be offset by environmental degradation related to congestion, solid waste, and air pollution.

Two types of targeted policy can be used—command and control, and incentive- or market-based policies. Within these two categories, policies can be either direct or indirect. Command and control policies involve government mandating of environmental quality standards on emissions, technology type, or input use. Incentive-based policies use prices to try to affect pollution and resource use.

Market-based approaches to regulations that mandate the behavior of decision-makers are preferable to regulatory approaches, because policies that use economic incentives are often less costly. Taxing industrial emissions, for example, provides an incentive for firms to invest in cleaner technologies and gives firms with lower pollution abatement costs an advantage over firms with higher pollution control costs. Regulations leave these decisions to the regulators, who are rarely informed about relative costs and benefits in industry. Moreover, market-based policies that price environmental damage affect all polluters, in contrast to regulations, which affect only those firms that comply. Market-based policies send the right long-term signals to resource users, and provide polluters with an incentive to use technologies that are most cost effective at reducing environmental damage. Regulations that mandate standards give polluters no incentive to go beyond the regulated standard. Regulations also require monitoring and enforcement, and governments must be prepared to prosecute violators. In many developing countries, including Pakistan, the necessary monitoring and enforcement capability is weak.

II. Major Brown Problems and Their Causes

This section briefly describes the nature and range of Pakistan's major brown environmental problems. As noted earlier, these problems are serious, but there is no precise estimates of their seriousness, particularly in comparison to green problems. Brandon (1995) estimates that health impacts of water pollution is the most serious (accounts for nearly half of the total environmental damages). According to him, health impacts of air pollution accounts for nearly one-fifth of environmental damages. This section shows that many of these problems are caused by failures of policies.

Industrial Waste Water Pollution

The level of industrial pollutants emitted is growing at a very rapid pace in Pakistan and the adverse health and productivity impacts are significant and worsening. Indiscriminate discharge of industrial waste water is causing serious environmental problems, among them contamination of groundwater, including water drawn for drinking; contamination of sea water, affecting aquatic life and drinking water; and contamination of rivers, particularly in areas with low levels of mixing, such as harbors and estuaries. Unless policies are changed, environmental degradation as a result of industrial waste water is likely to accelerate as the manufacturing sector—already the single largest user of commercial energy in Pakistan—continues to grow.

Much of the technology used by industry in Pakistan was acquired at a time when energy prices were artificially low and environmental impacts were not considered. Pollution from this technology is therefore higher than it is in many industrial countries. Industries with high levels of water contamination in Pakistan include textiles, leather, paper and board, sugar, fertilizer, and cement, which together account for 80 percent of total water consumed.

Adequate disposal of industrial waste water in Pakistan is quite rare. Waste water drainage practices employed by industry vary greatly, although the most common practice is to drain effluent into natural surface drainage channels. Drainage into unlined open ponds followed by evaporation is also practiced by some industries located in canal-irrigated areas. Seepage from such drainage ponds raises the water table and contaminates the groundwater. Drainage into irrigation canals has also been observed at some of the textile units located south of Lahore.

No comprehensive current data exist on either total industrial pollution loads or pollution intensities in Pakistan. Levels of six types of industrial pollutants—toxics, heavy metals, BOD pollutants, and suspended solid water pollutants, particulates, sulfur dioxide air pollutants—increased between six- and tenfold between 1963 and 1988, during which time GDP grew by a factor of three. This rate of growth of pollution output was above the rate of growth in India, where pollution grew at about the same rate as GDP.

Economywide policy distortions have contributed significantly to the problems of industrial waste water. A subsidy on energy use keeps prices below economic levels, undermining incentives for energy conservation (World Bank 1995b). Pakistan is gradually moving toward a more rational system of energy pricing, which has had a positive effect on energy efficiency. Other resources,

however, including water, remain underpriced, leading to inefficient use and wastage. Because access to groundwater is free and water is made available to industries at a low price, industries have very little incentive to conserve water. As a result, water usage levels are ten times higher in some industries in Pakistan than they are in industrial countries.

Targeted policies aimed at addressing industrial waste water have focused on the NEQS. To date, however, these have not been enforced. A new system, based on the "polluter pays" principle used in some industrial countries, is being discussed by the government and NGOs. Under the policy effluent charges would be imposed based on pollutant loads and the quantity of water wasted. Other potentially effective targeted policies, such as economic incentives for industries to acquire environment-friendly technology, have not been introduced.

