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INDIA'S ENVIRONMENT
TAKING STOCK OF PLANS, PROGRAMS AND PRIORITIES

AN ASSESSMENT OF THE ENVIRONMENT ACTION PROGRAM - INDIA

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INDIA, NEPAL, BHUTAN COUNTRY DEPARTMENT (SA2)
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Abbreviations

ADB	Asian Development Bank	MINAS	Minimum National (Discharge) Standards
ASCI	Administrative Staff College of India	MNES	Ministry of Non conventional Energy Sources
AEP	Alternative Energy Plan	MOEF	Ministry of Environment and Forests
CEE	Centre for Environment Education	MOUD	Ministry of Urban Development, Government of India
CETP	Common Effluent Treatment Plants	MRD	Ministry of Rural Development
CIDA	Canadian International Development Agency	MW	megawatts
CII	Confederation of Indian Industry	NAEB	National Afforestation and Ecodevelopment Board
CTIN	Clean Technology Institutional Network	NEAC	National Environmental Awareness Campaign
DALY	Disability Adjusted Life Years	NCERT	National Council of Education Research and Training
DANIDA	Danish International Development Agency	NEERI	National Environmental Engineering Research Institute
DESU	Delhi Electricity Supply Undertaking	NFAP	National Forestry Action Program
DPAP	Drought-Prone Area Program	NGO	Nongovernmental Organization
DRDA	District Rural Development Authority	NORAD	Norwegian Ministry of Development Corporation
DWD	Department of Wasteland Development	NTPC	National Thermal Power Corporation
EAP	Environment Action Program	ODA	Overseas Development Administration (UK)
EU	European Union	OECD	Overseas Economic Cooperation Fund-Japan
ENVIS	Environmental Information System	PFC	Power Finance Corporation of India
EPA	Environment (Protection) Act	R&D	Research and Development
FAO	Food and Agricultural Organization of the United Nations	SCERT	State Council of Education Research and Training
GEF	Global Environment Facility	SIDA	Swedish International Development Authority
GIS	Geographic Information Systems	SPWD	Society for the Promotion of Wasteland Development
GOI	Government of India	UN	United Nations
GTZ	German Agency for Technical Cooperation	UNDP	United Nations Development Program
ICFRE	Indian Council of Forestry Research and Education	UNCED	United Nations Conference on Environment and Development
IDA	International Development Agency	UNEP	United Nations Environment Program
IDBI	Industrial Development Bank of India	UNESCO	United Nations Education and Scientific Organization
IIPA	Indian Institute of Public Administration	UNIDO	United Nations Industrial Development Organization
IIT	Indian Institute of Technology	USEPA	United States Environmental Protection Agency
IREDA	Indian Renewable Energy Development Agency	USAID	United States Agency for International Development
IWDP	Integrated Wasteland Development Program	WHO	World Health Organization
JICA	Japan International Cooperation Agency		
KFW	Kreditanstalt fur Wiederaufbau		
MEIP	Metropolitan Environment Improvement Program		
MHRD	Ministry of Human Resource Development, India		

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Preface and Acknowledgments

This report was prepared primarily for discussion with the Ministry of Environment and Forests. It is neither intended as an extensive review of all environmental issues in India, nor is it presumed that the assessments of the various sectors included in the report, i.e. forestry, water, energy, urban infrastructure, are fully comprehensive. It should be noted that discussions on the Environment Action Program—India with officials of the Ministry of Environment and Forests and other Ministries, and Departments in the states has led to the development of several projects which are proposed for Bank/IDA financing. These are:

- Technical Assistance for Environment Management Capacity Building
- Ecodevelopment
- Urban (Delhi and Surat) Environmental Management
- Hazardous Waste Management
- Industrial Safety and Disaster Prevention

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Executive Summary

The World Bank's environmental stocktaking exercise commenced in January 1995. It uses as its starting point the seven priority areas identified in the *Environment Action Program—India* issued by the Ministry of Environment and Forests, Government of India, in January 1994. These priority areas are:

- ❑ Conservation and sustainable utilization of biodiversity in selected ecosystems.
- ❑ Afforestation, wasteland development, conservation of soil and moisture, and prevention of ground and surface water pollution.
- ❑ Control of industrial pollution, with emphasis on the reduction and management of wastes, particularly hazardous wastes.
- ❑ Access to clean technologies.
- ❑ Urban environmental issues.
- ❑ Development of an alternative energy plan.
- ❑ Scientific understanding of environment issues, training, creation of environmental awareness, resource assessment, and water management problems.

The stocktaking was facilitated by the Ministry of Environment and Forests through the active cooperation and support of senior officials, provision and sharing of information, and access to a wide range of government and nongovernmental institutions and organiza-

tions working on environmental issues in India. It also benefited from consultations with bilateral and multilateral donor agencies in India, especially the Asian Development Bank, which shared its report, *Environmental Projects Supported by Multilateral and Bilateral Donor Agencies* with the World Bank.

The analytic framework for the stocktaking consisted of assessing each priority area to: determine whether issues additional to those identified by the government required attention; understand better the major programs developed by the government; assess the range, type, and impact of the support provided by the World Bank and other donors; and outline policy (legal, regulatory, economic), and institutional (administrative, organizational), technical and scientific, and financial areas for further concentrated action. Estimates were also made of the magnitude of the economic costs associated with environmental degradation as measured by the impacts on health and productivity. *It is important to note that for all of its coverage, the environmental stocktaking is not intended as a comprehensive review of India's environmental problems.*

Among the numerous findings of the stocktaking, six require special emphasis:

- ❑ The economic costs of surface water pollution are high and add urgency to the need for water resource management including urban water supply, regulation of industrial effluents, and reforms in

the pricing of agricultural inputs.

- ❑ Soil conservation and irrigation management are critical given the high costs associated with the loss of agricultural output from soil degradation.
- ❑ Urban environmental issues including air pollution, urban transport, solid waste management, water supply, and waste water disposal and sanitation require urgent attention.
- ❑ Despite a strong legal framework and various ministries at the center, departments and boards at the state level and local agencies involved in environmental management, implementation remains weak. Institutional capacity-building to strengthen monitoring, enforcement, and compliance with existing laws can have a high payoff.
- ❑ Fiscal instruments for pollution abatement exist, such as excise and customs exemptions, accelerated depreciation allowances on pollution control equipment, soft loan schemes, water levies, and so on. However, these are limited in scope and do not reflect an overall strategy for both "brown" and "green" environmental management. These incentives need to be reviewed and a broad-based set of economic instruments aimed at the market developed to complement the current command and control regulatory system.
- ❑ Recognizing that the government alone cannot be responsible for environmental management, stronger efforts have to be made to involve the large

nongovernmental organization community in programs ranging from biodiversity conservation to alternative energy programs. This cooperation will require more transparent policies and practices such as early involvement in the environmental impact assessment process, access to information, and actions to increase involvement through public participatory processes.

BIODIVERSITY CONSERVATION

India's biodiversity conservation strategy is still evolving. The National Wildlife Action Plan was adopted in 1983. A biogeographic classification system for conservation planning was developed in 1985. A plan for a revised protected area network was created by the Wildlife Institute of India in 1988. A Biodiversity Action Plan is currently under preparation by the Ministry of Environment and Forests. However, limited implementation capacity and institutional and jurisdictional overlaps prevent effective management of the various ecosystems.

The Ministry of Agriculture, Ministry of Rural Development, and Ministry of Environment and Forests (MOEF) are central agencies responsible for conserving wildlife and biodiversity, with the MOEF having the lead responsibility. Currently, the MOEF concentrates on wildlife conservation rather than biodiversity conservation. There is no designated agency at the center or state level for protecting grasslands and mountain ranges. Decision making for wetland management is concentrated in a National Committee on Wetlands, Mangroves, and Coral Reefs within the MOEF, supported by state-level steering

committees. Implementation is difficult because jurisdictions over these ecosystems differ. Except for mangroves, most natural wetlands are managed by the Department of Fisheries and local authorities.

The following recommendations emerge from the stocktaking:

- Encourage government and local populations to work toward the collaborative management of biodiversity. Changes in attitudes and behaviors come slowly and can be achieved through a multidimensional approach starting with better training for forest officials, forums for discussion of biodiversity, and promotion of public support for conservation.
- Create an incentive framework that motivates the different actors (forest officials, women, nongovernmental and community-based organizations, revenue officials) to contribute to biodiversity conservation and development.
- Develop broader criteria for classifying protected areas to protect a wider range of biodiversity.
- Develop and implement strategies for protecting wildlands and wetlands, including establishing marine parks and reserves.

AFFORESTATION AND WASTELAND DEVELOPMENT

The Environment Action Program recognizes that the improper use of land resources has created serious ecological and socioeconomic problems. Growing demand

for fuel, wood, fodder, and food has depleted or eliminated protective vegetative cover in many areas. As much as half the country's land area is subject to some form of degradation. For years the government has emphasized tree-planting schemes as the principal mechanism for arresting and reversing land degradation trends.

Programs to restore and manage degraded lands outside the forest face a number of constraints. Many programs fall within the jurisdiction of village panchayat authority, common lands under customary group tenure, lands managed by road and railway authorities, and lands loosely administered by the district collector. Tenure arrangements on revenue lands often are complex and understood differently by many users. Problems arise due to conflicts between line agencies. The wide range of agro-ecological conditions in India makes it difficult to develop a common technical package for wasteland development. Finally, wasteland development programs tend to be one-dimensional, focusing on tree-planting activities.

Programs to restore and manage degraded land in public forest lands also have problems. Three major studies—the World Bank's 1993 Forest Sector Review, the Government of India's Forest Sector Review, and the Government of India's National Forestry Action Program—concluded that the most important issues relate to incentives for local participation and private development, the quality and performance of investments, and the effectiveness of public sector forest protection and management.

Given that the government's approach to wasteland reclamation is slowly evolving

from a one-dimensional (tree-planting) approach to one using integrated watershed development, a number of recommendations emerge from the stocktaking:

- ❑ Remove disincentives to private investment in farm forestry, afforestation, and wasteland reclamation on private lands.
- ❑ Build government-NGO relationships and develop partnerships and increase participatory planning and beneficiary participation for sustainability.
- ❑ Integrate and coordinate inter-departmental programs, particularly watershed development programs.
- ❑ Promote efforts to improve the quality of planting stock (restocking and enrichment planting of natural, secondary forests), make nursery and seed improvements, and better match species with site characteristics.

PREVENTION OF GROUND AND SURFACE WATER POLLUTION

The Environment Action Program points out that water scarcity results not just from inadequate quantity but from inadequate quality of water as well. Consequently, efforts to ensure water quality must take into account both the need to substantially control, reduce, or at least limit preventable pollutants from entering water bodies untreated (pollution abatement), and the need to manage water as a resource (water management).

Pollution from domestic pollutants is normally referred to as point source pollution. However, the lack of an effective wastewater collection system for 95 percent of the generated wastewater in cities, coupled with

gross deficiencies in garbage collection as well as widespread practices of open defecation, gives domestic pollutants the same nonpoint characteristics that characterize agricultural pollutants. Both are difficult to monitor. Abatement of domestic pollution is technically feasible only if the waste is captured in a stream or conduit (giving it point source characteristics) and treated before discharge into water bodies. Contamination of municipal water supplies due to leakages in the delivery network as well as a lack of protection of the distant watersheds that supply water to cities, must also be addressed.

The EAP focused substantial discussion on the water problems arising out of the irrigation sector. Only half the water storage capacity is utilized in the surface irrigation sectors, and only about 10 to 15 percent reaches farmers due to evaporation and transmission losses. As in urban areas, where water supply network expansions have not been accompanied by an expansion of drainage networks, the irrigation sector has deferred investments in drainage. Where drains have been constructed, they have become silted or overgrown with weeds due to a lack of maintenance. Electricity subsidies for farmers have encouraged excessive water use, and groundwater tables are declining rapidly. The cumulative impact of these practices has resulted in waterlogging problems in about 250,000 hectares of land in northwest India, and another 3 million hectares may be in jeopardy over the next 30 to 50 years.

To support crop production targets, fertilizer use is expected to increase. Therefore, options for mitigating agricultural runoff contaminated with pesticides and fertilizers are more limited than for other environmental discharges because fewer

opportunities for abatement exist, at least in the near future. Pollution from these practices is widespread, and its nature does not lend itself easily to physical control.

The GOI's major program for pollution abatement of water sources has been projects undertaken under the Ganga Action Plan. Scientific studies undertaken under this program have focused largely on some physicochemical and biological water quality parameters. There have been no studies on the ecosystem processes, river flood plain interactions, or problems caused by flow regulation. The roles of point and nonpoint sources of pollution have not been investigated. Management strategies for the prevention of pollution under the Ganga Action Plan have, therefore, been developed in the absence of critical strategic analysis. The EAP also identified action plans for eleven other rivers in India based on the conceptual framework of the Ganga Action Plan. In addition, it identified eight lakes under its National Lakes Conservation Plan for pollution control and abatement. Before India embarks on implementing these programs, a critical strategic analysis based on realistic environmental objectives should be undertaken. Based on this analysis, technically sound methods for achieving desired water quality should be developed. India should desist from replicating environmental strategies that have not proven successful.

The following additional recommendations emerge from the stocktaking:

- Develop simple modeling techniques of the impacts of open defecation practices so that city managers and municipalities can make informed strategic decisions for pollution

abatement at local levels.

- Develop water quality standards for different points along a river based on flow, assimilative capacity, and local conditions.
- Encourage the participation of voluntary organizations, local civic bodies and NGOs in solving water quality as well as water resource management problems.
- Undertake a simple pilot initiative in a city where the effectiveness of a covered drain that runs parallel to the river, capturing hidden drains and natural flows from the city can be examined.
- Examine the merits of an integrated approach for pollution abatement and pollution prevention in the region of lakes under The National Lakes Conservation Program.
- Set prices for water, electricity, fertilizers, and pesticides, to encourage efficient use and the conservation of resources.

INDUSTRIAL POLLUTION AND CLEAN TECHNOLOGIES

The Environment Action Program includes a comprehensive action program for the abatement of pollution. It is backed by legislation covering all aspects of industrial pollution and environmental management, including the Water Act of 1974, amended in 1988; the Air Act of 1981, amended in 1987; the Environment Act of 1986; the Hazardous Waste Rules of 1989, and the Manufacture, Storage, and Import of Hazardous Chemical Rules of 1989.

In addition, in 1992, the government issued a Policy Statement on Pollution Abatement. The statement, reflecting a broad approach, emphasizes that it is not enough for the government to create laws; it also must integrate environmental concerns with an emphasis on preventing pollution and promoting technological inputs to reduce industrial pollutants. Specific steps identified to meet this objective include preventing pollution at the source; encouraging, developing, and applying the most practical technologies; ensuring that the polluter pays for pollution and control arrangements; focusing protection on heavily polluted areas and river stretches; involving the public in decisionmaking; and increasing the safety of industrial operations.

In the area of applying technology to pollution abatement, the Environment Action Program envisages clean technologies as providing valuable tools for dealing with the environmental problems associated with the industry and energy sectors. The Clean Technology Program includes strengthening research and technology institutions; launching a technology mission on cleaner production; formulating industry-specific task forces to select demonstration projects; facilitating the transfer and adoption of cleaner technologies developed abroad; developing a centralized data base to provide information to industry; building capacity for environmental audits; establishing standards for waste discharge of raw material; and formulating legal and economic measures to ensure adoption of clean technologies.

Although the plan for pollution abatement is comprehensive, there are several problems relating to implementation. Most enforcement for pollution abatement is based on regulatory standards, and there is a need

to establish a stronger link between source-specific and ambient standards. In addition, the state pollution control boards lack capacity at the regional and local levels to perform their tasks.

Adoption of clean technologies also is hampered by several problems. Inadequate intellectual property rights enforcement discourages investment and technology licensing; the policy and institutional framework associated with technology transfer and absorption is still cumbersome; fiscal incentives for clean technologies similar to those for pollution control do not exist; research institutions and business groups lack a means of exchanging information; and technical and scientific development of clean technology focuses on hardware to the neglect of skills, information, and support.

A number of recommendations emerge from the stocktaking, including:

- ❑ Develop an area-based strategy for pollution abatement.
- ❑ Develop additional economic instruments for pollution abatement.
- ❑ Improve substantially the capacity of state pollution control boards and departments of environment in the states to deal with monitoring, enforcement, and environmental management.
- ❑ Encourage private industry support and participation in the Clean Technology Information Network.
- ❑ Foster more transparent public disclosure and cooperation with NGOs to reinforce the government's position that "environmental quality cannot be achieved by actions of the government alone."

URBAN ENVIRONMENTAL ISSUES

Like most developing countries, India is experiencing massive urbanization. At 217 million, the country's urban population is one of the largest in the world. Three areas will require concentrated action if urban environmental issues are to be alleviated: air pollution, solid waste management, and provision of safe drinking water, and sanitation and sewerage facilities.

Air Pollution

Six of the ten largest cities—Bombay, Calcutta, Delhi, Ahmedabad, Kanpur, and Nagpur—have severe air pollution problems. Annual average levels of total suspended particulates in these cities are at least three times the World Health Organization (WHO) standard. In Delhi, Calcutta, and Kanpur, the average values are more than five times the standard. More than 90 percent of the stations for which mean concentrations are reported by the Central Pollution Control Board exceed 75 micrograms per cubic meter of particulates, the midpoint of the WHO recommended standard.

In contrast, annual average concentrations of sulfur dioxide and nitrogen dioxide are low in relation to WHO ambient standards. In the case of lead, however, hypertension and IQ losses would be reduced if current ambient levels, which include some seasonal high points were reduced to zero. The current ambient levels are estimated to cause 200,000 cases of hypertension a year and to lower the IQs of Indians by 4.7 million points over a ten-year period.

Solid waste management

Municipal solid waste—predominantly

domestic waste—is a serious challenge for most Indian cities. Urban garbage is disposed of at uncontrolled landfill sites. These sites generally are dumps where waste is used to fill in low-lying areas. A lack of precautionary environmental measures often results in surface and groundwater pollution. Other problems include odor, rodents, and unsightliness. Apart from household waste, other waste materials (from the maintenance of streets and drains, animal waste, commercial waste, building refuse, hospital refuse, and so on) not only add to the volume of solid waste but also affect its composition and aggravate resulting health problems. As the density of urban populations increases, municipal solid waste collection will become even more critical to preventing the spread of disease and pollution. The September 1994 outbreak of the plague in Surat is the most dramatic manifestation yet of the close links among poverty, dense population concentrations, and weak environmental management in urban areas.

Water supply, sanitation and sewerage

Conventional sewerage is too expensive an option for most cities. Sewerage systems exist in just 20 percent of the 300 Class I cities, and where they exist coverage is partial. Less than half of the total wastewater generated in most cities is collected, and less than half of what is collected undergoes any form of treatment. While water supply has been a priority at the official level, sewerage system development has lagged substantially behind. In many cities efforts to augment water supply systems without concomitant development of systems to carry away wastewater have worsened environmental

conditions. The lack of sewerage has resulted in the bulk discharge of municipal waste, domestic waste, and industrial effluent into surface water bodies, contributing to surface and groundwater pollution. More than half of the urban population—125 million people—have no access to basic sanitation and instead use the open spaces surrounding slums, fostering the spread of fecal-borne diseases such as dysentery, hepatitis, helminthic infections, and cholera. Water pollution harms more people than any other environmental problem: 60 percent of all deaths in 1987 were due to water-related diseases.

The following recommendations emerge from the stocktaking:

Air Pollution

- ❑ Control particulate emissions from two-stroke engines by replacing two-stroke with four-stroke engines using smoke-free oil and installing catalytic converters on vehicles with two-stroke engines.
- ❑ Control particulate emissions from diesel vehicles by reformulating diesel fuel, ensuring proper engine maintenance and engine modifications, treating diesel exhaust, and replacing diesel-fueled engines with compressed natural gas-fueled engines.
- ❑ Implement control strategies for particulates from industrial fuel combustion by relocating industry, coal washing, end-of-smokestack controls, and making boilers more energy efficient.
- ❑ Implement control strategies for particulates from domestic sources by

switching to cleaner fuels, using more energy-efficient stoves, venting smoke outdoors, and improving garbage collection and disposal practices.

Solid waste management

- ❑ Privatize solid waste collection, at least on a pilot basis.
- ❑ Establish a centralized demonstration program in a single institution that trains municipal managers, engineers, and health officials on sound solid waste management practices.
- ❑ Organize community self-help projects in the poor urban and periurban areas where solid waste management services are inadequate or nonexistent with the help of social and political activists capable of spearheading an urban public relations campaign.
- ❑ Educate the public on the costs of municipal solid waste management to increase their willingness to pay for improved municipal services.

Water supply, sanitation and sewerage

- ❑ Develop water policies and plans for all large cities and within states, undertaking comprehensive demand projections, with coordination across sectors.
- ❑ Initiate pilot privatization projects in small and medium-size towns, including promoting private, community-based firms that can manage segments of operations requiring good community outreach and links. This could include water users groups that can own, operate, and maintain their facilities.
- ❑ Train municipal workers to develop a

service orientation toward poor communities so that these communities can develop site-specific cost recovery programs.

- Launch public awareness campaigns that employ various communication schemes (school curriculums, community workers, NGOs, street theater) to better inform citizens of environmental protection needs, as well as the need for accountability.

ALTERNATIVE ENERGY PLAN

The alternative energy plan outlined in the Environment Action Program has two strategies to address the main issues in the energy sector. The first argues that the efficiency of energy production, conversion, and use should be improved; energy demand should be managed; and technology and process changes should be encouraged. Proposed solutions include conservation of natural resources, promotion of clean coal technologies, reduction of transmission and distribution losses, demonstration projects for demand-side management, research and development of various modes of renewable energy, and studies for retrofitting and modernizing existing power plants.

In the area of natural resource conservation, particular attention will have to be given to coal-fired thermal plants that use natural resources (land water, air), but no incentives are in place for their conservation. Water is used by thermal plants as makeup water and in open cooling systems. While a levy is paid for makeup water, no charges are imposed on the use of marine coastal water or inland water as sources of cooling water. The water levy does not deter the use of large volumes of makeup water

for ash disposal, and few efforts have been made to recycle ash disposal water, which contaminates surface and underground water used for drinking and irrigation. Large areas of land are used also for ash disposal in coal-fired thermal plants, leading in some cases to air and underground water pollution. Resettlement issues are usually associated with land acquisition for these ash ponds. Lastly, a carbon tax is seen as one tool for improving fuel efficiency and reducing air pollution. The success of using a carbon tax for coal-fired thermal power plants will depend on the availability of coal of consistently high quality.

The second strategy recommends that India move toward more environmentally benign energy forms, that is, renewable energy resources. Priority programs under the alternative energy plan consist of projects, research activities, and studies in the area of renewable energy. However, several of the recommendations outlined in the EAP have been overtaken by recent developments in the sector. In July 1993, the government reoriented its program to emphasize the commercialization of larger-scale demand-driven energy systems for power generation, promotion of private initiatives and investment, reduced subsidy support, and competition in supply of systems. Nonetheless, many barriers remain to commercialization of renewable energy systems such as the need for significant up-front capital investment; lack of access of renewable energy users to appropriate and affordable financing mechanisms; systems tend to be small-scale, sites dispersed, and operations highly dependent on local conditions; and systems require greater end-use participation, and at early stages, greater organizational and technical promotion effort

than conventional energy systems. Other institutional and policy constraints include subsidized prices for kerosene and electricity, traditional focus of suppliers' marketing efforts toward government-administered programs rather than consumers, and absence of after-sales service resulting in a proliferation of nonperforming systems.

A number of recommendations emerge from the stocktaking, including:

Conventional energy

- ❑ Create environmental management divisions in State Electricity Boards to focus on environment-related activities and to provide training in environmental management and regulatory compliance.
- ❑ Adopt technology improvements both to increase efficiency and to decrease environmental impacts.
- ❑ Introduce new fiscal incentives to encourage conservation of water and land and decrease air pollution in the generation of coal-fired power.

Renewable energy

- ❑ Continue the current policy of promoting the commercialization of mature technologies and eliminating subsidy support for these technologies.
- ❑ Increase training and technical assistance support for the development of a wider and stronger consultancy base on alternate energy.
- ❑ Undertake a program of more extensive and intensive resource mapping incorporating the latest available technology (GIS, satellite data).

- ❑ Limit research and development activities to moving technologies closer to requirements of the market and users, adapting them to local operating conditions, and improving manufacturing capabilities, rather than reinventing technologies developed abroad.

ENVIRONMENTAL EDUCATION

The priority programs identified in the Environment Action Program for addressing environmental education issues include the following: strengthening environmental training, research, and education activities through existing government and nongovernmental organizations and institutions at different levels; providing assistance and funding to NGOs to set up district and village training centers; establishing a program for training of trainers; developing a scheme to allow practitioners, activists, professionals, civil servants, and others to participate in regeneration activities; establishing training facilities for civil servants through the environmental training activities of their induction institutions; developing environmental training programs for students and the general public, especially in townships located in or around areas of special ecological significance; developing regular and sustained environmental education programs for professionals, decisionmakers and local self-government authorities in environmental impact assessment; developing methods to introduce environment-related subjects in social science courses; initiating new environmental courses that are accessible to students of all backgrounds; developing a wide range of environmental education materials for mass distribution; establishing environmental

education programs for the newly constituted Paryavaran Vahini (voluntary environmental task forces); and building capacity for the collection and analysis of environmental statistics for natural resource accounting.

There are limitations in the above strategy. Current government policies in India prescribe the need for a "national policy framework towards environmental education." This may not necessarily be the most effective for grassroots activity. Teacher training in environmental education has been mandated by the courts in India, and the Ministry of Environment and Forests has instituted the Environmental Orientation to School Education program to foster this activity. However, the reality is that teacher training institutions do not incorporate environmental concepts into teacher preparation and there is little incentive for teachers to pursue training on their own. There is also a shortage of environmental education materials available for teachers, teacher trainers, and community educators. Public awareness currently conducted through mass media have minimal impact. The poor are not reached by current environmental education and training activities. Lastly, training in environmental impact assessment, natural resource accounting, and environmental auditing is not standardized.

The following recommendations emerge from the stocktaking:

- ❑ Establish a National Council on Environmental Education and create Regional Centers of Excellence for Training in Environmental Management.
- ❑ Develop tools for local awareness and

adaptation of environmentally sound technologies (for NGOs and local leadership development) including a training program for the Paryavaran Vahini.

- ❑ Develop an environmental education extension program.
- ❑ Provide assistance with technical training for mid-level government and industry managers.

ESTIMATING ENVIRONMENTAL COSTS

The two types of environmental costs estimated in the stocktaking are public health impacts due to air and water pollution, and productivity impacts due to higher water costs, soil degradation, deforestation, and reduced tourism. In all cases, conservative approaches were used so as not to overstate the costs of degradation. The overall limitations of the "back-of-the-envelope" approach to valuing environmental costs are very clear. The methodologies, data, and estimates of average costs and values are all subject to debate.

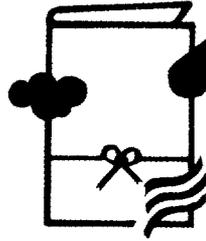
Environmental degradation and public health are most clearly linked in terms of air pollution and respiratory diseases, and water pollution with such waterborne diseases as diarrhea, dysentery, cholera, and typhoid. The results are divided into sickness (morbidity) and premature death (mortality). The value of premature death is based on the value of a statistical life, as determined using a human capital approach that values an individual's life according to the net present value of his or her productivity. (This approach requires substantially less data than willingness-to-pay or willingness-to-be-compensated approaches). The costs of

sickness are based on individual disutility (discomfort, suffering, and the opportunity cost of time), medical expenses, and lost wages (Margulis 1992). Only medical expenses and lost wages are estimated. Environmental degradation and economic output are most clearly linked where soil degradation reduces agriculture and rangeland output (or increases input costs); deforestation turns forests into land with little economic value; surface and groundwater pollution leads to local and regional scarcities, with commensurate increases in costs; and high ambient pollution levels inhibit tourism.

The total costs of environmental degradation and pollution are unknown. The calculations made as part of the stocktaking add up to a total of \$9.7 billion per year, or 4.5% of GDP. These are rough estimates and should be viewed as lower bounds, given the exclusion of several categories of costs. The overall incidence of degradation, in terms of 1992 GDP, is in the range of 2.9 to 6.7 percent, with an average estimate of 4.5 percent. This incidence is on the high end of estimates made in other countries, such as 2.6 percent in China, 3.3 percent in Mexico, up to 5 percent in Eastern Europe, and less than 1 to 2 percent in OECD countries.

Chapter 1

Environmental Management





Environment Management

1.01 Strategic environmental management is the process of developing and implementing a national program that improves environmental quality on a sustainable basis. Successful environmental management depends on the active involvement of key segments of society, including industry, agriculture, and individual citizens. More than 100 countries have long-term environmental or sustainable development strategies. Many adopt a management approach based on well-defined objectives, measurable targets, and action plans involving relevant actors. The principal objective of India's Environment Action Program (EAP) is improving the provision of environmental services

GOVERNMENT AND PRIVATE SECTOR INSTITUTIONS

1.02 India's constitution contains a general commitment to protecting and improving the environment and to safeguarding the country's forests and wildlife. These efforts are coordinated between the central and state governments. State governments are granted exclusive power over regional and local issues, while the central government, acting through the Ministry of Environment and Forests (MOEF), determines policy by issuing instructions (and sometimes funds) to the state governments and other agencies responsible for implementation. The central government usually retains control of issues or projects

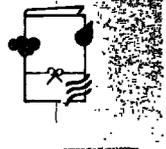
that are of national or strategic importance.

CENTRAL GOVERNMENT INSTITUTIONS

Ministry of Environment and Forests

1.03 Responsibility for ensuring that environmental concerns are addressed in a coordinated manner lies with the MOEF. Responsibility for integrating environmental concerns into sector plans lies with the Planning Commission. In many cases, however, other ministries and departments may have a large responsibility for key environmental tasks. Recent policy statements identified the following as the principal environmental tasks of the central government: forest conservation and regeneration; wildlife conservation; bio-diversity conservation; flood prevention and control; drought prevention and control; desertification prevention and control; erosion prevention and control; pollution prevention and control; conservation and regeneration of ecologically sensitive areas; protection of areas with special environmental problems; ozone layer protection; climate protection; conservation and management of water, energy, biomass, land, soil, mineral, and other resources; protection from occupational, chemical, nuclear, and other hazards; protection of traditional knowledge of ecological systems; and protection of animal rights.

1.04 The MOEF plays an important role in ensuring that these tasks are addressed in accordance with government policy and assesses the status of environmental resources



and the effectiveness of measures to conserve or protect them. Other ministries also play major roles in these areas (Box 1.1).

1.05 At the national level, the MOEF is the principal agency for planning, promotion, and coordination of environ-

mental and forestry programs (Box 1.2). The MOEF also coordinates external assistance of environmental projects. Proposals for such projects must be approved by the ministry's International Cooperation Division. This division selects projects in accordance with overall environmental priorities and attempts

Box 1.1 Ongoing Environmental Tasks of Ministries Other than the MOEF

Ministry	Task
Ministry of Agriculture	Conservation of wildlife Conservation of biodiversity Prevention and control of desertification Conservation and regeneration of watersheds Conservation and management of land and soil Prevention and control of floods Protection of irrigation command areas Conservation and regeneration of forests Prevention and control of pollution Recycling of resources Conservation and management of energy
Ministry of Water Resources	Prevention and control of floods Conservation and regeneration of wetlands Conservation and regeneration of coral reefs and coastal regions Protection of irrigation command areas Monitoring water quality
Ministry of Rural Development	Conservation and management of land and soil Prevention and control of drought Conservation and regeneration of forests Prevention and control of pollution
Ministry of Power	Prevention and control of pollution Recycling of resources Conservation and management of energy Use of alternative sources of power
Ministry of Petroleum	Protection of mining and oil extraction areas Recycling of resources Prevention and control of pollution Conservation and management of energy
Department of Ocean Development	Conservation and regeneration of coral reefs and coastal regions Conservation and regeneration of island resources
Ministry of Urban Development Planning Commission	Prevention and control of pollution Conservation and management of energy Conservation and regeneration of island resources Conservation and regeneration of mountain resources
Department of Nonconventional Energy Sources	Prevention and control of pollution Recycling of resources Conservation and management of energy Use of alternative sources of power
Ministry of Human Resource Development	Education and awareness
Ministry of Labor	Protection from occupational health hazards



Box 1.2 Functions of the MOEF

- Develop and implement conservation and protection strategies, including the establishment of biosphere reserves, pollution monitoring, environmental appraisal of developmental projects, and the protection of historical monuments of national importance.
- Coordinate environmental management programs with other ministries and agencies, volunteer organizations, professional bodies, and other groups.
- Develop national policy planning strategies.
- Work with global agencies on environmental issues.
- Support research on environmental problems.
- Develop environmental education programs to increase national awareness of environmental protection issues and the importance of natural resource preservation and citizen participation.
- Review legislation and formulate additional legal measures when needed for environmental protection.
- Maintain a national environmental information system and data base on environmental problems.
- Review policies and programs on human settlement.

- G.B. Pant Himalayan Institute, Almora
- Center for Environmental Education, Ahmedabad
- Ecological Research and Training Center, Bangalore
- CPR Environmental Education Center, Madras
- Salim Ali Center for Ornithology and Natural History, Coimbatore
- Botanical Survey of India, Calcutta
- Zoological Survey of India, Calcutta
- Forest Survey of India, Dehradun
- National Museum of Natural History, New Delhi
- Indian Institute of Forest Management, Bhopal
- Indian Plywood Industries Research Institute, Bangalore
- Center for Mining Environment, Dhanbad

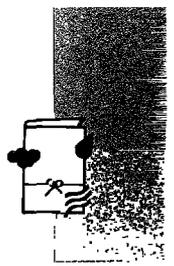
to minimize overlap between the various sources of funding. The ministry also oversees a number of independently managed bodies listed below.

1.06 The following organizations assist the MOEF:

- Indian Council for Forestry Research and Education, Dehradun
- Central Pollution Control Board, New Delhi
- Wildlife Institute of India, Dehradun
- Indira Gandhi National Forest Academy, Dehradun

Planning Commission

1.07 The Planning Commission, formed in 1950, plays a key role in formulating national economic policy and drafting five-year plans, which set directions and targets for economic growth. The Fourth Five-Year Plan (1969-74) was the first to recognize the need to integrate environmental considerations into economic development planning. Awareness of the potentially pivotal role of the Planning Commission in environmental management has continued to grow since that time. The Seventh Five-Year Plan (1986-91) took sustainable development in harmony with



the environment as a basic principle. Human development is the ultimate goal of the Eighth Five-Year Plan (1992-97). Environmental management within the eighth plan includes planning for sustainable use of resources; protection and conservation of endangered systems through education, training, and awareness; and the cooperation of government organizations and non-governmental organizations (NGOs) in all stages of environmental planning.

Central Pollution Control Board

1.08 The Central Pollution Control Board was created in 1974 to control water pollution; its mandate was extended to include air pollution in 1981 when it was placed under the administrative control of the MOEF. Its responsibilities were further extended by the 1986 Environment Act, the 1989 Hazardous Waste Rules, and the 1991 Public Liability Insurance Act, and it has become a key agency for implementation of national environmental policy and legislation for the control of industrial pollution (Box 1.3).

1.09 To carry out its duties, the board devises implementation strategies and sets environmental norms that are binding on state governments. The most important norms are established by the MOEF with the assistance of a committee on which the board, as well as other government departments and leading experts from academia and industry, is represented. These norms include the Minimum National Standards (MINAS), standards for effluents and emissions that can be made more stringent by state governments depending on the circumstances, and ambient quality standards for air and water, which vary according to the surrounding environment.

1.10 The Central Pollution Control

Box 1.3. Functions of the Central Pollution Control Board

- Advise the central government on any matter concerning water and air pollution and the improvement of air quality.
- Plan and implement a national program for the prevention or abatement of water and air pollution.
- Coordinate the activities of the state pollution control boards and resolving disputes among them; provide technical assistance and guidance to the state boards; carry out and sponsor investigation and research relating to problems of water and air pollution.
- Organize training for people working on the prevention or abatement of water and air pollution.
- Organize a comprehensive public awareness program on the prevention and abatement of water and air pollution.
- Compile data relating to water and air pollution and the measures needed for prevention and abatement; prepare guidelines on the treatment and disposal of sewage, trade effluents, and stack gas cleaning devices.
- Set standards for stream and well water and for air quality in consultation with the state governments.
- Perform such other functions as may be prescribed by the government.

Board has seven regional offices that are mainly concerned with research and identification of emerging problems. The board's officers may contribute to local decisionmaking by sitting on environmental committees.

STATE GOVERNMENT INSTITUTIONS

State Departments of the Environment

1.11 All the states and territories have departments responsible for implementing the Water and Air Pollution Control Acts and enforcing the Minimum National Standards. These units direct the activities



Box 1.4 The 1986 Environment (Protection) Act

This act is umbrella legislation that provides a single focus for the protection of the environment and seeks to plug the loopholes of earlier legislation relating to the environment. Several sets of rules relating to various aspects of the management of hazardous chemicals, wastes, micro-organisms, and so on, have been written under this act.

Salient features of this act are:

- The central government may restrict an industry, operation or process, or class of industries or operations from a particular area.
- Emissions and effluent standards with respect to 61 categories of industries have been developed.
- The standards with respect to pollutants are to be achieved within a period of one year from the date of their notification.
- If a particular State Pollution Control Board desires, it may reduce the time limit and also specify more stringent standards with respect to a specified category of industries within their jurisdiction. The board cannot relax either the time limit or the standards.
- Industries that require consent under the Water Act, Air Act or both, or authorization under the Hazardous Waste (Management and Handling) Rules, 1989, are required to submit an environmental audit report to the concerned State Pollution Control Board on or before September 30 every year.

Source: GOI, Ministry of Environment and Forests, Handbook of Environmental Procedures and Guidelines, 1994

of the State Pollution Control Boards and may be supported by specialized institutions responsible for specific issues or research (such as the Kerala Forest Research Institute or Maharashtra State Wastelands Development Board). State departments authorize the environmental conditions imposed by the State Pollution Control Boards and may be used as a court of appeal against their rulings. Other responsibilities include coordinating the environmental activities and initiatives of other state government departments and

advising on policy formulation.

State Pollution Control Boards

1.12 With the exception of Arunachal Pradesh and Nagaland, all the states in India have formed State Pollution Control Boards in response to the 1986 Environment (Protection) Act (Boxes 1.4 and 1.5). The boards report to the State Department of Environment. The boards are funded with fees from authorized dischargers to water bodies. They review development proposals to assess the local environment's capacity to receive polluting effluents and act as the implementing agency.

PRIVATE INSTITUTIONS

Industry

1.13 Much of Indian industry uses outdated, polluting technologies. The industries that contribute most of the air and water pollution are cement plants, thermal power stations, iron and steel works, fertilizer factories, metal smelters, oil refineries, distilleries, pulp and paper mills, producers of dyes and dye intermediates, pesticide manufacturers, petrochemical plants, tanneries, sugar producers, and pharmaceutical manufacturers. Of the 1,539 industries in these categories in 1993, only 55 percent were fitted to comply with minimum emission standards, and compliance is not guaranteed, even among those with the necessary equipment. Some plants allow pollution control equipment to fall into disrepair or fail to operate it correctly.

1.14 Small industries in India (those with a total capital investment of less than 7.5 million rupees) benefit from a number of government and state initiatives to



encourage their growth. More than 800 products are reserved for small industry, for example, and there are a number of tax incentives. The Confederation of Indian Industry estimates that there are 3.5 million small-scale enterprises operating in India. Large industries are generally more willing to institute environmental management procedures and invest in pollution control than smaller ones, which are much more likely to evade regulation altogether. Many small enterprises are attracted to areas where environmental enforcement is weak.

1.15 Many industries are paying for training for their staff in response to increased environmental awareness among the population and a tougher regulatory regime. This has created a large market for training, particularly in the environmental audit of activities and resource use, environmental management and audit systems, and training of trainers in environmental management.

1.16 Bodies that can provide training, advice, and consultant services to industry include the Confederation of Indian Industry, the Federation of the Indian Chamber of Commerce and Industry, and the National Productivity Council set up by the Ministry of Industry. These groups report that demand for training outstrips existing resources. To some extent, the market is being satisfied by unqualified trainers offering a low-grade product. Even good training is sometimes misapplied because of the failure to conduct training needs assessments.

Environmental NGOs

1.17 Environmental NGOs have played an increasingly important role in environmental decisionmaking in recent years. NGOs are particularly concerned with the participation of local communities and

Box 1.5. Functions of State Pollution Control Boards

- Set up emission standards for local industries based on the Minimum National Standards and the carrying capacity of sites.
- Issue consent orders allowing discharge of industrial pollutants to air and water.
- Monitor compliance with discharge consents.
- Issue No Objection Certificates allowing industries to develop a site. (Depending on the industry, an environmental assessment may still be required from the MOEF.)
- Publish statistics on pollution control for the state and disseminate information through lectures, seminars, and so on.

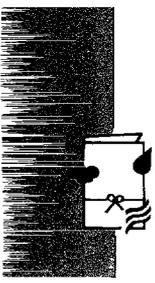
affected parties in the development of environmental management initiatives. The EAP states that NGO involvement at the local level and in the coordination of international work is essential to the success of environmental planning. The central authorities believe that NGOs can play an important role in monitoring compliance by developers and industry with the standards imposed on them. NGOs also encourage state authorities to implement the directives of the central government and to enforce their own policies. A wide range of NGOs are working in India. Some of the most influential are discussed below.

Bombay Natural History Society

1.18 Based in Maharashtra, the Bombay Natural History Society has more than 3,000 volunteers who collect data, disseminate information, and recommend management plans to conserve wildlife and its habitat throughout India.

World Wildlife Fund–India

1.19 The World Wildlife Fund–India was established in 1969. With a network of



eighteen branch units in various states and a Data Center for Natural Resources in Bangalore, the fund is the country's largest conservation NGO. Its work includes environmental impact studies, nature park development, legal intervention in environmentally destructive projects, and an extensive conservation education program for youth.

Dasohli Gram Swarajya Mandal

1.20 This organization, based in Uttar Pradesh, focuses on protection of forests. It opposes commercial felling, promotes tree planting involving local citizens, and aims to improve environmental awareness among rural populations.

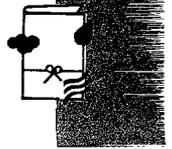
Center for Science and Environment

1.21 Founded in 1980, this is a private, nonprofit, academic research organization based in New Delhi. Primary areas of concern include health and occupational hazards, water resources, air pollution, and protection of climate, atmosphere, energy, food, and agriculture. It aims to promote research in science and technology appropriate to the

development needs of India and to create public awareness in science and technology.