Domestic Waste Water Pollution

Waste water in Pakistan is often dumped into open drains, streams or ponds, shallow pits, or septic tanks connected to open drains (many leading out directly to agricultural land); less often it is dumped into sewers. Household refuse is also dumped into streams and drains, which over time have become overloaded. Direct disposal of municipal waste water into streams not only reduces groundwater quality, but also disturbs the aquatic ecosystems, depletes aquatic resources, and affects agricultural uses of the surface water. Another problem is the practice of municipal waste water for farm use prior to treatment. Besides serious health dangers when consumed, soils irrigated by untreated municipal waste water become enriched in salts and quickly become unproductive for cultivation.

Only 80 percent of the urban and 45 percent of the rural population is estimated to have access to clean water in Pakistan, and migration to the cities is putting pressure on inadequate urban water and sanitation facilities. Pollution has led to the spread of water-related infections: more than 40 percent of the hospital beds in Pakistan are occupied by patients with water-related diseases, such as cholera, typhoid, hepatitis, diarrhea, dysentery, yellow fever, and malaria, and about 60 percent of infant mortality is associated with water-related infectious and parasitic diseases.

A recent World Health Organization (WHO) study found that improved water supply and sanitation produced a median reduction in illness and a median reduction in death of 65 percent. Because high income groups are more likely to have access to clean water supplies or to be able to purify their water or to purchase bottled water, the incidence of water-related illness falls with income.

Problems of domestic water disposal tend to stem from distortions due to economywide policies, failure of targeted environmental policies, and institutional failures. Uneconomic water pricing exacerbates the problem in urban areas, where a flat rate is charged or water is provided free of charge, a policy that both encourages the wasteful use of water and eliminates incentives for suppliers of water services to upgrade their water supply, treatment, and disposal facilities. In rural areas, waste water is used as a cheap, nutrient-rich source of supplemental irrigation, so that the need to invest in treatment facilities is not recognized. Targeted policies to control domestic waste water have not developed.

Motor Vehicle Emissions

Vehicle emissions represent the greatest source of air pollution in Pakistan, reflecting the rapid growth in vehicle use. Growth has been especially strong within the past decade. Motor vehicle emissions account for about 90 percent of total emissions of hydrocarbons (smog), aldehydes, and carbon monoxide. Other emissions include lead, which can cause mental retardation in young children; sulfur dioxide (the precursor to acid rain); and nitrogen oxides.

Economic factors that have led to increased vehicle emissions include the growth in population and disposable income, the mass production of affordable vehicles, the deterioration of alternate modes of transportation, and the need to travel longer travel distances as a result of urban sprawl have led to the increase in vehicle emissions. Although petrol prices are high, encouraging fuel efficiency, car owners are for the most part unable to respond to the incentive to conserve gas because of the lack of alternatives: maintenance and tune-up facilities and public transportation are inadequate, and cleaner or less expensive fuels have only recently been available in Pakistan. A subsidy on diesel fuel provides incentives to switch consumption to diesel, which is more polluting than many alternative energy sources.

A study by the Applied Economic Research Center (AERC 1995) noted that increased vehicle emissions result from economic growth. Therefore, additional policies are needed to ensure that the benefits from economic growth are not offset by the costs of increased pollution. Targeted policies have been introduced in Pakistan, but are ineffective because of institutional failures. For instance, restrictions are placed on vehicle emissions under the 1965 Motor Vehicle Ordinance and 1969 Motor Vehicles Act. However, even the rudimentary compliance with these laws is not enforced in any meaningful way. Regulations go unenforced because of difficulties monitoring compliance, because of lack of resources, and because of corruption. A new enforcement strategy must therefore propose institutional reform of the legal, administrative, and police departments.

The absence of emissions regulations, the lack of enforcement of motor vehicle fitness regulations, and owners' lack of capital to purchase replacements mean that old vehicles stay on the roads longer. The results is that the average vehicle in Pakistan emits 20 times more hydrocarbons, 25 times more carbon monoxide, and 3.6 times more nitrous oxides than the average vehicle in the United States.

A start has been made in providing better vehicle maintenance facilities to the driving public through the GEF-funded fuel efficiency improvement program, which will set up modern gasoline and diesel engine diagnostic and tune-up centers in major urban centers in Pakistan. The project seeks to demonstrate the economic viability of such technology in the hope that such centers will be set up throughout the country. Immediate attention also needs to be paid to expanding and improving the public transportation system, currently patronized by only the lowest income groups; improving intercity railways; and enforcing regulations on excessive emissions from vehicles in all category groups.

Urban and Industrial Air Pollution

The level of air pollution is not known because very little information is available on industrial emissions in Pakistan. Industry indiscriminately releases carcinogens (such as asbestos and soot), radioactive substances arising from nuclear waste and other manufacturing, and particulate matter and noxious fumes (such as carbon monoxide, sulfur dioxide, and hydrogen sulfide) into the air, and air quality is declining. A 1985 survey found that only 3 percent of industrial plants in Pakistan treated their wastes according to commonly accepted international standards.

Air pollution primarily affects urban areas, where the density of industry and vehicles prevents pollutants from being dispersed. Urban air pollution consists of particulate, sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, hydrocarbons, and heavy metals (such as lead).

Little information is available on the extent of environmental damage caused by industrial emissions, although observations close to major cities and industrial complexes indicate that the problems are severe.

Economywide policy failures are directly related to air pollution. Air typically becomes polluted because the social costs of emissions are not fully taken into account by decisionmakers motivated by private profit, and because state enterprises, which may not be profit maximizing, fail to internalize the environment. As was the case for industrial and urban waste water problems, such market failure suggests a need for government intervention through targeted environmental policies.

Retail prices to households for nontradable energy products, such as electricity and natural gas, remain below the economic cost of supply.

Several incentive-based approaches that have been used effectively in other countries—including emissions taxes, tradable pollution permits, and economic incentives for industries to acquire environment-friendly technology—have not been tried in Pakistan. Instead, the government has relied on regulatory approaches, which can be effective only if they are adequately monitored and enforced. Because provincial EPAs, which are responsible for monitoring and enforcement, are poorly equipped in terms of both equipment and trained staff, regulation has been largely ineffective, and industries are more or less free to pollute at will.

Marine and Coastal Zone Pollution

The coastal environment has changed over time, partly as a result of the massive take-off from the Indus River for irrigation and extensive pollution, particularly around the Karachi area. Most striking is the reduction in the mangrove forests, which has adversely affected fish and shellfish nurseries. Construction of barrages has reduced the size of fish catches and reduced the sediment load reaching the ocean, causing coastal erosion.

For the most part, marine and coastal zone pollution in Pakistan is limited to Karachi, a city of 8 million people that accounts for about 45 percent of the country's industry. All of Karachi's industrial waste, effluents, and domestic sewage, and all of the agricultural run-off from the hinterland and the Indus River find their way, untreated, into the sea.

Oil pollution is also a problem: of the 4 million tons of oil imported in 1986, 20,000 tons are believed to have leaked into coastal waters.

Many marine and coastal zone problems can be associated with the absence or inappropriateness of policy. Waste water from industrial and domestic sources and agricultural run-off eventually end up in the river systems and ultimately in the sea. As a result, the economic policy failures that have led to industrial and domestic waste water have also caused coastal zone problems. No incentive- or market-based policies specifically address problems of marine and coastal zone pollution; only regulatory approaches have been used, and enforcement has been weak.

III. Major Green Problems and Their Causes

Pakistan contains at least six major natural resource systems: irrigated agriculture; rainfed, or *barani* agriculture; forests; rangeland; fisheries;, and systems focused on preserving biodiversity (wildlife). Each system has different resource management and conservation problems[3]. The area affected and the estimated production loss for each major problem are shown in tables 2 and 3.

Table 2. Estimated Annual Losses Resulting from Natural Resource Degradation, 1988

Problem	*Percentage of area affected*	*Annual loss (millions of dollars)*
Soil degradation	-	350
Salinity and sodicity	16	213
Waterlogging	9	79
Erosion	9	44
Nutrient depletion	12	9
Unclassified	-	7
Deforestation	10	30
Rangeland degradation	-	125
Total	-	515

Irrigated Agriculture

Eighty percent of Pakistan's cultivated area, or 17 million hectares, is irrigated, and irrigated agricultural accounts for more than 90 percent of agricultural output and 22 percent of national GDP. Pakistan has the largest contiguous canal irrigation system in the world, with over 1.6 million kilometers of canals, branches, distributaries, field channels, and watercourses. Forty percent of the total water supply is lost in the canals and watercourses before reaching the farm gate. Total availability of irrigation water at the farm gate is estimated at 105 million acre feet, of which 60 percent is supplied by canals, 35 percent by the more than 300,000 private tubewells, and the remaining 5 percent by public tubewells (Mohtadullah, Rehman, and Munir 1992). Most of the system is unlined, however, and since the 1970s water from private tubewells has

[3] In order to focus on the other major systems, fisheries and wildlife have been excluded from this study.

accounted for a growing share of total water supplies. In many regions of the central Punjab as much as 70 percent of irrigation is supplied by tubewells, particularly in the *rabi* season.