Center for Environmental Law

1.22 The Center for Environmental Law was set up by the World Wildlife Fund—India to provide that organization with legal support and to strengthen the professional support base for environmental law and policy in India. The center is an integral part of the World Wildlife Fund—India and has the support of several other NGOs and the government. The center focuses its attention on international law, but it is also interested in areas where it regards the law as being weak (such as the preservation of genetic resources and the import or export of biological material). Its domestic aims include capacity-building in environmental law, lobbying for changes in government policy, and providing legal consultancy services. An example of such activity is its preparation of India's Legal Action Plan for implementation of the International Convention on Conservation of Biological Diversity on behalf of the MOEF.



The Environment Action Program

1.23 The EAP identifies environmental programs, categorized as institutional or noninstitutional, and places them into seven priority areas. Although one priority area deals specifically with the issues of education and institution building for environmental

management, these issues cut across all priority areas. Table 1.1 shows all programs listed in the EAP and highlights those that relate directly to strengthening institutions or providing knowledge or tools for strategic environmental management.

Table 1.1. GOI Priority Environment Programs

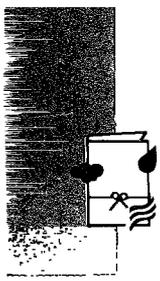
Priority area	Noninstitutional	Institutional
Conservation and sustainable utilization of Biodiversity in selected Ecosystems	Ecological evaluation of wetlands, mangroves, and coral reefs Survey of protected wetlands Conservation education on wetlands, mangroves, and coral reefs Sustainable management of manmade water bodies Natural resources accounting studies Wildlife projects, particularly for elephants and rhinos Development of comprehensive national species atlas Listing of fauna of important ecological locations Research on cultivation and farming of medicinal and commercially valuable wild plants Conservation of traditional domesticated animal breeds Ex-Situ conservation	Networking of Zoological and Botanical Surveys of India with universities and NGOs
Afforestation, Wasteland Development, Soil and Moisture Conservation, Ensuring Clean Water Sources	Afforestation and wasteland development Demand management to improve protection of newly forested and regeneration areas Research and development of energy forestry and efficient fuelwood use Pasture regeneration Agroforestry and extension support Rehabilitation and catchment area treatment for irrigation works Formulation of water management plans based on soil surveys and land use capability for irrigation works Networking of governmental departments, research institutions, and experts in irrigation projects	Strengthening of Indian Council of Forestry Research and Education, Dehradun Encourage user participation in irrigation projects from planning onwards Organizational strengthening for better operations and maintenance systems for irrigation



Priority Area	Noninstitutional	Institutional
	<p>Data base for monitoring crop patterns, and productivity in irrigation</p> <p>Streamlining state command area development Programs for better returns from irrigated agriculture and use of water</p> <p>Rehabilitation of irrigation tanks</p> <p>Legislative, fiscal, and credit measures for proper exploitation of groundwater</p> <p>Conjunctive use of surface and groundwater resources</p> <p>Rehabilitation of public tubewells</p> <p>Small surface water storage in rainfall-short areas</p> <p>Low-cost rain-fed, agronomic and soil conservation technologies to small and marginal farmers</p> <p>Development and demonstration of biofertilizers</p> <p>Survey on waterlogging, saline soils, and flood hazards</p> <p>Involvement of women in implementation of agricultural, watershed development, and soil conservation programs</p> <p>Formulation of regionwide water pricing policy</p>	<p>Capacity building for developing dry-land works agriculture, irrigation and hydrological data for crop planning, water and flood mapping and environmental impact assessment of agricultural projects</p> <p>Strengthening of State Land Use Boards for soil and water conservation</p> <p>Capacity building for formulation of flood control master plans for major river basins</p>
<p>Industrial and Related Pollution and Waste Reduction/ Management, particularly Hazardous Waste</p>	<p>Cleaner production in leather, textile, paper and pulp industries</p> <p>Quantification of pollutants from nonpoint sources</p> <p>Research on role of hydrology, land use, and management practices on pollutant transport</p> <p>Development of decisionmaking methods for control of nonpoint pollution sources</p> <p>Development of nonpoint pollution control technologies</p> <p>Development and demonstration of water treatment technologies</p> <p>Demonstration and dissemination of water conservation technologies</p> <p>Pollution control and waste management in mining</p>	<p>Organizational strengthening for research in natural dyes</p>
<p>Improving Access to Clean Technologies</p>	<p>Launching of a Technology Mission on Cleaner Production</p>	<p>Strengthening of National Materials Research and Technology Development</p>



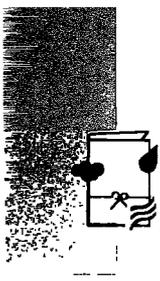
Priority Area	Noninstitutional	Institutional
	<p>Task forces for selection of demonstration and development projects</p> <p>Transfer of technologies from research laboratories</p> <p>Formulation of standards of waste discharge per unit of raw material</p> <p>Formulation of economic and legal measures to ensure absorption of clean technologies</p>	<p>Initiative</p> <p>Establishing centers for cleaner technologies and development of centralized data base</p> <p>Capacity building for environmental auditing</p> <p>Capacity building for adaptation and improvement of imported technology</p> <p>Capacity building for environmental impact assessment of clean technologies</p>
<p>Tackling Urban Environmental Issues</p>	<p>Reducing solid waste generation</p> <p>Fiscal instruments for waste minimization</p> <p>Development of biodegradable packaging</p> <p>Improving refuse vehicles</p> <p>Assessing space requirements for solid waste treatment</p> <p>Rehabilitation of ragpickers</p> <p>Protection of natural water sources</p> <p>Health education, awareness, and risk assessment</p> <p>Managing storm drains</p> <p>Energy efficient street lighting</p> <p>Alternative energy and efficiency programs</p> <p>Pricing policies to promote energy conservation</p> <p>Improving public distribution of kerosene</p> <p>Improving coal thermal properties and reducing smoke</p> <p>Preparation of energy audits</p> <p>Road pricing</p> <p>Developing housing policy</p> <p>Monitoring air pollution</p> <p>Protecting natural amenities</p> <p>Urban forests</p> <p>Environment management plans</p>	<p>Strengthening Building Materials and Technology Promotion Council</p> <p>Capacity building for pollution control, waste management, risk assessment, and environmental impact assessment</p> <p>Strengthening NGO participation</p>
<p>Public Transport</p>	<p>Introducing innovative fiscal instruments</p> <p>Improving the performance of State Road Transportation Corporations</p> <p>Reviewing the 1988 Motor Vehicles Act</p>	



Priority Area	Noninstitutional	Institutional
<p>Strengthening Environment Science Education, Training, and Awareness</p>	<p>Training of trainers at all levels and identification of suitable agencies and institutions</p> <p>Environmental training activities for civil servants in their induction institutions</p> <p>Assist NGOs to set up district and village level training centers</p> <p>Environmental training for students and the public, especially around areas of ecological significance</p> <p>Environmental education for professional and government authorities in environmental impact assessment</p> <p>Initiation of environmental courses for students of all backgrounds</p> <p>Development of environmental education materials for teachers</p> <p>Environmental education for new Paryavaran Vahini (voluntary environmental task forces)</p> <p>Environmental education for local policymakers and NGOs</p>	<p>Establishment of national center for long-term training in environmental impact assessment</p> <p>Evolve a network of regional centers for preparation of environmental impact assessment reports and disaster management plans</p> <p>Strengthening training, research, and education in existing governmental institutions and NGOs</p> <p>Capacity building for collection and analysis of statistics for natural resource accounting</p>
<p>Alternative Energy: Coal Sector</p> <p>Power Sector</p> <p>Transport Sector</p> <p>Industrial Sector</p> <p>Alternative Energy</p>	<p>Coal benefaction</p> <p>Coal bed methane</p> <p>Coal gasification</p> <p>Tackling of coal mine areas</p> <p>Reduction of transmission and distribution losses</p> <p>Demonstration projects on energy efficient lighting</p> <p>Evaluation on pollution control measures in thermal power stations</p> <p>Shift from road to rail freight</p> <p>Mass rapid transport systems</p> <p>Conversion of two- and three-wheelers from two-stroke to four stroke</p> <p>Use of compressed natural gas</p> <p>Energy conservation</p> <p>Natural resource accounting for commercial fuels</p> <p>Demonstration, diffusion, and monitoring of alternative sources</p>	<p>Capacity building for environmental impact assessment for thermal and hydro power plants</p>



Priority Area	Noninstitutional	Institutional
	<p>Research on energy-efficient electric and diesel pumpsets</p> <p>Converting agricultural waste to fertilizer</p> <p>Policy measures and incentives for wind power generation</p> <p>Indigenization of wind electric generation systems</p> <p>Development of small hydro capacity</p> <p>Alternative strategy for biogas implementation</p> <p>Designing of effective biogas delivery systems</p> <p>Evolving design criteria for improved cookstoves</p> <p>Development and marketing of solar hot water systems</p> <p>Resource accounting for noncommercial energy sources in rural areas</p>	<p>Organization strengthening for wind power generation</p> <p>Capacity building for decentralized energy plans</p> <p>Capacity building for environmental impact assessment of energy use in rural areas</p>



Major Issues and Recommendations

1.24 India's environmental management system covers all aspects of environmental protection. As the EAP acknowledges, however, the system needs strengthening to be able to address the environmental issues that result from

resource consumption and waste production. It also identifies financial, legal, institutional, organizational, technical, and human resource constraints to implement environmental programs (Box 1.6).

Box 1.6. Constraints to Implementing Environmental Programs

The EAP highlights the following constraints:

Financial

- Incorporating environmental considerations into development projects requires more resources, which puts more pressure on the already meager amounts of public investment.

Legal

- There is no separate legislation for conservation and protection of lands and the environmentally critical ecosystems of wetlands, mangroves, coral reefs, range lands, watersheds, and irrigation command areas.
- Although there is a national water policy, legislation for regulating exploitation of surface and groundwater resources has not yet been formulated.
- The number and variety of fiscal instruments to tackle environmental problems are limited.

Institutional

- The research and development infrastructure is inadequate.
- Panchayats and urban local bodies that are to implement the program have not yet been assigned the crucial tasks of conservation and environmental protection.
- The constitutional status accorded to local governments has underscored the urgency of evolving a participatory management system.

Organizational

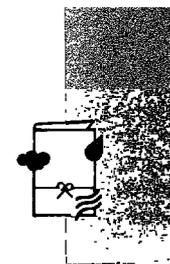
- There are no organizations capable of imparting technical skills for environmental management, such as environmental impact assessments at the local and regional levels.
- Policymakers, administrators, trainers, educators, students, local government authorities, and grassroots individuals and organizations are not adequately trained in environmental sciences and management.

Technical

- Accounting for the intrinsic value of natural resources is still a process in its infancy.
- Environmental impact assessments for various categories of natural resources and development projects are constrained by a lack of data on resource availability as well as by the pressure to ensure quick development.
- The need to define environmental parameters at local levels is constrained by a lack of data.

Human resources

- There is a lack of high-quality human resources and organizations at the local and regional levels.
- There is only limited public awareness of environmental issues at the school, university, and nonformal levels.



1.25 Environmental management at the national level requires a review of current performance and formulation and implementation of new policy. In addition, an effective environmental management system must have:

- ❑ Institutions capable of carrying out each task in the environmental management cycle.
- ❑ Instruments for policy development and appraisal, and regulatory and technical instruments to enable institutions to carry out their assigned roles.
- ❑ Inputs from parties outside the regulatory framework whose activities or interests are affected.

INFORMATION GATHERING

1.26 Much survey work on the status of environmental resources is under way, and the MOEF and Central Pollution Control Board publish annual reports of their activities and progress in key areas. Major undertakings to assess the status of the natural environment include forest surveys by the Forest Survey of India, a flora survey by the Botanical Survey of India, a fauna survey by the Zoological Survey of India, and surveys of sensitive, endangered, or valuable ecosystems (mangroves, coral reefs, and so on). Often, however, the information that is gathered is not made available to concerned parties. The Central and State Pollution Control Boards, for example, can withhold information from environmental NGOs if they consider it to be in the national interest.

1.27 Networking of the Zoological and Botanical Surveys with the universities and NGOs listed in the EAP is key to successful, comprehensive management. The local

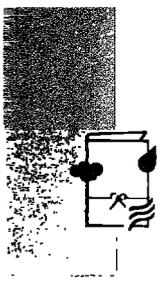
knowledge of the state universities and NGOs can supplement the efforts of the survey organizations. If this information is made available to developers and consultants preparing environmental assessments, it will improve the quality of their reports and the decisions that are based on them.

POLICY FORMULATION AND TARGET SETTING

1.28 Achieving sustainable development depends on environmental objectives being incorporated into the sector policies of government ministries besides the MOEF. Areas of key importance in India include spatial planning (land use and physical infrastructure), urban environmental management, and economic sectors such as energy and power generation, industry, transport, and agriculture. Many experts interviewed in India felt that the activities of government ministries other than the MOEF were carried out with insufficient regard for their environmental impacts and sometimes conflicted with the policy for environmental improvement being pursued by the MOEF.

1.29 One priority action in the EAP is environmental training for policymakers and decisionmakers. Such training should include regional environmental impact assessment profiles and a scientific system of natural resources accounting.

1.30 Achieving these goals will require ensuring that government departments have adequate environmental awareness and that knowledge of the techniques of strategic impact assessment for policy evaluation is available. Studies of the carrying capacity of regions are under way on a pilot scale. These studies should be used as a model for future decisionmaking, and strategic environmental assessment and



analysis of environmental costs and benefits should be made a part of the policy formulation process within key ministries.

PREPARATION OF LEGISLATION AND STANDARDS

1.31 Few priorities in the EAP relate directly to the formulation of environmental legislation or to the setting of ambient quality standards and emission limits. The reason for this may be that environmental authorities feel that India has a well-established legal framework and set of standards and that, even though the development of emission limits for industry is incomplete, the task is part of the ongoing efforts of the Central Pollution Control Board.

1.32 But some industrialists—particularly in the power sector—now believe that a more flexible approach to pollution control, based on a balance between the value of the resource to be protected and the costs to the economy of controlling emissions, is needed. The emphasis on natural resource accounting to provide a scientific basis for decisionmaking, and the move to regional environmental assessments based on carrying capacity, may reflect a growing awareness of the potential for conflict between strict environmental norms and the need for increased industrial output.

1.33 The functioning of the judicial system in enforcing environmental legislation also has given rise to some concern. Action against polluters moves through the courts slowly, and since prosecutions often fail or result in only a small fine, some polluters have found it cost-effective to ignore emission standards. In addition, State Pollution Control Boards are reluctant to bring actions against state-owned industries,

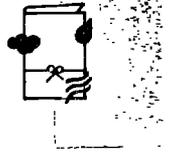
some of which (coal, petroleum, iron and steel, agrochemicals) are among the most significant polluters.

1.34 Members of the public and environmental activists have found that it may be more effective to resort to base litigation on the human rights provisions of the constitution. Such actions have been used to prevent quarrying, protect wetlands, and manage water resources, but they also create difficulties. Judges are not compelled to take into account the evidence or policies of the relevant State Pollution Control Board, and different interpretations of the constitution as granting the right to a pollution-free environment have produced inconsistent decisions. There is therefore a danger of a parallel system of environmental regulation emerging from the legal system that does not reflect the legislative background. This situation would send unclear signals to the public and to industry.

PROGRAMS OF ACTION

1.35 No government can achieve lasting environmental improvement on its own. Achieving the objectives of the EAP will require the cooperation of non-governmental actors, and regulation often may be inappropriate to this end. For example, achieving compliance with environmental controls on industry will require that regulators understand the options and constraints facing industry, and that industry understand the consequences of its polluting activities, have access to cost-effective control technologies, and be aware of the opportunities represented by improved resource management.

1.36 For example, the EAP attaches great importance to mandatory environmental



auditing, aimed at raising awareness in industry by requiring annual audits of material use. But most target industries have failed to join this scheme. Although about 10,000 factories with consents to discharge effluent or hazardous waste are eligible, audit statements were submitted by only about 3 percent of these in the first year of the scheme, and this share is likely to fall. Industry is concerned that the information demands of the scheme are difficult to meet and may compromise commercial confidentiality. In addition, neither industry nor the pollution control boards are experienced in compiling or reviewing audit statements. A revision of this scheme is therefore indicated, together with a major training effort.

1.37 If the public is to be empowered to influence environmental performance, it must have access to information about available products and services and incentives that influence lifestyle choices. Reforestation and afforestation schemes now routinely include such incentives. An ecolabeling scheme also has been introduced to provide consumers with information on products, but progress has been slow. Problems include the lack of expertise in life-cycle analysis, which limits the scientific basis for setting ecolabel criteria; the fact that the scheme has introduced one product at a time, which limits public awareness of the scheme; and inadequate support from industry, which believes that the public has no interest in ecolabeled products.

MONITORING AND ENFORCEMENT

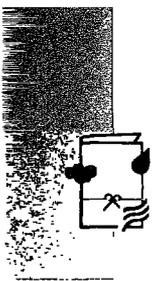
1.38 Many industries are not fitted with pollution control equipment to achieve minimum standards, and many of those that are fitted still do not comply. This is partly because operators are trying to avoid the cost

of pollution control equipment and because pollution control boards lack the resources to enforce compliance. Other problems include:

- ❑ State pollution control boards that are reluctant to enforce compliance when doing so might result in plant closure with attendant socioeconomic impacts.
- ❑ Variable enforcement by states, which leads to industry migration to regions with less-stringent enforcement standards.
- ❑ Industry perception that certain restrictions and requirements are too stringent and that the cost of compliance outweighs the potential benefits.

1.39 Tools that assist industry in monitoring environmental performance and identifying opportunities for improvements and cost savings include auditing, Environmental Management and Auditing Systems, and so on. These systems are being developed for India by organizations such as the Confederation of Indian Industry. These efforts should be encouraged, and the capacity of state pollution control boards to evaluate the information should be enhanced.

1.40 Implementation of planning regulations, pollution controls, and operating norms depends heavily on such considerations being incorporated into project design. Environmental impact assessments are central to achieving this goal. The guiding principle behind these assessments is that local people and organizations should play an important role in environmental protection efforts. It is therefore surprising that recent amendments to procedures for evaluating these reports have reduced the role of the



states and transferred the decisionmaking role to the MOEF. But it is clear why this rearrangement has been necessary. The state pollution control boards' focus on water and air pollution is too narrow to effectively manage assessments of large facilities, and expertise to review these reports is not widely available. Nevertheless, the reconfigured system forgoes many of the benefits of environmental impact assessments (such as incorporation of mitigation into early project design and public consultation before the design is fixed) and focuses on a narrow range of development types—those identified as priority by the MOEF.

1.41 The number of EAP priority actions relating to environmental assessment reflects how important the government considers this tool to its environmental management strategy. Still, decisionmaking on all but strategic projects should be returned to the local level. It also will be necessary to ensure that public involvement in local decisionmaking occurs early in the project cycle and is transparent to all affected by the decision.

1.42 Only one action identified in the EAP relates specifically to environmental monitoring, but many actions imply monitoring or rely on the information that it would provide. Such monitoring is required for effective enforcement and to gauge the success of implemented policy. The results also enable authorities to prioritize their programs and can be used to inform and empower the public. National actions in this area include:

- ❑ Ambient air quality monitoring by the National Ambient Air Quality Monitoring Network.
- ❑ Water quality monitoring by the

Monitoring of India National Aquatic Resources Scheme, Global Environmental Monitoring System, and Ganga Action Plan.

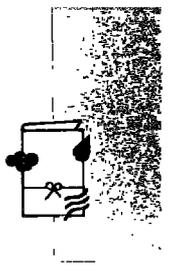
- ❑ Noise pollution monitoring in major cities by the state control boards with the help of the National Environmental Engineering Research Institute (NEERI) and coordinated by the central control board.

1.43 Water quality monitoring was recently strengthened by the commissioning of automatic monitoring stations on the Ganges River (although there have been some problems with these) and programs to monitor coastal ocean waters and estuarine waters. The EAP points out, however, that there is still no reliable information on the contribution of nonpoint sources to water pollution.

1.44 Although many industrial facilities do not comply with air pollution controls, the monitoring network reveals few instances of pollution threatening human health, and these cases are due mainly to mobile sources (motor vehicles). This may be because monitoring stations are located in the main cities. Many industries that are known to be heavy polluters lack the required control equipment, but no monitoring stations are nearby.

RECOMMENDATIONS

1.45 India's central government provides funding and technical assistance for developing environmental action plans at the state and municipal levels, but effective management requires mechanisms that allow all groups in society to participate in the environmental management system. Consultation and negotiation are central to



this effort. The chances of achieving policy objectives are further improved if projects are developed by those responsible for implementing them. This applies as much to environmental NGOs and the village-level political bodies as it does to industry.

1.46 Each of the EAP's priority areas would benefit from improved knowledge of environmental science, more training of people involved in environmental management, and awareness raising among those whose activities could contribute to environmental improvements. Many such programs are under way with multilateral and bilateral donor support, but in some cases the scale of the activity does not match the scale of the problem. Bilateral organizations such as the Canadian International Development Agency (CIDA) and the German Agency for Technical Cooperation (GTZ) have implemented limited institutional strengthening projects in some of these areas. Because these organizations have limited manpower and funding and must achieve results quickly, they tend to focus on well-established organizations in selected target states. The World Bank is in a position to take a more strategic view. Projects or programs that are suitable for Bank funding in this area must be:

- Compatible with the EAP.
- Compatible with the mission and ongoing efforts of the Bank.
- Strategic in scope or replicable in other states and cities.
- Urgently needed.
- Suitable for counterpart institutions.
- Funded solely by the Bank.

1.47 Taking these criteria into account, assistance should be provided for activities involving the legal and judicial systems, sector policy and planning, the participation of industry, regional planning and environmental impact assessment, ensuring cost-effectiveness, ensuring quality training, municipal environmental management, and public participation.

Legal and judicial strengthening

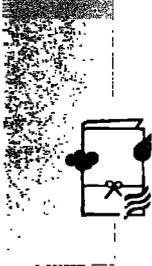
1.48 The courts are failing to enforce environmental legislation, and when parties resort to human rights legislation it creates confusion and sends unclear signals to industry and environmental groups. Three actions could be taken to address these problems.

Training for magistrates and judges

1.49 Magistrates and judges must be more involved in and aware of pollution control legislation. Training to achieve this goal could focus on government policy, the role of the state pollution control boards, what constitutes reliable evidence in environmental actions, assessing environmental costs and benefits, appropriate types of sanction and fines, options available to industry to combat pollution, and balancing the interests of industry and those affected by hazardous emissions.

Review of legal decisions

1.50 The decisions of the supreme court and high courts in environmental cases should be reviewed to identify the causes of inconsistency and to see whether decisions are compatible with the direction of environmental policy in India. This review could be used to propose environmental definitions, legal rules, and guidelines for



environmental human rights cases.

1.51 These tasks could be undertaken by the Center for Environmental Law, perhaps with some external support.

Strengthening the State Pollution Control Boards

1.52 The weakness of some state pollution control boards is a major constraint on enforcement of environmental legislation. Several bilateral donor programs are under way or are planned to support selected boards with funds and training. The role of the boards is evolving quickly, however, from air and water pollution control regulators into quasi-state environmental protection agencies. Action is needed from the Central Pollution Control Board to manage this transition.

1.53 Consideration should be given to supporting the Central Pollution Control Board in its efforts to build up the state pollution control boards. This might include developing a joint strategy, setting priorities, and developing an action plan to implement these. The priorities would probably include training activities for staff of the state boards and would require clarifying the scope of state duties and activities.

Sector policy and planning

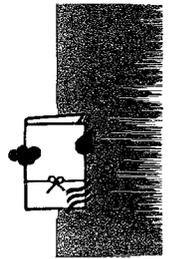
1.54 The activities and policies of government departments (agriculture, urban development, water resources, power, the Planning Commission) have a great impact on environmental resources. The MOEF reviews the plans of other ministries and agencies, but to fully integrate environmental concerns into planning each ministry needs in-house environmental expertise. Ministries need to be familiar with the tools used to analyze policy, and they must introduce

procedures to ensure that the tools are used effectively. Assistance could be provided to the MOEF in developing these tools and procedures and in carrying out high-level staff training in the use of the tools.

The participation of industry

1.55 Effective environmental management at the national level requires that duties and responsibilities be devolved to key players, such as industry. It is usually possible to obtain the cooperation of industry without relying on overly stringent regulatory and compliance regimes. It is necessary, however, to provide industry with tools and incentives that contribute to environmental goals. The Bank has helped to develop industry participation by funding effluent treatment plants for small industry. Further assistance might include:

- ❑ Refining the environmental auditing scheme and funding the training that must precede its relaunching.
- ❑ Setting up institutions to design and administer training for an Indian Environmental Management and Audit Systems accreditation scheme.
- ❑ Assisting the Central Pollution Control Board with the development of Minimum National Standards and ensuring that these are the best available and most appropriate technology for India.
- ❑ Developing the bodies that work with industry and government (Confederation of Indian Industry, National Productivity Council) to ensure that they have the capacity to lobby effectively, to reach smaller industries, and to provide information, guidance,



and training.

Regional planning and environmental impact assessment

1.56 Environmental assessments are key to the proper planning, siting, and operation of new development. A number of government and donor actions are aimed at improving capacity in this area. One activity that could benefit from funding involves studying areas to determine their carrying capacity in terms of pollutant load, land use, sensitive receptors, and so on. This information can be used for zoning and for scoping of subsequent assessments.

1.57 This effort is being undertaken by a unit of the MOEF and could benefit from funding for pilot studies, evaluation of pilot studies, and development and transfer of the methodology used in the studies.

1.58 Many agencies are engaged in activities related to environmental impact assessment. Thus there is a rapidly growing body of national experience of assessment practices and problems. An institute already engaged in these activities, such as the Center for Environmental Science and Engineering in Bombay, could be funded to run a library and data base of work and statistics that could be used to monitor and assess environmental assessment efforts nationwide.

Ensuring cost-effectiveness

1.59 There is a danger that objectives, standards, and procedures for environmental protection are being adopted without regard to the balance of costs and benefits, particularly of the costs to industry. In addition, pollution charges are not always set systematically or imposed on as wide a scale as they could be. More capacity in

environmental economics is needed. An institution such as the Gandhi Institute for Development Research in Bombay, which is already active in natural resource accounting, should be supported to disseminate environmental economics expertise and explore such issues as:

- Valuation of environmental goods.
- Potential for developing the scope of economic instruments in India.
- Cost implications of rigorous enforcement of existing standards.
- Natural resource accounting.
- Scope for user charges for environmental services.

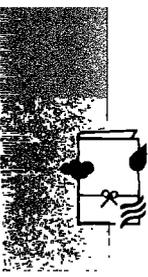
Ensuring quality training

1.60 Training is needed in many environmental fields, and much is under way. But some training is of poor quality, and the capacity needs to be developed to accredit training courses and individual trainers and to educate trainers so that the following apply:

- A training needs assessment takes place.
- Training materials and methods are appropriate.
- Trainers are qualified.
- The effectiveness of training is evaluated.

Municipal environmental management

1.61 Integrated environmental management of large cities is a developing technical area, although its components are well known:



- Collecting and disposing of urban solid waste.
- Controlling traffic congestion and pollution.
- Improving air and water quality.
- Collecting and treating wastewater and sewage.
- Developing urban forests and open spaces.
- Controlling land use and siting of new development.
- Controlling nuisances (noise, odor, dust).

1.62 The urban environment is one of the EAP's priority areas, but it is poorly represented in current donor projects. There is an urgent need to build capacity at the municipal level for the planning and management of these tasks. The first step

could be to review the results of the Metropolitan Environment Improvement Program (MEIP) and similar programs to determine which approaches contribute to urban environmental management in the developing world. This would help to strengthen environmental management capacity among municipal service providers (solid waste collection and disposal, wastewater treatment, water supply), town planners, and municipal governments.

Public participation

1.63 Public participation in decision-making and public cooperation in policy implementation are essential to any environmental strategy. The public, particularly the rural poor, needs institutional support to express its concerns and to be represented in local decisionmaking forums. Ways should be explored to assist development of capacity at the village level.



Other Donor Support

The environmental activities supported by donors are coordinated by MOEF's International Corporation Division and the Department of Economic Affairs, Ministry of Finance. The EAP priority area, strengthening scientific understanding and improving training, is receiving a considerable share of donor funds, mainly for institutional strengthening projects. They include: capacity-building in the state pollution control boards; environmental impact assessment training; establishment of training institutes; awareness-raising and NGO support; environmental management for industry and environmental impact assessment methodology development.

A brief description of the activities of donors other than the World Bank is given below.

Overseas Development Administration (ODA)

ODA's highest priority objective is poverty alleviation. Its strategy focuses on a small number of states in the Gangetic plains and associated uplands (Karnataka, Andhra Pradesh, Orissa, and West Bengal). Key projects include:

- ❑ Western Ghats Forestry, Karnataka (1989). £25.7 million grant to assist the Karnataka Forestry Department in developing sustainable forest management in Western Ghats, an area of ecological significance and local importance for fuelwood and other forest resources.

- ❑ Environment (1993): £60 million grant for various environmental projects.

United Nations Industrial Development Organization (UNIDO)

Most UNIDO projects focus on industrial problems or phasing out chloro-fluorocarbons. One falls into the category of institutional strengthening:

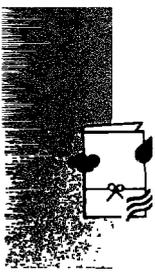
- ❑ Master plan for environmental quality management for the Dhanbad, Bokaro, Thalcar, and Bhilai regions in Eastern India (\$210,000): Government counterpart, Bihar Pollution Control Board; subcontractor, Tata Energy Research Institute.

European Union

EU has a potentially large budget for projects—perhaps as much as \$200 million in India—and is advised by a Council Directive to spend 10 percent of funds on environmental projects. Purely environmental projects comprise just one awareness-raising project at the moment, although other projects have environmental components. EU is interested in assisting national resource accounting projects and remote sensing for surveying forest areas, but has experienced difficulty developing project proposals in collaboration with Indian authorities.

Asian Development Bank (ADB)

The ADB has no current environmental project in India. Four environmental projects have been proposed, of which two have



institutional strengthening components.

- ❑ The Industrial Pollution Control Project (\$600,000) would mitigate environmental degradation caused by industrial operations by strengthening the state control boards of Gujarat, Maharashtra, Tamil Nadu, and Uttar Pradesh; encouraging industrial units to install pollution control devices; assisting in the establishment of common effluent treatment plants; and introducing clean technologies. The executing agency would be the MOEF.
- ❑ The State Environmental Improvement Project (\$600,000) would prepare a detailed feasibility study covering policy, environmental, technical, financial, economic, and institutional aspects of the proposed project. The main objective of the proposed study will be to demonstrate that such projects are financially and economically viable.

United States Agency for International Development (USAID)

USAID has one project aimed at institutional strengthening in the energy sector, focusing on facility management (\$20 million)

Canadian International Development Agency (CIDA)

Two of CIDA's umbrella projects relate to training and capacity-building:

- ❑ The India Canada Environment Facility (\$53 million) is a seven-year project to develop the capacity of selected Indian institutions to address sustainable development issues through environmental subprojects that have a substantial impact not only on the client

communities, but also on the institutions themselves.

- ❑ The Small Projects Environment Fund (\$400,000) supports small-scale environment projects, human resource development, and awareness-building activities. Indian partners are the International Journal of Sustainable Development, Center for Women's Development Studies, Center for Environment and Education, and Development Alternatives.

Danish Ministry of Environment (DANIDA)

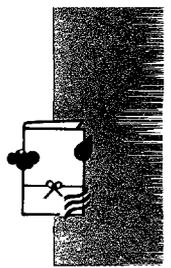
DANIDA's total involvement in India in 1993 was \$35 million; it plans to lower this amount to \$29 million by 1997. By 1998, 15 percent of total allocations should go toward environment projects. DANIDA is currently involved in two environmental projects relating to capacity building and training:

- ❑ Preparation of an environmental master plan for the South Kanara District, Karnataka (\$4.2 million).
- ❑ Establishment of environmental training institutes in Tamil Nadu and Karnataka (\$3 million).

Norwegian Ministry of Development Cooperation (NORAD)

The Norwegian Parliament has decided to phase out cooperation with India after 1995 in order to increase cooperation with African countries. The planned budget for 1995 is \$6.2 million. Much of this spending focuses on capacity-building, information exchange, and raising awareness, including:

- ❑ A training air pollution model project (\$150,000) to transfer expertise in air



quality modeling and environmental impact assessment. Implementing agency: the Central Pollution Control Board.

- ❑ Monitoring of air pollution from aluminum industry (\$384,000) to strengthen monitoring and analysis capacity in State Pollution Control Boards and the aluminum industries in Orissa and Uttar Pradesh. Implementing agency: the Central Pollution Control Board.
- ❑ An environmental program in Himachal Pradesh (\$5.5 million) to support ecologically sustainable development and strengthen the Himachal Pradesh government.
- ❑ An institutional cooperation project (\$4.1 million) to promote cooperation between Norwegian and Indian institutions in the environment and productive sectors. The Indian institutions involved are G. B. Pant Institute, Almora, Uttar Pradesh; Central Institute of Freshwater Aquaculture, Bhubaneshwar, Orissa; University of Rajasthan, Jaipur, Rajasthan; Kapur Solar, Delhi; and Institute of Paper Technology, Saharanpur, Uttar Pradesh.
- ❑ An environmental allocation program (\$165,000) to fund different environmental projects to promote sustainable use of natural resources in four states, to promote smaller families, and to initiate environmental impact assessment activities.

Swedish International Development Agency (SIDA)

SIDA's development cooperation with

India is planned to decrease from commitments of \$51 million in 1991 to \$39 million in 1995. Disbursements increased, however, to an estimated \$64 million in fiscal 1994.

Existing projects include one institution-building project:

- ❑ Establishment of an Environmental Protection Training and Research Institute, Hyderabad, Andhra Pradesh, to work within the five southern states.

Netherlands government

Indo-Dutch cooperation in environmental issues focuses on five states: Uttar Pradesh, Gujarat, Andhra Pradesh, Karnataka, and Kerala. Three themes guide Dutch aid in the sector: pollution abatement, clean technology, and institutional strengthening. Current institutional strengthening projects include:

- ❑ Indo-Dutch Kanpur/Mirzapur Project, Uttar Pradesh. Environmental and sanitary engineering and institutional strengthening. Indian counterparts: Ganga Project Directorate and the Uttar Pradesh Pollution Control Board.
- ❑ Environmental Impact Assessment Phase II. Institutional strengthening for environmental impact assessment. Indian counterpart: MOEF.
- ❑ Kallada Environmental Action Program, Kerala. Sustainable river basin planning, wetland and forest conservation, and pollution abatement. Indian counterpart: MOEF.
- ❑ Institutional strengthening of the State Kerala Pollution Control Board.
- ❑ Pollution Perception Studies. Social

surveys of urban and rural communities, policymakers, and industrialists. Counter-parts: various universities and institutes.

- Environmental NGOs. Supports NGOs contributing to pollution abatement and to raising awareness, including the Center for Science and Environment; Society for Promotion of Wasteland Development; SEC (environmental magazine); Joe Hamun (tree planting); Indian Institute of Technology (biomass densification); Accion Fraternal (ecodevelopment); ANET (biodiversity conservation on Andaman and Nicobar islands); HSM (socio-ecological transformation); and NRDMS (environmental atlas GIS in Karnataka).

Proposed projects include the preparation of an environmental atlas, including GIS for Karnataka, a river basin in Kerala, and a district in Andhra Pradesh where irrigation and drinking water projects are planned. Counterparts: MOEF, the Central Pollution Control Board.

German government (GTZ)

German technical cooperation with India in the area of institution building or development of scientific knowledge includes the following projects:

- Assistance in creating environmental protection agencies, New Delhi and other locations (\$7.4 million).
- Consulting in the field of industrial environmental protection, National Productivity Council, New Delhi (\$6 million).
- Civil and National Remote Sensing Institute, Hyderabad, Andhra Pradesh (\$3.13 million).

Japanese government (OECF)

OECF projects in India do not include any projects specifically aimed at education or institution building. A forestry project in Rajasthan has a research and training component.

Chapter 2

Conservation and Sustainable Utilization of Biodiversity in Selected Ecosystems





Conservation and Sustainable Utilization of Biodiversity in Selected Ecosystems

2.01 Biodiversity conservation, *defined as the conservation of genetic, species, and ecosystems diversity*, is an important challenge for India. As one of the twelve megadiversity countries which together account for 60 to 70 percent of the world's biodiversity, India has a broad range of ecosystems and species within ten biogeographic zones. Its flora represent 10 percent of the world's total, and faunal diversity is also high, representing 7 percent of the world total. Only about 20 percent of this biodiversity has been documented in terms of species, habitats, and ecosystems. Some 10 percent of all plant species and more than 21 percent of the 372 mammal species are endangered, indicating a widespread degradation of ecosystems that has significant economic implications (Table 2.1).

2.02 The major threat to biodiversity comes from the explosive expansion of the country's human and livestock populations. India has the second highest population density in the world, about 900 million people living on just over 2 percent of the world's land area, and growing annually by 2.3 percent. A third of Indians are very poor and depend on land for their subsistence. This, coupled with grazing by the largest livestock population (about 500 million), poses a potent threat to biodiversity. Local people lack commitment to using the forest in a sustainable way because they have limited rights over local resources. This lack of commitment is a major threat to conservation. Common practices include cattle

Box 2.1. Wildlife (Protection) Act 1972

The Wildlife (Protection) Act, 1972 is a unified national act superseding previous specific state laws and the Indian Forest Act, 1927, which enables the constitution and management of areas as national parks, sanctuaries, game reserves, and closed areas. It also specifies the procedures for establishing protected areas, the management parameters for them, and the procedures for allowing or disallowing diverse uses within them. Under this act, national parks are given a higher level of importance than sanctuaries, since no grazing or private land holding or right is permitted within them.

The act also provides for denotification of sanctuaries for certain human uses. It specifies for hunting of wild animals with respect to license needed, maintenance of records of wild animals killed, restrictions of hunting etc. It provides for the declaration of any area to be a sanctuary, national park or game reserve by the state government, if it is considered that the area is of adequate ecological, faunal, floral, geomorphological, natural or zoological significance for the purpose of protecting, propagating wildlife or its environment. In addition, the act also prohibits the trade of wild animals or animal articles and trophies derived from certain animals.

Wildlife (Protection) Amendment Act, 1991

It provides for the protection of specified plants and the establishment of a Central Zoo Authority and the recognition of zoos.

Source: Bharat Desai, ed., *Environmental Laws of India*, 1994.

grazing on forest land, cutting trees for firewood and timber, and extracting nontimber forest products.

2.03 Though the original forest cover in India and the extent of its loss are difficult



to estimate, there is a consensus that there has been a significant loss of original habitat. The formal sector (sponsored by the state) has been the main contributor to this loss since the late 18th century through such activities as logging and plantations. The informal sector (subsistence agriculture, grazing, fuelwood collection) has had less of an impact because of lower population density. Dense forest coverage has decreased by nearly 18 percent in the past two decades, while open degraded forest coverage has more than doubled.

2.04 Indian wetlands are threatened by cultivation, conversion for industries and

urban habitats, siltation, weed infestation, and pollution. Grasslands, mountains, and deserts face similar threats from increasing pressures on land.

2.05 India's biodiversity conservation strategy is still evolving. Biodiversity management is not just an ecological concern. It is also intrinsic to socioeconomic development. The rural poor in particular depend on biological resources in the form of food, medicine, income, employment, and cultural integrity for their livelihood and welfare. Successful biodiversity conservation depends on sound policies, effective laws, and institutional and social arrangements.

Table 2.1. Status of Biodiversity Ecosystems in India

Ecosystem	Status
Forest	<p>Loss of forest cover. The forest cover is 63.59 million hectares (ha), 19.44% of the country's geographic area. Only half of the forests have a crown density of over 40%, and forest cover is lower than the stipulated 33%. The rate of deforestation and degradation was 1 million hectares a year prior to 1980 (World Bank Forest Strategy Report 1993). Of the total area of 63.59 million ha., dense forests (crown density over 40%) account for only 38.50 million ha. About 52.8% of forests do not have adequate regeneration. The per capita forest area has decreased from 0.20 ha in 1951 to 0.11 ha. in 1981.</p> <p>Degradation of land. Vast tracts of forest land, especially in the Himalayan range have become bare because of commercial exploitation and resultant soil erosion, which prevents regeneration and plantation.</p> <p>Greater recurrence of environmental disasters. Deforestation and degradation of river catchments have resulted in severe and frequent droughts and floods. Also, forest area affected by fire ranges from 33% in West Bengal to 99% in Manipur (Forest Survey of India)</p> <p>Loss of plant and wildlife biodiversity. The growing pressure by livestock on forests has resulted in fierce competition with the endemic wildlife. Among the larger animals 79 species of mammals, 44 of birds, 15 of reptiles, and 3 of amphibians are threatened. Nearly 1,500 plant species are considered endangered.</p> <p>The degradation of forests and biodiversity is a result of the following:</p> <ul style="list-style-type: none"> ● Commercial felling, fires, drought, air pollution, and introduction of exotic weeds. ● Livestock grazing. India's 500 million livestock require 882 million tonnes of green fodder. Only half of it is sustainably available from forests and the rest is illegally extracted.