In the 1950s and 1960s, waterlogging and salinity posed major hazards for irrigated agriculture. In most areas, the threat of waterlogging has receded since the 1970s, when the Salinity Control and Reclamation Project (SCARP) tubewells were installed and drainage was improved. The problem of salinity has become more acute in recent years, however, as a result of increased tapping of brackish groundwater for irrigation, and salinity poses the greatest danger to Pakistan's most important natural resource.

Table 3. Extent of Soil Degradation by Province, 1988 (thousands of hectares)

	Punjab	*Sindh*	*NWFP*	*Balochistan*	*Northern Areas*	*Pakistan*
Total area surveyed	20,625	9,222	9,139	19,141	3,685	61,812
Water erosion	1,904	59	4,282	2,635	2,282	11,172
Wind erosion	3,804	639	36	280	-	4,760
Salinity and sodicity	2,667	2,110	48	502	-	5,328
Waterlogging	696	625	92	142	-	1,554
Nutrient degradation	1,580	246	296	96	-	2,218
Flooding	915	763	276	598	5	2,557
Ponding	691	-	245	-	-	936

- Not available.
Source: Mian and Mirza 1993

Salinity and sodicity (hereafter referred to as salinity) and waterlogging dominate the environmental agenda in irrigated agriculture. Other problems include soil productivity losses and excessive use of agricultural inputs, especially chemicals.

Waterlogging, Salinity, and Groundwater Management

Salinity is partly the result of naturally occurring geological processes and depends on the soil material, landform, relief, climate, and land use. In Pakistan, salinity has almost certainly increased as a result of the canal irrigation system as water containing dissolved salts from the lower parts of the soil profile seep from the canal system, and evaporate from the surface of adjoining soils. WAPDA has estimated that 2.12 million hectares of land are waterlogged, and Sandhu (1993) estimates that an additional 40,000 hectares per year are lost to waterlogging. These reports are based on outdated information; regular monitoring of waterlogging and salinity using standardized assessment criteria is needed so that more accurate estimates can be made.

The most neglected problem is that of tertiary salinity from the low-quality groundwater provided by tubewells. Surveys have shown that three-fourths of tubewells provide brackish water that is unfit or only marginally fit for agriculture. The cost of salinity in terms of reduced yields is hard to evaluate. Using farm-level data, Siddiq (1994) estimated that yield losses in wheat as a result of sodic irrigation water were 9 percent and 20 percent in two different locales in the central

Punjab. Other experts have estimated that crop yields are reduced by about one-third for crops grown on slightly saline areas and that yields on moderately affected areas are reduced by about two-thirds. Crop production of any kind is difficult on highly saline soils.

Much of the problem of salinity caused by low-quality tubewell water can be reduced through the use of gypsum, and the government has tried to popularize gypsum use by farmers through provision of a sizable subsidy. A similar program was very successful in the Indian Punjab, where the problem of salinity has been drastically reduced through the use of subsidized gypsum. There are no data on the effects of the Pakistani program. Field experience indicates, however, that in most instances, influential farmers appear to be the main beneficiaries of the subsidies. Moreover, application of gypsum to fields has not always followed disbursement of subsidies, because of rent-seeking behavior. Despite these problems, marginal returns from gypsum application to rice-wheat rotation far exceed its cost (Siddiq 1994). Given the profitability of the practice, direct subsidization of gypsum should be halted and the Rs. 100 million spent on the program in 1991 should be used to finance programs that increase awareness of the benefits of gypsum application by farmers and provide extension information on its efficient use. Once demand is created, gypsum should become easier to obtain and less expensive.

Concerns about groundwater quality have been raised repeatedly over the past three decades but little effort has been made—by the provincial or the federal government, or by any of the multilateral aid agencies that invest heavily in the irrigation sector of the Indus Basin during the 1960s and 1970s—to monitor the effects of salinity of groundwater on soil resources and crop productivity. In the absence of a public agency with an official mandate to monitor the effects of salinity, provincial irrigation departments should be legally mandated to do so.

A critical issue in any discussion of salinity and waterlogging is the effect of water pricing policy on the efficiency and use of water. The subsidy on canal water has been substantial in recent years, accounting for more than 50 percent of the subsidy on operation and maintenance costs; the subsidy is much higher if measured in terms of the opportunity cost of water or against the cost of tubewell water. The underpricing of water and the basing of charges on the area irrigated in a season rather than on the quantity of water applied eliminates incentives to use water efficiently and has aggravated waterlogging and salinity (Ahmad 1992). The structure of water pricing provides no incentives for using canal water efficiently, and discourages investments in water conservation, such as drip or sprinkler irrigation systems (Noman 1994). All of these problems are linked to the lack of property rights on canal water. Although some canal water is unofficially exchanged and traded, rights to canal water are not officially recognized and there is no well-developed market to allocate canal water to its most efficient uses.

Use of tubewell water is also distorted by economic policy. Tubewell drilling and electricity are subsidized, and electricity prices for tubewells are based on the area irrigated in a season regardless of the volume used. Although tubewell water is widely traded at a price several times higher than that of canal water, there are no restrictions on the drilling of tubewells. In areas of limited groundwater, this means that there is no way of regulating or influencing through property rights the overexploitation of groundwater. One area of the country where this problem is particularly severe is in Balochistan.

On the output side, prices of major crops continue to be distorted through trade policy and price supports. Domestic sugar prices, for example, have regularly been set above import prices, encouraging the domestic production of sugar, a crop with high water requirements. Factor price distortions that artificially encourage capital intensive techniques lead to the adoption of production methods that do not reflect factor endowments (Noman 1994). Subsidies or targeted credit for tractors and threshers have displaced labor, for example. The resulting environmental stress can be alleviated by providing more rural employment by removing the policy induced distortions in favor of highly capital intensive methods. Employment creation may also be the most effective strategy for reducing pressure on fragile soils in the mountain areas of northern Pakistan.

Resolution of the environmental problems facing Pakistan's water resources requires the implementation of fundamental changes in water pricing and in institutional structures to improve the efficiency of allocating water and maintenance. Radical new institutional structures have been proposed, including the devolution of water management to farmers organizations, and the establishment of public utilities to operate and price water further up the system (Ahmad and Faruqee 1995). In the longer run, Pakistan must recognize full property rights for irrigation water, and allocate water through markets by volumetric measuring. Many issues—especially the initial allocation of the rights in an equitable manner—will need to be resolved before such a system can be implemented.

Other Soil Productivity Problems

The mining of soil nutrients associated with a decline in organic matter and the extraction of other nutrients at a rate greater than their replacement through additions of inorganic and organic sources of nutrients threaten the sustainability of irrigated areas in Pakistan. In much of the irrigated area, farmers plant a single rotation, such as rice-wheat, without introducing a rotation crop or using organic manures. Indeed, there is evidence that cropping patterns have become less diverse as the area of fodder crops and pulses has fallen. Declining organic matter and declining yields for the same input level have been found in on-farm trials of the Soil Fertility Institute in the Punjab. Intensive monocropped agriculture may also be causing other as yet unrecognized soil problems.

Part of the problem stems from the lack of research (until recently) on integrated soil nutrient management. This lack of research is in part a legacy of the green revolution, which emphasized the application of higher doses of chemical fertilizers, encouraged by fertilizer subsidies, and paid almost no attention to complementary ways of maintaining soil fertility.

With the removal of fertilizer subsidies, the need to promote organic sources of nutrients through farmyard and green manures, to diversify rotations to include legumes, and to employ other environment-friendly practices, such as conservation tillage, has grown. The Pakistan Agricultural Research Council has only very recently initiated a bio-organic approach to agriculture that emphasizes organic sources of nutrients, including green manures, farmyard manure, composting, and microbiological approaches. Although these technologies are being extended, little research has been done on back up, especially on the fine tuning of these technologies needed to take account of the socioeconomic situations of small farmers. More research, especially participatory research with farmers, must be undertaken to develop appropriate methods for integrated nutrient management.