Ecosystem	Status
	<ul style="list-style-type: none"> ● Fuelwood extraction. Total fuelwood removal both authorized and unauthorized is more than 235 million cu.m. as against the sustainable production of only 48 million cu.m. ● High population and fragile natural resource base. Finite land coupled with rapid population growth has increased demands on the fragile biodiversity. ● Economic incentive system. ● Technological factors that limit yields from land. ● Institutional weakness. Lack of adequately trained and equipped manpower and of financial resources.
Wetland	<p>Marshes, swamps, floodplains, lakes, deltas and coral reefs form the core of the wetland system. They are mainly managed as common property resource systems. There are around 17 million hectares of wetlands in the country excluding paddy fields. The area under natural wetlands is 1,450,771 ha. and under manmade wetlands is around 1,589,266 ha. which is increasing every year. However, only 28% of the area of 93 important wetlands is under total protection, which amounts to 53 of the 93 sites. Of the 85 wetland sites of international importance in the country, 45% are subjected to moderate or high threat.</p> <p>Extensive use leading to degradation. Wetlands are being significantly threatened because of their intensive use by a growing population. The wetlands are being perceived as common, not communal property. Some problems faced by wetlands include weed infestation and siltation, pressures of agriculture, chemical and organic pollution, and conversion of wetlands for industrialization, urbanization and habitation.</p>
Coral Reefs	<p>India, with a coastline of 7,500 km. has about 19,000 sq. km. of coral reefs (also called rainforests of the sea), most of which are around the islands of Andaman and Nicobar, and Lakshwadeep.</p> <p>Coastal regions are threatened by mechanized trawling, weed infestation and siltation.</p>
Mangroves	<p>Total area of mangroves in India is estimated at about 6 000 sq km. along the mainland and about 600 sq. km. along the Andaman and Nicobar coast, comprising about 7% of the world's total mangrove area. About 60 species of plants occur, many of which are endemic.</p> <p>Mangroves along the west coast have disappeared as a result of biotic pressures such as land use changes in surrounding areas, pollution of waters and firewood extraction.</p>
Grassland	<p>Only 3.7% of the country is under permanent pastures and other grazing lands (Steering Committee Report 1989).</p> <p>Lack of government policy. This ecosystem is particularly threatened because the government has no specific policy on grasslands and there is no specialized agency dealing with it.</p> <p>Other threats include:</p> <ul style="list-style-type: none"> ● Commercial pressures such as encroachment and conversion to agricultural lands and tree plantations. ● Grazing, fires, exotic weed. ● Pollution, development projects. ● Environment hazards such as floods and drought.



Ecosystem	Status
Mountain/Cold Desert	<p>Highly biodiverse mountain ranges in the eastern and western Himalayas, Lahaul and Spiti, Kinnaur and the Western Ghats. Of these, the Western Himalayas and the Western Ghats face high levels of pressure. The Himalayas are in a highly seismic zone and frequent tremors cause the progressively degrading hillsides to slide down, destroying the vegetation and habitat of wild animals.</p> <p>Pressure on this ecosystem is due to lack of clear policy and institutional control by government. Commercial timber felling, extraction of fuel and fodder, rapid growth of population, conversion of hill slopes into agricultural fields, and the practice of shifting cultivation have contributed to the degradation of this ecosystem.</p>
Hot desert	<p>The hot deserts of Rajasthan.</p> <p>Pressure on wildlife biodiversity has led to some animals such as the great Indian bustard and wild ass becoming endangered species. This ecosystem has been threatened by growing human and livestock usage and poaching, waterlogging caused by irrigation, and ecological modifications due to introduction of irrigation.</p>

Source: Indian Institute of Public Administration 1993, India Ecodevelopment Project Working Papers.



The Government's Strategy for Biodiversity Conservation

2.06 Several efforts have been made to promote biodiversity conservation, including a National Wildlife Action Plan adopted in 1983, a biogeographic classification system for conservation planning, and a plan for a revised protected area network created by the Wildlife Institute of India in 1988. The need for biodiversity protection now requires that efforts move from strategies to action.

PAST EFFORTS

2.07 The National Wildlife Action Plan recommended the following approaches for biodiversity conservation:

- ❑ Establishment of a representative network of protected areas. To arrest deforestation, the government adopted a scheme of declaring ecologically sensitive areas (as identified by the Wildlife Institute of India) as protected areas. Nearly 4 percent of the land area has been set aside in 480 parks and sanctuaries. Protected areas cover 12 million hectares, of which 8 million is forest land with tree cover.
- ❑ Development of appropriate management systems for protected areas, taking into consideration local needs and ensuring local support and involvement. The Ministry of Environment and Forests has moved to a management system that emphasizes the need to involve local communities in the management of protected areas. This objective is achieved through an eco-

Box 2.2. Ramsar Convention

To ensure conservation of wetlands, an international convention was held in 1971 in Ramsar, Iran, to provide a framework for international cooperation for the conservation of wetland habitats. As of June 1992, there were 70 signatories to the convention, and 565 wetlands covering over 6 million hectares had been declared Ramsar sites. India acceded to the convention in October 1981 and has so far designated six wetlands for inclusion on the list of wetlands of international importance.

Under the convention there is a general obligation for the contracting parties to formulate and implement plans to promote the wise use of wetlands in their territories, thereby ensuring the preservation of the ecological character of these habitats. A second obligation is the designation of wetlands for inclusion on a "List of Wetlands of International Importance" with selections based on "international significance in terms of ecology, botany, zoology, limnology or hydrology". Specific conservation duties pertain to the listed sites. Finally, the signatories are obliged to promote the conservation of wetlands in their territory (whether or not they are included in the list) through the establishment of nature reserves. They are also required to undertake training of personnel in wetland research, management and wardening.

Source: Paper on Biodiversity, Environmental Stocktaking Exercise for India.

development strategy that addresses the impact of local people on protected areas and the impact of protected areas on local people. Ecodevelopment involves local people in planning, develops incentives for conservation, supports sustainable alternatives to harmful use of resources, and improves the manage-



Map 2.1. Conservation of Natural Ecosystems

There are 421 sanctuaries and 75 national parks which shelter varied and representative ecosystems. India has five natural world heritage sites and six wetlands of international importance



The boundaries, colors, denominations & any other information shown on this map do not imply, on the part of World Bank Group, any judgement or the legal status of any territory or any endorsement or acceptance of such boundaries



Wetlands of International Importance

1. Keoladeo Ghana National Park, Bharatpur (Rajasthan)
2. Chilka Lake (Orissa)
3. Wular Lake (Kashmir)
4. Loktak Lake (Manipur)
5. Sambhar Lake (Rajasthan)
6. Harike Lake (Punjab)

Natural World Heritage Sites in India

1. Sundarbans National Park (West Bengal)
2. Kaziranga National Park (Assam)
3. Manas National Park (Assam)
4. Nandadevi National Park (Uttar Pradesh.)
5. Keoladeo Ghana National Park (Rajasthan)



ment of protected areas. Ecodevelopment also builds private support for conservation among NGOs, nature tour operators, and the general public.

- Biodiversity protection within multiple use areas. There is a long history of communities managing forests and wildlife, usually without government recognition or sanction. In recent years the government has tried to increase community participation in forest management through joint forest management programs. These programs emphasize government and local collaboration in designing inputs into sustainable land use practices, alternative income-generating initiatives, rural cottage industries, and marketing strategies. Products, responsibilities, control, and decisionmaking authority over forest lands are shared by forest departments and local user groups. Recent experiences in a number of states (West Bengal, Haryana, Gujarat, and Orissa) indicate that forest lands under joint management show appreciable recovery, increased productivity, and consequent improvement and sustainability of local livelihoods and biodiversity. The application of this approach to protected areas is currently under consideration.
- Extending conservation efforts beyond protected areas. The government is preparing a National Forestry Action Plan as a complement to its 1988 National Forest Policy, to ensure sustainable management of forests and

forest lands. This plan will identify short and long term priority actions and approaches.

FUTURE ACTIONS

2.08 A status report on biodiversity is being formulated through nationwide expert consultations, and a framework has been developed for a biodiversity action plan by the Ministry of Environment and Forests. In addition, the M. S. Swaminathan Research Foundation (MSSRF 1993) has set the following policy actions and priority goals for state and central governments to consider:

- Saving prime habitats and endangered species.
- Conserving the entire range of species.
- Meeting the minimum needs of the people in an ecologically sustainable way.
- Enhancing conservation practices through education and awareness.
- Facilitating community activity for biodiversity conservation.
- Assessing the implications for biodiversity of international conventions and agreements on national sovereignty.
- Strengthening enabling legislation for biodiversity conservation.
- Strengthening administrative mechanisms at the community, state, and national levels.
- Ensuring that biodiversity conservation efforts are supported at central and state levels with financial, technical, and institutional resources.



The Environment Action Program

2.09 The Environment Action Program identifies major issues threatening biodiversity, including inappropriate use of natural resources, overpopulation, poverty (and the methods of exploitation associated with subsistence), forest degradation, insufficient research, and inadequate institutional support. To address these concerns, the program recommends a number of strategies (Box 2.3).

2.10 The following programs are

identified in the Environment Action Program.

2.11 *Survey of Natural Resources: encompassing forests, flora and fauna.*

- Survey the plant resources of the country.
- Undertake and complete taxonomic studies of all the flora of the country.
- List endangered species and undertake measures for effective conservation; and

Box 2.3. Ecosystem Protection Strategies

- Conduct research to evaluate the ecological importance, biotic potential, and conservation value of wetlands, mangroves, and coral reefs.
- Disseminate conservation education materials.
- Survey existing and proposed protected wetlands.
- Conduct natural resources accounting studies for coral reefs, forests, mangroves, wetlands, and protected areas.
- Develop a comprehensive national listing of all phylums, genuses, species, and subspecies with their location, distribution, description, and status.
- Initiate research on cultivation of commercially valuable wild plants.
- Establish farms for medicinal and other commercially valuable plants.
- Conduct research on various species of domesticated animals for conservation of traditional domesticated species, many of which are being replaced by modern hybrid breeds.
- Encourage research and development on bioenergy programs such as high-density energy plantations and efficient fuelwood use systems by strengthening the Indian Council of Forestry Research and Education in Dehradun.
- Promote afforestation and wasteland development.
- Develop programs for pasture regeneration.
- Support wildlife conservation projects, particularly for elephants and rhinos.
- Set up extension support projects for agroforestry.
- Encourage networking of the Zoological Survey of India and Botanical Survey of India with universities and other nongovernmental organizations.
- Develop programs for sustainable management of manmade bodies of water such as reservoirs, urban tanks, village ponds, percolation and irrigation tanks, and so on.
- Demand that management development projects protect newly afforested areas and areas undergoing natural regeneration.
- Extend support for ex-situ conservation in zoological and botanical gardens.



Box 2.4. The Manufacture, Use, Import, Export and Storage of Hazardous Micro-Organisms and Genetically Engineered Organisms or Cells Rules, 1989

The central government established these rules with a view to protecting the environment, nature and health, in connection with the application of gene technology and micro-organisms.

These rules are applicable to the manufacture, import and storage of micro-organisms and gene-technical products.

The Department of Bio-Technology under the Ministry of Science and Technology is the nodal agency for granting licences for manufacture, import and export of micro-organisms and genetically engineered organisms. However, such licenses are issued only after the proposal is cleared from the environmental angle by the Ministry of Environment and Forests. For according such clearances, the Ministry has notified the "Rules for the Manufacture, Use, Import, Export and Storage of Hazardous Micro-organisms and Genetically Engineered or Cells" in 1989 under the EPA 1986.

The investor is required to submit an application to the Ministry of Environment and Forests. The Genetic Engineering Approval Committee (GEAC) constituted by the Ministry of Environment and Forests examines the application form and makes recommendations.

All industries involving hazardous micro-organisms or genetically engineered organisms are required to constitute an Institutional Bio-Safety Committee (IBSC) to oversee the planning of an on-site emergency plan to deal with any accident which may occur due to hazardous micro-organisms.

Source: Bharat Desai, ed., *Environmental Laws of India*; GOI, Ministry of Environment and Forests, Handbook of Environmental Procedures and Guidelines, 1994.

collect and maintain germ plasm and gene bank of endangered, threatened and vulnerable species.

- Identify, collect, and preserve specimens of plants which are economically and otherwise beneficial to human beings.

- Prepare a national data base of herbarium collections including types, live collections, plant genetic resources, plant distribution and nomenclature.
- Undertake studies on selected critical and fragile ecosystems.
- Survey existing and proposed protected wetlands.
- Undertake assessment of flora relating to environmental impact studies and evaluate plants of economic utility in specified areas.
- Carry out geobotanical studies in specified areas.

2.12 *Conservation of natural resources including forestry and wildlife.* The National Conservation Strategy and Policy Statement on Environment and Development, 1992, the National Forest Policy, 1988, and the Policy Statement for Abatement of Pollution, 1992, are the major policy instruments of the government for dealing with various facets of environment and development in a comprehensive manner.

2.13 The following strategies can be grouped under biodiversity conservation and include programs for Biosphere Reserves, Wetlands, Mangroves and Coral Reefs, Forest Conservation, Lake Conservation, Desertification, Zoological Parks, Wildlife Conservation, Animal Welfare and Ex-situ/ In-situ Conservation.

- Conserve the biodiversity and genetic integrity of plants, animals and micro-organisms in their totality as part of the natural ecosystems so as to ensure their self-perpetuation and unhindered evolution of the living resources.



- ❑ Promote research that would assist ecological conservation both within these reserves and in areas adjacent to these reserves.
- ❑ Provide facilities for international cooperation in a whole range of bioclimatic and biogeographical situations of the biosphere.
- ❑ Extend support for ex-situ conservation in zoological and botanical gardens.
- ❑ Establish farms for medicinal and other commercially valuable plants.
- ❑ Support wildlife conservation projects such as Project Elephant & Project Rhino.
- ❑ Set up extension support projects for agroforestry.
- ❑ Evolve programs for sustainable management of manmade water bodies such as reservoirs, urban tanks, village ponds, and percolation and irrigation tanks. (The National Lake Conservation Plan proposes to augment the ongoing program on wetlands by large scale conservation activities such as resource surveys by way of remote sensing technology and GIS, prevention of point and nonpoint source pollution, catchment area treatment, desilting and weed control).

2.14 *Institutional development and strengthening of the forestry sector, including development of appropriate management systems for protected areas, taking into consideration local needs and ensuring local support and involvement.* The Ministry of Environment and Forests has moved to a management system that emphasizes the need to involve local

communities in the management of protected areas. This objective is achieved through an ecodevelopment strategy addressing the impact of local people on protected areas and the impact of protected areas on people. (Ecodevelopment involves local people in planning develops incentives for conservation, supports sustainable alternatives to harmful use of resources, and improves the management of protected areas). In addition, demand management development projects to improve protection of newly afforested areas and areas undergoing natural regeneration are planned.

2.15 *Community development.* In recent years, government has tried to increase community participation in forest management through joint forest management programs. These programs emphasize government and local collaboration in designing inputs into sustainable land practices, alternative income generating initiatives, rural cottage industries, and marketing strategies. Products, responsibilities, control and decisionmaking authority over forest lands are shared by forest departments and local user groups. Recent experiences in a number of states (West Bengal, Haryana, Gujarat and Orissa) indicate that forest lands under joint management show appreciable recovery, increased productivity, and consequent improvement and sustainability of local livelihoods and biodiversity. The application of this approach to protected areas is currently under consideration.

2.16 *Research and education.*

- ❑ Conduct research to evaluate ecological importance, biotic potential, and conservation value of wetlands, mangroves and coral reefs and disseminate research results.



- ❑ Conduct natural resources accounting studies for coral reefs, forests, mangroves, wetlands, protected areas and biodiversity.
- ❑ Initiate research on cultivation of commercially valuable wild plants.
- ❑ Conduct research on various species of domesticated animals for conservation of traditional domesticated species, many of which are being replaced by modern hybrid breeds.
- ❑ Encourage research and development on bio-energy programs such as high density energy plantations and efficient fuel wood use systems by institutionally strengthening the Indian Council of Forestry Research and Education, Dehradun.
- ❑ Encourage networking by the Zoological Survey of India and Botanical Survey of India with universities and other non-governmental organizations.



Major Issues and Recommendations

2.17 Some of the major issues faced in biodiversity conservation efforts in India are discussed below.

LOCAL COMMITMENT TO BIODIVERSITY CONSERVATION

2.18 In the past few decades the needs of India's rapidly growing rural population have multiplied while land availability has shrunk. The resulting pressures have destroyed a largely self-regulating and sustainable system of forest land use and replaced it with practices of overexploitation of natural resources and alienation of local communities from forest management and regulation. Even protected areas suffer from problems caused by the pressures of human population. A survey conducted by the Indian Institute of Public Administration found that of the 32 national parks and 138 sanctuaries responding, 18 parks and 100 sanctuaries reported human habitation within their boundaries (IIPA 1994). The average density was just over 2.5 people per hectare—higher than the national average.

2.19 Illegal use of forest lands for cultivation, grazing, and fishing is another issue facing protected area managers. In the past, protected areas were policed to limit these activities. Park authorities deployed fences, guns, and guards, which led to confrontations with local people and their livestock. Serious conflicts between park management and local people have occurred in nearly 21 percent of the protected areas.

EXPLOITATION OF FORESTS FOR COMMERCIAL PURPOSES

2.20 Rural resources, especially forests, have been diverted for development projects or to meet urban demands. Under the 1927 Indian Forest Act, forests are classified as reserved or protected, and managed by state forest departments through working plans for each forest division. These plans have focused on commercial forestry, implying that the objective of sustainable extraction of timber overrides the objective of protecting biodiversity. Huge tracts of forests have been destroyed by commercial felling. Only about half the forests have a crown density of more than 40 percent, and in many places the forest cover has disappeared. Deforestation and degradation proceeded at a rate of 1 million hectares a year until 1980. The diversion of forest lands for nonforestry purposes was reduced significantly with the enactment of the Forest Act in 1980 and its amendment in 1986. In addition, the Environment Act mandated environmental impact assessments for various types of development projects and activities.

LEGAL

2.21 The level of legal protection for biodiversity conservation varies, with domesticated varieties receiving less coverage than natural biodiversity. Some ecosystems, such as grasslands and deserts, lack any



specific legal protection. State control of forest lands and lack of central authority to make states comply with national laws makes governance of forest areas very difficult. People living in protected areas also have legal rights pertaining to grazing, habitation, agriculture, fuelwood collection, and collection of minor forest produce. Thus states have to cope with balancing the pressures of commercial exploitation with environmental conservation.

ATTITUDES

2.22 Officials see themselves as policemen, not as facilitators of a partnership between biodiversity and its users. This often results in conflict between the officials and the local users. While the government is starting to focus more on collaboration and less on policing, as mandated in the National Forestry Policy, the process will take time. In response to these concerns, the Ministry of Environment and Forests has recently undertaken capacity-building activities, including curriculum changes for the Indian Forest Service and special wildlife protection training for the Wildlife Institute in Dehradun. The other areas of biodiversity remain neglected.

INSTITUTIONAL

2.23 Capacity building activities are minimal and lack sufficient budgetary support. Data on this level of support needs to be compiled, especially at the state level.

Limited capacity

2.24 The Ministry of Environment and Forests, the Ministry of Agriculture, and the Ministry of Rural Development are the central agencies responsible for conserving wildlife and biodiversity. The MOEF has lead

responsibility, but it lacks authority over other ministries, which makes for poor coordination. The Ministry of Environment and Forests appears better-suited to wildlife conservation than biodiversity conservation for a number of reasons: biodiversity conservation requires a broader scope of activities than wildlife conservation; both central and state governments are responsible for implementing biodiversity conservation, whereas the state is responsible for wildlife conservation; and the institutional network for implementing biodiversity conservation is inadequate. As a result, wildlife institutions are implementing many of the biodiversity conservation programs, even though they have not been properly trained for this additional responsibility.

Lack of leadership for protecting other ecosystems

2.25 There is no designated agency at the state or the central government level for protecting grasslands. Grasslands that come within forest areas are controlled by the Forest Department, but little attention has been paid to their management. For grasslands located outside protected areas, the state and central Departments of Environment can offer protection under general acts such as the Environment (Protection) Act and the Wildlife Act. But there is no central scheme or policy for protecting and managing grasslands.

2.26 Decisionmaking for wetland management is concentrated in a National Committee on Wetlands, Mangroves, and Coral Reefs within the Ministry of Environment and Forests, supported by state-level steering committees. Implementation is difficult because jurisdictions over these ecosystems differ. Wetlands that have been declared national parks or sanctuaries and



rivers are managed by the ministry, where management expertise is land- or forest-based. Except for mangroves, most natural wetlands are managed by the Department of Fisheries, the Ministry of Agriculture and local authorities. While the Department of Fisheries may have an interest in conserving aquatic resources, the ministry and local authorities often have different views of wetlands.

2.26 No government institution specifically safeguards the environment of mountain ranges. In fact, a few institutions, such as the North Eastern Council, are promoting the economic development of hill regions.

RECOMMENDATIONS

2.27 A number of changes, properly implemented, could improve significantly the state of biodiversity conservation efforts in India.

Sociocultural Changes

2.28 Government officials and local populations must work toward collaborative management of biodiversity. Changes in attitudes and behaviors come slowly and can be achieved only through a multidimensional approach, starting with better training for forest officials, forums for discussions of biodiversity, and promotion of public support for conservation. The government already has instituted curriculum changes for forest officials. The Bank's ecodevelopment project (currently in the pipeline) recommends the establishment of protected area research advisory committees at the local and national levels, comprising all relevant actors and stakeholders, to review progress and priorities for biodiversity management in the eight sites of the project. The project also supports public awareness campaigns.

Economic and financial incentives

2.29 An incentive framework must be created that motivates the different actors (forest officials, women, NGOs, community-based organizations, revenue officials) to contribute to biodiversity conservation and development. The system could, for instance, remove disincentives for the involvement of the private sector in the development of degraded forest lands. This framework already has been established in unprotected forest areas through the joint forest management strategy.

Legal loopholes

2.30 While India has a comprehensive and coherent legal framework for environment protection, loopholes exist that exclude domesticated varieties from legal coverage and should be removed. In addition, specific legislation covering grasslands and desert ecosystems should be created. Laws where they exist should be changed to remove government rights to forests, restrictions on felling trees on private lands, transit pass requirements, and mandatory sales of forest produce to the government.

2.31 There also is a need for broader criteria for classifying protected areas in order to protect a wider range of biodiversity. India lacks a uniform criteria for classifying protected areas, with the result that some areas of great biological value are declared sanctuaries rather than national parks or are left out altogether, while some parks and sanctuaries include areas of low biological value. Even areas that are designated as sanctuaries are not immune to degradation since directives often are ignored.

2.32 The Wildlife Institute of India is conducting a study on expanding the protected areas network to include important biomes currently left out, and to provide links between



parks to facilitate seasonal migration and outbreeding. But the government has yet to determine which remaining areas are a high priority for conservation, which lands are so encroached on or degraded that they are unavailable for development, and what to do with the degraded forest areas that fall between those two categories. The goal ultimately should be to develop a flexible law with gradations in zones.

Policy framework

2.33 A policy framework is required that integrates management of the green sector with the brown and water sectors. While the Environment Action Program is a first step, there is a need for actions across sectors to be prioritized. For instance, an analysis of the constraints that apply to forestry development from nonforest policies (tax, industrial, and so on) would be fundamental to a forest action plan. The development of state policies on forest management within a coherent national policy should be encouraged. In this context, the Bank's ecodevelopment project supports the integration of protected area concerns into regional planning and regulation, as well as joint forestry management of buffer zones of the protected areas. Bank-assisted forestry projects in West Bengal, Maharashtra, and Andhra Pradesh have similar objectives.

2.34 *Expand the role of NGOs and the private sector in biodiversity management.* The government has started to encourage local participation in the management of village and forest lands and buffer zones of protected areas. But implementation of this approach on a large scale will require redirection of current investment patterns and some fundamental policy changes.

2.35 *Evolve strategies for protecting*

wildlands and wetlands. A short-term action plan should be designed to collect and assess baseline data on the current situation of wetlands. This plan would enhance a long-term holistic plan for managing wetlands, biodiversity and afforestation. Two strategies could be developed to conserve biodiversity in the wetland ecosystem:

- A freshwater wetlands strategy is needed that prioritizes investments for protecting a representative sample of these ecosystems. These wetlands, which include Himalayan, Kashmir Valley, Himachal Pradesh, and the Indo-Gangetic area, experience intense pressures from land use and urbanization in their watersheds. The GOI has a freshwater wetlands program which could be built upon.
- Coastal and marine wetlands experience intense pressures from land and sea uses, and from coastal urbanization. Priorities need to be set among different wetland types in relation to their economic importance and biodiversity conservation potential. These wetlands include brackish water, mangroves, seagrass beds, submerged banks, coral reefs, mudflats, and beach sands. A rich diversity of marine organisms—some of them unique species—use coastal and marine wetlands.

2.36 *Set up marine parks and reserves.* In view of the physical contiguity of coastal and marine wetlands, a system of marine parks and reserves could capture representative samples of their varied habitats and ecosystems. The system could include spawning grounds of commercially important fish species; feeding, nesting, breeding, and nursery grounds for important aquatic species



and threatened habitats and ecosystems; recreational areas such as fisheries and geological, historical, cultural, and aesthetic sites; and near-shore and adjacent land in coastal zones undergoing rapid change as a result of agroindustries and human activities.

Institutional reforms

2.37 Government officials must begin thinking of themselves as facilitators of biodiversity conservation rather than merely as policemen. A change in government attitude toward the private sector could be accomplished by designing a conceptual framework of comparative advantage. As noted earlier, the change in attitudes could be accomplished through training, curriculum change, and workshops for officials and policymakers.

2.38 In addition, an agency should be designated at the state and national levels to manage grasslands and mountain ranges. A focus on wetlands and coastal area conservation, also essential, may require consideration of institutional issues, such as the establishment of a marine parks authority

or equivalent to ensure the expertise needed for managing coastal and marine areas. A start has been made with the establishment of marine biosphere reserves and bird sanctuaries, even though the reserves are not yet legally protected. These reserves are Gulf of Mannar, Sunderbans, Great Nicobar, North Andaman, and the Little Rann of Kuchchh.

Technical changes

2.39 The World Bank is planning to support a biodiversity information project which would improve access to, use of, and management of scientific and ethnobiological information on biodiversity and protected area management. The project would improve the collections data bases in the Zoological Survey of India, the Botanical Survey of India, and the Wildlife Institute of India, among others. No aquatic or marine sciences training is currently available for the Department of Forests, since aquatic resources and biodiversity were traditionally under the purview of the Department of Fisheries. This area needs further study. In addition, a study of the impact of biodiversity degradation on tribals and rural poor should be undertaken.



GOI Program Objectives

Category: *Survey of Natural Resources*

Government Objectives/Programs:¹

Survey plant resources; taxonomic studies of all flora; detailed listing of fauna; enlist endangered species; identify, collect and preserve economically useful specimens of plants; prepare national data base of herbarium collections; and survey existing and proposed protected wetlands.

Donor Agency Support

Project	Donor	Funding
<i>Forests</i>		
Indira Gandhi Conservation Monitoring Centre	British (ODA)	£95,000 (US\$153,567 equiv.)
Andaman & Nicobar Islands	USA	US\$122,000
<i>Flora</i>		
Andaman & Nicobar Islands	USA	US\$122,000
Madhya Pradesh Forestry	World Bank	US\$58.0 M equiv.
<i>Fauna</i>		
Andaman & Nicobar Islands	USA	US\$122,000
Madhya Pradesh Forestry	World Bank	US\$58.0 M equiv.

Category: *Conservation of Natural Resources including Forestry and Wildlife*

Government Objectives/Programs:

Conserve biodiversity and genetic integrity of plants, animals and micro-organisms; promote research assisting ecological conservation; extend support for ex-situ conservation in zoological and botanical gardens; provide facilities for international cooperation; establish farms for medicinal and other commercially valuable plants; support wildlife conservation projects i.e. Project Elephant & Project Rhino; set up extension support projects for agro-forestry; evolve programs for sustainable management of man-made water bodies such as reservoirs, urban tanks, village ponds, percolation and irrigation tanks. The National Lake Conservation Plan proposes to augment the on-going program on wetlands by large scale conservation activities such as resource surveys by way of remote sensing technology and GIS, prevention of point and nonpoint source pollution, catchment area treatment, desilting and weed control.

¹ GOI programs in biodiversity conservation have been extracted from India's Environment Action Program and the Annual Reports of The Ministry of Environment and Forests (1993-94 and 1994-95)



Donor Agency Support

Project	Donor	Funding
<i>Biosphere Reserves, Wetlands, Mangroves and Coral Reefs</i>		
West Bengal Forestry ¹	World Bank	US\$58.0 M equiv.
<i>Forest conservation</i>		
Tamil Nadu Social Forestry	Sweden (SIDA)	SK313 M (US\$35 M equiv.)
Orissa Social Forestry	Sweden (SIDA)	SK263 M (US\$30 M equiv.)
Western Ghats Forestry	British-ODA	£23.19 M (US\$37.5M equiv.)
Changar Integrated Forestry	Germany	DM 8.5 M (US\$11.7 M equiv.)
Andhra Pradesh -Agro Forestry	Canada	C\$4.87 M (US\$6.63M equiv.)
Andhra Pradesh Forestry	World Bank	US\$77.4 M equiv.
Madhya Pradesh (MP) Forestry	World Bank	US\$58.0 M equiv.
Maharashtra Forestry	World Bank	US\$124 M equiv.
West Bengal Forestry	World Bank	US\$34.0 M equiv.
<i>Wildlife conservation</i>		
Wildlife Management and Eco-development Capabilities ²	UNDP	US\$1.4 M
West Bengal, Andhra Pradesh and Madhya Pradesh Forestry Projects and the Forestry) Research Education and Extension Project (FREEP) ³	World Bank	US\$216.0 M equiv.
<i>Ex-situ / In-situ conservation</i>		
Strengthening Medicinal Plants Resource Base in South India	Denmark	DK 26.6 M (US\$4.0 M equiv.)
Madhya Pradesh Forestry	World Bank	US\$58.0 M equiv.

Category: *Institutional Development and Strengthening of the Forestry Sector*

Government Objectives/Programs:

Development of appropriate management systems for protected areas taking into consideration local needs and ensuring local support and involvement. Emphasizing the need to involve local communities in the management of protected areas through an eco-development strategy addressing the impact of local people

¹ Project contributes towards afforesting or rehabilitating about 28,000 ha of mangrove areas.

² Project contributes towards wildlife conservation but not particularly Project Tiger or Project Rhino.

³ Projects contributes towards wildlife conservation but not particularly Project Tiger or Project Rhino.



on protected areas and impact of protected areas on people. Demand management development projects to improve protection of newly afforested areas and areas undergoing natural regeneration.

Donor Agency Support

Project	Donor	Funding
<i>Efficient Management</i>		
Support to Indian NGO's	Sweden (SIDA)	US\$0.4 M equiv.
Himachal Pradesh Forestry	British-ODA	£3 M (US\$4.85M equiv.)
Andhra Pradesh Forestry	World Bank	US\$77.4 M equiv.
Madhya Pradesh Forestry	World Bank	US\$58.0 M equiv.
Maharashtra Forestry	World Bank	US\$124 M equiv.
Forestry Research Education and Extension	World Bank	US\$47.0 M equiv.
<i>Technical Development</i>		
Plant Genetic Resources	USA	US\$27.95 M
Establishment & Assistance to the Wildlife Institute of India.	UNDP	US\$1.95 M
		US\$0.47 M
Maharashtra Forestry	World Bank	US\$124 M equiv.

Category: *Incentives for Community Collaboration*

Government Objectives/Programs:

Biodiversity protection within multiple use areas. Increase community participation in forest management through joint forest management programs. These programs emphasize government and local collaboration in designing inputs into sustainable land practices, alternative income generating initiatives, rural cottage industries and marketing strategies.

Donor Agency Support

Project	Donor	Funding
<i>Eco-development</i>		
Support to Indian NGOs	Sweden (SIDA)	US\$0.4 M equiv.
Support to N I Vavilov Research of the MS Swaminathan Research Foundation	Sweden (SIDA)	US\$0.15 M equiv.
Western Ghats Forestry	British-ODA	£23.19 M(US\$37.5 M equiv.)
Changar Integrated Forestry	Germany	DM 8.5 M (US\$11.6 M equiv.)
Andhra Pradesh - Agro Forestry	Canada	C\$4.87 M(US\$6.63 M equiv.)
Wildlife Management and Eco-development Capabilities	UNDP	US\$1.4 M
Andhra Pradesh Forestry	World Bank	US\$77.4 M equiv.
Forestry Research Edu.and Extension	World Bank	US\$47.0 M equiv.
Maharashtra Forestry	World Bank	US\$124.0 M equiv.
Madhya Pradesh Forestry	World Bank	US\$58.0 M equiv.
West Bengal Forestry	World Bank	US\$34.0 M equiv.



Category: *Research/Education*

Government Objectives/Programs:

Conduct research to evaluate ecological importance, biotic potential, conservation value of wetlands, mangroves and coral reefs and disseminate conservative education; conduct natural resources accounting studies for coral reefs, forests, mangroves, wetlands, protected areas and biodiversity; initiate research on cultivation of commercially valuable wild plants; conduct research on various species of domesticated animals for conservation of traditional domesticated species, many of which are being replaced by modern hybrid breeds; encourage research and development on bio-energy programs such as high density energy plantations and efficient fuel wood use systems by institutionally strengthening the Indian Council of Forestry Research and Education, Dehradun; and encourage networking of the Zoological Survey of India (ZSI) and Botanical Survey of India (BSI) with universities and other nongovernmental organizations.

Donor Agency Support

Project	Donor	Funding
<i>Forestry/Plant Research</i>		
Support to N I Vavilov Research of the MS Swaminathan Research Foundation	Sweden (SIDA)	US\$0.15 M equiv.
Plant Genetic Resources	USA	US\$27.95 M
Andhra Pradesh Forestry	World Bank	US\$77.4 M equiv.
Forestry Research Education and Extension	World Bank	US\$47.0 M equiv.
Madhya Pradesh Forestry	World Bank	US\$58.0 M equiv.
West Bengal Forestry	World Bank	US\$34.0 M equiv.
<i>Forestry Education, Training and Extension</i>		
Indira Gandhi Conservation Monitoring Center	British-ODA	£95,000 (US\$0.15 M equiv.)
Forestry Research Education and Extension (FREEP)	World Bank	US\$47.0 M equiv.



World Bank Support

- Project:** **Andhra Pradesh Forestry**
- Fiscal Year:** 1994
- Loan/Credit Amount:** IDA—US\$77.4 million (equivalent)
- Description:** Finance a six year program to support :
- (a) *Regenerating or afforesting degraded forest areas* with multitier coverage under participatory management arrangements with local populations; plantation forestry including silvicultural operations on teak plantations; and expanding community and farm forest coverage.
 - (b) *Alleviation of poverty* through employment and sustainable forest benefits targeted to fringe forest dwellers, tribals and small farmers.
 - (c) *Special action programs* geared to improve forestry research and plant propagation, support the joint forest management process through training and some funding to NGOs, improve biodiversity conservation and protected areas management, undertake collaborative fodder development with the Forest Department and other organizations, and a tribal development plan.
 - (d) Buildings, vehicles, equipment, training studies, incremental staff and operating costs for the forest administration.
- Project:** **Forestry Research Education and Extension**
- Fiscal Year:** 1994
- Loan/Credit Amount:** IDA—US\$47.0 M (equivalent)
- Description:** To be implemented over five years and cover the following:
- (a) *Research management* based on the development of Indian Council of Forestry Research and Education (ICFRE) to improve the management and coordination of forestry research and extension, through staff training, studies and consultancies to develop priority setting methodologies and a management information system, and provision of a headquarters, building and equipment.
 - (b) *Research program support* providing necessary infrastructure, equipment and operating expenses for selected research programs in ICFRE institutes, the establishment of a research



- grant fund to commission research by public and private sector agencies, measures to improve the quality of planting stock, human resource development through staff training, scientific review of institutes and programs, and the improvement of library and information systems and statistical services.
- (c) *Forestry education* involving the development and validation of forestry curricula in formal education through provision of funds for review and revision work, and development of the Deemed Forestry University at DehraDun.
 - (d) *Forestry policy and preparation* which would strengthen capabilities within the MOEF for the analysis of forest policies and preparation of future forestry projects through staff training and provision for studies and consultancies.
 - (e) *Conservation of biodiversity* which would support development of programs for eco-development around two protected areas, by involving communities in the planning and implementation of programs for creation of alternative natural or social resources or for income generation. Concurrent improvements in the planning and management of the protected areas would also be financed. The project would support research and monitoring and evaluation programs.

Project:	Madhya Pradesh Forestry
Fiscal Year:	1995
Loan/Credit Amount:	IDA—US\$58.0 million (equivalent)
Description:	The main objective of the project would be to assist with the implementation of the Government of Madhya Pradesh's strategy for development of the forestry sector in Madhya Pradesh. The most important strategy under the project would be the attempt to rationalize and improve management of villagers' forest usage activities, through encouragement of more sustainable forest management strategies and by replacement of the Madhya Pradesh Forest Department's existing command and control style of management with a more participatory approach. The project will be consistent with the national strategy for forest management, protection and biodiversity conservation, addressing eight priority regions: afforestation and wasteland development, demand management to improve protection of newly afforested areas/areas undergoing natural regeneration, development programs for pasture regeneration, extension support services for agro forestry, developing a detailed listing of fauna of ecologically important locations,



research on cultivation of commercially valuable plants, establishment of farms for medicinal plants, and support for ex-situ conservation.

- Project:** Maharashtra Forestry
Fiscal Year: 1992
Loan/Credit Amount: IDA—US\$124.0 million (equivalent)
Description: Project to undertake sector reforms through:
- (a) *Reorganization of the public forest administration* and seeking a more active role of the NGOs, village panchayats, cooperatives and the private sector in the development of the sector.
 - (b) *Improvements of the state's technical capability* particularly in the field of seed production, genetic planting material, nursery and planting practices and planning, and management, including monitoring of the forest resource base and training.
 - (c) *Rationalization of the policies and regulations* constraining the sector. The project would also support five discrete investment activities related to land treatment:
 - (i) Village eco-development and joint management.
 - (ii) Rehabilitation of wasteland and degraded lands.
 - (iii) Production forestry.
 - (iv) Biodiversity conservation.
 - (v) Pasture and fodder development.

- Project:** West Bengal Forestry
Fiscal Year: 1992
Loan/Credit Amount: IDA—US\$34.0 M (equivalent)
Description: Finance a five-year program to support:
- (a) *Forestry works* consisting of regenerating or afforesting degraded forest areas with multitier coverage under joint management arrangements with local populations; plantation forestry; strip plantations; and expanding farm forest coverage. Provisions are also made for some ongoing forestry development works.
 - (b) *Supporting works* including survey and demarcation of forest land, roads, small earthen dams, ponds and wells.
 - (c) *Special action programs* geared to improve forestry research and plant propagation, train all forestry staff, support the joint management process through training and funding to



NGOs, improve wild life and protected areas management, and afforest or rehabilitate mangrove areas.

- (d) Buildings, vehicles, equipment, incremental staff and operating costs for the Forest Department.
- (e) *Fodder development* in forest and nonforest areas with the Forest Department and the Animal Resources Development Department.



Other Donor Support

- Project:** **Tamil Nadu Social Forestry**
Donor: Sweden (SIDA)
Loan/Credit Amount: SK313 million
Description: Creation of productive resources and ecological restoration and employment generation.
- Project:** **Orissa Social Forestry**
Donor: Sweden (SIDA)
Loan/Credit Amount: SK263 million
Description: Creation of productive resources and ecological restoration.
- Project:** **Support to N I Vavilov Research of the M.S. Swaminathan Research Foundation**
Donor: Sweden (SIDA)
Loan/Credit Amount: US\$150,000 equivalent
Description: Community involvement in the conservation and sustainable management of biodiversity.
- Project:** **Support to Indian NGOs**
Donor: Sweden (SIDA)
Loan/Credit Amount: US\$400,000 equivalent
Description: To establish the viability and cost effectiveness of new approaches to sustainable land forests management, including joint forest planning and management in Kullu and Mandi districts and their potential replicability elsewhere in Himachal Pradesh.
- Project:** **Indira Gandhi Conservation Monitoring Centre**
Donor: British-ODA
Loan/Credit Amount: £95,000
Description: This is to be a national center for the collation and dissemination of data and information relating to biodiversity and conservation management in India.
- Project:** **Changar Integrated Forestry Project**
Donor: Germany
Loan/Credit Amount: D.M. 8.5 million



Description : The project aims to narrow considerably the existing gap between biomass production and its consumption and improve the living conditions of the people by bringing about behavioral change in the use of natural resources through a social development approach with the help of governmental and nongovernmental organizations.

Project: **Agro-forestry Phase II (Andhra Pradesh)**

Donor: Canada

Loan/Credit Amount: C\$4.87 million

Description: Reduction of environmental degradation through community-based forestry conservation.

Project: **Plant Genetic Resources**

Donor: USA

Loan/Credit Amount: US\$18.70 million

Description: Strengthen the National Bureau of Plant Genetic Resources and improve its capability to play a more effective role in scientific conservation and sustainable use at the national, regional and global levels. Major activities supported under the project include construction of four controlled-environment plant quarantine greenhouses at selected locations, procurement of modern scientific equipment, establishment of a data base network for global use, advanced training of scientists, provision of expert technical assistance and the carrying out of joint explorations and collaborative research in identified biodiversity areas of mutual Indo-U.S. interest.

Project: **Andaman & Nicobar Islands**

Donor: Netherlands

Loan/Credit Amount: US\$122,000 equivalent

Description: Identification of areas where biodiversity conservation is needed.

Project: **Strengthening Medicinal Plants Resource Base in South India**

Donor: Denmark

Loan/Credit Amount: DK 26.6 million equivalent

Description: Conservation of medicinal plants in Karnataka, Kerala and Tamil Nadu. Fifteen in-situ medicinal plants conservation areas, thirty ex-situ medicinal plants conservation parks, information network and medicinal plant data base.



- Project:** **Strengthening Wildlife Management and Eco-development Capabilities**
- Donor:** UNDP
- Loan/Credit Amount:** US\$1.4 million
- Description:** Develop management and eco-development planning capabilities within the central and state government agencies. This will ultimately lead to proper management-planning and implementation of eco-development plans around the national parks and wildlife sanctuaries, thereby minimizing the conflict between the wildlife and human beings.
-
- Project:** (a) **Assistance for the Establishment of the Wildlife Institute of India**
(b) **Assistance to the Wildlife Institute of India**
- Donor:** UNDP
- Loan/Credit Amounts:** (a) US\$1,949,848
(b) US\$470,915
- Description:** To strengthen the technical capability of the Wildlife Institute of India, Dehradun, in the field of wildlife biology, wildlife conservation and wildlife extension activities so as to enable it to act as a premier institution and to provide necessary training to forest officers in managing the national parks and wildlife sanctuaries in the country.

Chapter 3

Afforestation, Wasteland Development, and Conservation of soil and Moisture



Afforestation, Wasteland Development, and Conservation of Soil and Moisture

Restoration of Degraded Lands through Afforestation and Integrated Watershed Management

3.01 India's Environment Action Program recognizes that the improper use of land resources has created serious ecological and socioeconomic problems. Growing demand for fuel, wood, fodder, and food has depleted and even eliminated protective vegetative cover in many areas. As much as half the country's land area is subject to some form of degradation.

3.02 For years the government has emphasized tree-planting schemes as the principal mechanism for arresting and reversing land degradation trends. The government has set, and sometime achieved, ambitious targets for these schemes. Despite these achievements, some critics maintain that many wasteland reclamation programs amount to little more than temporary rural employment schemes. While tree-planting programs have provided some relief, there are doubts about the long-term sustainability of these schemes, and insufficient attention has been given to the monitoring and evaluation of plantation works (survival rates, productivity, and so on). Thus the long-term benefits of these schemes, both economically and ecologically, are poorly understood and are rarely used to evaluate the programs. The benefits of these schemes to individuals, local communities, and the nation are thus taken as a matter of faith.

3.03 The government is addressing the issue of wasteland reclamation and management through a number of related programs and investment projects. Numerous ministries and government agencies are responsible for these efforts. The results have been somewhat confusing, with programs overlapping as the government struggles to deal with different aspects of the wasteland restoration problem.

3.04 Efforts to develop wastelands through afforestation and integrated watershed management are based in the Ministry of Rural Development and the Ministry of Environment and Forests. The Ministry of Rural Development is home to the Department of Wastelands Development, the National Wastelands Development Board, the Drought-Prone Area Program, and the Desert Development Program. To address wastelands on forest department lands, the Ministry of Environment and Forests has established the National Afforestation and Ecodevelopment Board. This board is responsible for promoting afforestation, tree planting, ecological research, and ecodevelopment activities.

3.05 Attempts to measure the geographical extent of wastelands have been problematic. Many agencies collect information on wastelands, but only one comprehensive review of wastelands and their



potential has been carried out. In 1989 the National Wastelands Development Board commissioned a survey of wastelands in 186 of the most seriously affected districts. While this survey helped to determine the extent of wastelands, it has not been used to guide planning or to set priorities.

3.06 Other attempts to quantify wastelands have been carried out in the past fifteen years; a summary of these efforts appears in Table 3.1. The types of degraded land and their causal factors vary widely among regions (Table 3.2). The distribution

of degraded wasteland types at the national level is shown in Map 3.1.

3.07 Generalizations about the causes of wastelands often mask the complexities of local conditions. The main physical manifestations of degraded lands are the removal of topsoil through wind and water erosion and the gradual increase in the toxicity of root zones through salinization. Human land use practices also can accelerate the physical deterioration of the land, and differences in tenure arrangements significantly alter the ability of local communities to address land management

Table 3.1. Estimates of the Extent of Degraded Land in India

Estimated By	Area Considered Degraded (million hectares)	Comments
National Commission on Agriculture (GOI 1976)	175	Included in this figure are 85 million hectares of agricultural land, the degradation of which has been questioned by Bhumbla and Khare (1984).
Gadgil and others (1982)	88	These authors' breakdown is pasture, 12 million hectares; degraded forests, 36 million hectares; culturable waste, 17 million hectares; and fallows, 23 million hectares. They assumed that the entire area of culturable waste, fallows and pasture lands was degraded. Cultivated degraded lands were not considered in the estimate.
Bentley (1984)	115	This includes 15 million hectares of marginal agricultural lands and recently deforested forest lands.
Bhumbla and Khare (1984)	93	They considered only nonforest wastelands. Adding 36 million hectares of degraded forest area brings the total to 129 million hectares. The National Wastelands Development Board (NWDB) accepts this figure of 129 million hectares.
Vohra (1985)	103	The breakdown is forest land, 30 million hectares, and uncultivated land, 33 million hectares.
Khan (1987)	80	According to Khan, a forester working in the NWDB, this consists mostly of degraded forests and private marginal land.
World Bank (1988)	115-130	This includes 32-40 million hectares of degraded agriculture land. The rest of the breakdown is similar to that of Gadgil and others.

Source: Chambers, Saxena, and Shah 1989, in Molnar and Jenson, Campbell.



Map 3.1. Estimated Total Degraded Areas (SPWD 1989)



The boundaries, colors, denominations & any other information shown on this map do not imply, on the part of World Bank Group, any judgement or the legal status of any territory or any endorsement or acceptance of such boundaries

	State	Degraded Area (sq. km)		State	Degraded Area (sq. km)
1	Madhya Pradesh	201400	12	Haryana	24800
2	Rajasthan	199300	13	Himachal Pradesh	19600
3	Maharashtra	144000	14	Meghalaya	19200
4	Andhra Pradesh	114200	15	Assam	17300
5	Karnataka	91700	16	Jammu & Kashmir	15700
6	Uttar Pradesh	80600	17	Manipur	14400
7	Gujarat	78400	18	Nagaland	13900
8	Orissa	63800	19	Kerala	12800
9	Bihar	54600	20	Punjab	12300
10	Tamil Nadu	44000	21	Tripura	9700
11	West Bengal	25400	22	Sikkim	2800



Table 3.2. Summary of Land Degradation in India (sq. mi.)

State	Degraded Forest	Degraded Nonforest	Total Degraded	Nonforest Saline Area	Wasteland Subject to Water Erosion	Subject to Wind Erosion
Andman Islands	0	0	0	0	0	0
Andhra Pradesh	37,340	76,820	114,120	2,400	74,420	0
Arunachal Pradesh	0	0	0	0	0	0
Assam	7,950	9,350	17,300	0	9,350	0
Bihar	15,620	38,960	54,580	40	38,920	0
Gujarat	6,830	71,530	78,360	7,040	52,350	0
Haryana	740	24,040	24,780	5,260	2,760	15,990
Himachal Pradesh	5,340	14,240	19,580	0	14,240	0
Jammu and Kashmir	10,340	5,310	15,650	0	5,310	0
Karnataka	20,430	71,220	91,650	4,040	67,180	0
Kerala	2,260	10,530	12,790	160	10,370	0
Madhya Pradesh	71,950	129,470	201,420	2,420	127,050	0
Maharashtra	28,410	115,600	144,010	5,340	110,260	0
Manipur	14,240	140	14,380	0	10	0
Meghalaya	11,030	8,150	19,180	0	8,150	0
Mizoram	0	0	0	0	0	0
Nagaland	8,780	5,080	13,860	0	5,080	0
Orissa	32,270	31,570	63,840	4,040	27,530	0
Punjab	790	11,510	12,300	6,880	4,630	0
Rajasthan	19,330	180,010	199,340	7,280	66,590	106,230
Sikkim	1,500	1,310	2,810	0	1,310	0
Tamil Nadu	10,090	33,920	44,010	40	33,880	0
Tripura	8,650	1,080	9,730	0	1,080	0
Uttar Pradesh	14,260	66,350	80,610	12,950	53,400	0
West Bengal	3,590	21,770	25,360	8,500	13,270	0
Total	331,740	927,960	1,259,700	66,390	727,140	122,220

Source: Society for Promotion of Wasteland Development 1989.



issues. Any long-term strategy to rehabilitate degraded lands will need to recognize the importance of developing technical, institutional, and policy options that recognize the physical and regional variation in degraded lands.

3.08 The government also has introduced an ambitious program to track forest land degradation at the national level. Using remote-sensing technology, the Forest Survey of India has executed four biennial "State of the Forest" surveys. These data provide a good indication of forest cover change. The latest report (1993) suggests that forest cover at the national level has stabilized, with a marginal (22 square kilometer) increase in total forest cover. Recent trends in forest cover are summarized in Table 3.3. Map 3.2 illustrates the distribution of forest cover at the national level in 1993.

3.09 This possible stabilization of forest cover should not lead to complacency on the government's part. Many of the changes in the estimates of forest cover result from

refinements in methodology and availability of data. And while the aggregate national picture may be stable, significant regional problems persist, particularly in the northeastern states. The remote-sensing surveys do not assess the qualitative aspects of the forest—especially the condition of the understory, which is vital to the long-term condition of forests. The surveys also do not gauge the relative value of the forests with respect to different use options, such as commercial timber production, village forest production, wildlife conservation, watershed management, and plantation site suitability.

3.10 Finally, the State of the Forest reports do not quantify forest resource deficits at the local level. The conclusions of the reports seem inconsistent with operational field experience, which suggests that hundreds of Indian villages are incapable of meeting basic fuel, fodder, and timber supply due to lack of quality forests. Efforts should be made to reconcile the contradictions between the field-based surveys and the remote-sensing surveys.



Table 3.3. Summary of Forest Conditions in India (sq. km.)

State	State Area (Administrative)	Forest Area 1989	Dense Forest 1989	Open Forest (Actual 1989)	Forest Area (Actual 1991)	Forest Area 1993	Dense Forest 1993	Open Forest 1993	Man-grove 1993	Forest Area (Actual 1993)
Andaman Islands	8,290	7,171	6,518	133	7,624	7,622	6,567	91	966	7,624
Andhra Pradesh	276,820	63,726	25,535	21,971	47,911	47,290	25,008	21,870		47,256
Arunachal Pradesh	83,580	51,540	54,272	14,491	68,763	68,757	54,510	14,151		68,661
Assam	78,520	30,708	15,688	9,370	26,058	24,751	15,998	8,510		24,508
Bihar	173,880	29,230	13,412	13,522	26,934	26,668	13,172	13,415		26,587
Goa	3,810	1,256	975	322	1,300	1,225	995	249	3	1,247
Gujarat	195,980	19,388	5,259	5,999	11,670	11,907	6,301	5,324	419	12,044
Haryana	44,220	1,685	130	433	563	513	329	184		513
Himachal Pradesh	55,670	37,591	7,100	6,277	13,377	11,780	9,565	2,937		12,502
Jammu and Kashmir	222,240	20,174	10,824	9,600	20,424	20,064	10,953	9,490		20,443
Karnataka	191,770	38,644	247,490	73,510	32,100	32,199	24,852	7,491		32,343
Kerala	38,870	11,222	8,312	1,837	10,149	10,292	8,421	1,915		10,336
Madhya Pradesh	442,840	155,414	91,448	41,743	133,191	135,785	95,537	39,859		135,396
Maharashtra	307,760	63,861	26,177	17,767	44,058	44,044	25,688	18,024	155	43,859
Manipur	22,360	15,155	5,060	12,825	17,885	17,685	5,307	12,314		17,621
Meghalaya	22,490	9,496	3,427	12,263	15,690	15,875	3,305	12,464		15,769
Mizoram	21,090	15,935	3,883	14,295	18,178	18,853	4,238	14,459		18,697
Nagaland	16,530	8,625	4,632	9,724	14,356	14,321	3,487	10,861		14,348
Orissa	155,780	59,555	27,561	19,384	47,137	47,205	27,151	19,799	195	47,145
Punjab	50,360	2,842	97	1,064	1,161	1,343	481	862		1,343
Rajasthan	342,210	31,559	2,902	10,064	12,966	12,835	3,581	9,518		13,099
Sikkim	73,000	2,650	2,410	714	3,124	3,033	2,395	724		3,119
Tamil Nadu	130,070	22,699	9,759	7,909	17,715	17,713	9,422	8,283	21	17,726
Tripura	10,480	6,292	1,214	4,111	5,325	5,535	1,819	3,719		5,538
Uttar Pradesh	294,411	51,502	22,632	11,212	33,844	33,609	22,965	10,966	2,119	36,050
West Bengal	87,850	11,879	3,332	2,953	8,394	8,015	3,362	2,705		6,067
Total	3,350,881	769,779	600,049	323,493	639,919	638,919	385,401	250,184	4,256	639,841



Map 3.2. Actual Forest Cover (sq. km.)



The boundaries, colors, denominations & any other information shown on this map do not imply, on the part of World Bank Group, any judgement or the legal status of any territory or any endorsement or acceptance of such boundaries

	State	Actual forest cover (sq. km.)		State	Actual forest cover (sq. km.)
1	Madhya Pradesh	135369	14	Nagaland	14348
2	Arunachal Pradesh	68661	15	Rajasthan	13099
3	Andhra Pradesh	47256	16	Himachal Pradesh	12502
4	Orissa	47145	17	Gujarat	12044
5	Maharashtra	43859	18	Kerala	10336
6	Uttar Pradesh	36050	19	Andaman Islands	7624
7	Karnataka	32343	20	West Bengal	6067
8	Assam	24508	21	Tripura	5538
9	Jammu & Kashmir	20443	22	Sikkim	3119
10	Mizoram	18697	23	Bihar	2658
11	Tamil Nadu	17726	24	Punjab	1343
12	Manipur	17621	25	Haryana	513
13	Meghalaya	15769			

Source: MOEF 1993.



Afforestation and Wastelands Reclamation of Nonforest Lands

3.11 Strategies for wastelands development have evolved considerably in recent years. While most schemes still emphasize tree planting as the preferred treatment, government programs are beginning to address other technical possibilities as well as alternative sources of income generation as part of their wastelands development strategies.

3.12 There is a widespread recognition that achieving sustainable wastelands reclamation and afforestation programs will require solving the underlying economic and social concerns of individuals and communities. The government has endorsed community participation in setting objectives and implementing programs as an important component of wastelands restoration programs. NGOs and voluntary organizations figure prominently in current strategies to address wasteland issues. In addition, the government now endorses the concept of integrated planning and management of wastelands reclamation using micro-watersheds (about 500 hectares) as the preferred unit of program implementation.

ISSUES IN WASTELANDS DEVELOPMENT

3.13 Programs to restore and manage degraded lands have struggled with a number of constraints. These issues comprise a range of institutional, technological, and sociological problems that have undermined the sustainability of investments in wastelands development.

Institutional issues

3.14 Government schemes to rehabilitate degraded public lands outside forest estates fall within the jurisdictions of village panchayat authorities, common lands under customary group tenure, lands managed by road and railway authorities, and lands loosely administered by the district collector.

3.15 Reforestation and wasteland reclamation schemes have experimented with a number of institutional strategies for developing revenue lands. These usually involve transfer to panchayat bodies under tree tenure schemes such as panchayat woodlots. All have proved problematic due to conflicts over competing land claims. The tenure arrangements on revenue lands often are complex and may be understood differently by different users.

3.16 Government programs addressing wastelands reclamation through afforestation and watershed management on nonforest lands have encountered problems. These include unclear institutional responsibilities, and unclear administrative procedures for investment planning, monitoring, and evaluation. The operational management of land reclamation schemes, especially watershed projects, has experienced problems due to clashes between line agencies and the lack of coordination of work programs.

3.17 Each agency approaches the problem of wasteland development from its own perspective. Programs such as the



Drought-Prone Area Program (DPAP), the Desert Development Program (DDP), and the National Watershed Development Program in Rainfed Areas have developed guidelines for land restoration and conservation that reflect their individual objectives and criteria. While the geographic focus of these programs varies, the processes by which management plans are developed and implemented are quite similar.

3.18 While the government recognizes the importance of NGOs in the process of land reclamation and restoration, few NGOs with appropriate technical skills, operational experience, and the ability to service large areas have been identified. Many NGOs, though skilled at motivating communities, are less adept at the technical aspects of land reclamation. In addition, current models of participatory planning require large numbers of staff both from the government and from the NGO community. The sheer area of wastelands to be reclaimed and the number of villages to be coordinated will continue to strain the already limited sources of experienced personnel.

Technological issues

3.19 Several problems have emerged with respect to the technical aspects of wastelands reclamation. While operational expediency, quality control, and extension services are greatly improved if a limited number of well-understood technologies are promoted—the government's approach thus far—the wide range of agroecological conditions found in India makes it impossible to develop a common technical package for wasteland development. Despite these variations, there is still a tendency to take a top-down approach to planning, with line agencies dictating the range of technical

options to be implemented.

3.20 As noted at the outset, wasteland development programs tend to be one-dimensional, focusing on tree-planting activities. The technologies proposed for reforesting wastelands often reflect a limited knowledge of local conditions and tend to stress well-known, commercial tree species. In addition, the technical models offered to local communities were developed as production forest plantation models and rarely match community development needs. Initiatives that are poorly matched to local needs and conditions are not fully accepted or adequately maintained.

3.21 The issue of quality control in nurseries and quality assurance for planting stock will continue to plague afforestation efforts. In general, the links between the regional research centers and the implementing agencies are poor. In recent years there has been a move away from engineering approaches to soil and water conservation toward vegetative approaches. Field experience suggests that such combinations of technologies often are appropriate and should be explored during project design.

Economics and sustainability

3.22 The related issues of economics, replication, and sustainability of wasteland reclamation and watershed management efforts are poorly understood. Wastelands restoration schemes historically have been regarded as rural employment programs rather than as programs with intrinsic ecological merit. While these schemes have emphasized equity concerns, they have made little effort to quantify the costs and benefits of specific project investments. Restoration efforts tend



to be evaluated in terms of physical achievements rather than rates of adoption. Limited information is available on the performance of restoration investments, which makes it difficult to say whether the government should continue to invest in these programs.

3.23 The government recognizes that past initiatives have failed to meet physical and financial targets. Individuals and communities will support restoration and conservation efforts only if a clear link to increased productivity can be demonstrated. Sustainability also is linked to effective participation and clear rules on benefit-sharing.

GOVERNMENT INITIATIVES

3.24 In 1985 the National Wastelands Development Board was established within the Ministry of Environment and Forests to promote the reforestation of India's wastelands. In 1992 the board was made a part of the Department of Wastelands Development within the Ministry of Rural Development. The board continues to have a mandate to promote programs and approaches for developing wastelands in nonforest areas. The Department of Wastelands Development is also responsible for the National Land Use and Wastelands Development Council; for promoting rural development through wastelands development; for promoting fuel, fodder, and timber production on nonforest lands, including private wastelands; for research and development of low-cost technologies; for coordinating interdepartmental and interdisciplinary programs; and for promoting participation and public cooperation. As part of these roles, the department oversees a number of schemes and

initiatives.

Integrated Wastelands Development Program

3.25 The IWDP under implementation since 1989, promotes an integrated approach to wastelands development on micro-watersheds. The plans are based on intensive community participation and promote soil and moisture conservation, natural regeneration of village common lands, afforestation and agroforestry on private lands, pasture improvement, and local institution-building.

3.26 About 65 percent of the Department of Wastelands Development's 1993 budget of Rs. 25 crores was allocated to these schemes. By end-1993 about fifty such projects had been implemented nationwide. These projects address wasteland development on a watershed basis; the average watershed size is about 500 hectares. The 1994 program funded an additional seventeen schemes. Rs.40.72 crores were allocated under the 1994 budget to cover about 44,000 hectares of wasteland reclamation.

3.27 One of the program's recent objectives is to encourage projects that are more responsive to local needs. To this end the program is promoting the establishment of state-level steering committees to monitor progress, ensure the timely flow of funds to the project sites, and improve interdepartmental coordination. Many states, however, are finding it difficult to establish state committees because of vertical administrative structures that effectively inhibit coordination between the various agencies dealing with agriculture, land use planning, soil conservation, forestry, and economics. Experience from the Bank's pilot project for rainfed agriculture indicates that it can take as long



as five years to establish these committees. Where committees have been established, most seem ineffective.

3.28 To ensure a more consistent approach to the design and implementation of wasteland rehabilitation schemes, the Ministry of Rural Development has published *Guidelines for Watershed Development* (MRD 1994). This document provides a comprehensive reference on micro-watershed development. The guidelines emphasize the organizational and institutional aspects of watershed management, explicitly specifying the roles of Zila Parishads/District Rural Development Authorities (DRDAs), project implementing agencies, Panchayati Raj organizations, watershed development teams, watershed associations, and watershed development committees.

3.29 The guidelines also cover technical and administrative aspects of watershed development, including local design criteria; criteria for selection of participant villages; establishment of users groups; recommended institutional arrangements at the state, district, and village levels; development of watershed plans; and requirements for investment monitoring and evaluation.

3.30 While these guidelines endorse a common set of operational objectives, strategies, and financial planning norms, they are not restrictive in terms of the treatment models or technical solutions that may be applied in a given situation. In addition to traditional afforestation and nursery activities, the guidelines promote a range of technical approaches that are eligible for program funding, including in situ soil and moisture conservation, drainage line treatments, water harvesting, basic surveys, and pasture development. The guidelines stress flexibility

in both the technical approach and the institutional and management arrangements based on local conditions and constraints.

3.31 With regard to institutional support and funding, the guidelines endorse the concept of mutually exclusive watershed development programs. Thus, rather than trying to coordinate activities among the DPAP, DDP, IWDP, and other schemes, individual watersheds would be developed under only one scheme. This will reduce confusion over responsibilities and will help to eliminate conflicts over the channeling of funds. Predefined cost limits are avoided in the guidelines, but there are suggested expenditures on such items as treatment (80 percent), administrative overhead (10 percent), community organization (5 percent), and training (5 percent).

Grants-in-aid scheme

3.32 The grants-in-aid scheme is designed to promote NGO involvement in wastelands development. NGOs and voluntary organizations receive 100 percent funding to promote wastelands development programs. Activities eligible for funding under this scheme include nursery improvement, soil and moisture conservation, plantation work, and public awareness campaigns. In 1993–94 the budgetary allocation for the grants-in-aid scheme was about Rs.3 crores, an increase over the previous year's budget of Rs.85 lakhs.

Communication, education, and public awareness

3.33 The department continues to be active in raising public awareness through publications, public service films on wasteland development, media outreach, NGO field trips, and conservation awards in recognition of innovative and outstanding work.



New initiatives

3.34 The Ministry of Rural Development has proposed a number of schemes. These include investment promotion schemes, formulation of a wastelands development task force, establishment of a unit for promotional and critical support services, and an initiative to improve program appraisal, monitoring, and impact evaluation. New technical initiatives would expand the technological packages beyond tree-planting efforts to include other productive investments, such as promotion of jojoba plantations in arid and semi-arid regions. In addition, investments in cashew and tea plantations are being considered.

BANK INVOLVEMENT IN WASTELANDS DEVELOPMENT

3.35 The World Bank's agricultural portfolio historically has included investment projects that focus on land management. The Bank's operational experience in soil and moisture conservation dates to 1980 and has included efforts in a number of agroclimatic conditions throughout India. The principal counterpart in these efforts has been the Ministry of Agriculture, although recent watershed projects have required the involvement of numerous agencies at the state, local, and central levels.

3.36 In recent years the Bank has discouraged engineering approaches to soil conservation in favor of approaches stressing vegetative control technologies. Experiences generally have been positive, although numerous operational problems have emerged (see below). The Bank's recent operational

experiences in this field include:

- Himalayan Watershed Management Project (closed in 1992).
- Pilot Project for Watershed Development in Rainfed Areas (completed in 1993).
- Integrated Watershed Development Project (hills and plains).
- Uttar Pradesh Sodic Lands Reclamation.

3.37 The Bank's projects have contributed to the government's understanding of the organizational, technical, institutional, and sustainability issues involved in wastelands reclamation and micro-watershed development. Watershed projects have been more effective at achieving physical targets than at meeting major institutional or sustainability objectives. In general, it has been difficult to quantify the benefits of micro-watershed treatments.

WORK OF INTERNATIONAL DONORS

3.38 Financial assistance from the international community has not been a major source of program funding for wastelands development schemes within the Ministry of Rural Development. In fact, no program was identified as receiving external assistance. Wastelands development projects are, however, being implemented through the Ministry of Environment and Forests. For example, the Swedish International Development Agency is funding an Integrated Wastelands Development Project in Rajasthan through the MOEF, and the European Union is funding a project for the rehabilitation of common lands in the Aravallis in Haryana.



Afforestation and Wastelands Reclamation of Forest Lands

3.39 Despite a long tradition of managing public forest lands, degradation and declining institutional capacity are evident throughout India. Controlling this degradation will be impossible without significant changes in the performance of the forestry sector. The government recognizes the growing pressures on forest resources and is seeking ways to manage them in a more sustainable manner. There is general awareness that the problems confronting the sector are not primarily technical, but are social, economic, and political.

ISSUES IN FORESTRY MANAGEMENT

3.40 Two major explorations of the issues confronting forestry management have been completed: the World Bank's 1993 Forest Sector Review and the Government of India's National Forestry Action Program. These reviews conclude that the most important issues facing the sector relate to the incentives for local participation and private development, the quality and performance of investments, the effectiveness of public sector forest protection and management, and the areas for future development. Now that these problems have been defined, there must be consensus on how and when they will be solved.

LEGAL AND INSTITUTIONAL FRAMEWORK

3.41 Legislation governing forestry management has been introduced at the central and state levels. The principal central acts are the 1927 Indian Forest Act, the 1980 Forest

Box 3.1. Forest (Conservation) Act, 1980 and 1988 Amendments

The act provides for the conservation of forests and matters related to the same. It calls for restrictions on the dereservation of forests or use of forest land for non-forest purposes i.e. the clearing of any forest land for the cultivation of tea, coffee, spices, rubber, palms, oil-bearing plants, horticultural crops or medicinal plants, or any purpose other than reforestation. It also provides for the constitution of advisory committees and outlines the jurisdictions of government departments and provides the central government with power to make rules for carrying out the provisions of the act.

Source: Desai 1994; GOI, Ministry of Environment and Forests, Forest Conservation Act, 1980, Rules and Guidelines.

Act and the 1988 Forest Amendment Act (Box 3.1), the 1972 Wildlife Act, and the 1986 Environment Act.

3.42 These acts are supplemented by the 1988 National Forest Policy (Box 3.2). The policy sets a goal of having one-third of the country's total area under forest or tree cover. There has been considerable debate about whether this target—which would total 100 million hectares—is realistic. Some analysts (Molnar, Jansen, and Campbell 1995) argue that only about 74 million hectares of India's land base can be realistically developed as a productive forest or silvo-pastoral resource. The policy also recommends maintaining two-thirds of hilly and mountainous regions under forest cover.

3.43 One of the most significant aspects of the policy is its emphasis on a massive people's movement for achieving forest



Box 3.2. National Forest Policy, 1988

The National Forest Policy focused on a new strategy of forest conservation which included preservation, maintenance, sustainable utilization, restoration and enhancement of the natural environment. The following are the objectives governing the forest policy:

- Maintenance of environmental stability through preservation and where necessary, restoration of the ecological balance that has been adversely distributed by serious depletion of the forests of the country.
- Conserving the natural heritage of the country by preserving the remaining natural forests with the vast variety of flora and fauna, which represent the remarkable biological diversity and genetic resources of the country.
- Checking soil erosion and denudation in the catchment areas of rivers, lakes, and reservoirs in the interest of soil and water conservation, for mitigating floods and droughts, and for the retardation of siltation of reservoirs.
- Checking the extension of sand dunes in the desert areas of Rajasthan and along the coastal tracts.
- Increasing substantially the forest tree cover in the country through massive afforestation and social forestry programs, especially on all denuded, degraded and unproductive lands.
- Meeting the requirements of fuelwood, fodder and minor forest produce and small timber of the rural and tribal populations.
- Increasing the productivity of forests to meet essential national needs.
- Encouraging efficient utilization of forest produce by maximizing substitution of wood.
- Creating a massive people's movement with the involvement of women, for achieving these objectives and to minimize pressure on existing forests.

In addition, the policy outlines the essentials of forest management, strategies of afforestation, social forestry and farm forestry, wildlife conservation, forest-based industries, and forest education and research.

Source: GOI, Ministry of Environment and Forests, National Forest Policy, 1988.

management objectives. A major shift from the traditional approach to forest management came in 1990 when the Ministry of Environment and Forests ordered State Forest Departments to involve village communities and voluntary agencies in the regeneration of degraded forest lands. This resolution suggests a flexible approach to collaborative management and stresses that no restrictions should be placed on membership in village committees. The resolution also suggests that communities be given rights over timber and nontimber products, that communities be involved in developing working plans, and that communities help to protect forests from illegal forest practices. At least fourteen state governments have approved resolutions enabling forest-dependent communities and the State Forest Departments to experiment with collaborative forest management.

3.44 Experience with joint forestry management has had favorable results. Still, a number of important issues need to be worked out. These include the relationship of village committees to local government, resolution of the long-term rights of participating communities, clarification of the legal authority of community management programs, provisions for extending membership in village committees, resolution of pre-existing user rights in forest areas, overreliance of user groups on forest departments, and clarification of the role of women.

GOVERNMENT PROGRAMS

3.45 The Government of India continues to make progress toward achieving its environmental objectives for the forest sector (Box 3.3). The Ministry of Environment and Forests has prepared a National Forestry Action Program based on the forestry action



Box 3.3. India's Initiatives in Implementation of the Principles of the National Forest Policy

Initiatives Relating to National Policies and Programs

- Adoption of the National Conservation Strategy in 1992.
- Eighth Five-Year Plan provides for conservation, development and sustainable management of existing resources and eco-restoration of degraded lands.
- The National Ecodevelopment and Afforestation Board and National Wastelands Development Board involve women, farmers, tribals.
- The National Forestry Action Program prepared in line with the National Forest Policy. It emphasizes the critical role played by forests in environmental protection and social and economic development.
- Scheme launched by the government in 1992 to associate tribals and rural poor in regeneration of degraded forests on usufruct sharing basis with the aim of improving the biomass resource base in degraded forests and providing gainful employment.
- Guidelines for Joint Forest Management make women's participation in executive committees mandatory.
- Appropriate methodologies for the realistic valuation of forestry goods are being employed.
- Forest management strategy focuses on conservation of the existing natural forests with emphasis on natural generation, development of degraded forests, and afforestation in nonforest lands including agro-forestry on private lands.
- Increasing attention being given in various afforestation programs to plantation of indigenous species.
- Ecodevelopment programs being expanded.
- A network of protected areas including national parks, sanctuaries and biosphere reserves has been developed.

Initiatives Relating to Information Sharing

- Environmental Information Service is being networked with national and international institutions.
- The Indian Council of Forestry Research and Education (ICFRE), Wildlife Institute of India, Indian Plywood Industries Research Institute, Center for Environment Education, state forest departments, and state agricultural universities all carry out forestry-related research.
- Indian foresters and forestry scientists regularly attend educational and training institutions throughout the world for skill updating.

Initiatives Relating to Strengthening of Institutional Capabilities

- ICFRE provides financial support to universities for strengthening forestry faculties.
- The Forest Survey of India, the Wildlife Institute of India, Dehradun, and the Indian Institute of Forest Management being strengthened by staff training, course content revision, and research.

Initiatives Relating to Planted Forests

- Indigenous and exotic species are being planted in production forestry programs.
- Massive programs of afforestation and tree planting, with an emphasis on fuelwood and fodder development on all degraded and denuded lands in the country, as well as discouraging monoculture on all unutilized lands whether forest or nonforest, have been identified as a national imperative.

Initiatives Relating to Trade and Tariffs on Forest Products

- The National Forestry Action Program identifies aspects of marketing and processing of forest products to be comprehensively analyzed and lead to better strategies.

Initiatives Relating to International Initiatives

- Cooperation with Food and Agricultural Organization, United Nations Environment Program, United Nations Development Program, International Trade Organization and other international organizations.
- Ensuring technology transfer.



plans for every state in the country. The national plan has been undertaken with financial support from the United Nations Development Program and with technical assistance from the Food and Agricultural Organization. In addition to the state reviews, sixteen national studies have been carried out dealing with a variety of thematic issues, including agroforestry, rural sociology, market analysis, seed technology, and pasture and fodder development.

THE NATIONAL AFFORESTATION AND ECODEVELOPMENT BOARD

3.46 The National Afforestation and Ecodevelopment Board was established to promote wastelands reclamation on forest lands. To this end, the board has instituted a number of programs, including the following:

- ❑ *Integrated afforestation and eco-development projects.* About 126 integrated watershed management projects promoting afforestation of degraded forest lands covering 360,000 hectares are under implementation.
- ❑ *Fuelwood and fodder scheme.* This scheme augments fuel and fodder supply, as well as provides programs to manage demand in districts identified as having high-priority fuel and fodder deficits.
- ❑ *Raising minor forest produce.* About twenty-five projects covering about 44,120 hectares provide assistance to state governments for increasing minor forest products, including medicinal plants.
- ❑ *Grants-in-aid.* About 600 projects addressing tree planting have been funded under this scheme, which

encourages public involvement in project design and implementation. Funding is provided to NGOs and voluntary agencies working at the grassroots level.

- ❑ *Seed development schemes.* This program promotes higher-quality planting materials by developing facilities for the collection, testing, certification, storage, and distribution of seeds.
- ❑ *Aerial seeding.* This program supports efforts to regenerate inaccessible areas through airborne seeding systems.

BANK INVOLVEMENT

3.47 The World Bank has been the leader among international donors in funding for forest initiatives and has taken a leadership role in engaging the government in a dialogue on national forest sector reforms. In the past the Bank has provided substantial support to social forestry initiatives in various states. These projects focused on increasing the supply of fuelwood, timber, fodder, and minor forest products by establishing village woodlots and other plantations on government and village wastelands. The Bank's investment strategy has evolved in recent years to develop projects that address a wider range of forestry issues. The Bank is currently supporting five comprehensive state forestry projects (West Bengal Forestry, Maharashtra Forestry, Bihar Forestry, Andhra Pradesh Forestry, Madhya Pradesh Forestry). In 1993 the Bank completed a national forest sector review. Through its Forestry Research Education and Extension Project, the Bank is addressing forest research and education priorities. Global Environment Facility ecodevelopment projects are being prepared that address issues related to biodiversity conservation through improved



management of priority parks and protected areas.

WORK OF OTHER DONORS

3.48 Although a number of international donors are currently active in the sector, future support for forestry projects appears limited.

Donor support focuses on afforestation, on-site soil and moisture conservation, fuel-saving technologies, and management practices. About ten additional forestry projects have been identified for donor support, but no funding sources have been secured.



Major Issues and Recommendations

3.49 The Indian government is committed to addressing wastelands reclamation through afforestation and watersheds development. Several programs have achieved progress, both strategic and technical. As mentioned, the government's approach to wastelands reclamation is slowly evolving from a one-dimensional approach (tree-planting) to one using integrated watershed development. The current approach correctly stresses the need for community involvement in setting objectives, choosing technical design, performing implementation, and sharing benefits.

3.50 Still, there is scope for improving program performance. The two main weaknesses relate to the quality of afforestation works (nursery materials, survival rates, species selection, site analysis, site maintenance, extension, and training) and the incentives for long-term maintenance and sustainability of these works. The forestry sector does not require major new initiatives; rather, the government must do more to improve the effectiveness of policies and programs already in place. Programs should stress the quality of afforestation over the quantity of area planted. This, of course, implies some refinements—such as consolidating overlapping programs. The government is investing adequately in afforestation and watershed development efforts, but programs and policies must be reoriented to improve performance in key areas: institutional strengthening and policy

reform, technology development, and performance monitoring and evaluation.

INSTITUTIONS AND POLICIES

3.51 Institutional and policy weaknesses are inhibiting the development of sector resources and require strengthening and restructuring to promote growth. The government should remove disincentives to private investment in farm forestry, afforestation, and wastelands reclamation on private lands. Current models emphasizing government funding, technical input, and extension cannot be sustained on the scale required to have meaningful impact. Rules regarding tree tenure, harvesting of trees on private lands, transit regulations, and marketing restrictions must be revised if private investment in afforestation is to increase.

3.52 In addition, the government should continue to build on its relationships with NGOs and seek to develop partnerships. Expansion of the grants-in-aid schemes could help to increase the skills of NGOs and voluntary agencies. The government should encourage partnerships between NGOs with complementary skills. Efforts also should be made to increase the number of state and district-level agencies for wastelands reclamation. Finally, there should be better integration and coordination of inter-departmental programs, particularly watershed development programs.



TECHNOLOGY

3.53 New technology must be harnessed to enhance productivity. To this end, the government should continue to promote efforts that improve the quality of planting stock, including nursery and seed improvements. Programs also should emphasize planning to better match species with site characteristics. Such efforts will require improving the information base, both with respect to applied research and to the creation of data bases that target priority development areas. Research could be expanded to include horticulture planting schemes for shrubs and grasses, development and use of nontimber forest products, and rural income-generating schemes. Extension services could be expanded to private farmers interested in farm forestry. Finally, better technical models are needed for the development of restocking and enrichment planting of natural, secondary forests.

SUSTAINABILITY

3.54 More systematic efforts are

required to improve the monitoring and sustainability of afforestation schemes. The government has recognized the importance of these efforts but has achieved few results. Efforts should be made to demonstrate the economic benefits of afforestation and wastelands reclamation schemes. Lessons from watershed projects indicate that projects will be supported when there is a clear link between afforestation efforts and benefits. Where benefits are not clear or where use rights are poorly articulated, afforestation efforts are not sustained.

3.55 Sustainability will also be strengthened if the government continues to expand the experience base in participatory planning and beneficiary involvement. Although progress has been made, there is clearly more scope for involving beneficiaries in the process of wastelands reclamation. There is still a tendency for programs to be supply driven, especially regarding species choice and benefits sharing. This issue is key to the initial success and long-term sustainability of afforestation efforts.



GOI Program Objectives

Category: *Degraded forest lands development*

Government Objectives/Programs:¹

Besides tree planting as the preferred treatment, the GOI has strongly endorsed community participation in objective setting, program implementation and benefits sharing as an important component of all watershed restoration programs; identifying priority districts regarding fuel and fodder deficits; supporting efforts to augment fuel and fodder supply; providing assistance to state governments for increasing minor forest products; implementing a grants-in-aid scheme by providing funding to NGOs; promoting improved quality of planting material; and supporting efforts to regenerate inaccessible areas through airborne seeding systems.

Donor Agency Support

Project	Donor	Funding
<i>Integrated Afforestation by Watershed Development/ Management</i>		
Afforestation in Aravalli Hills	Japan (OECF)	US\$81 M equiv.
Forestry Dev. Rajasthan	Japan (OECF)	US\$42 M equiv.
Hyderabad Greenbelt	Netherlands	US\$2.67 M equiv.
Comprehensive Watershed Dev. Tamil Nadu (R)	Denmark	US\$4.0 M equiv.
Karnataka (D) Watershed Dev.	Denmark	US\$7.42 M equiv.
Comprehensive Watershed Dev. Koraput, Orissa	Denmark	US\$7 M equiv.
Watershed Dev. Maharashtra (Tech. Coop.)	Germany	US\$0.68 M equiv.
Watershed Dev. Karnataka	Germany	US\$27.4 M equiv.
Andhra Pradesh Forestry	World Bank	US\$77.4 M equiv.
West Bengal Forestry	World Bank	US\$34 M equiv.
Madhya Pradesh Forestry	World Bank	US\$58 M equiv.
<i>Fuelwood and Fodder Scheme</i>		
Afforestation & Pasture Dev. along Indira Gandhi Canal	Japan (OECF)	US\$79.0 M equiv.
Society for Promotion of Wasteland Development	Netherlands	US\$0.45 M equiv.
Andhra Pradesh Forestry	World Bank	US\$77.4 M equiv.
Maharashtra Forestry	World Bank	US\$124.0 M equiv.



Project	Donor	Funding
<i>Grants-in-Aid</i>		
Hyderabad Greenbelt	Netherlands	US\$2.67 M equiv.
Watershed Dev. Maharashtra (Tech. Coop)	Germany	US\$0.68 M equiv.
West Bengal Forestry	World Bank	US\$34.0 M equiv.
Maharashtra Forestry	World Bank	US\$124.0 M equiv.
<i>Seeds Development Schemes</i>		
Maharashtra Forestry	World Bank	US\$124.0 M equiv.

Category: *Wastelands development*

Government Objectives/Programs:

Promoting an integrated approach to wastelands development using micro-watershed as the primary unit of implementation; plans based on intensive community participation and promotion of in-situ soil and moisture conservation, natural regeneration of village common lands, afforestation and agroforestry on private lands, pasture improvement and local institution building. Grant-in-aid schemes designed to promote NGO involvement in wastelands development.

Donor Agency Support

Project	Donor	Funding
<i>The Integrated Wastelands Development Program</i>		
Dungarpur Integrated Wastelands	Sweden(SIDA)	US\$10 M equiv.
Rehabilitation of Common Lands in Aravallis	EU	US\$31.17 M equiv.
Hyderabad Greenbelt	Netherlands	US\$2.67 M equiv.
Society for Promotion of Wasteland Development	Netherlands	US\$0.45 M equiv.
Comprehensive Watershed Dev. Tamil Nadu (R) equiv.	Denmark	US\$4.0 M
Comprehensive Watershed Dev. Tamil Nadu (T)	Denmark	Phase I-US\$3.8M equiv. Phase II-US\$10.5 M equiv.
Maharashtra Forestry	World Bank	US\$124.0 M equiv.
Madhya Pradesh Forestry	World Bank	US\$58.0 M equiv.
Bihar Plateau Development	World Bank	US\$117.0 M equiv.
U.P. Sodic Lands Reclamation	World Bank	US\$54.7 M equiv.
Integrated Watershed Dev. Hills	World Bank	US\$75.0 M equiv.
Integrated Watershed Dev. Plains	World Bank	US\$55.0 M equiv.



Project	Donor	Funding
<i>Communications, Education and Public Awareness</i>		
Strengthening/Dev. of Indian Council of Forestry Research and Education	UNDP	US\$2.56 M equiv.
Andhra Pradesh Forestry	World Bank	US\$77.4 M equiv.
Maharashtra Forestry	World Bank	US\$124.0 M equiv.



World Bank Support

- Project:** **Andhra Pradesh Forestry**
- Fiscal Year:** 1994
- Loan/Credit Amount:** IDA—US\$77.4 M (equivalent)
- Description:** Finance a six-year program to support :
- (a) *Regenerating or afforesting degraded forest areas* with multitier coverage under participatory management arrangements with local populations; plantation forestry including silvicultural operations on teak plantations; and expanding community and farm forest coverage.
 - (b) *Alleviation of poverty* through employment and sustainable forest benefits targeted mainly to fringe forest dwellers, tribals and small farmers.
 - (c) *Special action programs* geared to improve forestry research and plant propagation, support the joint forest management process through training and some funding to NGOs, improve biodiversity and protected areas management, undertake collaborative fodder development with the forest department and other organizations, and a tribal development plan.
 - (d) Buildings, vehicles, equipment, training studies, incremental staff and operating costs for the forest administration.

- Project:** **West Bengal Forestry**
- Fiscal Year:** 1992
- Loan/Credit Amount:** IDA—US\$34.0 M (equivalent)
- Description:** Finance a five-year program to support:
- (a) *Forestry works* on consisting of regenerating or afforesting degraded forest areas over with multitier coverage under joint management arrangements with local populations; plantation forestry; strip plantations; and expanding farm forest coverage.
 - (b) *Supporting works* including survey and demarcation of forest land, roads, small earthen dams, ponds and wells.



- (c) *Special action programs* geared to improve forestry research and plant propagation, train all forestry staff, support the joint management process through training and funding to NGOs, improve wildlife and protected areas management, and afforest or rehabilitate mangrove areas.
- (d) Buildings, vehicles, equipment, incremental staff and operating costs for the forest department.
- (e) *Fodder development* in forest and nonforest areas with the Forest Department and the Animal Resources Development Department.