Pollution from Agricultural Chemicals

The indiscriminate use of agricultural chemicals, such as fertilizers and pesticides, has contaminated ground- and surface water. Excess nutrient loading as a result of fertilizer run-off can lead to uncontrolled algae growth. Pesticide run-off has caused an increase in the numbers of dead fish (especially on the banks of the Kabul River in certain seasons). Pesticide residues are of particular concern because they are assimilated into the environment at a slow rate, and accumulate in fish and animal tissue. Increased intensities of nitrates in groundwater wells are converted into more toxic nitrites in the stomachs of adults and infants, and are known to cause blood disorders in infants. Other risks from agricultural chemicals include contamination of shallow wells used for drinking water in villages and cities, and pesticide residues on grain and vegetables products in markets.

Agricultural chemical use in Pakistan's irrigated agriculture has expanded rapidly over the past twenty years. The most serious agricultural chemical problem stem from the rapid increase in pesticide use, from less than 1,000 tons in 1980 to more than 20,000 tons in 1993. The most commonly used pesticide is insecticide, most of which is applied to the cotton crop. Pesticide use was initially stimulated by subsidies, discontinued in 1985, and by a major government and private sector campaign to induce small cotton farmers to use pesticides in the wake of the pest epidemic of 1983.

The widespread use of often dangerous pesticides on the cotton crop is associated with several potential health hazards, including contamination of workers who apply it (three quarters of producers use a back-pack sprayer and no protective clothing), harvesters (all of whom are women), soil and groundwater used for drinking, and consumers of agricultural products. Very few data are available to document the extent of these various health hazards. Jabbara and Mallick (1994) summarized evidence from blood tests that shows that as many of one third of cotton workers in Pakistan have been exposed to dangerous levels of pesticides. Other studies have noted unacceptable levels of pesticide residues on at least 20 percent of samples of vegetables in urban markets.

The exclusive reliance on pesticides to reduce pest losses is unsustainable as pest populations change and some pests develop resistance to commonly used pesticides. Resistance to pesticides has caused the cotton crisis of the past two years, in which losses from curl-leaf virus have sharply reduced the cotton harvest and even threatened supplies to the domestic textile industry. Short-run success in increasing cotton production over the past decade has come at the price of long-run sustainability.

Integrated pest management (IPM) is widely advocated as a means of reducing pesticide use and developing more sustainable production systems through the employment of a range of practices to combat pest populations. Despite the magnitude of the environmental and health problems associated with high levels of pesticide use on some crops, Pakistan has been a latecomer to the practice of IPM, and has been reactive rather than proactive. IPM is a knowledge-intensive practice that requires good extension service and is facilitated by literate farmers. Both are deficient in Pakistan and unless major emphasis is placed on promoting IPM it will be decades before pesticide use is reduced significantly.

Rainfed Agriculture (Barani)

About 20 percent, or 4.3 million hectares, of the total cultivated area in Pakistan is rainfed (*barani)*. Rainfed agriculture is particularly important in northern Punjab and NWFP. Many of the natural resource issues affecting irrigated areas, particularly the use of agrochemicals and the decline in soil productivity, also affect rainfed areas, although usually to a lesser degree.

The major problem in rainfed areas is soil erosion, which has worsened over the years as population pressure, poverty, and stagnant yields have forced more people onto marginal areas to meet food, fodder, and fuelwood needs. Water erosion is the major cause of soil erosion in rainfed areas. About 11 million hectares of land are slightly or severely affected by water erosion problem in Pakistan, particularly in NWFP, where one-third of rainfed area is classified as seriously affected by water erosion.

Removal of vegetative cover for forage and fuel; loosening of previously stabilized loess surfaces in an effort to bring more land under cultivation; repeated shallow mechanized tillage, encouraged by cheap credit for tractor purchases, that has created a hard pan beneath the top soil restricting moister infiltration and inducing rainfall runoff; inappropriate terracing and ineffective field embankments allowing mud slides and torrential flows; and lack of crop cover as a result of bare fallowing, removal of organic matter, and rodent damage aggravate the problem of rainfall run-off (Mian and Mirza 1993).

Water erosion has serious environmental consequences in both the short and long term, include a continued decrease in the depth, fertility, and extent of productive soils; a decrease in agricultural production; continued deterioration of rangelands and forests reserves; increased rates of sedimentation in water reservoirs and channels, affecting their maintenance cost and life span; and adverse effects on the transportation infrastructure (roads, railways, bridges).