Project: Maharashtra Forestry

Fiscal Year: 1992

Loan/Credit Amount: IDA—US\$124.0 M (equivalent)

Description: Project to undertake sector reforms through:

- (a) *Reorganization of the public forest administration* and seeking a more active role of the NGOs, village panchayats, cooperatives and the private sector in the development of the sector.
- (b) *Improvements of the state's technical capability* particularly in the field of seed production, genetic planting material, nursery and planting practices and planning, and management, including monitoring of the forest resource base and training.
- (c) *Rationalization of the policies and regulations* constraining the sector. The project would also support five discrete investment activities related to land treatment:
 - (i) Village ecodevelopment and joint management.
 - (ii) Rehabilitation of wasteland and degraded lands.
 - (iii) Production forestry.
 - (iv) Biodiversity conservation.
 - (v) Pasture and fodder development.

Project: Madhya Pradesh Forestry

Fiscal Year: 1995

Loan/Credit Amount: US\$58.0 million (equivalent)



Description:

The main objective of the project is to assist with the implementation of the Government of Madhya Pradesh's strategy for development of the forestry sector in Madhya Pradesh. The most important strategy under the project would be the attempt to rationalize and improve management of villagers' forest usage activities, through encouragement of more sustainable forest management strategies and by replacement of the Madhya Pradesh Forest Department's existing command and control style of management with a more participatory approach. The project will be consistent with the national strategy for forest management, protection and biodiversity conservation, addressing eight priority regions: afforestation and wasteland development, demand management to improve protection of newly afforested areas/areas undergoing natural regeneration, development programs for pasture regeneration, extension support services for agroforestry, developing a detailed listing of fauna of ecologically important locations, research on cultivation of commercially valuable plants, establishment of farms for medicinal plants, and support for ex-situ conservation.

Project:

Bihar Plateau Development

Fiscal Year:

1992

Loan/Credit Amount:

IDA—US\$117.0 M (equivalent)

Description:

The project is designed to help the Government of Bihar in its efforts to increase rural incomes and reduce the incidence of poverty in the underdeveloped plateau area of southern Bihar State by:

- (a) *Making investments in critical areas of infrastructure needed for improved delivery of agricultural services to increase production and ease marketing problems.*
- (b) *Strengthening the planning, coordination and monitoring function of the tribal area administration.*
- (c) *Introducing a participatory and integrated approach to planning and implementation of multisectoral activities.*
- (d) *Supporting environmentally sustainable activities.*

Project:

Uttar Pradesh Sodic Lands Reclamation

Fiscal Year:

1993

Loan /Credit Amount:

IDA—US\$54.7 M (equivalent)



- Description:** The project would build on past experience to reclaim sodic lands in the state by establishing models which in the future could be replicated on a much larger scale, emphasizing participatory management:
- (a) *Land reclamation* through provision of effective drainage network; on-farm development; application of chemical amendments; irrigation development; and support for the establishment of food and tree crops on privately owned land, and forest tree species on community land.
 - (b) *Institutional development*, comprising strengthening of
 - (i) Uttar Pradesh Land Development Corporation, the main implementing agency.
 - (ii) The Remote Sensing Application Center (RSAC) responsible for site identification and selection in the planning process and for monitoring and reclamation induced evaluation of changes to soil and ground water environments.
 - (iii) Participating NGOs through training to assist beneficiary participation.
 - (c) *Agricultural development and technology dissemination* consisting of demonstrations of reclamation models for the production of crops, fruit tree and forestry species on sodic lands; nursery development for fruit tree seedlings production; and extension support involving motivational campaigns, production of publicity material, and use of mass communication techniques
 - (d) *Reclamation technology development and special studies* comprising adaptive research to improve existing reclamation technology, diversification of cropping systems, and development of methods for preventing further expansion of sodicity, along with special studies to improve the efficiency of drainage system and shallow tubewells.

Project: **Integrated Watershed Development (Hills)**
Fiscal Year: 1990
Loan/Credit Amount : IBRD Loan US\$13.0 M / IDA Credit US\$75.0 M (equivalent)



Description: This project addresses one of India's most serious environmental problems: watershed degradation. The seven-year project would help finance remedial programs in ecologically fragile and agroeconomic zones and support cost-effective vegetative technology which can be replicated over a wide area to conserve soil and moisture in both arable and nonarable lands. Other treatments include introduction of horticulture in marginal arable lands and livestock improvement programs, such as introducing improved bulls for natural breeding and promoting stall feeding. The project would also train staff of implementing agencies in this type of technology and in interactive planning with beneficiaries to ensure sustained management of common property resources.

Project: **Integrated Watershed Development (Plains)**

Fiscal Year: 1990

Loan/Credit Amount: IBRD Loan US\$7 M / IDA Credit US\$55 M (equivalent)

Description: The main goal is to stabilize selected watersheds in the participating states (Orissa, Rajasthan and Gujarat) through a menu of land treatments emphasizing soil and moisture conservation and by introducing more sustainable land management systems, including seeking long-term, community-based, management solutions for public nonarable lands. The project consists of the establishment of vegetative contour barriers and demonstrations of associated production systems, such as agroforestry, alley cropping and dryland horticulture on arable, private land; land treatments such as vegetative soil and moisture conservation measures, afforestation, silvipasture development on nonarable, public land; and structural and vegetative treatments for stabilization of natural drainage lines on both arable and nonarable land, and on nurseries. The project would also support strengthening implementing agencies, including NGOs, through physical and participatory watershed planning, and enhancing monitoring capability, research and training.



Other Donor Support

- Project:** **Dungarpur Integrated Wastelands Project**
- Donor:** Sweden (SIDA)
- Loan/Credit Amount:** US\$10 M equivalent
- Description:** Improve rural incomes through capability building in natural resources management and ecological restoration.
-
- Project:** **Rehabilitation of Common Lands, Aravallis**
- Donor:** EU
- Loan/Credit Amount:** ECU23.2 M (US\$31.17 M equivalent)
- Description:** Forestry/land development
-
- Project:** **Afforestation and Pasture Development along Indira Gandhi Canal**
- Donor:** Japan (OECF)
- Loan/Credit Amount:** ¥7,869 M (US\$79 M equivalent)
- Description:** To protect canals, agricultural fields, and infrastructural facilities such as roads and other communication linkages from blown desert sands and to meet the local need of fuel and fodder.
-
- Project:** **Afforestation in Aravalli Hills-Rajasthan**
- Donor:** Japan (OECF)
- Loan/Credit Amount:** ¥8,095 M (US\$81 M equivalent)
- Description:** To check desertification and to restore the ecological status of the Aravalli by intensive reforestation. To meet the fuelwood, fodder and household needs in the area by increased production of fuelwood, tree fodder, grass, timber, fruit and minor forest products. To provide employment to the rural/tribal population and thereby improve their socioeconomic conditions. To improve the habitat for wild animals in the wildlife sanctuaries. To check soil erosion and thereby improve infiltration of water and hydrological balance. Geni-pool conservation and improvement of biodiversity of flora and fauna.



- Project:** **Forestry Development, Rajasthan**
Donor: Japan (OECF)
Loan/Credit Amount: ¥4,219 M (US\$42 M equivalent)
Description: To check desertification and to restore the status of the area by intensive afforestation and silvipasture development by adopting “bottom-up” planning approach; to meet fuelwood, fodder, small timber and minor products requirement of the local people on a sustained basis; to provide gainful employment to the rural poor and thereby improve their socioeconomic conditions.
- Project:** **Hyderabad Greenbelt**
Donor: Netherlands
Loan/Credit Amount: US\$2,672,000 equivalent
Description: Reforestation of urban areas and reclamation of derelict lands with the help of Hyderabad Urban Development Authority, local NGOs and local community. Stretches of wasteland will be planted with tree crops to provide fuelwood and other products in a sustainable manner in the urban environment.
- Project:** **SPWD (Society for Promotion of Wasteland Development) National Level**
Donor: Netherlands
Loan/Credit Amount: US\$450,000 equivalent
Description: Support projects on rehabilitation of degraded land, supply of fuel and construction wood to the poor; development and better management of soil and water resources.
- Project:** **Comprehensive Watershed Development, Tamil Nadu (Ramanathanpur)**
Donor: Denmark
Loan/Credit Amount: DK 26.423 M (US\$4.0 M equivalent)
Description: Promoting the practice of dryland agriculture, range management, horticulture and forestry including conservation and use of natural resources on a sustainable basis. The broad interventions are in-situ soil and moisture conservation measures, establishment of shelter belt with emphasis on agroforestry promotion benefiting nearly 12,000 hectares of land.



Project: Karnataka Watershed Development, Dharwar
Donor: Denmark
Loan/Credit Amount : DK 48.8 M (US\$7.42 M equivalent)
Description: The project aims at developing an appropriate land use system through soil and in-situ moisture conservation activities with emphasis on low- cost vegetative measures and promotion and cultivation of perennial tree crops to increase overall production in the area. Project will benefit nearly 20,000 hectares of arable and nonarable land including capacity building of watershed community and skill training in agriculture to farming community.

Project: Comprehensive Watershed Development Koraput, Orissa
Donor: Denmark
Loan/Credit Amount: DK 46.3 M (US\$7.0 M equivalent)
Description: The project aims at establishing an ecologically sound land use system that enables the poorer rural communities to improve their living conditions and their supply of food, fodder and other essentials. The project benefits nearly 40,000 hectares of arable and nonarable land including strengthening the training infrastructure and facilities at Soil Conservation and Training Institute at Koraput.

Project: Comprehensive Watershed, Tamil Nadu (Tirunelveli)
Donor: Denmark
Loan/Credit Amount: Phase I: DK 25.0M (US\$3.8 M equivalent)
Phase II: DK 68.4 M (US\$10.5 M equivalent)
Description: The project aims at arresting further erosion of degraded land and development of sustainable and cost-efficient utilization of various types of degraded land. This goal will be achieved through establishment of shelterbelts and wind breakers including in-situ soil and moisture conservation measures. Nearly 44,000 hectares of arable land would be benefited.

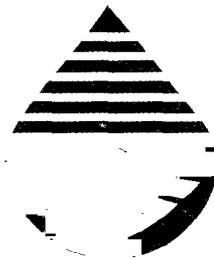
Project: Strengthening and Developing the Indian Council of Forestry Research and Education (ICFRE)
Donor: UNDP
Loan/Credit Amount: US\$2,560,000



- Description:** This assistance to ICFRE and its six institutes is to contribute to human resource development undertake appropriate forestry-related research, and develop mechanisms for effective transfer of technology to users for sustainable development.
- Project:** **Replication of Self-Help Activities in Watershed Development in Maharashtra**
- Donor:** Germany
- Loan/Credit Amount:** DM 50.00 for Tech. Cooperation (US\$685,850 equivalent)
- Description:** Develop micro-watersheds through village self-help group initiatives. Major components include soil, land, water, crop management, and afforestation.
- Project:** **Watershed Development, Karnataka**
- Donor:** Germany
- Loan/Credit Amount:** DM 200.00 M (US\$27.4 M equivalent)
- Description:** Provide ecological stability to the area, with erosion control, minimization measures, groundwater management, social forestry measures, afforestation and cleaning the drainage system.

Chapter 4

Prevention of Surface and Groundwater Pollution





Prevention of Surface and Ground Water Pollution

4.01 In 1992 the government issued a policy statement on pollution abatement. The statement affirms the government's intention to integrate the environmental and economic aspects of pollution abatement into decision-making at all levels and promote technologies that reduce industrial pollutants. Specific steps identified in the policy to meet this objective are:

- Preventing pollution at the source.
- Encouraging, developing and applying the most effective and practical technical solutions.
- Ensuring that the polluter pays for pollution and control arrangements.
- Focusing protection on heavily polluted areas and river stretches.
- Involving the public in decisionmaking.
- Increasing the safety of industrial operations.

4.02 Discussed in this section are MOEF programs that relate directly to the prevention of water pollution. Industrial pollution prevention programs also have a direct bearing on the prevention of pollution of water resources. These are covered in Chapter 5.

4.03 The Environment Action Plan segregates water management issues from water pollution prevention issues and therefore addresses the two as separate issues under different priority areas. This chapter argues

for the conjunctive treatment of water resource management and water pollution prevention because water quantity and water quality are closely linked: Water scarcity results not just from inadequate quantity but from inadequate quality as well.

THE DEMAND FOR WATER AND MANAGEMENT OF WATER RESOURCES

4.04 India's economic well-being and future growth depend on the prevention of water pollution and on the overall planning and management of water resources. India's water resources are limited and unevenly distributed. Irrigation, which accounts for 93 percent of gross water withdrawal, likely will continue to be the dominant user of water as India strives to be self-sufficient in meeting the food requirements of its large and growing population. At the same time, competing demands for water are emerging among states and sectors. By 2025 community use is expected to double, and industrial and power use is expected to increase sevenfold. Balancing these demands and mitigating the environmental impacts of development require careful analysis and targeting of development planning.

4.05 In the past, food demands were met with increased commercial agriculture (primarily irrigated agriculture), which has contributed to nonpoint sources of water pollution.¹ Large urban populations coupled with industrial concentration around urban



areas have resulted not only in the concentration of water demand, but in the intensification of water pollutants from urban areas. High pollution loads render critical the need to maintain minimum flows on rivers, particularly during the dry season, in order to flush pollutants and dilute wastewater. This concentration and interdependence of water demand and water pollution together exacerbate the constraints on water availability.

Pollutants and water sources

4.06 Water is polluted mainly by organic waste, waste generated from industrial processes, chemical agents from the fertilizers and pesticides used for crop production, silt from degraded catchments, and saline intrusion from the sea in coastal areas. In order to *prioritize* and *target* the actions needed to tackle water pollution, informed estimates of pollutant levels are essential. Furthermore, given the close link between pollution and water availability and the fact that state boundaries do not coincide with river basin boundaries, the political complexity of water pollution abatement must not be

underestimated.

Water resource management

4.07 India's constitution does not view water as a natural resource that is part of a larger ecological system. Instead, every state government has the power to legislate water rights and use patterns in an integrated and environmentally sustainable way, keeping in mind its particular needs. The current policy envisages planning for entire river basins but makes no reference to river basin entities. In addition, water policy has only the force of consent; the council overseeing its implementation was established by resolution and lacks the force of law. Still, with the prime minister as chairman, and several central ministers, all the chief ministers of the states, and the lieutenant governors of the union territories as members, the council is a body where national consensus can be achieved (Iyer 1994). Treatment of water as a national resource and planning for river basins as whole entities requires multistate consensus. Yet the government's Eighth Five-Year Plan merely emphasizes the need for river basin planning.

¹ More than 55 percent of agricultural output is from irrigated lands, with production elsewhere being constrained (World Bank 1991).



The Status of Water Pollution

4.08 This section summarizes the current status of water pollution as discussed in the Environment Action Program (EAP)

SOURCES OF POLLUTION

4.09 The EAP discusses water scarcity in different regions of the country as well as the declining water quality in various areas, particularly along river stretches, water courses, and canals. The EAP highlights point and nonpoint sources of water pollution of both surface and groundwater. The specific contribution of each source is difficult to determine at any one location and varies from area to area. In addition to waterlogging and salinity, the EAP identifies the following causes of water pollution:

- *Domestic sewage.* The primary source of water pollution in India, especially in and around urban areas, is pollution from domestic sewage and is largely a consequence of inadequate sewage collection and treatment facilities, as well as the lack of sanitation.
- *Industrial effluent.* Instead of being concentrated in urban centers, industry in India is regionally diversified. The protection afforded to industry and the emphasis on decentralization of industrial development have resulted in a proliferation of small-scale polluting industries in the paper, sugar, leather, and chemicals sectors. Small-scale industries are not being subjected to vigorous pollution controls. Only about half of the large and medium-scale

industries have partial or complete effluent treatment systems, and many of these do not achieve the stipulated emission standards. With no ecological zoning, water pollution in certain areas exceeds the carrying capacity of those areas. In addition, distant water sources that were developed to supply water to cities are polluted.

- *Irrigated agriculture.* The EAP recognizes that irrigated agriculture, coupled with inadequate attention to operations and maintenance in the irrigation sector, has increased nonpoint sources of water pollution, chemically contaminated drinking water, and overexploited groundwater aquifers. Tubewells and open or dug wells account for nearly half of the net irrigated area in the country. Siltation of reservoirs, tanks, and other surface irrigation sources has reduced the irrigation potential and lessened the groundwater recharge potential of these surface water sources. Distributional deficiencies, unbalanced use of irrigation water in the command areas, and irrational systems of water use and cropping have caused command areas to be affected by increasing salinity and waterlogging.

LEVELS OF DEGRADATION

4.10 The EAP focuses on nonpoint sources resulting from deforestation, mine sites, agricultural activities, urban solid waste disposal practices, and the concentration of human and animal waste in places of



pilgrimage. Emphasizing that limited access to natural resources will perpetuate, if not worsen, the problem of poverty in India, the EAP makes the following general statements about the pollution of India's water resources:

- ❑ Rivers are faced with increasing water quality deterioration due to pollution from industrial, municipal, and domestic waste, while the groundwater near urban centers has deteriorated due to a high concentration of nitrates, rendering it unfit for consumption. A study on water pollution in the Ganges basin found that about 75 percent of the wastewater generated is from municipal sources, with 88 percent of the municipal sewage coming from Class I cities. Few rivers meet the standards for safe drinking water (Central Pollution Control Board 1990). This is an important issue because rivers and lakes are the primary source of drinking water, most of which is untreated.
- ❑ Most urban lakes suffer from environmental degradation, and many are becoming degraded beyond the point of recovery. The water is becoming increasingly unfit for drinking and recreational activities, as well as for supporting aquatic life.
- ❑ Neglect of surface irrigation structures like tanks and reservoirs has reduced their irrigation and groundwater recharge potential.
- ❑ Coastal waters are polluted with high concentrations of lead, cadmium, and mercury, especially along Thane Creek in Bombay. The coastal water along Cochin region is affected predominantly by petroleum hydrocarbons. Along the

coasts of West Bengal and Orissa, the coastal water quality remains almost stable, although dissolved oxygen levels in some areas have dropped to critical levels.

- ❑ Groundwater, particularly in regions with a high concentration of irrigated agriculture, has turned brackish and is chemically contaminated with excess fluoride, iron, arsenic, and nitrates from fertilizers and pesticides. Groundwater quality in coastal areas is threatened by saline intrusion.
- ❑ Command areas of irrigated areas are affected by waterlogging and salinity.

QUANTITATIVE ASSESSMENT

Water pollution

4.11 No estimates are available for pollution from different sources or for the pollutant loads covered in the EAP. The United States Agency for International Development estimates that untreated sewage and other nonindustrial wastes account for four times as much pollution as industrial effluent (USAID 1994). It is unclear whether this estimate includes the pollution that is not captured by the wastewater conveyance system; as such the estimate could prove to be a gross underestimate.

Waterlogging and Salinity

4.12 The Ministry of Water Resources has measured the rise in the water tables in India but has not estimated the area affected by waterlogging. Estimates of waterlogging vary by source because some estimates include areas waterlogged during the monsoons as well as lands affected by seepage from canals and farm irrigation (Tables 4.1 and 4.2)



Table 4.1. Ministry of Agriculture Estimate of the Extent of Water Logging (million hectares)

State	1984-85	1990
Andhra Pradesh	0.34	0.33
Assam	0	0.45
Bihar	0.12	0.71
Gujarat	0.48	0.48
Haryana	0.62	0.62
Jammu and Kashmir	0.01	0.01
Karnataka	0.05	0.01
Kerala	0.11	0.06
Madhya Pradesh	0.06	0.06
Maharashtra	1.10	0.11
Orissa	0.35	0.06
Punjab	0.02	1.10
Rajasthan	0.81	0.35
Tamil Nadu	1.85	0.02
Uttar Pradesh	0	1.98
West Bengal	1.00	2.18
Total	5.98	8.52

Note: Estimates are based on depths of less than 2 meters.

Siltation

4.13 The deposition of eroded material in rivers, lakes, reservoirs, and irrigation systems is a major management problem. In the irrigation sector siltation poses high costs in terms of shortened life of investments, high maintenance costs, and reduced services. As a major source of pollution of both surface and groundwater, it increases treatment costs for potable water. Siltation in rivers inhibits the minimum flows required to support aquatic life and flush pollutants. Eroded material brings with it agricultural contaminants—fertilizer and pesticide residuals, livestock wastes, and so on. In time these contaminants damage aquatic life forms, pollute deep water aquifers, make water unsuitable for human consumption, and contribute to eutrophication in rivers,

Table 4.2. Waterlogging, Salinity, and Alkalinity in Irrigation Projects (hectares)

No. Of Projects Affected	Water-logging	Salinity	Alkalinity
4	266,040	5,000	22,040
-	-	-	-
3	362,670	224,300	-
7	89,408	1,214,165	-
3	229,840	-	-
0	1,500	-	-
9	24,543	34,244	-
8	11,600	10,610	-
1	4,260	-	-
1	6,000	-	-
1	196,260	-	-
1	200,00	1,008,000	1,211,300
1	179,500	70,000	-
1	18,000	20,120	27,480
1	35,200	483,000	-
1	360	-	17,170
42	1,625,181	3,069,439	1,277,990

Source: Vaidyanathan 1993; Suryanarayanan 1995.

lakes, and reservoirs. No assessments have been made of the location-specific water pollution that results from sedimentation.

Groundwater

4.14 No quantitative assessments have been made of groundwater pollution. Pollution of groundwater aquifers as a result of the leaching of chemicals is, however, of concern in India.

Water availability

4.15 The average annual precipitation in India is about 4,000 cubic kilometers. Some of this precipitation goes into groundwater storage and surface water sources. The rest is lost through evapotranspiration. The average flow in the river systems is estimated to be



1,880 cubic kilometers. More than 90 percent of the annual runoff in peninsular rivers and more than 80 percent of the annual runoff in the Himalayan rivers occurs during the monsoon months of June to September, necessitating the storage of floodwaters in reservoirs. About 690 cubic kilometers of water can be stored in surface structures. The availability of extracted groundwater has been estimated to be about 450 cubic meters. Total water available is therefore estimated to be 1,140 cubic meters (Ramasubban 1993). Given the runoff regimes on the river systems, this figure from both sources is very high. Since groundwater and surface water in India are not assessed conjunctively, there is a need for caution when working with estimates of utilizable water resources.

Table 4.3. Current and Projected Demand for Water

Use	1990	2000	2025
Domestic	25	33	52
Irrigation	460	630	770
Energy	19	27	71
Industry	15	30	120
Other	33	30	37
Total	552	750	1,050

Source: Ramasubban 1993.

Water demand

4.16 The EAP includes no estimates of water demand. A recent estimate is shown in Table 4.3.



The Environment Action Program

4.17 "Afforestation, wastelands development, conservation of soil and moisture, and ensuring that water sources are not polluted" is the second of the seven priority action areas listed in the EAP. "Strengthening scientific understanding of environmental issues and structures for training for water management problems" is included in the sixth priority area. Ensuring that water resources are not polluted and water management are, as discussed earlier, inextricably linked. In fact, water pollution is related, directly or indirectly, to all the priority areas of action, including biodiversity, urban pollution, industrial pollution, clean technology, and alternative energy.

INDIA'S EIGHTH FIVE-YEAR PLAN (1992-97)

4.18 India's Eighth Five-Year Plan suggests action on four fronts for water pollution control:

- Preventing pollution from domestic pollutants.
- Mitigating irrigation impacts.
- Water resource management.
- Mitigating the impacts of irrigation practices.

GOVERNMENT OF INDIA RIVER AND LAKE ACTION PROGRAMS

The National Lake Conservation Plan

4.19 The National Lake Conservation

Plan will augment the ongoing program on wetlands conservation by undertaking large-scale conservation activities in selected lakes. The program will concentrate initially on major urban lakes that are seriously threatened by an inflow of municipal sewage. Conservation plans will be developed on the basis of Geographic Information Service (GIS) and remote-sensing technology, as well as research and studies. The conservation plans are intended to prevent point and nonpoint source pollution, improve catchment area treatment, control desilting, promote weed control, improve research and development for flora and related ecological aspects, and integrate development involving the people in the area.

4.20 Scientific criteria prescribed by the International Union for the Conservation of Nature and Natural Resources form the basis of guidelines that states will use to compile information about the lakes. Twenty-one lakes in nine states have been identified; eleven of these (those listed first in Table 4.4) will be included in the first phase. Financial support for the initial study and development of plans will be provided to state governments by the central government. With specific commitments from state governments, donor support will be sought to support the implementation of the lake conservation and development plans.

4.21 The eleven urban lakes included in the first phase of the National Lake Conservation Plan are shown in Map 4.1



Map 4.1. National Lakes Conservation Plan Phase I

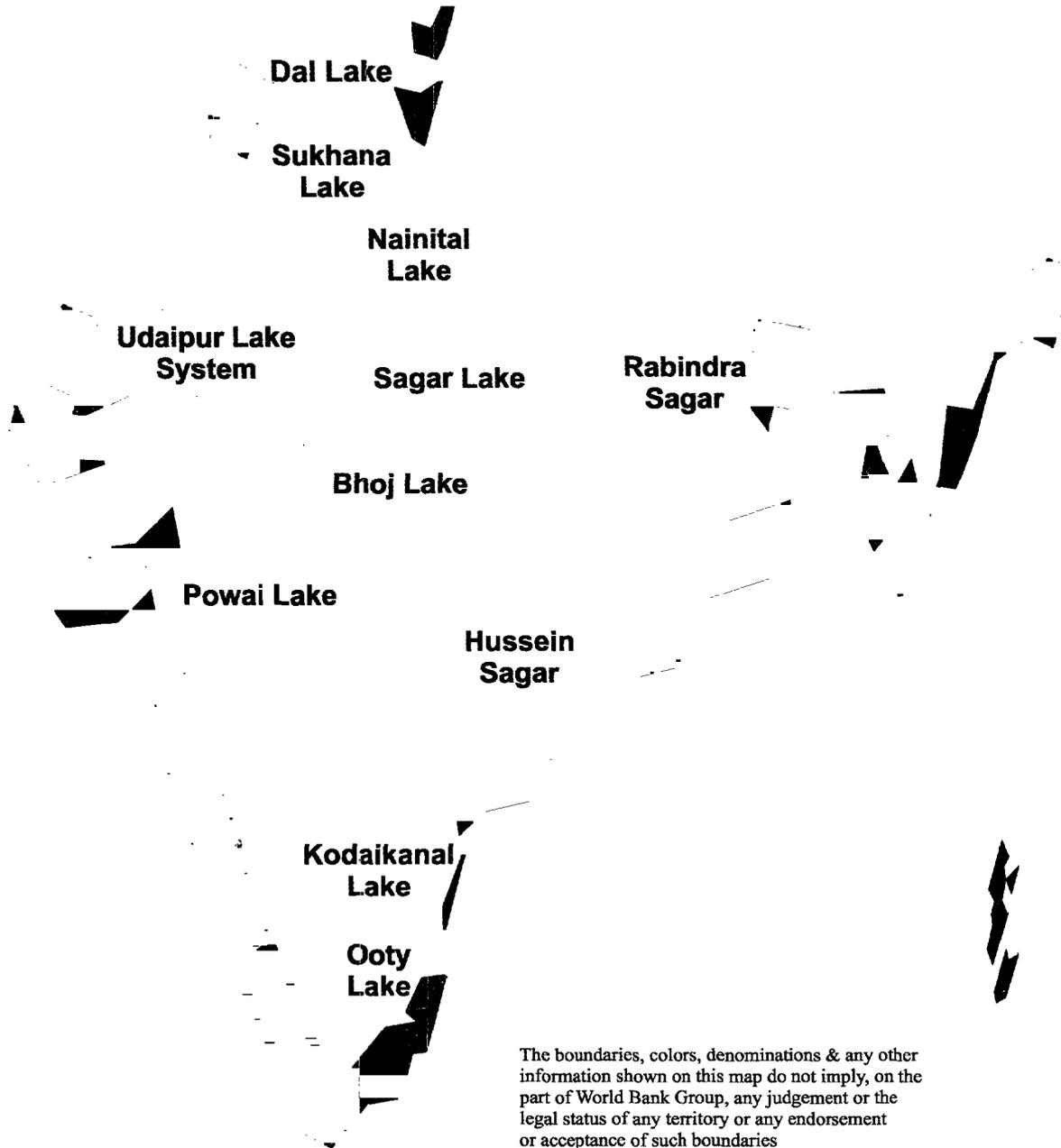




Table 4.4. Lakes Identified in the National Lakes Conservation Program

State	Lake
Jammu and Kashmir	Dal
Madhya Pradesh	Bhoj
Madhya Pradesh	Sagar
Andhra Pradesh	Hussein Sagar
Uttar Pradesh	Nainital
Tamil Nadu	Ooty
Tamil Nadu	Kodaikanal
Maharashtra	Powai
Rajasthan	Udaipur lake system
Chandigarh	Sukhana
West Bengal	Rabindra Sagar
West Bengal	Suchindra Tank
West Bengal	Adra
West Bengal	Salt Lake
West Bengal	Santragchi
West Bengal	Subhash Sagar
West Bengal	Halishahar cluster
West Bengal	Garden reach area
West Bengal	Belhoria system
West Bengal	Mirik
West Bengal	Senchal

Pollution assessment using surveys

River basin studies

4.22 India contains fourteen major, forty-four medium, and fifty-five minor river basins. Intensive surveys to assess the pollution load in the basins were undertaken, and reports have been published on the Yamuna sub-basin and the Ganga, Subarnarekha, Bhraman-Baitarani, Sabarmati and Krishna basins. Reports have been published on the Mahanadi, Tapi, Narmada, Cauvery, and Godavari basins. Reports on the Mahi and Indus basin are being prepared. Studies on the Brahmaputra, Pennar, and Ulhas basins are underway.

Pollution Assessment using Monitoring

Water quality monitoring—surface water

4.23 Inland water monitoring is being done under the Monitoring of the Indian National Aquatic Resources System; the Global Environmental Monitoring System; and the Ganga Action Plan. A total of 480 stations are in place under these programs, of which 398 stations are for rivers, 39 are for lakes, and 27 are for groundwater sources. Sixteen stations are at miscellaneous locations.

Water quality monitoring—groundwater

4.24 In 1993-94 the groundwater quality project assessed water quality in twenty-one of twenty-four critically polluted areas (Map 4.2) (Govindhgarh in Punjab, Udyog Mandal in Kerala; Parwanoo and Kala Amp in Himachal Pradesh; Vapi in Gujarat; Singrauli in Uttar Pradesh; Korba, Ratlam and Nagoda in Madhya Pradesh; Digboi in Assam; Talcher in Orissa; Bhadravati in Karnataka, Howrah in West Bengal, Dhanbad in Bihar; Pali and Jodhpur in Rajasthan, Manali and North Arcot in Tamil Nadu; Visakhapatnam and Patancheru in Andhra Pradesh; Chembur in Maharashtra; Najafgarh in Delhi). Thirty-four parameters were monitored at these twenty-one sites through a network of 134 sampling locations. The data are being interpreted with a view to preparing a comprehensive report.

Automatic water quality monitoring station of the Ganga

4.25 Of the nine locations identified along the stretches of the Ganga River, six automatic water quality monitoring stations are installed and operational (one in Kannauj, two in Kanpur, one in Patna, one in Varanasi, and one in Allahabad). These continue to monitor three parameters at one-hour intervals.



Automatic water quality monitoring of the Yamuna

4.26 Eight basic parameters are monitored through two automatic water quality monitoring stations.

Control of Industrial pollution along the Ganga

4.27 Sixty-eight industries along the Ganga continue to be monitored for the implementation of the provisions of the 1974 Water (Prevention and Control of Pollution) Act (Box 4.1).

Water quality atlas of India

4.28 A water quality atlas released in June 1994 by the Survey of India has thirty-seven plates with relevant text and individual basic maps. The information provided includes the water quality monitoring stations and the monitoring indices wherever possible, polluted stretches of various rivers, problem areas, Class I and II towns, and information pertaining to the seventeen major categories of high-polluting industries.

GANGA ACTION PLAN, PHASE I

4.29 The Ganga Action Plan, funded entirely by the central government, was launched in 1986 to improve the quality of the water in the river. Three states—Uttar Pradesh, Bihar, and West Bengal—are involved in the implementation of the first phase. This first phase involves 261 schemes, of which 237 are complete. These schemes are:

- Interception and diversion of sewage at eighty-eight points along the Ganga, of which seventy-nine are complete.
- Thirty-five sewage treatment plants,

Box 4.1. The Water (Prevention and Control of Pollution) Act, 1974

The Water (Prevention and Control of Pollution) Act, 1974 provides for the prevention and control of water pollution and maintaining or restoring good quality of water for any establishment. The act assigns functions and powers to the central and state boards for prevention and control of water pollution and all related matters. On a case-by-case basis or where there may be a union territory involved, the act allows for the constitution of a joint board i.e., by two or more governments of contiguous states or by the central government. Subject to the provisions of the act, functions and powers of central as well as the state boards have been delineated individually and with respect to each other.

For the prevention and control of water pollution, the state government has the power to restrict the application of the act to certain areas, obtain information, take samples of effluents and follow appropriate procedures thereafter, enter and inspect an establishment, prohibit use of streams or wells for disposal of polluting material, restrict new outlets and discharges, restrict existing discharge of sewage or trade effluent, and refuse or withdraw any consent by the state board.

The central board as well as the state boards are eligible for contributions from the central government and state governments respectively to enable the boards to perform their functions appropriately. The act also prescribes stringent penalties for those who operate their industry without the valid consent or in violation of consent conditions.

The Water (Prevention and Control of Pollution) Amendment Act, 1988

This act was passed to overcome administrative and practical difficulties in implementing the provisions of the original act.

of which twenty two are complete.

- Forty-three low-cost sanitation schemes, all of which are complete.
- Twenty-eight electric crematoriums, of which twenty-six are complete.
- Thirty-five riverfront facilities, all of



Box 4.2. The Water (Prevention and Control of Pollution) Cess Act, 1977

This act provides for the levy and collection of a cess on water consumed by persons carrying on certain industries and by local authorities, with a view to augment the resources of the central board and the state boards for the prevention and control of water pollution constituted under the Water (Prevention and Control of Pollution) Act, 1974. It also covers specifications on affixing of meters, furnishing of returns, assessment of cess, interest payable for delay in payment of cess, and penalty for nonpayment of cess within the specified time.

Salient feature of this act are:

- The assessing authority under the act levies and collects a cess based on the amount of water consumed and the purpose for which the water is used.
- The concerned industries are required to install standard water meters for measuring and recording the quantity of water consumed.
- Based on cess returns to be furnished by the industry every month, the amount of cess is assessed by the assessing authorities.
- Aggrieved persons may appeal the assessment to the Appellate Authority.
- The act also provides for a 25 percent rebate on the cess, payable to those industries that consume water within the quantity prescribed for that category of industries and also comply with prescribed effluent standards.

which are complete.

- Thirty-two schemes for biological regeneration of the river, all of which are complete.

GANGA ACTION PLAN, PHASE II

4.30 Phase II of the Ganga Action Plan, although sponsored by the central government, is funded equally by the central and state governments. Its two main components are the cleanup of the Yamuna (including the river Hindon) and Gomti rivers.

- *Pollution abatement of the Yamuna River*

is planned over five years, at an estimated total cost of Rs. 3,570 million, assisted by a soft loan of ¥17.77 billion by the Government of Japan. Pollution abatement works include the interception, diversion, and treatment of 770 mld. of sewage through the construction of twenty-nine sewage treatment plants of varying capacity. Works are planned in fifteen towns (Delhi, eight towns in Uttar Pradesh, and six towns in Haryana). Project feasibility reports for the eight towns in Uttar Pradesh have been approved. Apart from the sewage facilities, construction of community toilets, electric and improved wood-based crematoriums, afforestation, and the development of ghats are envisaged.

- *Pollution abatement of the Gomti River* is planned over five years at an estimated cost of Rs.640 million in three towns in Uttar Pradesh (Lucknow, Sultanpur, and Jaunpur). A total of 243 mld. of domestic waste from the three towns is to be intercepted, diverted and treated, with 230 mld. of sewage being from Lucknow alone. The Overseas Development Administration is contributing funds for the implementation of this plan. Preliminary surveys, such as CCTV surveys, and sewer cleaning works have been taken up in Lucknow with expertise provided by the Thames Water Authority, and low-cost sanitation schemes and electric crematoria have been sanctioned for Sultanpur and Jaunpur. In addition to the above, proposed works include riverfront development, afforestation, and solid waste management.

4.31 There is some discrepancy in the available information regarding the cost of this program. There seems to be no sewage



expansion planned to link large residential areas developed by both private developers as well as the Lucknow Development Authority and the Housing Board, which do not have a sewage system. These residential areas dump their solid waste into the Kukrail drain, which carries as much as 40 mld. of effluent into the Gomti.

4.32 The cities that are covered under Phase II of the Ganga Action Plan are shown on Map 4.2.

National River Action Plan

4.33 An approach paper on the National River Action Plan was approved by the government. The paper proposes an outlay of Rs.10,000 million over a period of ten years, with the central government providing about half. This plan includes cleaning up grossly polluted stretches of rivers (based on the pollution loads identified by the Central Pollution Control Board) that are not included in the Ganga Action Plans. Fourteen highly polluted stretches in nine rivers and fourteen less polluted stretches in eight other rivers have been identified. Work on polluted stretches of eighteen rivers in ten states at an estimated cost of Rs.7,720 million is being considered for inclusion under the plan.

4.34 The eleven river action plans presented by the National River Action Plan are listed in Table 4.5.

Sabarmati River Action Plan

4.35 The Sabarmati, flowing through Ahmedabad, receives the discharge of 998 mld. of sewage. Under this plan, interception and diversion of the sewage outfalls is envisaged through a 18.75 km. sewerage line as well as through installation of treatment

Table 4.5. River Action Plans

Name of River	Sewage to be Treated (mld.)	Cost (crores Rs.)
Sabarmati	891	98.70
Sutlej	350	229.04
Tapti	12	5.53
Khan-Kshipra	170	70.69
Betwa	—	9.09
Narmada	15	2,312.00
Wain Ganga	6.3	2.80
Krishna	—	—
Chambal	108	17.86
Cauveri	—	43.55
Subarnarekha	96	32.22
Total	1,648.3	2,821.48

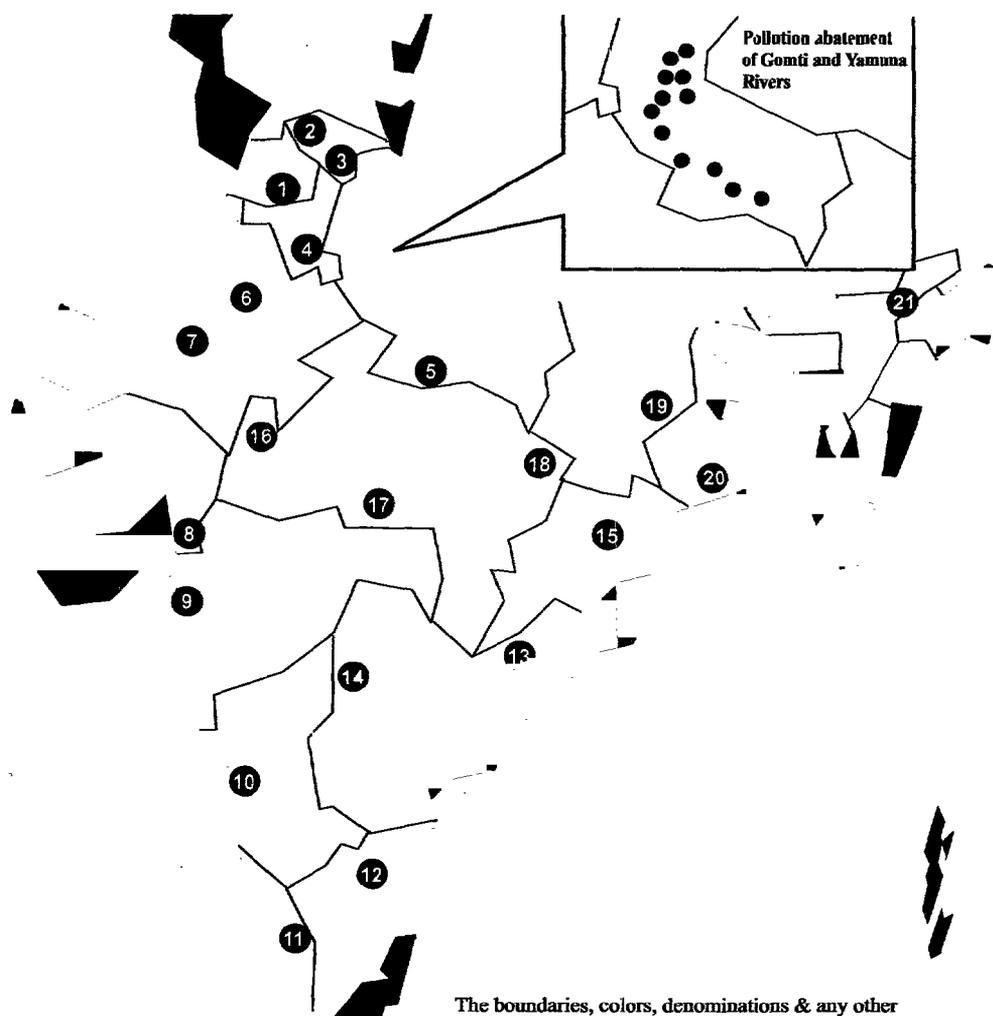
capacity for 891 mld. of sewage. The cost is estimated to be Rs. 840 million. Forty hectares of land will be acquired to set up sewage treatment plants, at an estimated cost of Rs.20 million. In addition to sewage diversion and treatment, 400 toilets (Rs.1 million), one electric crematorium (Rs.4 million), and twenty hectares of afforestation (Rs.0.4 million) are envisaged. The total estimated cost is Rs. 987 million.

Sutlej River Action Plan

4.36 Interception, diversion and treatment of the 350 mld. of sewage produced each day by the towns of Ludhiana, Jalandhar, Phagwara, and Phillaur are envisaged under this plan, at an estimated cost of Rs.1,550 million. In addition, there are plans for low-cost sanitation facilities, electric and improved crematoriums, solid waste collection and disposal, and afforestation programs. The overall cost of the program is estimated to be Rs.2,229 million, with construction spread over five years.



Map 4.2. Ganga Action Plan : Phase II & Critically Polluted Areas



Water Quality Assessed in Critically Polluted Areas

	Area	State		Area	State
1	Govindgarh	(Punjab)	12	Manali, North Arcot	(Tamil Nadu)
2	Parwanoo	(Himachal Pradesh)	13	Vishakhapatanam	(Andhra Pradesh)
3	Kala Amp	(Himachal Pradesh)	14	Patancher	(Andhra Pradesh)
4	Najafgarh	(Delhi)	15	Talcher	(Orissa)
5	Singrauli Area	(Uttar Pradesh)	16	Ratlam	(Madhya Pradesh)
6	Pali	(Rajasthan)	17	Nagoda	(Madhya Pradesh)
7	Jodhpur	(Rajasthan)	18	Korba	(Madhya Pradesh)
8	Vapi	(Gujarat)	19	Dhanbad	(Bihar)
9	Chembur	(Maharashtra)	20	Howrah	(West Bengal)
10	Bhadravati	(Karnataka)	21	Digboi	(Assam)
11	Udyog Mandal	(Kerala)			



Tapti River Action Plan

4.37 The major stretch of pollution on this river lies between the towns of Nepanagar and Burhanpur. Pollution from Nepanagar is predominantly industrial, and will be tackled by enforcing existing law. Sewage interception, diversion, and treatment is planned for the 12 mld. of sewage from Burhanpur which finds its way into the Tapti through seven major drains. In addition, ten improved, wood-based crematoriums, five units of community toilets, riverfront development activities, tree-planting, afforestation, and solid waste management components are planned. The total cost of this plan is estimated to be Rs.56 million, with the outlay being spread over three years.

Khan-Kshipra River Action Plan

4.38 The Khan River is a tributary of the Kshipra River. Together the two carry the untreated sewage of Ujjain and Indore. About 170 mld. of sewage will be intercepted, diverted, and treated. In addition, there are plans for low-cost sanitation programs, improved, wood-based crematoriums, riverfront facilities, solid waste collection and disposal, and afforestation programs. The total cost of the plan is estimated to be Rs.706.9 million. Once initiated, the program is expected to be operational in four years.

Betwa River Action Plan

4.39 Interception, diversion, and treatment of sewage from Mandi Deep, Vidhisha, and parts of Bhopal are planned. In addition, solid waste collection and disposal, low-cost sanitation facilities, ghat development, crematorium construction, and tree planting projects are planned. The total cost of the plan is estimated to be Rs.90.9 million, with an implementation period of four

years.

Narmada River Action Plan

4.40 Sewage from Jabalpur, a town of about 900,000 people, is carried by six drains into the Narmada either directly or through its tributary, Prayat. Sewage from the two major drains, Omti and Moti Nallas, are to be intercepted, diverted, and treated. Diversion is planned for 15 mld., with a treatment capacity of 5 mld. In addition, there are plans for improved, wood-based crematoriums, low-cost sanitation schemes, ghat development, solid waste collection and disposal, and afforestation. The estimated cost of the plan is Rs.23,120 million, with an expected implementation period of five years.

Wain Ganga River Action Plan

4.41 This river is highly polluted between Chapra and Quarali in Madhya Pradesh. About 6.3 mld. of sewage from Chapra, Seoni, and Quarali will be intercepted, diverted, and treated at an estimated cost of Rs.12.5 million. In addition, there are plans for improved, wood-based crematoriums, low-cost sanitation facilities, riverfront development, solid waste management, and afforestation programs, at an estimated cost of Rs.15.5 million. The total cost of the plan is Rs.28.0 million.

Krishna River Action Plan

4.42 Preparation studies are under way for pollution abatement on this river. Hyderabad, Pune, Satara, Sholapur, Kholapur, Bizapur, Belgaum, Raichur, and Kurnool lie on the banks of the river. More than 500 important industrial units (many of which are large-scale industries) are located along this stretch of the river. Once feasibility reports are completed, bilateral assistance will be sought to undertake pollution abatement works.



Chambal River Action Plan

4.43 A major tributary of Yamuna, the Chambal is the major source of drinking water for Nagda, Ratlam, Nimuch, and Kota, among others. About 6 mld. of sewage from Nagda and 102 mld. of sewage from Kota is discharged in to the river in addition to industrial effluent. An investment of Rs.39.2 million in Nagda and Rs. 139.4 million in Kota is envisaged for the interception, diversion, and treatment of sewage, in addition to wood-based crematoriums, bathing ghats, solid waste management projects, low-cost sanitation, and afforestation schemes, as well as the promotion of environmental awareness through public participation.

Cauvery River Action Plan

4.44 The governments of Karnataka and Tamil Nadu will undertake sewage interception and treatment using low-cost methods in four towns in Karnataka (Shrirangapatna, Nanjangud, Kollegal and

K.R. Nagar) and five towns in Tamil Nadu (Erode, Bhavani, Pallipalyam, Kumar Palyam, and Tiruchi). In addition, there are plans for low-cost sanitation schemes, crematoriums, solid waste management, riverfront development, and afforestation schemes. Feasibility studies and surveys are not yet complete. Preliminary estimates place the cost of the program for the two states at Rs.435.5 million.

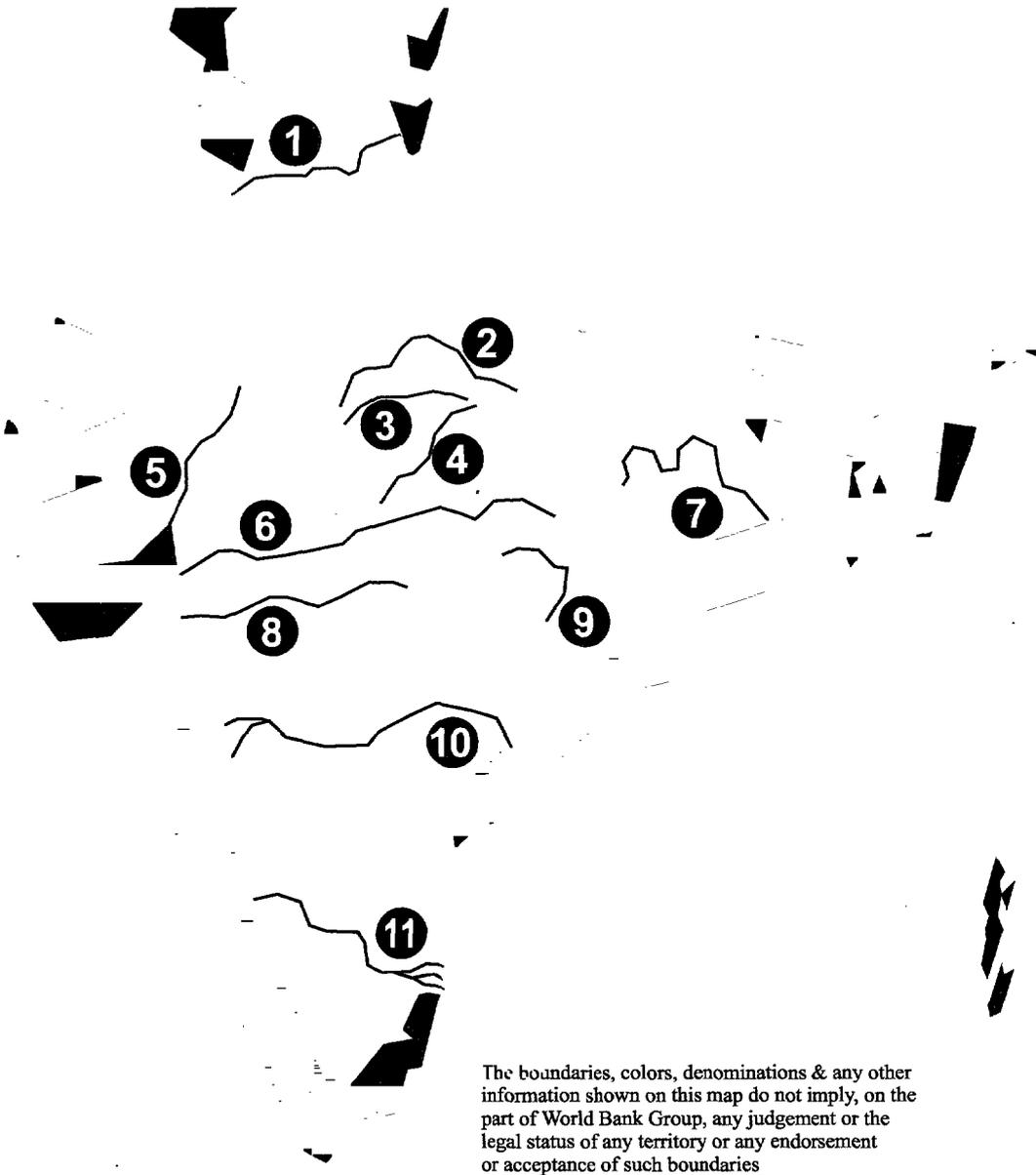
Subarnarekha River Action Plan

4.45 Sewage from Ranchi, Jamshedpur, and Ghat-Shila is discharged into the Subarnarekha through open drains. About 96 mld. is to be intercepted, diverted, and treated using low-cost sewage treatment technologies. In addition, there are plans for low-cost sanitation, crematoriums, riverfront development, and afforestation programs. The total cost of the plan is estimated to be Rs.322.2 million.

4.46 Map 4.3 shows the location of the rivers under the National River Action Plan.



Map 4.3. River Cleanup Planned Under the National River Action Plan



- 1. Sutlej River
- 2. Chambal River
- 3. Khan Kshipra River
- 4. Betwa River
- 5. Sabarmati River
- 6. Narmada River

- 7. Subarnarekha River
- 8. Tapti River
- 9. Wain Ganga River
- 10. Krishna River
- 11. Cauveri River



Major Issues and Recommendations

4.47 Two important conceptual issues arise from the EAP's discussion of point and nonpoint sources of water pollution. First, the EAP does not recognize that most water pollution from urban areas is nonpoint source and not confined to the banks of rivers. In fact, given the slow progress in collecting and treating human wastes, there is considerable pollution in the open spaces surrounding slum settlements. Second, the EAP does not differentiate between pollution sources that can be dealt with within a reasonable time frame (point source pollutants) and those that cannot (nonpoint pollutants). These oversights impede rational decisionmaking. Critical environmental concerns based on specific technical criteria cannot be rigorously analyzed, priority actions cannot be defined, project formulation is made difficult, key stakeholders cannot be identified, and effective implementation cannot be ensured.

4.48 The EAP acknowledges that there are regional variations in water pollution. While the causes of water pollution in India are indeed generic (population growth, development, and poverty exacerbated by market, government, and institutional failures), water pollution is location specific. Mitigating the environmental and economic impacts of water pollution requires differentiating these impacts by source of pollution. When highlighting coastal pollution, for example, it is not clear how much of India's coastline is polluted. Whether coastal pollution is only a problem in certain hot spots, what the economic and social costs of the loss of marine resources are, whether there are impacts on tourism, and whether the pollution is impacting

groundwater has to be assessed. While the EAP includes pollution from open mine sites as a concern, the magnitude, range, and location of impacts and health and productivity losses of this pollution are not clear. The same holds true for discussions about river water pollution. Without gross estimates that differentiate pollution by sources of pollution and pollutant loads, it is difficult to set priorities and weigh alternatives for pollution abatement, and to allocate the costs of pollution to the polluter—a step identified by the government in its policy for pollution prevention.

4.49 The setting of priorities among pollution mitigation actions should be based on a systematic comparison of social costs and benefits. Having identified priority areas for environmental action, as well as the factors that impact water pollution, the next steps are to define realistic objectives for pollution abatement, determine the most cost-effective priority actions within and between sectors, and choose environmental instruments that reflect cost-benefit and cost-effective analyses.

PREVENTING POLLUTION FROM DOMESTIC SOURCES

Urban wastewater

4.50 Water pollution from urban areas is normally considered point source pollution. This classification assumes that wastewater is an identifiable stream and therefore can be brought to a point and treated before discharge. Such a classification is erroneous in India. Class I and Class II cities in India collect less than 5 percent of the total wastewater in



conveyance systems and have the capacity to treat about 15 percent of the wastewater collected. The rest passes uncollected and untreated into the environment. Discharges are not made directly into water bodies, but begin as residuals in soil before they ultimately reach the larger bodies of water. There is no defined waste stream and therefore no way of mitigating the harmful effects of wastewater before it reaches the major water system. Other nonpoint urban sources of pollution of both ground and surface water include human excreta, garbage, and leachate from garbage. The lack of an effective collection system for 95 percent of the wastewater generated by cities, coupled with gross deficiencies in solid waste disposal, makes urban water pollution difficult to monitor and in some ways gives it the nonpoint characteristics of agricultural pollution.

4.51 The EAP recognizes bankside water pollutants (washing, defecation, and disposal of corpses) as nonpoint sources of pollution, and the government has designed programs and schemes to address this type of pollution. But the environmental, health, economic, and poverty impacts of the large quantities of uncollected wastewater in cities could be more severe than the impacts of bankside pollutants; bankside pollutants are at least confined to definable areas and therefore are easier to mitigate. A sharper focus is needed on the nonpoint source pollution resulting from uncollected municipal wastewater. It is technically feasible to deal with this dispersed pollution, but not until the wastewater is captured in a stream or conduit and treated before discharge into water bodies.

Sewerage and sanitation

4.52 Sewerage coverage is usually expressed in terms of the share of wastewater generated by a city that is collected by the

sewer system. In India there is no clear information on the quantity of water that is delivered to individual cities, the quantity that is actually distributed through the mains, the extracted groundwater that augments municipal supply, or the wastewater that is actually collected through a city's sewers. Thus, it is difficult to estimate either generated wastewater or the domestic pollution emanating from wastewater.

4.53 About 80 million people—30 percent of the country's urban population—live in slums in the twenty-three major cities in India. Most have inadequate access to potable water and sanitation. Given the inadequate sanitation coverage, it is not possible to estimate the amount of nonpoint organic pollution from open defecation practices in Indian cities. These pollutants stay in soil until they degrade or get washed away into surface water sources. There is no information on whether this pollution exceeds the assimilative capacity of the soil and water (especially in areas of high density) or what role such practices play in the spread of disease through water pollution. The government has implemented several toilet construction schemes in slums on municipal land. There are, however, reports that the toilets are inadequate, choked, dilapidated, and impossible to use. The toilets constructed by the government should be surveyed to ascertain the effectiveness of these programs before such programs are expanded or replicated. Most public toilets, whether constructed by the government or by the private sector, are located in congested areas and discharge their effluent into septic tanks; there are no digesters for the treatment of raw sewage. This poses a significant pollution threat to groundwater. Ironically, there is no alternative to septic tanks until the sewerage system is extended to unauthorized colonies and slums.



Integrated management of liquid and solid wastes

4.54 Sewerage coverage is far from comprehensive in Indian cities. As a result open stormwater drains and natural gullies are major carriers of untreated sewage—including indiscriminately dumped solid waste (often including toxic and hazardous waste)—into rivers. This leads to clogging and flooding of open stormwater drains and overburdens any scheme to intercept, divert, and treat discharges from stormwater drains before they enter the rivers. Treatment plants frequently break down because of the excess solid waste that comes with inflows of stormwater, making it impossible to realize the benefits of water pollution abatement schemes.

Contaminated piped water supply

4.55 Municipal water supply is also routinely contaminated by sewer line leakages that seep into the water supply through cracked or broken pipes or as a result of the suction effect that is created in supply pipes when supply is intermittent. Cities must implement their own programs for minimizing the chances of water contamination (including replacement of old water mains, internal pipe linings, and so on).

Watershed protection

4.56 Growing water scarcity in urban areas has led to the development of water schemes at great distances from cities in order to augment the supply. The quality of these supplies is threatened by a lack of protection of the watersheds, largely because industry is allowed to locate in the watershed, often close to the water sources. Inadequate enforcement of water pollution regulations inevitably leads to either contamination by industrial pollutants or the discharge of

municipal waste into these sources of supply. New Delhi and Tirupur regularly have to deal with contaminated water supplies due to these factors.

MITIGATING IRRIGATION IMPACTS

4.57 The EAP gives considerable attention to the water problems arising from India's irrigation sector. But although it identifies priority areas in the sector, it does not recommend specific programs. The Eighth Five-Year Plan suggests several avenues to mitigate the impacts of irrigation; in fact, it classifies waterlogging and salinity as a national menace and calls for systematic surveys and a phased program for cost-effective reclamation and restoration of irrigated land.

Water utilization and the need for reliable data

4.58 Economical use of water is perhaps the most important challenge facing India today. About Rs.360 billion has been invested since 1950 to create a surface storage capacity totaling about 18 million hectares in the irrigation sector. About half of this capacity is unused, and only 10 to 15 percent of it reaches farmers due to transmission losses and evaporation from reservoirs. Government data regarding the area served by irrigation paint conflicting pictures. Moreover, these figures cite system potential, not the actual areas that get irrigated after construction is over and the systems are working. Groundwater irrigation, on the other hand, has taken place almost entirely from private investment. While not always available in all locations as an alternative to surface water, groundwater is an important source that a farmer can control. Estimates of groundwater availability and use are suspect, however, because groundwater



and surface water are not conjunctively managed; furthermore, there is no systematic, continuous observation of groundwater extraction. Rational decisionmaking for water development, allocation, and pollution prevention requires comprehensive data on the economic and environmental costs and benefits of various approaches. While it is recognized that collecting information is expensive, affordable ways of collecting basic information need to be found in order to efficiently manage and sustain the water supply.

Waterlogging and salinity

4.59 The total area subject to waterlogging in India was estimated by the National Commission on Agriculture in 1976 at 6 million hectares, including both rainfed and irrigated areas. This figure is thought to be a substantial underestimate. Based on data from individual command areas, it is estimated that irrigation has induced waterlogging or salinization on about 3 percent of the created command area. Waterlogging problems have developed in about 250,000 hectares of land in northwest India, and another 3 million hectares may be in jeopardy over the next thirty to fifty years. As in urban areas, water supply network expansion in irrigation has not been accompanied by an expansion of drainage. While the need for drainage has long been recognized, such investments have been deferred in favor of new irrigation investments. Where drains have been constructed, they often have been poorly maintained. Apart from inadequate drainage, overwatering at head-reaches is common and has created waterlogging that is exacerbated during the monsoons.

Siltation

4.60 Apart from reducing the groundwater recharge potential, siltation of water bodies also contributes to water pollution. As a body of water becomes silted, the eroded soil washing into the water source can cause water quality deterioration due to the transference of pollutants. Siltation from eroded soil treated with fertilizer can, over time, lead to the deterioration of water quality due to the dissolution of potassium and phosphorous. Siltation also reduces the availability of light for photosynthesis and ultimately can have major negative impacts on the aquatic life in the body of water.

Water resource management

4.61 Beyond the problems of salinity and waterlogging, perhaps the most significant negative impact of irrigation has been the inefficient use of water. To underscore the importance of irrigation in the overall management of water, it is important to note that resolution of conflicting demands for water requires answering critical economic and social questions that go beyond the confines of individual users and states. These conflicts are unlikely to see resolution in the near term. But efficiency of water use can be enhanced in the near term for all sectors of the economy. Improved efficiency of water use in irrigation, while politically the most complex goal to achieve, is technically the most important.

Water: A state subject

4.62 The National Water Policy adopted in 1987 brought all water development under a single ministry, the Ministry of Water Resources. The ministry, however, lacks the



power to impose its policies on states. Since water allocation cannot be imposed by the central government, states have tried to make claims on the water in the river basin. Decisionmaking for water allocation is not based on information about the availability of the resource; rather, the decisions are determined politically, and historically have been dominated by irrigation demands. This situation persists despite the fact that the national water policy gives irrigation second priority in allocation, with the first priority given to domestic and livestock needs. Without analysis of the resources available and the current uses, supported by reliable hydrological data, India can neither develop definitive criteria for different user groups nor explicitly incorporate environmental considerations. Such analysis and priority setting are essential if India expects to successfully develop and manage its water resources.

Groundwater development and management

4.63 The constitution assigns groundwater development rights to state governments. None of the Indian states, however, has introduced any form of legal control over groundwater development. Surface and groundwater resources are parts of the hydrological system of a river basin. Any action that modifies the flow of the river, the extraction of groundwater, or the biological or chemical characteristics upstream affects the hydrology of the basin and impacts downstream users. In the absence of a sound government program for developing private groundwater irrigation, exploitation of groundwater to its maximum potential as envisaged in the Eighth Five-Year Plan could result in overexploitation of the resource and therefore is cause for concern.

4.64 Wells now serve a larger area than the canal systems. The gross area irrigated by wells is estimated to be at least 30 million hectares (Repetto 1994). The overexploitation of groundwater is reflected in a progressive deepening of wells and a permanent lowering of the water table in different parts of the country, especially in areas that rely on wells for irrigation (for example, the average depth of water is estimated to be falling by 1 to 33 centimeters a year in different districts in Haryana). In most states average groundwater levels have fallen by more than 2 meters in the past ten years; in many areas the fall exceeds 4 meters. Groundwater organizations have made only minimal attempts to keep records of the number of wells, the annual water yield, or the area irrigated. In principle, the groundwater markets developed all over the country over the past two decades give non-well owners access to groundwater. For the most part, however, the bulk of water pumped is used by the owners, with only the surplus being sold.

4.65 State regulations governing well locations and spacing have failed in the past. For political reasons, states are unwilling to deny credit and energy to wells in violation. Small farmers, who typically cannot afford their own well, are further disadvantaged as water tables fall and crop yields decline. While there is clearly a need to regulate groundwater use, it must be borne in mind that past attempts at regulation have been unsuccessful.

MITIGATING THE IMPACTS OF IRRIGATION

Nonpoint sources of water pollution

4.66 The EAP gives considerable attention to water pollution from irrigated agricultural activities. Some of the chemical fertilizers and pesticides that are applied to irrigated land to increase crop yields leach



into the groundwater or are washed off into rivers and lakes. This kind of pollution is most common in Europe and North America, but pollution from agricultural chemicals in northwest India is approaching levels comparable to the industrial countries. While there is a need to address this issue, it is equally important to recognize that India has nearly reached the limits of land available for cultivation, and improving agricultural productivity is critical to meeting growing demand. Achieving crop production at the production target of 285 million tons by 2006-07 will require increasing the use of fertilizers by 60 percent by the final year of the current Five-Year Plan compared with fertilizer use in the final year of the last Five-Year Plan. On pesticide control and management, the Eighth Five-Year Plan is limited to suggesting the gradual phasing out of DDT and BHC.

Fertilizers and pesticides

4.67 Fertilizer use is concentrated on five crops—rice, wheat, sugarcane, cotton, and maize—in about 150 irrigated districts. There are no longer differences in chemical fertilizer use between large and small farms, although there are differences between irrigated and unirrigated areas. For instance, nearly 6 million tons of nitrogenous fertilizer are applied to less than one-third of the gross irrigated area. The average nitrate content of groundwater increased almost two and a half times from 1975 to 1982.

4.68 Pesticide use grew by more than 6 percent between 1970-71 and 1990-91. Nearly 70 percent of the pesticides used in India are banned or severely restricted for agricultural uses in other countries. Pesticide residues of DDT and BHC have been detected in the aquatic invertebrates and mollusks found in the Yamuna River (Ganges basin) as well as in crabs collected from Andhra Pradesh,

where endosulfan also was detected. Options for controlling agricultural pollution are thus more limited than for other environmental discharges because fewer opportunities for abatement exist, at least in the near future. Equally important, it must be recognized that pollution from agricultural activities is widespread and does not lend itself easily to mitigation efforts.

RECOMMENDATIONS

Preventing pollution from domestic pollutants

4.69 Most of the government's efforts to protect water resources from domestic pollutants have been the projects under the Ganga Action Plan. Several studies have been undertaken under the plan, but they have focused on physiochemical and biological water quality parameters. There have been no studies on the ecosystem processes, river-flood plain interactions, or problems caused by flow regulation, nor have the roles of point and nonpoint sources of pollution been investigated. Management strategies for the prevention of pollution have been developed in the absence of critical strategic analysis.

4.70 About Rs. 4 billion has been spent on the Ganga Action Plan since 1985. Prevention of pollution of the Ganges river has been attempted by capturing sewage streams from cities, diverting and treating the sewage, and then discharging it into the river. No projects under the plan have been undertaken to expand the inadequate sewage collection network in these cities or to link up areas that may be covered by a sewage network but that lack connections to the system.

4.71 The plan's primary intention has been to cleanup the river water, not the cities



through which the river water flows. No health benefits were expected for the populations of the cities as a result of the cleanup of the river. Furthermore, projects under the plan have not been conceptually comprehensive because they have dealt only with sewage treatment and disposal, and have not addressed solid waste management in the urban centers. In India a conjunctive approach to the two is imperative in order to realize sustainable benefits.

4.72 Sewage treatment technology choices under the plan are questionable because many of the treatment facilities financed under the program are either underutilized, incomplete, not commissioned or broken down, or construction has not yet begun. The 1974 Water Act and its amendments require industrial effluents to meet certain standards; municipalities responsible for domestic sewage, however, are not covered by the act and generally have not provided sewage treatment plants. Effluent standards for industry along the river do not give consideration to desired river standards at specific locations depending on the uses required at that location, the river's available critical dilution ratio, and the assessed waste-assimilative capacity of the river. As a result, the standards are arbitrary, disregard the total amount of effluent discharged at any point or upstream, and do not take into account the natural assimilative capacity of the river in different places at different points in time. Furthermore, the act applies only to point discharges from specific units, so several large and many small drains are not covered by the act and continue to receive discharges from small-scale industry and slum areas.

4.73 Despite these shortcomings, the same concepts for river water pollution management are used in the second phase of

the Ganga Action Plan, as well as in the National River Action Plan. Thus neither plan reflects any lessons learned or questions raised under the first phase of the Ganga Action Plan.

4.74 Neither the second phase of the Ganga Action Plan nor the National River Action Plan contains quantitative assessments of expected water quality improvements after pollution abatement works are undertaken along various river stretches. Instead, the expected benefits are couched in the hope that river quality will improve to the "desired best designated use."

4.75 An increasing number of international donors are getting involved in environmental management in India. It is important that support be given to comprehensive environmental programs so that environmental mitigation efforts in one sector are not nullified by the environmental neglect of a closely allied sector. For example, the benefits of investments in sewage expansion are not likely to be realized or sustainable without a concomitant program for solid waste collection and management, as the two are closely linked to water pollution issues. Furthermore, support must be given to strategic priorities that have been determined to produce the highest cost-benefit.

4.76 Consideration should be given to providing support to achieve priority objectives:

- To ensure that pollution control investments are cost-effective, a common strategy for donors financing projects under the government's program to prevent water pollution should be promoted. This strategy should be based on strategic analysis of realistic environmental objectives and technically sound methods for achieving desired



water quality, with priority given to the balance between costs and benefits.

- ❑ Donor consensus should be forged in order to end replication of environmental strategies that have not proved successful. Low-cost sanitation schemes under the Ganga Action Plan are a case in point. Performance evaluation of these schemes should be encouraged, and private sector participation in these schemes should be strongly supported.
- ❑ A simple study to model and estimate the water quality impacts of open defecation and uncollected sewage in a typical Indian city should be undertaken. If the study could be modeled so that city managers and municipalities could feed in their own population and other data, it could become an important tool that would enable governments, donors, development banks, international and national nongovernmental organizations (NGOs), and the public to make more informed strategic decisions for pollution abatement.
- ❑ Assistance should be provided to the government to develop standards that determine water quality at different points according to flow, assimilative capacity, and local conditions. Furthermore, a mechanism could be instituted for constant monitoring and updating of effluent and treatment efficiency standards.
- ❑ Voluntary organizations, local civic bodies, or other NGOs should be encouraged to formulate plans for solving the water supply problems in their areas. While it may seem that initiatives for solving water problems

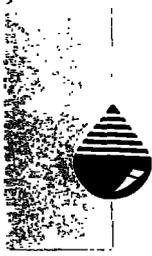
Box 4.3. Solving Water Problems with Local Initiatives

The water crisis in Dewas, Madhya Pradesh, has been steadily worsening. Intensive groundwater extraction far exceeds the recharge rate. The municipality's proposal for solving the water problem consisted of a dam 20 km. away, estimated to cost Rs. 48.55 crores and with a completion time of twenty-two years.

A voluntary group, Samaj Pragati Sahayog, has a proposal before the planning commission. The proposal abandons the centralized supply approach and recommends a three-pronged strategy to overcome the water deficit: total watershed planning which will regenerate aquifers in the Dewas region; recycling of water in industries and of municipal sewage to meet industrial demand for water; and reviving traditional water storages in Dewas town. The plan covers 4,170 hectares that comprise three microsheds, includes afforestation measures that cover wastelands and commons, outlines measures for gully control and drains, and proposes the construction of fresh storages. This action plan is expected to yield a total of 12.62 mld. of water for Dewas within a couple of years, turning the deficit in the current supplies into a surplus.

are irrelevant in the context of preventing the pollution of water resources, in fact water scarcity is closely linked to water pollution (Box 4.3).

4.77 In order to prevent hidden drains and natural drainage channels from emptying into rivers, a pilot that demonstrates the effectiveness of a covered drain that runs parallel to the river (intercepting and collecting wastewater) and discharges downstream would illustrate a low-cost technically sound option for channeling wastes and improving the water quality along river reaches. This study in conjunction with a comprehensive approach to environmental improvement under Phase II of the Ganga Action Plan or under the



Box 4.4. Drip Irrigation System Saves Water and Improves Efficiency

While not applicable for field grain crops like rice and wheat, drip irrigation system (DIS) offers marked advantages for systematically planted row crops like vegetables, fruits, and flowers and cash crops like sugarcane, cotton, spices, tea, and coffee. DIS is especially suitable and appropriate in water-scarce areas and near urban centers where high-value crops can be marketed. The Eighth Five-Year Plan targets 500,000 hectares for DIS.

DIS can be adapted to poor soil and water quality as well as to difficult terrain. The system requires 40 to 50 percent of the water used by flood irrigation because only roots get watered, thereby minimizing weed proliferation. In combination with liquid fertilizer use, it offers the further advantage of reducing fertilizer use by the 20 to 30 percent that normally gets dispersed in the air. Unlike conventional irrigation methods that erode soil fertility due to waterlogging and salinity, it preserves soil fertility. DIS also reduces labor costs and addresses the basic issue of efficient water management. Increasing productivity, rather than increasing the area under cultivation, will be the only way to meet the needs of a growing population.

Despite its proven track record, the system has not gained a foothold in India since its introduction in the 1970s, largely because of government indifference, farmer resistance, and the poor quality of the systems available for drip irrigation at that time. There has been some progress since then. About 36,500 hectares of land is irrigated by the drip method in six states, but the high initial investment and lack of know-how about its use are impeding progress in other states.

Source: Khanna 1992.

National River Action Plan should be piloted. Support for a pilot lake project under the government's Lake Conservation Program that promotes an integrated approach to sustainable management should also be considered. Rather than capital investments for pollution abatement alone, the project should cover the region that contains the lake.

IMPROVING WATER RESOURCE MANAGEMENT

4.78 The World Bank's Irrigation Sector Review puts forth a series of recommendations that cover actions to improve water policy and planning, expenditures and financial management, and technical performance of the irrigation departments as well as defining the roles of the government and nongovernment sectors in irrigation. While these recommendations are not covered here, close attention to the irrigation sector is important because of the close links between water quality and water quantity. Given the needs of India's growing population—and the fact that there is little scope to harness more water in surface storage structures—the need for efficiency in water use cannot be stressed enough. Throughout Asia, planners are concentrating less on developing new supplies and more on managing demand. Support can be provided to these efforts with the following:

- Introducing market-based pricing for water, electricity, and fertilizers and pesticides would encourage farmers to use natural resources and other inputs more efficiently. India's agricultural policy sets official prices for commodities and production inputs, thereby encouraging farmers to deplete natural resources and use water inefficiently. This leads to over-exploitation of groundwater, overuse of surface water (waterlogging and salinity), and overuse of fertilizers and pesticides. Getting the prices right is the first principle for demand management.
- Ecologists, epidemiologists, and other specialists should study current agricultural practices in order to ascertain



the economic significance of the health impacts of groundwater contamination, pesticide use, and other problems related to agricultural production.

- A stocktaking exercise of drip irrigation system (DIS) in conjunction with other donors in the sector should be initiated (Box 4.4). Based on this exercise, a cohesive national strategy to promote DIS could be formulated to underpin projects in regions where groundwater or spring water can be used (because the two carry less sediment, which tends to choke the filtration systems of DIS

technology). Agricultural departments should be trained to promote DIS. Comprehensive projects to promote DIS would be in keeping with the government's objectives for rural poverty alleviation.

- River basin planning should address downstream reservoir flows during months of water scarcity to ensure that pollutant load dilution is within the assimilative capacity of the river. This is especially important for large rivers and for rivers that carry high pollution loads.



GOI Program Objectives

Category: *Irrigation related*

Government Objectives/Programs:¹

Rehabilitation and catchment area treatment for major and medium irrigation works; water management plans based on detailed soil surveys and land use capability for major and medium irrigation works; developing networks with government departments with research institutions and experts for research, design and evaluation of irrigation projects; developing data base for post-evaluation studies for periodic monitoring of actual crop patterns, water use pattern and productivity in all irrigation commands; review of command area development programs in each state for streamlining the program for better returns from irrigated agriculture and for optimum use of water; rehabilitation of system and nonsystem irrigation tanks; promotion of programs and projects for conjunctive use of surface and groundwater resources; rehabilitation and utilization of public tubewells; organization strengthening for better operation and maintenance systems for irrigation works; protection for small surface storage structures in rainfall-short areas; dissemination and extension of low-cost rainfed, agronomic and soil conservation technologies to small and marginal farmers; mission mode project on development, demonstration and promotion of biofertilizers; survey on waterlogging, saline soils, flood hazards, etc.

Donor Agency Support

Project	Donor	Funding
Watershed Development, Karnataka	Germany	US\$27.4 M equiv.
Maharashtra Rural Water Supply/Environmental Sanitation	World Bank	US\$109.9 M equiv.
Haryana Water Resources Consolidated	World Bank	US\$258.0 M equiv.
National Hydrology	World Bank	US\$158.6 M equiv.
Karnataka Rural Water Supply / Env. Sanitation	World Bank	US\$92.0 M equiv.
Punjab Irrigation and Drainage	World Bank	US\$165.0 M equiv.
Maharashtra Composite Irrigation III	World Bank	US\$160.0 M equiv.
Tamil Nadu Water Resources Consolidated	World Bank	US\$282.9 M equiv.

¹ GOI programs were extracted from India's Environment Action Program and the 1994-95 annual reports of the Ministry of Environment and Forests.



Category: Capacity building

Government Objectives/Programs:

Formulation of Flood Control Master Plans for major river basins and for undertaking post-facto evaluation of flood control works; organizational strengthening of State Land Use Boards for the tasks of soil and water conservation; natural resource / agricultural statistics in respect of dry land agriculture, irrigation and hydrological data for better crop planning, optimum application of water and flood mapping, and environmental impact assessments for river valley and agricultural development projects; schemes to involve women for implementation of national programs in agriculture, including watershed development and soil conservation schemes.

Donor Agency Support

Project	Donor	Funding
Watershed Development Karnataka	Germany	US\$27.4 M equiv.
Haryana Water Resources Consolidated	World Bank	US\$258.0 M equiv.
National Hydrology	World Bank	US\$158.6 M equiv.
Tamil Nadu Water Resources Consolidated	World Bank	US\$282.9 M equiv.

Category: Institutional development

Government Objectives/Programs:

Framing of legislative measures, fiscal measures and credit delivery schemes for proper exploitation of groundwater; formulation of a regionwide pricing policy.

Donor Agency Support

Project	Donor	Funding
Haryana Water Resources Consolidated	World Bank	US\$258.0 M equiv.
Karnataka Rural Water Supply and Drainage	World Bank	US\$92.0 M equiv.
Punjab Irrigation and Drainage	World Bank	US\$165.0 M equiv.
Tamil Nadu Water Resources Consolidated	World Bank	US\$282.9 M equiv.

Category: National Lake Conservation Plan

Government Objectives/Programs:

Carrying capacity studies in environmentally sensitive areas to identify actions to be taken to conserve, protect and preserve the environment as well as to draw up sustainable development plans so that the overall development of the area is optimal.



Donor Agency Support

Project	Donor	Funding
Conservation of Lakes, Bhopal	Japan (OECF)	US\$71.0 M equiv.

Category: *Environmental statistics and mapping*

Government Objectives/Programs:

Information on location of water and air quality monitoring stations, location of critically polluted areas, designated best use classification of streams, major cities with populations over one lakh, administrative divisions-district boundaries, major river basins and drainage network.

Donor Agency Support

Project	Donor	Funding
National Hydrology	British-ODA	US\$12.1 M equiv.
Biomonitoring Kallada	Netherlands	(Not available)
Environmental Action Program	Netherlands	US\$222 M equiv.
Haryana Water Resources Consolidated	World Bank	US\$258.0 M equiv.
National Hydrology	World Bank	US\$158.6 M equiv.

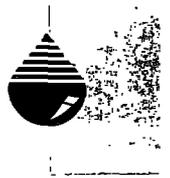
Category: *Water quality monitoring*

Government Objectives/Programs:

Monitoring of Indian National Aquatic Resources System, Global Environmental Monitoring System and Ganga Action Plan.

Donor Agency Support

Project	Donor	Funding
<i>Surface water</i>		
Watershed Management	Germany	Phase I:US\$3.57 M equiv. Phase II:US\$10.9 M equiv.
Gomti River	British-ODA	US\$48.5 M equiv.
Water Quality Monitoring Stations	Netherlands	US\$0.39 M equiv.
Biomonitoring	Netherlands	
<i>Groundwater</i>		
Water Quality Monitoring Stations	Netherlands	US\$0.39 M equiv.
<i>Automatic water quality monitoring of River Yamuna</i>		
Yamuna Action Plan	Japan (OECF)	US\$178.0 M equiv.



World Bank Support

Project: **Maharashtra Rural Water Supply and Environmental Sanitation**

Fiscal Year: 1991

Loan/Credit Amount: IDA—US\$109.9 M (equivalent)

Description: To be implemented in about ten districts in Maharashtra. It would raise the standard of living in rural areas through improved health and productivity by expanding access to potable rural water supply systems and environmental sanitation facilities. The rural water supply component would include about 75 large, regional piped water supply schemes, 170 individual village piped water supply schemes, and the installation of about 3,000 India Mark III hand pumps. The project would promote enhanced approaches to environmental sanitation and health communications through the development of new strategies and their implementation through innovative programs. The environmental sanitation component would promote the disposal of wastewater in villages with piped water supply through improved drainage and the construction of low-cost latrines. The health communications component would create greater community awareness and demand for improved hygiene, giving field staff in the Department of Public Health a greater role in promoting a cleaner environment.

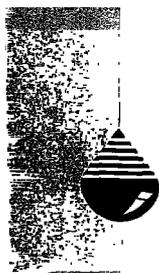
Project: **Haryana Water Resources Consolidated**

Fiscal Year: 1994

Loan/Credit Amount: IDA—US\$258.0 M (equivalent)

Description: The project would be a sector investment loan, financing a statewide program to improve the water distribution and drainage systems and upgrade institutional capacity for water management and planning. The project would finance the following investments under the areas of the Bhakra Canal System and Western Yamuna Canal System :

- (a) Rehabilitation of the existing canal and drainage systems and selective lining of canals and watercourses.
- (b) Modernization of canal and drainage systems and watercourses.



- (c) Upgraded operation and maintenance of the water distribution and drainage system.
- (d) Institutional strengthening to support administration, data collection, planning, design, beneficiary participation and formation of water user associations, research and training. Investments would be supported by reforms to reorganize the Haryana Irrigation Department. A water policy framework would be developed through multi-use water resource planning and formulation of a state water plan.

Project: National Hydrology
Fiscal Year: 1995
Loan/Credit Amount: IDA—US\$158.6 M (equivalent)
Description: The project would assist the GOI and participating states to develop comprehensive, easily accessed and user friendly data bases covering all aspects of the hydrological cycle, including surface water and groundwater in terms of quantity and quality and climatic measurements, particularly of rainfall. The project supports the objectives of the GOI's National Water Policy and the Bank's strategy for India's water sector and policy regarding water resources management. Special attention would be paid to standardization of criteria, processes and procedures for measurement of hydrological parameters and for storage and retrieval of information so that data series would be structured as a six-year operation and include support of upgrading and expanding the physical infrastructure for all aspects of the collection, collation, processing and dissemination of hydrological and hydrometeorological data; provision of equipment and materials; training and technical assistance; and institutional strengthening including new buildings and incremental operating and maintenance costs.

Project: Karnataka Rural Water Supply and Environmental Sanitation
Fiscal Year: 1995
Loan/Credit Amount: IDA—US\$92.0 M (equivalent)
Description: The project would be implemented in about twelve districts, including 1,200 villages, expanding access to potable rural water supply systems and environmental sanitation facilities and comprising of:
(a) Construction of new and rehabilitation of existing water supply schemes, including leakage repair works, water quality



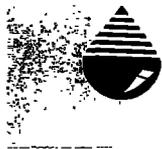
monitoring program, and measures for groundwater recharge.

- (b) Construction of environmental sanitation facilities.
- (c) Health communication for creation of greater community awareness and demand for improved hygiene and environmental sanitation.
- (d) Institutional strengthening through community development and comprehensive training programs. NGOs would play a key role in the planning and implementation of the environmental sanitation and health communication components.

Project: Punjab Irrigation and Drainage
Fiscal Year: 1989
Loan/Credit Amount: US\$15 million (equivalent) / US\$150 million (equivalent)
Description: The project would follow the successful Punjab Irrigation Project (Credit 889-IN), which supported investments in canal and watercourse lining. These investments, which were well executed and economically sound, would be continued and expanded to include facilities (communications and canal regulation structures) designed to allow improved system operation. Development of the Kandi area, which is the poorest region in the state, would be supported. The proposed project would also support investments and planning in drainage, which is an increasingly serious environmental and economic threat to large areas of northwest India. Institutional facilities would be provided to support the recent reorganization of the Irrigation Department into functionally specialized departments.

Project: Maharashtra Composite Irrigation III
Fiscal Year: 1985
Loan/Credit Amount: US\$160 million (equivalent)
Description : The project would encompass two command areas: Jayakwadi and Majalgaon.

- (a) The main components for Jayakwadi would be:
 - (i) Completion of irrigation systems.
 - (ii) Completion of main drains, link drains, and rural roads.
 - (iii) Construction of field channels, drains and structures



and field channel protection.