Soil erosion by wind is predominant in the sandy arid areas of Pakistan, mainly in the Thal and Cholistan Deserts in the Punjab, the Thar Desert in the Sindh, and the Kharan Desert in Balochistan, and depends on the nature of the soil, the wind velocity, the soil moisture, and the land relief. Dry fallow fields, saline soil surfaces, and loose dust in village and town streets supply large amounts of material that is transported to distant places by winds. Like water erosion, wind erosion occurs naturally but has been exacerbated by development activities, including overgrazing, burning and felling of plants by local inhabitants, cultivation on sand ridges, fallowing of land during dry windy periods (a common practice because of irrigation water shortages in the Indus plain), and untimely tillage and excessive loosening of topsoil of dry fallow fields. One of the major problems caused by wind erosion is that good agricultural land becomes buried with sand, causing soil productivity to decline. Sand also decreases the potential of rangelands, depletes good agricultural land as fertile portions of soil are blown off.

Policies have provided incentives for farmers to cultivate more land to intensify their production practices, thereby exacerbating the rate of soil damage and degradation. Much of the emphasis on controlling soil erosion has been through engineering solutions in the form of contours, bunds, and check dams, usually implemented through programs of the Ministry of Agriculture. Less emphasis has been placed on biological solutions involving cropping patterns to increase soil cover, conservation tillage, and use of vegetative contours and barriers. The National

Agricultural Research Council is now testing such approaches in a pilot program. The appropriate merging of engineering and biological solutions will require substantial participatory research and strong linkages between research and development. Community-based approaches are also needed. To reduce bare fallowing in the Potwar plateau, for example, farmers will have to abandon their traditional system of farming (the *do fasla-do sala* system), in which fallow land is treated as common grazing land. Property rights will also need to be defined in order to implement more effective soil conservation programs. In the Swat valley, for example, much of the steep land is farmed by Gujars, who have traditional tenancy rights to the land, which is owned by the Puktoons of the valley. Because they do not own the land, the Gujars have little incentive to invest in soil conservation methods such as terracing and leveling.

Forests

Forests occupy only about 5 percent of the land area in Pakistan, and only one-third of the forests are productive in terms of timber extraction. Forests nevertheless plays an essential role in the country's economy because of their importance as sources of fuelwood and grazing land. Almost a third of the nation's energy needs are met by fuelwood, and forests are used for grazing a third of the country's livestock. Catchment forests prolong the lives of the Tarbela and Mangla reservoirs, which are vital for generation of hydroelectric power and regulating water supply to the largest irrigation system in the world.

Over 4.2 million hectares of natural forests, of which 1.9 million hectares is coniferous forest are confined mainly to the northern hilly areas of Pakistan. Scrub forests, riverine forests, and mangrove forests are found in the Punjab and the Sindh. Planted forests include irrigated plantations, riverine forests, linear plantations along roads and canals, and farm trees (trees raised on agricultural farms). Farm forestry represents the largest source of wood, contributing more than 50 percent of total annual growth, 80 percent of timber, and 90 percent of fuelwood harvested in Pakistan. These forests also provide shelter from desiccating winds and sand, allowing marginal lands to be put to productive use; supplement and stabilize farmers' income; and provide farmers with fruits, fiber, fuel, fodder, small timber, green manure, mulch, honey, tannin, and leaves for sericulture. Decomposed tree leaves add nutrients to soil and some trees fix nitrogen. Productivity of these plantations has been falling over the years because of shortage of irrigation water, invasion by thorny shrubs, and inadequate operations and maintenance funds.

Deforestation leads to water erosion, which causes soil losses, siltation of reservoirs, and inefficiency in the irrigation system. This problem is most severe in the northern valleys, where migratory herdsmen and residents of the area have caused substantial destruction. The influx of Afghan refugees into the western border areas has placed additional strains on already overextended resources, and threatens to change the forest and rangeland ecosystem permanently. Deforestation is also a problem in the densely populated Indus Basin, where demand for housing land and crop land is increasing and large livestock herds have been introduced.

Establishing policies that do not distort the value of alternative uses for forest areas is also important. Artificially maintaining high agricultural output prices and low input prices, for example, increases the attractiveness of agricultural production and encourages the conversion of forests into farm land. Institutions are also required to increase awareness of sustainable

development of forest resources. Forestry extension needs to be restructured and forestry products marketing boards need to be established.

Government polices have provided disincentives for afforestation. The sapling subsidy, for example, which was designed to create incentives to plant trees, crowded out provision of saplings by the private sector, limiting the overall supply of saplings available to producers. Because of this problem, a recent report recommended that the subsidy be eliminated (Faruqee 1995).

Deforestation is also the result of poor forest management. Most natural forests are classified as state forests and the protection, timber extraction, and reforestation of these forests is vested in the Forest Departments. Revenues generated from timber sales are credited to the Treasury, however, and the departments responsible for forest management receive operational funds through annual budget appropriations that cover only a fraction of their requirements. As a result, needed replanting and maintenance are not carried out, resulting in deforestation and deterioration of the existing forests. Local communities have traditional rights in state forests, which increases pressure on forest resources as the population grows. Deforestation also takes place indirectly when regeneration efforts fail because of excessive grazing and inefficient supervision.

The role of local communities in managing forest resources should be expanded. Traditionally local communities have not been consulted in forest management decisions and forest revenues have not been shared with local residents. Projects in NWFP have successfully demonstrated that communities can effectively protect forests and manage communal lands, however. These projects encourage local land use planning and assist the local population with the development and implementation of management plans to increase and sustain the privately and jointly owned forest, rangeland, and farm land for their benefits. Local communities in the region receive 60—80 percent of revenues from harvested timber. Other donor-funded projects have attempted to turn over control over both the harvesting of timber and reforestation to local people.

Rangeland

Most of Pakistan—30 million hectares, or 86 percent of the total area—is covered by rangeland, 80 percent of which is believed to be degraded. Much of the rangeland is threatened by overstocking, overgrazing, and overharvesting of the natural vegetation; and many of the ranges in Pakistan are populated by more animals (mostly sheep and goats) and people than they can support. Rangeland is damaged by deterioration and degradation. Range deterioration is caused mainly by climatic events, such as droughts. Losses are temporary and the productivity of the rangeland is renewed when more favorable climatic conditions return. Range degradation occurs when land becomes less productive because of mismanagement during drought years. Measures such as reducing stocking and frequencies until regrowth of palatable species reaches acceptable levels are required to remedy the condition; the return to more favorable climatic considerations is insufficient to restore the range.

In some parts of Pakistan, rangeland has become so badly degraded that the vegetative cover has become inedible or has disappeared altogether. Soil damage is a problem on such lands and degradation is so extensive that significant economic investment is required to restore

productivity. Rangeland degradation is extensive in Balochistan, where two-thirds of all rangeland is classified as having low productivity and most of the damage is believed to be irreversible damage leading to desertification.

Most of the rangeland in Pakistan is either privately or tribally owned, or has open access; about 2 percent of rangeland is publicly owned. Population pressure, changing socials structures, and commercialization of livestock enterprises have caused traditional tribal systems for controlling grazing to break down, leading to overgrazing and severe overstocking.

Failure to reduce the livestock population may be related to government policies that ban the export of meat and live animals in order to maintain the domestic price below international levels to subsidize domestic consumption. This has created incentives to overstock in defiance of communal pressures not to overgraze. Improvement of livestock productivity through improved veterinary services and extension should accompany any efforts to reduce livestock numbers. Research the technical, social, and institutional aspects of range management will be an important part of developing sustainable solutions to rangeland degradation.

IV. Conclusions

Economic policies that help eliminate market distortions generally stimulate growth and improve the environment. Many of Pakistan's environmental problems can be associated with economywide policies that have had indirect and unintended effects on the environment. Although some progress has been made at identifying the major environmental problems and their causes, and institutions have been established to tackle at least parts of the problems identified, recently progress has faltered. Environmental institutions have failed to fully monitor and regulate natural resource use and pollution adequately. According to government officials and local experts, progress has slowed largely because of the incentive structures created by existing policies and institutions. Economywide policies have discouraged conservation and pollution prevention, while the regulatory structure has failed because of inadequate enforcement and monitoring capability.

Through its structural adjustment program, Pakistan has made some beginning in introducing win-win policies, including privatization, trade reforms, and market liberalization, and these policies should be continued and strengthened. Such policies are not sufficient to ensure sustainable resource use, however, and additional policies targeted at specific environmental problems are also needed. Environment-friendly policies, such as the tax on industrial pollution, need to be adopted to ensure that the improved economic incentives do not conflict with the need to use natural resources in ways that are sustainable. In short, government in the future should not rely exclusively on regulation, and increasingly adopt market-based approaches, which can be more effective.

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