- (iv) Landshaping.
 - (v) Development of three specially developed distributaries (SDDs).
 - (vi) Technical support to farmers.
- (b) For Majalgaon the project would include:
- (i) Construction of 116 canal regulation structures.
 - (ii) Construction of Majalgaon main canal from 67 km. to 100 km.
 - (iii) construction of the distribution system up to the 1 cusec outlet.
 - (iv) Construction of main and secondary drainage and road networks
 - (v) On-farm developments and landshaping.
 - (vi) Development of a Majalgaon SDD on 4,000 ha.
 - (vii) Technical support to farmers.
- (c) Other investments would include:
- (i) Equipment for landshaping and telecommunication.
 - (ii) Monitoring and evaluation.
 - (iii) Extension service.
 - (iv) Technical and agricultural extension and research support.
 - (v) Training, studies, study tours and consulting services.

Project: Tamil Nadu Water Resources Consolidation

Fiscal Year: 1995

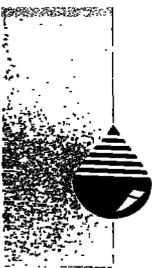
Loan/Credit Amount: US\$282.9 million (equivalent)

Description: The project would be a sector investment loan, to improve the productivity and sustainability of Tamil Nadu's irrigation sector, to introduce multisectoral water planning, to integrate farmers in irrigation management, and to strengthen the state's institutional and technical capability in water development, management and planning. Project components include:

- (a) Systems improvement and farmer turnover to improve productivity through rehabilitation and modernization of the existing irrigation systems.



- (b) **Scheme completion investments to complete viable investment on existing schemes for increased availability and reliability of water.**
- (c) **Capacity building in water planning, environmental management and research.**
- (d) **Institutional strengthening of Tamil Nadu's Water Resources Organization.**
- (e) **Associated land acquisition and economic rehabilitation for project-affected persons.**



Other Donor Support

Project: **Watershed Management (Bihar, Uttar Pradesh, Rajasthan, Himachal Pradesh and Tamil Nadu)**

Donor: Germany

Loan/Credit Amount: Phase I: DM2.6 M (US\$3.57 M equivalent)
Phase II: DM 8.0 M (US\$10.97 M equivalent)

Description: The broad objective of the project is to improve integrated watershed management based on hydrological monitoring in selected watersheds. On completion of phase II, the project aims to provide the central government, state departments and local people a strong data base and an appropriate model for water and soil conservation. The project has an on-the-job training component.

Project: **Replication of Self Help Activities in Watershed Development in Maharashtra.**

Donor: Germany

Loan/Credit Amount: DM 50.00 for Tech. Coop. (US\$6.85 M equivalent)

Description: The project aims to develop micro-watersheds in a comprehensive manner through participatory village self-help group initiatives so as to enhance the ecological basis of production and sustenance systems in order to create adequate and sustainable livelihood opportunities for all in the area of survival, thus leading to mitigation of the impact of drought and alleviation of poverty. Major project components are soil, land, water, crop management, afforestation, animal husbandry, rural energy management, human resource development and other nonfarm activities.

Project: **Watershed Development, Karnataka**

Donor: Germany

Loan/Credit Amount: DM 200.00 M (US\$27.4 M equivalent)

Description: The broad objective of the project is to ensure long-term sustenance basis for the rural population of the project area and to provide ecological stability to the area. Erosion control, minimization measures and groundwater management shall be undertaken. Rehabilitation of the affected population within a framework of five project areas covering 54,000 hectares of land with active



participation of the local population is envisaged. This will involve social forestry measures, afforestation and assistance in cleaning the existing drainage system.

- Project:** Yamuna Action Plan
Donor: Japan (OECD)
Loan/Credit Amount: ¥ 17.773 M (US\$178.0 M equivalent)
Description: The objective is to reduce pollution load on the Yamuna River and thereby improve the water quality.
- Project:** Conservation of Upper/Lower Lakes of Bhopal, Madhya Pradesh
Donor: Japan (OECD)
Loan/Credit Amount: ¥ 7.055 M (US\$71.0 M equivalent)
Description: Conserve and manage the Bhoj Wetland that consists of the Upper and Lower Lakes of Bhopal, which are now subject to severe environmental degradation due to pollution. Ensure availability of water from the Upper Lake, which is one of the major sources of water supply to Bhopal city, by increasing quantity and providing satisfactory quality.
- Project:** Gomti River
Donor: British-ODA
Loan/Credit Amount: £30 M (US\$48.5 M equivalent)
Description: Reduce the amount of pollution in the Gomti River and address causes of pollution in Lucknow.
- Project:** National Hydrology
Donor: British-ODA
Loan/Credit Amount: £75 M (US\$12.1 M equivalent)
Description: ODA to contribute training and other TC funds toward World Bank project to develop computerized data bases at national level in eight states covering important aspects of the hydrological cycle.
- Project:** Water Quality Monitoring Stations
Donor: Netherlands
Loan/Credit Amount: US\$390,000 equivalent
Description: Technical assistance to the Central Pollution Control Board in the



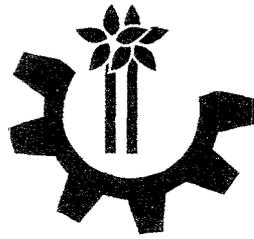
appraisal of the functioning of two water quality monitoring stations during a period of two years.

Project: **Biomonitoring, Phase I and Phase II**
Donor: Netherlands
Loan/Credit Amount: Not available
Description: *Phase I:* Compilation of a draft manual on biomonitoring of Indian surface waters (rivers), accompanied by an elaborate data base computer program.
Phase II: The use of the manual and the biomonitoring method will be tested by application in a monitoring program set up for this purpose with the help of the Central Pollution Control Board and State Pollution Control Boards.

Project: **Kallada Environmental Action Program (Quilon District, Kerala State)**
Donor: Netherlands
Loan/Credit Amount: US\$2,220,000 equivalent
Description: Development of a strategy for sustainable river basin management, including nature conservation as a pilot project.

Chapter 5

Control of Industrial Pollution



Control of Industrial Pollution

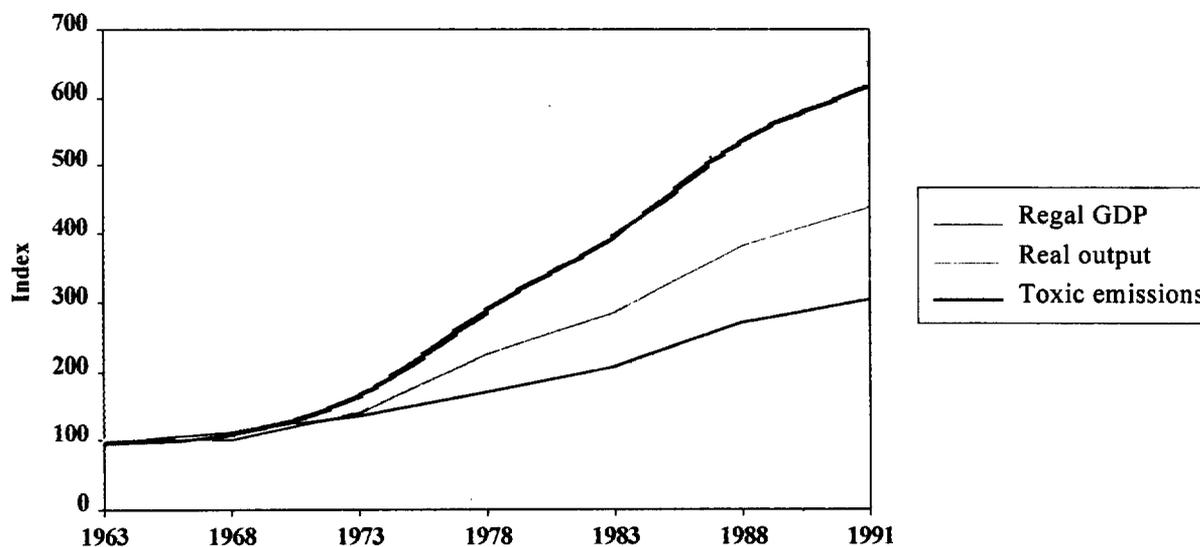
Industrial Growth and Pollution

5.01 Between 1963 and 1991, industrial output in India quadrupled, growing at an average annual growth rate of about 5.5 percent. The share of industry in gross domestic product (GDP) increased from 20 percent in 1963 to about 27 percent in 1992. Within the sector there have been modest shifts. In 1963, textiles and food products accounted for nearly half the output; by 1991 their share had declined to about a quarter. Iron, steel, refineries, and chemicals now account for nearly a third of output, and

machinery and transport equipment account for another fifth. The highest growth rates during these three decades were in the garments, petroleum refineries and chemicals, beverages, and ferrous and nonferrous metals subsectors.

5.02 Industrial growth has been accompanied by a variety of environmental problems. Whereas industrial output grew fourfold between 1963 and 1991, toxic releases grew sixfold (Figure 5.1). Toxic releases

Figure 5.1. Toxic Pollution and Industrial Growth, 1963-91





include heavy metals, cyanides, and pesticides. Preliminary work by the National Productivity Council in the State of Gujarat indicates that about 1 ton of toxic waste is generated by industry every year.

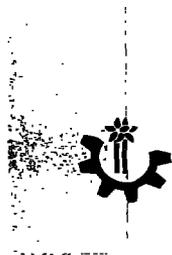
5.03 World Bank estimates show that pollution is concentrated among a few industrial subsectors and that a sector's contribution often is disproportionate to its contribution to industrial output (Table 5.1). For example, industrial chemical and iron and steel producers contribute nearly 70 percent of the toxic release but produce only

about 20 percent of the industrial output.

5.04 Reliable data regarding the share of industrial pollution in the total pollution load are hard to come by. The Ministry of Environment and Forests estimates that pollution from industrial sources contributes more than a third of the total pollution in rivers and other bodies of water. Data collected for the Bombay metropolitan region indicate that industry contributes only about 10 percent of the total pollution generated in the region (Coopers and Lybrand 1994).

Table 5.1. Industrial Contributions to Pollution by Subsector (percent)

Sector	Share of Industrial output	Toxics	Share of total Pollution			
			BOD	Particulates	Sulfur	Nitrogen
Industrial chemicals	7.5	44	29	8	11	15
Iron and steel	12.5	23	0	23	2	5
Nonferrous metals	2.1	6	10	3	1	0
Other chemicals	6.8	6	1	1	0	1
Food products	15.3	1	38	11	4	8
Paper and pulp products	2.0	2	19	4	15	11
Nonmetallic mineral products	3.4	1	0	32	3	10
Petroleum refineries	6.8	6	2	6	31	21
Textiles	11.1	3	1	6	30	23
Total	67.5	92	100	94	97	94



The Environment Action Program

5.05 The Indian government identifies control of industrial and related pollution as one of the seven priority areas in the Environment Action Program (EAP). The EAP advocates a mix of regulatory and economic measures to deal with industrial pollution and recommends increasing taxes to promote environmental protection (Box 5.1). Three

other priorities of the EAP also refer to industrial pollution:

- Improving access to clean technologies.
- Tackling urban environmental issues.
- Strengthening training, awareness, and scientific understanding of environmental issues.

Box 5.1. Priority Actions and Programs for Industrial Pollution Identified in the EAP

- Modernization of the leather, textiles, and pulp and paper industries.
- Institutional strengthening for research on natural dyes.
- Development of techniques to quantify pollutants from nonpoint sources (such as runoff from agricultural fields, waste disposal sites, leaky septic tank systems, mining and logging activities, and construction sites).
- Development of capacity to make reliable and cost-effective decisions on nonpoint sources of pollution control.
- Development of technologies for control of nonpoint sources based on past land-use practices.
- Development of physical methods for ascertaining the role of hydrology in influencing pollutant behavior, relating landuse to pollutant transport and effects on water bodies, relating contaminant concentrations to management practices, and addressing spatial and temporal variability in pollutant generation, transport, and delivery.
- Development of cost-effective water treatment technologies, particularly for desalination of brackish water, solutions to taste and odor problems, and removal of nitrates, pesticides, and heavy metals from drinking water.
- Dissemination of wastewater recycling technologies.
- Projects for least-hazardous methods of mining, erosion control in mining areas, proper mineral storage, proper disposal of mineral wastes in mined areas, pollution control from roads in mining areas, control of pollution in post-mining period, water diversion to prevent water contamination, and environmental rehabilitation of mined areas.
- Establishment of a national center for long-term training in environmental impact assessment and of a network of regional centers in various institutes for the preparation of these reports, including disaster management plans.
- A variety of training programs to create environmental awareness and to provide training on environmental matters.



GOI PROGRAMS

5.06 The following GOI programs are as identified in India's Environment Action Program.

Leather, Textiles, Paper

- ❑ Modernization for cleaner production in the leather, textiles, and paper and pulp industries.
- ❑ Organization strengthening for research on natural dyes.

Nonpoint source pollution

- ❑ Development of techniques for quantification of pollutants from nonpoint sources, for example, runoff from agricultural fields, waste disposal sites, leaky septic tank systems, mining and logging activities, and construction sites.
- ❑ Development of physical methods for ascertaining the role hydrology plays in influencing pollutant behavior; relating land use to pollutant transport and effects on water bodies; addressing spatial (single catchment, multiple catchments) and temporal (annual, event-based, continuous) variability in pollutant generation, transport and delivery; and relating contaminant concentrations to management practices.
- ❑ Development of decision-oriented methods to help make reliable and cost-effective decision about nonpoint sources of pollution control methods and their cost and relating contamination concentration to management practices.
- ❑ Development of technologies for control of nonpoint pollution as a result of past land use practices.

Industrial Waste and Waste-Water Treatment

- ❑ Development and demonstration of cost-effective water treatment technologies, particularly for removal of nitrates, pesticides and heavy metals from drinking water, desalination of brackish water, and providing solution to taste and odor problems.
- ❑ Demonstration and dissemination of wastewater treatment recycling and reuse technologies for water conservation.

Mining

- ❑ Projects for least-hazardous methods of mining, control of erosion in mining areas, proper storage of minerals, proper disposal of mineral wastes in mined areas, prevention and control of pollution from roads in mining areas, prevention and control of pollution in post-mining period, water diversion to prevent contamination of water, and environmental rehabilitation of mined areas.

5.07 The following programs are as identified in the annual report of the Ministry of Environment and Forests, 1994-95. These also include programs in hazardous waste management sponsored by the Central Pollution Control Board.

Hazardous Substances Management

5.08 Management of hazardous chemicals

- ❑ Creating infrastructure in State Pollution Control Boards to regulate the management of hazardous substances handled by hazardous industries.



- Mandatory safety audits in Major Accident Hazard Unit.
 - In order to reduce risk and prevent off-site consequences of accidents on-site, preparation of hazard analysis and off-site emergency plans.
 - For enhancing safety and emergency preparedness in units and reducing off-site consequences, initiation of industrial pocket-wise hazard analysis studies.
- 5.09 *Hazardous waste management*
- Handling and Management of biomedical waste.
 - Studies on inventorying of hazardous waste generating industries in various states.
- 5.10 *Crisis management*
- Management of crisis due to oil slick.



Major Issues and Recommendations

5.11 Industrial pollution abatement requires comprehensive efforts to improve the legal and regulatory framework, policies, institutions, and technologies that oversee and interact with industry.

LEGAL

5.12 Comprehensive legislation covers all the major aspects of industrial pollution and environmental management. The Water Act of 1974, amended in 1988, created central and state pollution control boards to enforce the Act. This was followed by the Air Act of 1981, which was amended in 1987. In 1986 the Environment Act was passed. In addition, there are Hazardous Wastes Rules (1989) and Manufacture, Storage, and Import of Hazardous Chemical Rules (1989).

POLICY FRAMEWORK

5.13 In 1992 the government issued a Policy Statement on Pollution Abatement (Box 5.2). The Statement, reflecting a broad approach, emphasizes that it is not enough for the government to create laws; it also must integrate environmental concerns with development planning, with an emphasis on preventing pollution and promoting technological inputs to reduce industrial pollutants. The overall policy objective is to integrate environmental considerations into decision-making at all levels. Specific steps identified to meet this objective include: preventing pollution at the source; encouraging, developing, and applying the best, most practical technologies; ensuring that the polluter pays for pollution and control

Box 5.2. Policy Statement for Abatement of Pollution

The Government of India issued a Policy Statement for Abatement of Pollution in February 1992. The policy statement affirms the government's intention to integrate environmental and economic aspects in development planning, with stress on the preventive aspects of pollution abatement, and promotion of technological inputs to reduce industrial pollutants. The overall policy objective is to integrate environmental considerations into decisionmaking at all levels.

Specific steps identified to meet this objective are:

- Prevent pollution at source.
- Encourage, develop and apply the best available practicable solutions.
- Ensure that the polluter pays for the pollution control arrangement.
- Focus protection on heavily polluted areas.
- Involve the public in decisionmaking.
- Increase the safety of industrial operations.

To achieve the objectives, maximum use will be made of a mix of instruments in the form of legislation and regulation, fiscal incentives, voluntary agreements, educational programs and information campaigns. The emphasis will be on increased use of regulations and an increase in the development and application of financial incentives.

Source: GOI March 1992.

arrangements; focusing protection on heavily polluted areas and river stretches; involving the public in decisionmaking; and increasing the safety of industrial operations.

5.14 Most enforcement for pollution abatement is based on regulatory standards. As a result of the Environment Act, the Central



Box 5.3. Fiscal Incentives to Encourage Control and Prevention of Pollution

The Government of India offers several incentives to ensure that industries are motivated to comply with the various environmental standards prescribed under different acts and rules to control and prevent pollution. Some major fiscal incentives are as follows:

Exemption from income tax. In order to ensure enthusiastic public involvement, particularly of the corporate sector and private individuals, donations given by a taxpayer to any association or institution for programs on conservation of nature and natural resources are exempt from income tax. The Secretary of the Ministry of Environment and Forests approves such institutions and associations.

Depreciation allowance. A depreciation allowance of 30 percent is allowed on devices and systems installed by industrial units for minimizing pollution or for conservation of natural resources.

Investment allowance. An investment allowance at the rate of 35 percent of the actual costs of new machinery or plant to assist in the control of pollution and protection of the environment is granted. The central government has notified a list of machinery and plant on which investment allowance is granted.

Exemption from tax on capital gains. The purpose of this incentive is to encourage industries to shift from congested urban areas. Capital gains arising from transfer of buildings or lands used for business purposes are exempt from tax if these are used for acquiring or for constructing buildings for the purpose of business at a new place.

Excise and duty exemption on utilization of fly-ash, phosphogypsum, and so on.

- Excise duty is exempted on the production of low-cost building materials and components.
- Excise duty is exempted on the production of building materials using fly-ash or phosphogypsum as raw material in 25 percent or greater quantities.
- Custom duty is exempted on the import of equipment, machinery and capital goods required for the production of building material such as bricks, light weight aggregates, light weight concrete elements, and so on, using fly-ash or phosphogypsum.
- Reduction in excise duty up to 15 percent is allowed on prefab components required for housing.

Source: MOEF 1994.

Pollution Control Board has established comprehensive national standards for industrial operations (Minimum National

Discharge Standards). These standards are comparable to standards in many industrial countries. In addition, states are allowed to establish more stringent standards. New industrial units have to undergo an environmental impact assessment, and to obtain clearances to establish and to operate. All established industrial units must renew these clearances every one to three years, depending on their activities and location. Though standards are largely concentration-based, the government is moving toward load-based standards (level of pollution related to level of production), especially for highly polluting industries. Most regulations, guidelines, and standards are fairly well developed. There is need, however, to establish a stronger link between source-specific and ambient standards.

5.15 Some fiscal instruments for pollution abatement exist: excise and customs exemptions and an accelerated depreciation allowance on pollution control equipment, soft-loan schemes, water levies, and so on (Box 5.3). But these instruments are limited in scope and do not reflect an overall strategy for environmental management. The policy statement recognizes the need to review these incentives and to identify a set of economic instruments to deal with pollution. Given the deregulation and tax reform that are under way in India, there is both a need and an opportunity to develop a broadly based set of economic instruments for pollution abatement.

INSTITUTIONS

5.16 The Central Pollution Control Board and the State Pollution Control Boards were established to implement the provisions of the Water Act. Although the increasing number of environmental laws require the



boards to operate as environmental management agencies, their operating philosophies and staff attitudes have changed little since the boards were established. Most of the boards have inadequate facilities and infrastructure. For example, while most of them have basic testing equipment at the central or state headquarters, this capacity is lacking at regional and local offices. Accordingly, there is a need to modernize the boards.

5.17 Although enforcement has improved significantly over the past several years in some of the more industrial states, this improvement is limited to nontoxic air and water pollution from large and medium-size private industrial units. Regulations for public units are poorly enforced due to political interference in the functions of the state boards. In addition, the boards cannot deal with the large number of small-scale industrial units. Most boards lack the capacity to monitor and enforce regulations related to hazardous waste management. As with other enforcement activities in India, corruption is pervasive. During the past few years, however, enforcement has been strengthened by active public interest litigation. The judiciary, especially at the highest levels, is taking an increasingly proenvironmental stance. Still, the judiciary has been unable to deal with policy issues, largely because it lacks the technical background that is needed to evaluate environmental impacts (Roychowdhury 1994).

TECHNICAL AND SCIENTIFIC ISSUES

5.18 India has a large pool of skilled technicians and managers capable of dealing with pollution issues. But given the boards' budget constraints and low salaries, it is difficult to attract and retain staff that is on par with the private sector. As a result, many

boards have excessive numbers of non-technical staff.

5.19 Also limiting technical progress are the many constraints to accessing clean technologies, ranging from information problems to constraints imposed by industrial and trade policies. These constraints are discussed in Chapter 6.

FINANCIAL ISSUES

5.20 Some of the enforcement boards are financially independent and do not depend on the state or central government for their operating budgets or, in some cases, for their capital budgets. These boards generate 80 to 90 percent of their revenues from licensing fees, water levies, and other charges. Collection rates from industrial units are high; the same cannot be said about collection from municipalities.

5.21 Given the rapid changes in the Indian financial markets, there are no obvious constraints for large industrial units wanting to access resources for investment in pollution abatement. There are, however, real constraints to investment by the small and medium-scale sector, since they often are not prime-rated borrowers.

PARTICIPATION

5.22 As mentioned, public interest litigation has been a driving force behind more effective environmental enforcement. The government's policy statement for pollution abatement recognizes this fact and addresses public partnership as a priority. But suppression of or inaccessibility to information has been a major stumbling block in litigation. Government officials often prevent access to



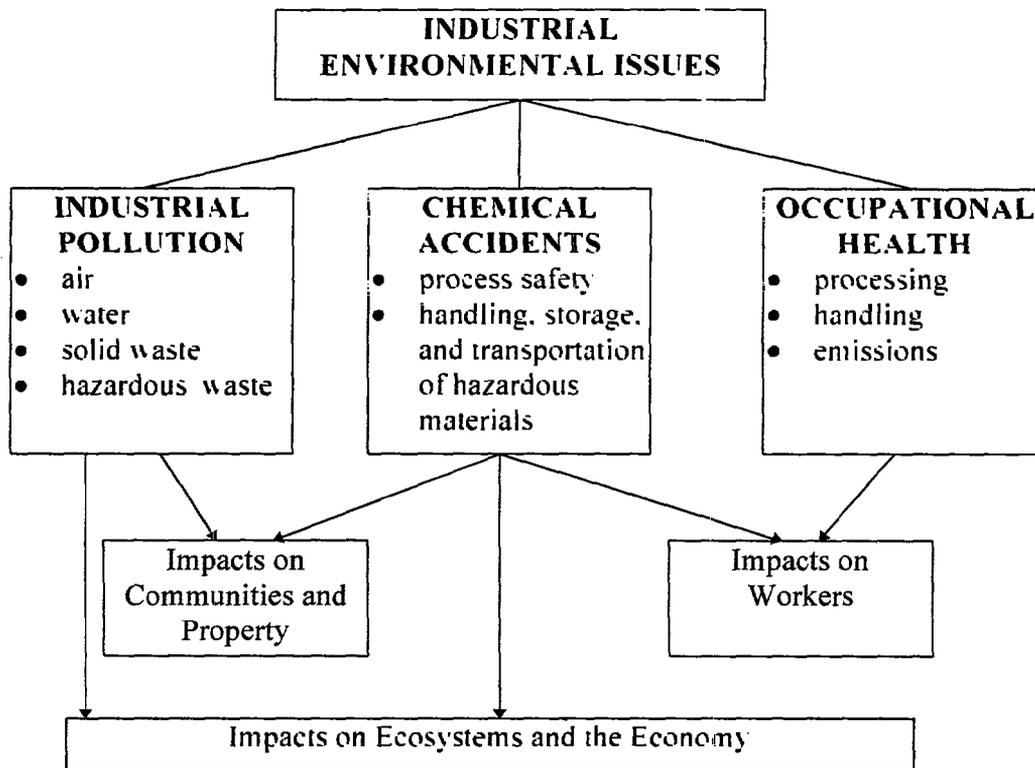
documentation. Given that enforcement agencies are weak, the capacity of the public to bring pressure on polluters must be strengthened. This cannot happen without a formal and transparent public disclosure process.

RECOMMENDATIONS

5.23 An examination of the interaction between industry and the environment identifies three major categories of environmental issues: industrial pollution, chemical accidents, and occupational health (Figure 5.2). These issues are identified based on their impacts on human populations, ecosystems, and the economy.

5.24 Bank assistance to India so far has focused on industrial pollution and has helped to establish fairly strong foundations for dealing with this problem. Bank assistance also has been a magnet for other multilateral and bilateral donors. The programs supported by the Japan's Overseas Economic Cooperation Fund and the Nordic Investment Bank have adopted the same structure as the Bank-assisted projects. The Bank has developed a strong working relationship with the Ministry of Environment and Forests and other central and state agencies. Though environmental management in India has improved significantly in the past several years, institutions are still weak, and the policy and implemen-

Figure 5.2. Environmental Issues in Industry





tation framework needs strengthening. Thus there is a need for further Bank assistance. The first priority is to refine and expand current efforts at industrial pollution abatement. The second priority is to develop assistance programs in other areas of industrial environmental management.

Refining and expanding industrial pollution abatement efforts

5.25 The two Bank-assisted projects have helped the government establish a basic framework for pollution abatement. Still, the approach to industrial pollution abatement must be refined in order to achieve further progress.

Policy framework

5.26 The Bank could assist the government in two areas: developing an area-based approach to pollution abatement.

5.27 The government's current strategy for pollution abatement is sector-based, focusing on industrial units in the chemical and allied sectors. While such an approach does reduce pollution from individual sources, it does not guarantee achievement of desirable ambient conditions in a defined area. The Central Pollution Control Board has identified twenty-two nonmetropolitan areas where pollution is at critical levels, and action plans have been prepared for fourteen of these areas. But these plans only address industrial units belonging to the seventeen highest-polluting categories. This approach is inadequate because an area's pollution often comes from multiple sources, requiring a strategy that identifies a hierarchy of cost-effective interventions across the different sources. Such an area-based strategy (Box 5.4) focuses the efforts and resources of enforcement agencies on targeted reductions of pollution and covers

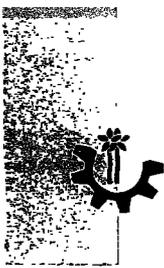
Box 5.4 Area-based Pollution Abatement Strategy

Area-based pollution abatement strategies focus on areas where pollution is at or near a crisis stage, and develop action plans. A set of ambient standards is usually determined for an area (a watershed, an airshed) based on evidence of environmental degradation of human health and welfare, with the recognition of some future population growth, encroachment factors, and so on. While theoretically there is a scientifically optimal level of pollution, it is more realistic to select acceptable ambient standards through some process of collective choice, as with other public goods. A program of environmental management should then ensure that the aggregate pollution from the area does not exceed the established standards. This can be achieved through a regulatory regime, a market-based regime, or a combination of the two.

all sources of pollution.

5.28 The EAP addresses economic instruments for pollution abatement as a priority in the industrial pollution strategy. Some fiscal incentives for environmental protection are already in place in the industrial sector, such as the water levy, though their effectiveness is questionable. Under the Industrial Pollution Prevention Project, the Ministry of Environment and Forests has established a task force to examine the feasibility of using economic instruments to complement the regulatory regime for industrial pollution abatement. It is important that this initiative be considered a priority in the Bank's dialogue with the government on environmental management.

5.29 Beyond this, one of the major causes of industrial pollution is industrial policy. For example, the cost-plus pricing of outputs, together with an inward-looking trade regime, has favored the development of energy- and capital-intensive sectors with



Box 5.5. The Public Liability Insurance Act, 1991

The Public Liability Insurance Act was enacted on January 23, 1991, to provide immediate relief to persons affected by accidents while handling hazardous substances. The act requires that:

- Where death or injury to any person (other than a workman) or damage to any property has resulted from an accident, the owner is liable to give relief on a "no fault basis."
- Every owner must take out, before he starts handling hazardous substances, one or more liability insurance policies equal to its paid up capital or Rs. 500 million, whichever is less. The policy has to be renewed every year. New undertakings must apply for liability insurance before starting their activity.
- Accidents are verified by the District Collector, who may hold an inquiry into the claim (s) and may make an award determining the amount of relief.
- The central government will set up an Environmental Relief Fund to be utilized for paying, in accordance with the provisions of the Act. The owner also has to pay an amount equal to its annual premium to the central government's Environment Relief Fund. The reimbursement of relief to the extent of Rs.2500 per person is allowed in case of fatal accidents in addition to the reimbursement of medical expenses up to Rs. 12,500. The liability of the insurer is limited to Rs. 50 million per accident up to Rs. 150 million per year or up to the tenure of the policy. Any excess claims will be paid from the environment relief fund or by the owner.

Owners must provide the final compensation, if any, arising out of legal proceedings.

The Public Liability Insurance Amendment Act specifies the responsibilities of different participants under the liability law.

Source: The Public Liability Insurance Act, 1991, Ministry of Law and Justice, Jan 23, 1991; The Public Liability Insurance Rules, 1991, Ministry of Environment and Forests, May 15, 1991; Handbook of Environmental Procedures and Guidelines, GOI, Ministry of Environment and Forests, 1994.

suboptimal plant sizes. Artificially low raw material prices provide few incentives for efficient use of materials or for resource recovery and recycling. High product prices arising from high effective protection encourage expansion of capacities that may not be consistent with India's comparative advantage and that provide enterprises with little incentive to be efficient. Suboptimal plant sizes increase both production costs and treatment costs (especially in the small-scale sector) and make it difficult for firms to meet environmental standards. In addition, policy constraints such as weak intellectual property laws may inhibit the availability and transfer of technology. The liberalization and structural reform currently under way should address many of these issues; it would be useful to study the changing industrial policies and their impacts on the environment.

Institutional strengthening

5.30 While institutions for pollution abatement exist at the central and state levels, improving their capacity to meet their mandates is an ongoing task and should be integral to any Bank assistance program. The boards have to be reoriented to deal with pollution abatement strategically, rather than just controlling pollution from all sources and at all places. To this end, the boards should prepare action plans for areas under their jurisdictions where environmental conditions are critical and should focus their resources on these areas. There also is a need for training and recruitment programs to address the large numbers of nontechnical staff.

5.31 While the capacity of the eight state control boards supported through Bank-financed projects to monitor and regulate large and medium-size industrial units in the highly polluting sectors has improved, there is little enforcement in the small sector or in the area



of toxic and hazardous waste. In addition, many state boards are unable to enforce compliance in the public sector (especially thermal power plants) due to political interference. The credibility of enforcement in the private sector has been strengthened in recent years by landmark proenvironmental judgments by the Supreme Court. But enforcement continues to be an uphill battle, and strengthening the capacities of the state boards and other enforcement agencies (through training, better facilities, and professional technical staff) must be a part of any environmental management work in India.

Technical and scientific issues

5.32 Efforts to strengthen the technical capacity of the boards have been linked to organizational restructuring of the boards, and have given them more autonomy in recruitment and compensation. Still, there are constraints to the development of cleaner technologies in India. To address the information problems and lack of demonstration, the Ministry of Environment and Forests has started developing a Clean Technology Information Network. This activity is being supported through the Bank-assisted Pollution Prevention Project. The network must receive the full support and participation of private industry in order to succeed.

Financial issues

5.33 Some of the State Pollution Control Boards have demonstrated the capacity for financial autonomy and effectiveness. The rest of the boards should emulate them. The issue of the boards' resource management is related to the framework of economic policy instruments. There seem to be no obvious constraints to financial resources for the large industrial units; these units should be made to contribute, through licenses and levies, to

Box 5.6. The Environmental Audit Notification, 1992

This notification applies to every person carrying on an industry, operation or process requiring consent to operate under the Water Act, Air Act, or both, or authorization under the Hazardous Wastes (Management and Handling Rules), 1989, issued under the Environment (Protection) Act, 1986.

The notification requires that an environmental statement for the financial year ending March 31 be submitted to the concerned State Pollution Control Board on or before September 30 every year, beginning in 1993.

The realization that industry and environment should go hand in hand so as to achieve sustainable development was brought in realization to consider environmental protection a bare necessity. "Environmental Audit" is a technique being introduced for integrating the interest of the industry and the environment so that these could be mutually supportive.

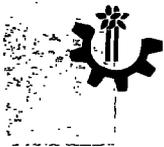
The Policy Statement for Abatement of Pollution by the Government of India, provides for submission of environmental statement by all concerned industries, which would subsequently evolve into an environmental audit.

[Environmental Auditing is a management tool comprising a systematic, documented, periodic and objective evaluation of how well the management systems are performing with the aim of: waste prevention and reduction, assessing compliance with regulatory requirements, facilitating control of environmental practices by a Company's management and placing environmental information in the public domain].

Source: Desai 1994; Central Pollution Control Board 1993.

the boards' operational costs.

5.34 While such concessionary financing may not be the answer for the medium-size and small units, an argument can be made for bearing the cost of concessions or subsidies through taxes levied on polluters, managed by an Environmental Fund.



Box 5.7. The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989

The Manufacture, Storage and Import of Hazardous Chemicals Rules were developed under authority conferred by the Environment (Protection) Act, 1986. The principal objectives of the rules are the prevention of major accidents arising from industrial activities, the mitigation of effects of such accidents on people and on the environment, and the harmonization of various control measures and agencies to prevent and limit major accidents.

The rules specify three levels of requirements.

- General or low-level requirements apply to 434 chemicals and require the industrial unit to take necessary precautions to prevent major accidents, to report those that do arise and take steps to limit consequences, prepare a Material Safety Data Sheet, report imports, and properly label the hazardous chemicals handled.
- The medium-level control applies to 179 chemicals and requires that the unit in control of the relevant activity provide workers on site with information, training and necessary equipment to ensure their safety as well as an off-site emergency plan.
- The high-level controls apply to 17 chemicals in quantities that are unsafe. Users of these chemicals must prepare a Safety Report. New industries are required to prepare the Safety Report within five years of beginning operation. An on-site emergency plan for dealing with major accidents is also required.
- Both medium and high-level controls require public disclosure. Information regarding a potential off-site spill or an on-site accident must be provided to the District Collector for the preparation of an off-site emergency plan before commencement of the activity. Also, the public in the vicinity of the plant needs to be informed of the nature of a major accident that might occur on-site and what to do in case of such an occurrence.

Source: MOEF 1992, 1994.

Participation

5.35 While the government's pollution abatement policy "encourages new forms of public partnership, recognizing the vital fact

that environmental quality cannot be achieved by the actions of the government alone," there is a need for more transparent public disclosure. The Environmental Statement and Audit Process could be extended to meet this objective. There is also the possibility of supporting nongovernmental organizations (NGOs) with equipment and training to monitor industrial units. Further, the state control boards could periodically release a list of environmental violators in the local press and television.

Expansion of the Industrial Pollution abatement program

5.36 The Bank's efforts to reduce industrial pollution in India are on track, but there is room for a few refinements (suggested above). There are, however, two critical areas in industrial pollution abatement that could benefit from Bank involvement:

- A program to strengthen the toxic and hazardous waste management system, focusing on reduction, safe handling and transportation, and safe disposal of waste (Boxes 5.7 and 5.8).
- An expanded pollution abatement program for small-scale industrial units, building on the common effluent treatment plants and environmental extension program already under way through Bank projects.

Developing assistance programs in other areas of industrial environmental management

5.37 India must develop new ways of dealing with industrial safety and efficiency issues if industrial development is to be sustainable and beneficial. Industrial safety efforts and the environmental agenda



accelerated following the 1984 Bhopal disaster. The government has passed comprehensive legislation and created institutions to deal with industrial safety. But these efforts have not prevented a series of chemical accidents and associated casualties. Though the impacts have not been as calamitous as the Bhopal incident, the frequency of accidents has raised questions about the effectiveness of enforcement and available facilities.

5.38 The Indian chemical industry is the second largest in the world, producing more than 102 million tons of chemicals each year (Shrivastava 1994). The consumption of fertilizers increased from about 200,000 tons in 1959 to about 12 million tons by 1992, and the toxicity of more than 60 percent of the chemicals that go into fertilizer production is unknown. The number of urban-industrial complexes with chemical factories is expanding rapidly.

5.39 The Ministry of Environment and Forests has indicated interest in a Bank-assisted program to strengthen the capacity of government agencies, the private sector, and communities to improve industrial safety and to mitigate the impacts of accidents when they occur. Dialogue on this subject is fairly well advanced, and the ministry has determined the structure of a program of assistance.

5.40 Two other areas should be explored for Bank assistance. The first, occupational health, is a component of environmental issues associated with the industrial sector. The second, fuel reformulation, is indirectly associated with the industrial sector in that policy reforms and investments have to be made in the petrochemical sector.

5.41 International Labor Organization statistics show that India experiences the third

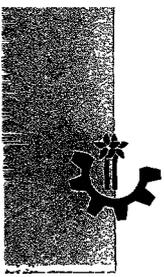
Box 5.8. The Hazardous Wastes (Management and Handling) Rules, 1989

The Hazardous Wastes (Handling and Management) Rules require industries to classify wastes into categories. Other provisions include:

- The occupier generating hazardous wastes must take all practical steps to ensure that such wastes are properly handled and disposed off.
- Hazardous wastes must be collected, treated, stored and disposed of only in facilities authorized for this purpose by the State Pollution Control Boards.
- Before hazardous wastes are delivered, the facility occupier or operator must ensure that the hazardous wastes are packaged in a manner suitable for storage and transport.
- The state government or a person authorized by it must undertake an ongoing program to identify disposal sites and compile and publish periodically an inventory of disposal sites within the state.
- The occupier generating hazardous waste and the operator of a facility for collection, reception, treatment, transport, storage and disposal of hazardous waste must maintain records of such operations.
- When an accident occurs during transport of hazardous wastes, the facility occupier or operator must report the incident immediately to the State Pollution Control Board.
- Import of hazardous wastes from any country to India for dumping and disposal is prohibited. However, import of such wastes may be allowed for processing or reuse as raw material.

Source: Notification of the Ministry of Environment and Forests, New Delhi, July 28, 1989; Desai 1994.

highest level of fatal accidents in the manufacturing sector—about 25 deaths per 100,000 workers every year. It is not known how many of these fatalities are caused by exposure to pollution, fugitive emissions, and handling of toxic material in industrial units. Nor is it clear how morbidity levels are affected by such exposure. The Ministry of Labor and the State Factory Inspectorates are responsible



for worker safety under the Factory Act of 1947. As preliminary steps toward exploring Bank involvement, it would be useful to understand the magnitude of this problem, and to determine whether the mandate of the government agencies includes occupational health, the possibility of enforcing that mandate, and the capacity of the private sector to meet that mandate.

5.42 Any air pollution mitigation

strategy should include fuel reformulation involving unleaded gasoline, reduction of the sulfur and aromatic content of diesel fuel, and introduction of alternative fuels such as compressed natural gas, liquefied petroleum gas, or alcohol fuels. These efforts would require investments in the industrial sector, especially in petrochemical units. Bank involvement in this area would be worth exploring, since it would address one of the major urban environmental problems in India.



GOI Program Objectives

Category: *Environment Action Program*

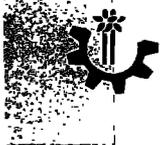
Government Objectives/Programs:¹

Modernization for cleaner production in leather, textiles, paper and pulp industries; research on natural dyes; development techniques for quantification of pollutants from nonpoint sources, such as runoff from agricultural fields, waste disposal sites, leaky septic tank systems, mining and logging activities and construction sites; development of physical methods for ascertaining the role of hydrology in influencing pollutant behavior; relating land use to pollutant transport and effects on water bodies and contaminant concentrations to management practices; development of technologies for control of nonpoint pollution as a result of past land use practices; development and demonstration of cost-effective water treatment technologies, particularly for removal of nitrates, pesticides and heavy metals from drinking water, desalination of brackish water and providing solution to taste and odor problems; demonstration and dissemination of wastewater treatment recycling and reuse technologies for water conservation; least-hazardous methods of mining, control of erosion in mining areas, proper storage of minerals, disposal of mineral wastes in mined areas, prevention and control of pollution from roads in mining areas, water diversion to prevent contamination of water and environmental rehabilitation of mined areas

Donor Agency Support

Project	Donor	Funding
<i>Leather, Textiles, Paper</i>		
Industrial Counseling, Tanneries	Netherlands	US\$1.56 M equiv.
Industrial Counseling, Mysore Paper	Netherlands	US\$0.78 M equiv.
Industrial Counseling Audit, Gujarat	Netherlands	US\$0.23 M equiv.
Environmental Audit, Tanneries	Netherlands	US\$0.02 M equiv.
Central Leather Institute	Netherlands	US\$2.28 M equiv.
Pollution Control in Tanning Industries	Switzerland	US\$0.026 M equiv.
Treatment of Tannery Effluents	UNIDO	US\$1.53 M million

¹ GOI programs were extracted from India's Environment Action Program and the annual reports of the Ministry of Environment and Forests (1994-95)



Project	Donor	Funding
<i>Nonpoint Source Pollution</i>		
Fly-Ash Pond Monitoring	Netherlands	US\$0.61 M equiv.
<i>Industrial Waste/Water treatment</i>		
Industrial Counseling, Gujarat, Fertilizers	Netherlands	US\$2.05 M equiv.
Industrial Pollution Control	World Bank	US\$124.0 M
	IDA	US\$31.6 M equiv.
Industrial Pollution Prevention	World Bank	US\$250.0 M

Category: *Hazardous Substances Management*

Government Objectives/Programs:

Creating infrastructure in State Pollution Control Board to regulate the management of hazardous substances handled by hazardous industries; mandatory safety audits in Major Accident Hazard Unit; preparation of hazard analysis and off-site emergency plans; initiation of industrial hazard analysis studies; handling and management of biomedical waste; management of crisis due to oil slick. Studies on inventorying of hazardous waste generating industries in various states.

Donor Agency Support

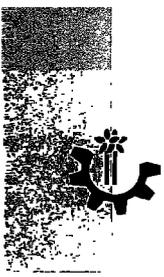
Project	Donor	Funding
<i>Hazardous Waste Management</i>		
Toxic & Haz. Waste Mgmt. Tamil Nadu	ADB	US\$0.52 M



World Bank Support

Project:	Industrial Pollution Control
Fiscal Year:	1991
Loan/Credit Amount:	IBRD US\$124.0 million / IDA US\$31.6 million (equivalent)
Description:	<p>The project objective is to support the GOI's efforts to prevent and alleviate environmental degradation caused by industrial operations and assist in the successful attainment of the proposed short- and medium-term targets of its environmental policy.</p> <p>The proposed project comprises three components:</p> <ul style="list-style-type: none"> (a) <i>An institutional component</i> designed to strengthen the Central and State Pollution Control Boards in the states of Maharashtra, Gujarat, Tamil Nadu and Uttar Pradesh. The component would finance a training program in technical and managerial skills; acquisition of equipment required to upgrade technical capabilities of the Boards; and other managerial skills. (b) <i>An investment component</i> designed to finance : individual projects in target sectors dealing with waste minimization, resource recovery and pollution abatement; the set up of common treatment facilities at industrial estates, for the treatment and disposal of liquid and solid wastes; and selected demonstration projects based on their prototype nature or novelty of application in India. (c) <i>A technical assistance component</i> designed to assist the Ministry of Environment and Forests to evaluate environmental problems and develop solutions; and the DFI's to assist enterprises in undertaking the required feasibility studies for pollution control investments.

Project:	Industrial Pollution Prevention
Fiscal Year:	1994
Loan/Credit Amount:	US\$250.0 M (equivalent)
Description:	<p>The project objective is to assist in the implementation of the government's policy on pollution abatement and promote cost-effective pollution abatement from industrial sources. The project will focus on the most polluting industrial sectors and comprise three components :</p>

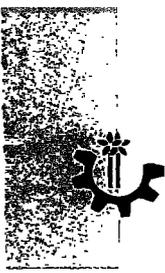


- (a) *An institutional component* designed to strengthen the State Pollution Control Boards in the states of Rajasthan, Madhya Pradesh, Karnataka and Andhra Pradesh. In addition, support to the boards in Gujarat, Maharashtra, Tamil Nadu, and Uttar Pradesh will continue to be provided, complementing the activities already sponsored under the Industrial Pollution Control Project.
- (b) *An investment component* will support subprojects by individual firms for pollution abatement, with a focus on waste minimization, and adoption of cleaner methods of production. The line of credit for priority investments provided under the first project would be continued. Resources would also be renewed for financing common effluent treatment plants (CETPs) which would now include funding for industrial water recycling plants (IWRPs) that use sewage as input.
- (c) *A technical assistance component* to support:
 - (i) *The establishment of a “clean technology institutional network”* designed to promote the development, diffusion and transfer of technologies with environmental benefits for industry.
 - (ii) *Extension services for the identification of waste minimization and abatement methods* for small-scale industry, and the organization of waste minimization circles.
 - (iii) *Preinvestment studies* for CETPs, IWRPs, and other waste minimization facilities proposed to be financed under the project.
 - (iv) *Finance for other training and consulting services* under planning by the MOEF, including the training requirements for the preparation of environmental statements by industries.



Other Donor Support

- Project:** Toxic and Hazardous Waste Management-Tamil Nadu
Donor: ADB
Loan/Credit Amount: US\$521,000
Description: The objective of the TA is to assess the feasibility of establishing a toxic and hazardous waste collection, storage, and treatment facility to service the Manali and Ennore industrial complex. The TA, which will be carried out in two phases, will focus on the required institutional arrangements and financial instruments to ensure long-term financial sustainability and full cost recovery.
- Project:** Industrial Counseling; Tanneries (Kanpur, Uttar Pradesh)
Donor: Netherlands
Loan/Credit Amount: US\$1, 556,000 equivalent
Description: To disseminate economically viable clean technology in combination with occupational health measures in the leather industry, it is proposed to set up a revolving fund and to finance technical assistance for the introduction of chrome recovery plants in tanneries.
- Project:** Industrial Counseling; Mysore Paper Mill
Donor: Netherlands
Loan/Credit Amount: US\$778,000 equivalent
Description: To demonstrate the techno-economical viability of clean technology in the paper industry in order to introduce environmental/safety measures along with energy conservation and mitigation of health hazards.
- Project:** Industrial Counseling, Gujarat State Fertilizers Comp.
Donor: Netherlands
Loan/Credit Amount: US\$2,056,000 equivalent
Description: To demonstrate and disseminate clean technology in the fertilizer industry, including safe occupational health measures, by cooperation with a fertilizer-producing company in Vadodara (Gujarat State).



Project: **Industrial Counseling, Textiles Audit (Jetpur, Gujarat State)**

Donor: Netherlands

Loan/Credit Amount: US\$236,000 equivalent

Description: To provide insight into the degree and nature of pollution caused by a cluster of 1,200 textile dyeing and printing facilities in Jetpur, Gujarat State, and to explore opportunities for pollution abatement and reduction of residues.

Project: **Environmental Audit Tanneries (Jajmau area of Kanpur)**

Donor: Netherlands

Loan/Credit Amount: US\$23,000 equivalent

Description: Conduct an environmental audit; recommend appropriate interventions in the production cycle to reduce pollution of the Ganges River and indicate measures to mitigate occupational health hazards for workers in the industry.

Project: **Industrial Counseling; Fly-Ash Pond Monitoring**

Donor: Netherlands

Loan/Credit Amount: US\$611,000 equivalent

Description: Monitor dispersion in groundwater and soil for heavy/toxic metals from a wet fly-ash disposal site of a large-scale power plant. Set up laboratory experiments such as leaching test facilities to forecast dispersion of these components in the environment.

Project: **Central Leather Research Institute of India (CLRI)**

Donor: Netherlands

Loan/Credit Amount: US\$228,000 equivalent

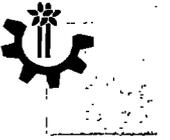
Description: Research program by the CLRI and the TNO Research Institute of the Netherlands, directed at reduction of pollution and environmental degradation by the leather industry in India.

Project: **Assistance in Pollution Control in the Tanning Industry in Southeast Asia**

Donor: Switzerland

Loan/Credit Amount: US\$0.026 M equivalent

Description: To assist the leather industry to expand without causing unnecessary damage to the environment or undue economic burden on the industrial enterprises.



Project: **Assistance in Treatment of Tannery Effluents**

Donor: UNIDO

Loan/Credit Amount: US\$1,534,500

Description: The immediate objective is containment of environmental degradation emanating from a selected agglomeration of tanneries in Tamil Nadu. The development objective is to assist the Indian leather industry to expand without causing unnecessary damage to the environment.

Chapter 6

Improving Access to Clean Technologies





Improving Access to Clean Technologies

6.01 Indian industrial output has quadrupled in real terms over the past thirty years (see Figure 5.1). Accompanying this industrial expansion has been rapidly growing consumption of energy and rising pollution. Clean technology is one of the tools available to deal with this pollution.

6.02 Two technological interventions are used to control pollution. The end-of-the-pipe method treats wastes or emissions that

already have been generated, reducing their volume and toxicity. Clean technologies, by contrast, reduce waste and emissions at their source (Box 6.2). Clean technologies can be used together with end-of-the-pipe treatment to considerably reduce pollution. Clean technologies are a cost-effective means of abating pollution, since the reduction of wastes and pollutants enhances process efficiency and production quality.

Box 6.1. Cleaner Technologies Institutional Network

The World Bank-funded Industrial Pollution Prevention Project is supporting the establishment of a Clean Technology Institutional Network (CTIN) with a \$2 million IDA credit. The CTIN is expected to facilitate information exchange through a computer-based network between various interest groups on opportunities for pollution prevention. A Host Center will be located at the MOEF, and a National Information Center for Cleaner Technologies (NICCT) will be located at the National Environmental Engineering Research Institute (NEERI). Supporting the Host Center and NICCT will be sectoral centers and sub-centers located at different premier research institutions and universities. User centers will be located at different State Pollution Control Boards and industrial associations. NICCT will be supported by grants from the MOEF during the first five years of operation and thereafter be autonomous.

The CTIN is expected to develop a master data base of clean technologies, provide information for quality control, develop guidelines for selection and implementation of demonstration projects, and network with regional systems. The data bases developed by the CTIN are expected to contain:

- National and international environmental policies and legislation.
- Financing mechanisms and incentives for implementation of cleaner technologies.
- Raw material usage, energy/water consumption and waste generated per unit of production.
- Waste minimization technologies, including the stage of development, terms of supply, sources and benefits.
- Energy conservation technologies.
- End-of-pipe treatment technologies, facilitating waste utilization, recycling, reuse, and by-product recovery;
- Integrated waste management technologies.
- Technologies for reduction/elimination of toxic and hazardous chemicals.
- Listing of equipment suppliers for environmental management.
- Listing of human resources for environmental management, including academic, research, and training institutions; consultants and consulting firms; and voluntary organizations.

Source: NEERI "Establishment of Cleaner Technology Information Network in India," a proposal submitted to the World Bank, 1994.



The Environment Action Program

6.03 The Environment Action Program (EAP) identifies “improving access to clean technologies” as one of the seven priorities for environmental management. The EAP notes that pollution prevention efforts are a priority because of the limited supply of raw materials and the need to adhere to global environmental norms on production output and processes. The growing incidence of energy shortages also has emphasized the need for clean technologies, which conserve energy.

6.04 The EAP envisages clean technologies as providing valuable tools for dealing with the environmental problems associated with the industrial and energy sectors. The program identifies a variety of measures that would improve access to these technologies while addressing environmental concerns:

- Strengthen institutions for research and technology development under the National Materials Initiatives for raw material upgrading; improving the performance of conventional materials; and promoting energy substitution, conservation, and environmental sustainability under the science and technology program under the industrial sector.
- Launch a technology mission on cleaner production to coordinate activities for promoting cleaner technologies through government policies, research and development institutions, industry associations, financial institutions, and regulatory agencies.
- Formulate industry-specific task forces to select demonstration and development projects.
- Identify cleaner technologies developed in research laboratories and industrial units in India and abroad and facilitate their transfer and adoption.
- Establish centers for cleaner technologies to develop a centralized data base and to provide information to industries.
- Build capacity for environmental audits to prevent pollution.
- Build indigenous engineering capacity for the adoption, adaptation, and improvement of imported technology.
- Formulate standards for waste discharge per unit of raw material.
- Formulate legal and economic measures to ensure adoption of clean technologies.
- Build capacity for environmental impact assessment of clean technologies.



Major Issues and Recommendations

6.05 Several constraints inhibit the adoption of clean technologies. The government must address these issues if the industrial and energy sectors are to adopt such technologies.

LEGAL

6.06 One of the main issues associated with the adoption of clean technologies is intellectual property rights. One view, often held by developing countries, is that enforcement of such rights prevents developing countries from accessing technologies from industrial countries and suggests that firms from industrial countries license their technology on favorable terms. The opposing view, held by industrial countries, is that inadequate intellectual property rights enforcement in developing countries discourages investment and technology licensing.

6.07 Indian industrial policy focuses on self-reliance; this has led to attempts to integrate local and imported technologies. When these efforts were hampered by inefficiencies and delays, the government encouraged importing technology in the context of large-scale turn-key projects. But technology imports are constrained by cumbersome procedures. Although these limitations may have encouraged the development of local technological capacity, they often have curbed the effective use of these technologies. The policy and institutional framework associated with technology transfer and absorption is slowly changing as economic liberalization spreads. But the impact of these

Box 6.2. Waste Minimization and Waste Minimization Circles

Waste minimization is an example of a clean technology intervention.

The Bank-financed Industrial Pollution Prevention Project provides Technical Assistance (US\$500,000) for extension services for the identification of appropriate waste minimization and abatement methods for small-scale industrial units, and the organization of waste minimization circles. The TA builds on experience gained in India with respect to pollution abatement in small-scale industrial units. Studies carried out by the Confederation of Chemical Industries, National Productivity Council (NPC), and the Indian Institute of Technology, Bombay, indicate that up to a 20 percent reduction in waste generation is possible through simple housekeeping measures which do not require large investments. More recently, the UNIDO-funded, NPC-executed project demonstrated that such results could be obtained in most industrial subsectors with a pay-back period for investment of less than a year.

Waste minimization circles are self-functioning groups developed among firms in the same industrial subsector in a geographical region, to share experiences in the promotion of waste minimization. They should provide a forum for small-scale entrepreneurs to come together to seek common solutions to waste minimization and pollution abatement. Some technical expertise will be provided through NPC and other technical institutions.

changes on development and adoption of clean technology is not yet understood.

POLICY FRAMEWORK

6.08 One of the underlying causes of industrial pollution in India is industrial policy. For example, the cost-plus pricing of outputs, together with an inward-looking trade regime, has favored the development of



energy- and capital-intensive sectors with suboptimal plant sizes. Suboptimal plant sizes increase the costs of production and treatment (especially in small firms) and make it difficult for firms to meet environmental standards. Artificially low raw material prices provide little incentive for the efficient use of materials or for resource recovery and recycling. High product prices arising from high effective protection encourage the expansion of capacities that may not be consistent with India's comparative advantage and that provide enterprises with little incentive to be efficient.

6.09 The government offers a variety of fiscal incentives—excise exemption, accelerated depreciation allowance, customs allowance, soft loans, and grants—for pollution control equipment. It is not known whether there are similar incentives for clean technology, though there is an accelerated depreciation allowance for technology developed by approved firms with in-house research and development facilities.

INSTITUTIONS

6.10 India has a large technology infrastructure, with an extensive network and large expenditures on public research and development institutions.¹ Public institutions account for more than three-quarters of research expenditures and have little private orientation in their activities. Under the ongoing liberalization, however, public institutions are being encouraged to augment their budgetary resources by working for the private sector. This orientation should make research institutes more responsive to demand while providing the industrial sector with a well-developed research network. Some of

these institutions have the capacity to develop clean technologies or to help in the assimilation of imported clean technologies.

6.11 A major problem constraining the development and use of clean technologies is that research institutions and business groups lack a means of exchanging information. Knowledge regarding available technologies, their environmental impacts, and their cost-effectiveness is not easily accessible by the industrial sector.

TECHNICAL AND SCIENTIFIC OBSTACLES

6.12 The technical and scientific development of clean technology is hampered by approaches that focus on hardware. It often is assumed that once equipment is installed, pollution reductions will follow automatically. This orientation neglects the software component of the clean technology approach—skills, information, and support. Indeed, cost-effective approaches to pollution reductions often depend on skills and information, with little need for hardware. Such approaches—good housekeeping, improved plant layout, collection and recycling of wastes—should be fully explored before approaches requiring hardware are pursued.

6.13 Coal will continue to be the main fuel in the power sector for the foreseeable future, with severe impacts on the local and global environment. The projected development rate of renewable energy technologies will hardly contribute to the levels of anticipated energy demand. Under these circumstances, no clean technology initiative in the power sector can afford to neglect coal.

¹In 1989, India spent about 0.9 percent of its gross domestic product on research and development.



Box 6.3. Common Effluent Treatment Plants

The Bank-financed Industrial Pollution Control Project provided US\$36 million (US\$24 million IBRD/US\$12 million IDA) to finance design and implementation of common effluent treatment plants (CETPs) for the treatment of wastewater and solid materials at industrial estates and other sites with a heavy concentration of chemical and related industries, especially in the small-scale sector. Most CETPs are constructed and operated by industrial cooperatives, while others are managed by incorporated companies or industrial estate authorities.

So far, seventeen CETPs have been financed, accounting for a total of US\$14.7 million. These plants together meet the wastewater treatment needs of over 3,200 mostly small and medium-scale industrial units. The total design capacity is about 125,000 cubic meters per day, removing more than 100 tons of BOD every day. Two CETPs (Tarapore, Pallavaram) have been commissioned and are in operation. The CETP approach to dealing with pollution from small-scale industrial units has provided a cost-effective and practical approach to the problem. The MOEF and the State Pollution Control Boards look to CETPs as the main plank of the strategy to deal with pollution from the small-scale sector.

FINANCIAL ISSUES

6.14 For industrial units, borrowing for pollution prevention efforts is not a major problem. Since most pollution prevention measures produce financial returns, most borrowers could borrow at market rates to undertake these investments. There might be constraints, however, for nonprime borrowers from medium-size and small-scale industrial units.

RECOMMENDATIONS

6.15 The focus on clean technologies should be central to sector work and project activities, and should not be seen as a stand-alone activity. Some specific measures,

undertaken in the short run, could help to identify opportunities for introducing clean technologies.

Legal

6.16 Intellectual property rights policies and the legal issues associated with the import of technologies should be reviewed to determine whether they constrain domestic technological innovation or international technology transfers.

Policy framework

6.17 It would be useful to examine how changing industrial policies and tax regimes—in the context of ongoing liberalization and tax reform—will influence technological innovation and adoption, specifically as they relate to clean technologies.

Institutions

6.18 The ongoing Bank assistance to the Clean Technology Information Network (Box 6.1) is a priority activity that will bring together the large network of research institutions. Careful attention needs to be paid to this activity during implementation. The private sector should play a leading role in the establishment and operation of this network to ensure that its outputs respond to demands from the industrial and energy sectors.

Technical and scientific issues

6.19 India has the capacity to develop and apply clean technology, though some state-of-the-art technology may have to be imported. It is important that clean technology be used in World Bank supported operations, and that cost-effective pollution prevention options be examined before



resorting to end-of-the-pipe approaches. This approach should involve both equipment and techniques, emphasizing techniques where they alone could solve the problem. Developing skills and techniques in clean technologies could probably be the main strategy for dealing with the small-scale sector.

Financial issues

6.20 Although financial resources

may not be a constraint for large firms investing in clean technologies, medium-size and small firms may require financing arrangements. While concessionary financing may not be the optimal solution, a strong case can be made for bearing the cost of concessions or subsidies through taxes levied on polluters and managed through an environmental fund.



GOI Program Objectives

Category: Research and Technology Development
Government Objectives/Programs:¹

Organization strengthening for research and technology development under the National Materials Initiatives under industrial development program for raw material upgradation, performance improvement in conventional materials, energy substitution and conservation and environmental sustainability under the Science and Technology Program under the industrial sector. Launching of a Technology Mission on Cleaner Production to coordinate activities for promoting cleaner technologies in India through government policies, strengthening of R&D institutions, industry associations, financial institutions and regulatory agencies. Formulation of industry-specific task forces for selection of demonstration and developmental projects.

Donor Agency Support

Project	Donor	Funding
Industrial Pollution Control	ADB	US\$0.6 M
Industrial Pollution Control, West Bengal	Japan (OECF)	US\$45.0 M equiv.
Industrial Pollution Prevention	World Bank	US\$25.0 M
Cement Industry Restructuring	World Bank	US\$300.0 M
Power Utilities Efficiency Improvement	World Bank	US\$265.0 M
National Capital Power Supply	World Bank	US\$485.0 M
Private Power Utilities (TEC)	World Bank	US\$98.0 M
Renewable Resources Development	World Bank	IBRD US\$75.0 M IDA US\$115.0 M equiv.

Category: Technology Transfer
Government Objectives/Programs:

Identify cleaner technologies developed in research laboratories/industrial units in India and abroad and facilitate transfer and adaptation of such technologies in India. Establish centers for cleaner technologies in various parts of the country to develop a centralized data base and provide information to industries.

Donor Agency Support

Project	Donor	Funding
Indo-Nordic Industrial Pollution Control	Nordic Group	US\$40-45 M equiv.
Renewable Resources Development	World Bank	IBRD US\$75.0 M IDA US\$115.0 M equiv.

¹ GOI programs are as identified in the Environment Action Plan and the 1994-95 Annual Report of the Ministry of Environment and Forests.



Category: Capacity Building and Technical Development

Government Objectives/Programs:

For environmental audit for pollution prevention; developing indigenous design engineering capability for absorption, adaptation and improvement of imported technology; and assessment of environmental impact of clean technologies. Formulation of standards in terms of waste discharge per unit quantity of raw material. Formulation of legal and economic measures to ensure absorption of clean technologies. Action would be taken to establish a National Center for Long Term Training in Environmental Impact Assessment and evolve a network of regional centers in various institutes for training in the preparation of impact reports, including disaster management plans.

Donor Agency Support

Project	Agency	Funding
Industrial Counseling, Tanneries	Netherlands	US\$1.55 M equiv.
Industrial Counseling, Mysore Paper Mill	Netherlands	US\$0.78 M equiv.
Industrial Counseling, Gujarat Fertilizer	Netherlands	US\$2.05 M equiv.
Industrial Pollution Control	ADB	US\$0.60 M

Category: Development and Promotion of Cleaner Technologies

Government Objectives/Programs:

Scheme to set up Cleaner Technologies Promotion Network.

Donor Agency Support

Project	Donor	Funding
Industrial Pollution Control	ADB	US\$0.6 M
Industrial Pollution Prevention	World Bank	US\$250.0 M

Category: Clean Technologies in Small-Scale Industry

Government Objectives/Programs:

Training and awareness programs for personnel in Small Industry Development Organization (SIDO) and for entrepreneurs by Small Industry Service Institute.

Donor Agency Support

Project	Donor	Funding
Industrial Pollution Prevention	World Bank	US\$250.0 M

Category: Waste Minimization

Government Objectives/Programs:

Develop the concept of waste minimization circles—groups of representatives of similar types of industries in a cluster working collectively to promote waste minimization in their respective units as part of their overall business strategies.



Donor Agency Support

Project	Donor	Funding
Waste Min. in Automotive Components Sector	UNIDO	US\$0.04 M
Industrial Pollution Prevention	World Bank	US\$250.0 M

Category: *Montreal Protocol Implementation*

Government Objectives/Programs:

Phasing out manufacture of ozone-depleting substances (ODS).

Donor Agency Support

Project	Donor	Funding
Non-CFC Refrigerators	Germany	US\$2.06 M equiv.
Conversion of Cleaning Processes for CFC-113 to Non-CFC	UNIDO	US\$0.07 M
Recovery/ Recycling of CFC refrigerants	UNIDO	US\$0.05 M
Phaseout of ODS (UNIDO)	MFMP ¹	US\$0.05 M
Phaseout of ODS (World Bank)	MFMP	US\$13.0 M

¹Multi-Lateral Fund for the Implementation of the Montreal Protocol



World Bank Support

- Project:** Industrial Pollution Prevention
- Fiscal Year:** 1994
- Loan/Credit Amount:** US\$250.0 M
- Description:** The project objective is to assist in the implementation of the government's policy on pollution abatement and promote cost-effective abatement of pollution from industrial sources. The project will focus on the most polluting industrial sectors and comprise three components:
- (a) *An institutional component* designed to strengthen the State Pollution Control Boards in the states of Rajasthan, Madhya Pradesh, Karnataka and Andhra Pradesh, which as a group constitute the next tier of industrialized states in India. In addition support to boards in Gujarat, Maharashtra, Tamil Nadu, and Uttar Pradesh will continue to be provided, complementing the activities already sponsored.
 - (b) *An investment component* to support subprojects by individual firms for pollution abatement, with a focus on waste minimization and adoption of cleaner methods of production. The line of credit for priority investments provided under the first project would be continued. Resources would also be renewed for financing combined effluent treatment plants (CETPs), which would include funding for industrial water recycling plants (IWRPs) that use sewage as input.
 - (c) *A technical assistance component* to support:
 - (i) Establishment of a Clean Technology Institutional Network (CTIN), designed to promote the development, diffusion and transfer of technologies with environmental benefits for industry.
 - (ii) Extension services for the identification of waste minimization and abatement methods for small-scale industry, and the organization of waste minimization circles.
 - (iii) Preinvestment studies for CETPs, IWRPs and other waste minimization facilities proposed to be financed under the project.



- (iv) Finance for other training and consulting services under planning by the MOEF, including the training requirements for the preparation of environmental statements by industries.

Project: **Cement Industry Restructuring**
Fiscal Year: 1990
Loan/Credit Amount: US\$300 M
Description: The project is designed to support cement industry restructuring through the following components :

- (a) *A technical assistance component* to assist the DCCI in studying policy options for the mini-cement sector, coal washery and use of lignite, environmental protection and pollution control measures for the cement industry. The project would finance installation of pollution control equipment; ensure better environmental assessments, and encourage productive use of slag, a waste product from steel plants which must be disposed off in an ecologically acceptable manner.
- (b) *A pilot bulk cement transport component* to finance a pilot bulk cement transport system including loading facilities at participating cement plants.
- (c) *A human resource development component* to assist and finance a demand-driven, in-plant training system at selected regional training centers.
- (d) *An industry modernization and restructuring component* which would finance capacity expansion in cement-deficit regions and assist the industry in adjusting to a competitive environment.

Project: **Power Utilities Efficiency Improvement**
Fiscal Year: 1992
Loan/Credit Amount: US\$265 M
Description: Project objectives are to :

- (a) Support government efforts to make Power Finance Corporation (PFC) a viable and effective instrument for improving the power sector.
- (b) Strengthen the operations of the beneficiary utilities by lending



only to those willing to undertake acceptable reform programs.

- (c) Foster better use of existing power facilities by reducing constraints in the transmission and distribution systems.
- (d) Mitigate the adverse environmental impact of thermal plants in operation by providing adequate antipollution and monitoring facilities.
- (e) Improve the preparation of power projects and promote the development of the local consulting industry by funding preinvestment studies and engineering for power projects.

The project comprises a program to strengthen PFC's capabilities to discharge its responsibilities, the creation of a preinvestment fund in PFC, and five components to be financed by PFC:

- (i) Implementation of a pre-identified segment of the lending program of PFC.
- (ii) Environmental upgrading of power plants.
- (iii) Engineering studies for system renovation.
- (iv) Institutional strengthening of power utilities.
- (v) Improvements in State Electricity Boards' billing and collection.

Project:	Renewable Resources Development
Fiscal Year:	1992
Loan/Credit Amount:	US\$75.0 M/US\$115 M (equivalent)
Description:	<p>The Project comprises:</p> <ul style="list-style-type: none">(a) Financing through the Indian Renewable Energy Development Agency (IREDA) of private-sector investments in renewable energy subprojects, namely, irrigation-based small hydros, wind farms and solar photovoltaic systems.(b) Expansion of Tamil Nadu Paper Limited's bagasse-based paper mill.(c) Technical assistance for institutional development of IREDA and promotion of renewable energy technologies. <p>The main benefits of the project are:</p> <ul style="list-style-type: none">(a) Demonstration on a commercial scale of renewable resource systems that could lead to their replication in other parts of India and the world.



- (b) Mobilization of private investments into the energy sector and newsprint industry.
- (c) Reduced reliance on fossil fuels and forest resources and thus less environmental degradation.
- (d) Increased availability and improved reliability of power supply to help meet the industrial and decentralized rural energy needs.
- (e) Increased domestic newsprint supply in India.

Project:

National Capital Power Supply

Fiscal Year:

1987

Loan/Credit Amount:

US\$485 M

Description :

The main objective of the project is to assist in meeting electricity demand in the capital area through the addition of 840 MW of thermal capacity. The project comprises the installation of four coal-fired 210 MW units at Dadri (Uttar Pradesh), as well as the construction of about 110 km of 400-KV transmission lines and four associated 400-KV and 220-KV substations to complete the 400 KV transmission around Delhi. Project also provides for the rehabilitation of an existing 710 MW thermal power station at Badarpur, near Delhi. In addition, the project will provide for institutional strengthening of Delhi Electricity Supply Undertaking (DESU) through studies for reorganization and the development of a distribution master plan, and through the execution of a financial recovery plan. Consultancy support will be provided for these studies as well as for studies for the improvement of the quality of coal used in power generation, for rehabilitation of existing plant at Indraprastha, and for design and engineering of the main plant. The project will introduce dry ash disposal as a new technology in India. There are no unusual risks, as the dual firing feature of the power plant minimizes the risk of plant unavailability that could result from the transportation of coal over a long distance. National Thermal Power Corporation (NTPC) is experienced in the design and construction of generation and transmission facilities, but will receive assistance from consultants on the design of the dry ash disposal system.

Project:

Private Power Utilities

Fiscal Year:

1990

Loan/Credit Amount:

US\$98 M



Description :

Project objectives are to increase Tata Electric Company's peak generating capacity, reduce their dependence on the Maharashtra State Electricity Board, reduce the average cost of generation and improve system reliability and quality of supply to consumers in the Bombay area. The project comprises five components:

- (a) A pumped storage unit at the existing Bhira hydroelectric station to generate 150 MW additional peak power by consuming off-peak power.
- (b) A 220 KV transmission line to carry this power to the license area.
- (c) A gas-based combined cycle unit of 180 MW at the Trombay thermal power plant.
- (d) A second flue gas desulphurization unit to control the sulfur dioxide emissions from the coal and oil burning unit no.5 at Trombay.
- (e) Review of design and technical specifications and supervision of construction of the Bhira pumped storage scheme and acquisition of know-how for the extension of the flue gas desulphurization facility at Trombay.



Other Donor Support

Project: Industrial Counseling; Tanneries (Kanpur, Uttar Pradesh)
Donor: Netherlands
Loan/Credit Amount: US\$1.55 M equivalent
Description: To disseminate economically viable clean technology in combination with occupational health measures in the leather industry, it is proposed to set up a revolving fund and to finance technical assistance for the introduction of chrome recovery plants in tanneries.

Project: Industrial Counseling; Mysore Paper Mill
Donor: Netherlands
Loan/Credit Amount: US\$0.78 M equivalent
Description: To demonstrate the techno-economical viability of clean technology in the paper industry in order to introduce environmental/safety measures along with energy conservation and mitigation of health hazards.

Project: Industrial Counseling, Gujarat State Fertilizers Comp.
Donor: Netherlands
Loan/Credit Amount: US\$2.05 M equivalent
Description: To demonstrate and disseminate clean technology in the fertilizer industry, including safe occupational health measures, by cooperation with a fertilizer-producing company in Vadodara (Gujarat State).

Project: Industrial Pollution Control
Donor: ADB
Loan/Credit Amount: US\$0.6 M
Description: Strengthen the monitoring/enforcement abilities of the pollution control boards of the heavily industrialized states; install pollution control devices, establish effluent treatment plants and introduce clean technologies.

Project: Production of Non-CFC Refrigerators
Donor: Germany



- Loan/Credit Amount:** DM 1.5 M (US\$2.06 M equivalent)
- Description:** Transfer of technologies to transform the conventional fridge production into a CFC-free one.
- Project:** **Industrial Pollution Control West Bengal**
- Donor:** Japan (OECD)
- Loan/Credit Amount:** ¥4,525 M (US\$45 M equivalent)
- Description:** Strengthen the West Bengal Pollution Control Board, promote investment for pollution control and meet technical expertise and technology needs.
- Project:** **Conversion of Electronic Cleaning Processes for CFC-113 Alcohol Blended Solvents and 111-Trichloroethane to Non-CFC Cleaning**
- Donor:** UNIDO
- Loan/Credit Amount:** US\$0.07 M
- Description:** Assist the Indian government in formulating projects as per the project subject.
- Project:** **Feasibility Study for the Recovery and Recycling of CFC Refrigerants**
- Donor:** UNIDO
- Loan/Credit Amount:** US\$0.05 M
- Description:** Assist the Indian government in reducing and phasing out the production and consumption of ozone-depleting substances.
- Project:** **Phasing Out of ODS in Unorganized Sector**
- Donor:** UNIDO
- Loan/Credit Amount:** US\$0.05 M
- Description:** Assist the Indian government/industry in formulating projects for phasing out ODS in unorganized sector.
- Project:** **Indo-Nordic Industrial Pollution Control (Karnataka, Tamil Nadu, Andhra Pradesh)**
- Donor:** Nordic Group
- Loan/Credit Amount:** Approximately US\$40-45 M equivalent
- Description:** Emphasis on clean Nordic technologies, directed towards small

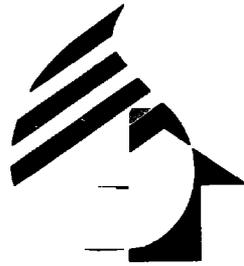


and medium-scale industries. Technical assistance aiming at competence development in the field of industrial pollution control and the dissemination of information on Nordic clean technologies.

- Project:** **Study on Waste Minimization in the Automotive Components Sector**
- Donor:** UNIDO
- Loan/Credit Amount:** US\$0.04 M
- Description:** Demonstrate financial and environmental benefits of cleaner production approach to industrial environmental management; demonstrate that pollution prevention is possible in the short term and that it has financial and environmental advantages; devise a systematic approach to pollution prevention and test its usefulness and efficiency; identify obstacles to the introduction of pollution prevention options and formulate strategies to overcome these; disseminate results of the case studies by written reports and by industry seminars.

Chapter 7

Urban Environmental Issues



Urban Environmental Issues

Urbanization

7.01 Like most other developing countries, India is experiencing massive urbanization. At 217 million, the country's urban population is one of the largest in the world. The urban population currently makes up 26 percent of the total population, up from

less than 12 percent in 1940. Before 1940 only one city in India had a population of more than 1 million; by 1991 there were twenty-three. Some cities (Ludhiana-Punjab, Surat-Gujarat, and Hyderabad-Andhra Pradesh) have grown by 70 percent in the

Table 7.1. Urbanization in India, 1971-91

State	Level of Urbanization		Average Annual Urban Exponential Growth		Urban-Rural Growth Differential		Rank	
	1991 (%)	1971-81	1981-91	1971-81	1981-91	1971-81	1981-91	
India	25.72	3.83	3.09	2.05	1.29	-	-	
Andhra Pradesh	26.84	3.96	3.55	2.39	1.88	7	7	
Assam	11.08	3.27	3.27	1.27	1.29	16	16	
Bihar	13.17	4.37	2.65	2.49	0.62	14	15	
Gujarat	34.40	3.47	2.9	1.46	1.51	3	2	
Haryana	24.79	4.67	3.58	2.67	1.73	8	9	
Himachal Pradesh	8.70	2.98	3.11	0.92	1.46	17	17	
Jammu & Kashmir	23.83	N.A.	N.A.	N.A.	N.A.	9	10	
Karnataka	30.91	4.10	2.55	2.35	0.97	4	4	
Kerala	26.44	3.19	4.76	1.73	4.44	12	8	
Madhya Pradesh	23.21	4.45	3.71	2.69	1.71	11	11	
Maharashtra	38.70	3.36	3.27	1.74	2.92	1	1	
Orissa	13.43	5.22	3.08	3.76	1.4	15	14	
Punjab	29.72	3.68	2.56	2.07	1.00	5	5	
Rajasthan	22.88	4.62	3.31	2.19	1.07	10	12	
Tamil Nadu	34.20	2.47	1.76	1.25	0.56	2	3	
Uttar Pradesh	19.89	4.74	3.29	2.94	1.27	13	13	
West Bengal	27.39	2.76	2.54	0.91	0.47	6	6	

N.A. = not available

Source : Government of India, Planning Commission, Eighth Five-Year Plan, 1992-97.



past decade.

7.02 Rural-urban migration is a major factor in India's urban growth. Even though the birthrate in urban areas is lower than that in rural areas, urban populations are increasing at a rapid rate. The urban sector's contribution to the economy increased from 20 percent in 1951 to 47 percent in 1981; by 2000 the urban share is expected to be 60 percent. Economic activity will continue to draw people to the cities.

7.03 Urban population growth has not been accompanied by a growth in urban prosperity. In some urban areas economic stagnation has been just as severe as in some rural areas. For example, there has been a steady decline in the growth of Class I and II

cities in North Bihar. Even cities like Bombay and New Delhi have experienced increasing numbers of urban slum dwellers. More than half of Bombay's population lives in slums. Increased population pressures have reduced the urban resource base, increased industrial activity and motorization, and exacerbated problems of safe water supply, sanitation, solid waste treatment and disposal, overcrowding, and congestion.

7.04 Three areas will require concentrated action if urban environmental issues are to be alleviated: air pollution, solid waste management, and water pollution. All three factors, typical of an urban agglomerate in India today, have adverse health implications and will require multifaceted strategies and city-specific planning.

Table 7.2. Urban Population Projection, 1991-2001

Year	Total Urban Population (Million)		Percentage Urban Population		Share of Million-Plus Cities to Urban Population (percent)
	Committee of Experts Projection	Now Projected	Committee of Experts Projection	Now Projected	
1991	235	217	27.5	25.7	32.5 (23)
1997	-	267	-	28.3	-
2001	332	307	33.0	30.5	35.8 (40)

Note: Figures in brackets indicate number of million plus cities.

Source: Government of India, Planning Commission, Eighth Five Year Plan, 1992-97.



Box 7.1. National Housing Policy

The National Housing Policy specifies the following objectives and goals to be achieved:

- Reduce houselessness and assist, especially the vulnerable sections, to secure affordable shelter through access to developed land, building materials, finance and technology.
- Create an enabling environment for housing activity by developing an efficient and equitable system for the delivery of housing inputs.
- Increase developed land and finance to different income groups and expand the provision of infrastructure facilities in rural and urban areas.
- Undertake within the overall context of policies for poverty alleviation and employment, steps for improving the housing situation of the poorest sections by direct initiative and financial support of the state.
- Promote the use of energy-saving building materials and cost-effective construction technologies to help mobilize resources and facilitate the expansion of investment in housing to meet construction and upgradation of infrastructure needs.
- Promote a more equal distribution of land and houses in urban and rural areas and curb speculation in land and housing.
- Promote vernacular architecture, preserving the nation's heritage in human settlements.
- Assist in the upgradation of all unserviceable houses in rural and urban areas, particularly improving the housing conditions of the rural homeless, slum dwellers, scheduled castes, scheduled tribes and other vulnerable sections.
- Provide the minimum level of basic services and amenities to ensure a healthy environment within the framework of integrated development of rural and urban settlements.

The main elements of the housing policy include the following:

- Housing norms—standardized housing designs for each geoclimatic region.
- Rural housing.
- Slums and squatter settlements, and housing for urban poor.
- Supply and management of land.
- Infrastructure—stepping up public and private investment in infrastructure.
- Conservation and housing stock and rental housing—modifications in building regulations; fiscal/property tax incentives; access to materials and technical assistance.
- Housing finance.
- Building material and technology.
- Special programs for disadvantaged groups.
- Role of government, private sector and community.
- Fiscal policy.
- Legal and regulatory framework.
- Human resource development.
- Action plan—state government's and union territories to play the primary role in formulating action plans and programs suited to local needs and conditions.

Source: Government of India, Ministry of Urban Development, National Housing Policy, New Delhi, August 1994.



Urban Water Supply, Sanitation, and Sewerage

7.05 India's urban population is expected to grow to 330 million people in 2001, with the slum population growing at a significantly higher rate than the other segments of the urban population Table (7.2). About one-fourth of urban dwellers live in slums today. With more than 60 percent of gross domestic product (GDP) generated in the manufacturing and service sectors of the economy (located predominantly in urban areas), India cannot afford to have the economic gains from industrialization overshadowed by the economic and social costs of water mismanagement and the consequent environmental degradation (MOEF 1992). Only 30 to 40 percent of the urban poor in India have access to a safe water supply, and just 15 percent of urban households have private toilets. More than 60 percent of households must resort to open defecation (Sivaramakrishnan 1992). Without immediate intervention this situation will worsen.

ISSUES FACING THE SECTOR

7.06 The critical environmental priorities in the urban water supply, sanitation, and sewerage sectors are:

- Ensuring water quality and supply for urban areas, especially the large urban conglomerations.
- Providing safe and adequate drinking water to the urban poor.
- Providing extensive low-cost sanitation in low-income neighborhoods.
- Providing sewer connections to trunk sewers in cities where they exist.
- Expanding trunk networks where critically needed with appropriate technology.
- Providing sewage collection where lacking.
- Treating collected sewage before indiscriminate discharge into water bodies and open channels.

Water

7.07 Inadequate mechanisms for meeting the demand for drinking water, industrial water and wastewater removal for 75 percent of India's urban population, as well as the inadequate treatment of wastes before disposal, threaten the existing water supply systems. The annual demand for water in 1990, 2000, and 2025 is summarized in Table 7.3.

Sewerage

7.08 It has never been possible to obtain any comprehensive information on sewerage systems in urban areas. As a result it is impossible to know how much wastewater is generated, collected, and treated. Some information is available in a report prepared by the Central Pollution Control Board, titled "Status of Water Supply and Waste Water Collection, Treatment and Disposal in Class I Cities 1988." The report painted a dismal picture of extremely limited collection and even more limited treatment. The situation has since worsened.

1.09 The lack of sewerage systems has

Table 7.3. Water Use and Demand, 1990-2025
(cubic kilometers)

Use	1990	2000	2025
Domestic	25	33	52
Irrigation	460	630	770
Energy	19	27	71
Industrial	15	30	120
Other	33	30	37
Total	1.552	750	1.050

Source: Ramasubban 1992.

resulted in the bulk discharge of municipal waste, domestic waste, and industrial effluent into surface water bodies, contributing to surface and groundwater pollution. Consequently, water pollution harms more people than any other environmental problem. Of all deaths in urban areas in India in 1987, 60 percent were due to water related diseases like cholera, dysentery, and gastroenteritis.

Sanitation

7.10 More than half the urban population—125 million people—lacks access to basic sanitary facilities, and instead makes use of open spaces surrounding slums, fostering the spread of fecal-borne diseases such as dysentery, hepatitis, worms, and cholera (Repetto 1994). The most effective intervention is safe sanitation and sewerage facilities, but infrastructure provision lags behind water supply.

Industrial water pollution

7.11 Industrial units located primarily in densely populated urban areas discharge their effluent untreated into surface water channels, land sites, and sewers. While India is pursuing a policy of industrial pollution control, the focus so far has been on the large industries, despite the fact that more than half of the industrial output comes from small-scale

industries that account for 60 to 65 percent of the pollution. As a result, 70 percent of India's surface water is seriously polluted (MOEF 1992). The water of the Yamuna River in Delhi, for example, is so polluted that many local industries cannot use its water during the worst months of the year, forcing some units to shut down during this period. It has become increasingly clear that the economic losses that are caused by water-related environmental problems—disease, costs of boiling water, productivity—are greater than previously imagined.

Inadequate urban water supply

7.12 Growing municipal and industrial water demand, coupled with mismanagement of the sector, has led to large cities being placed in direct competition for water resources. Conflicts between cities and populations from areas where water is drawn are becoming common and are likely to increase with urbanization. Water-related environmental issues relating to urbanization have direct links with upstream regions both within and outside state and country boundaries. If not managed comprehensively, the entire hydrological region (extending well beyond urban jurisdictions) is likely to suffer damage that investments are unable to reverse.

7.13 Lack of resources and ineffective management are more pronounced in smaller urban municipalities that have smaller financial bases, limited management capacity, low technical expertise, and little motivation. Municipalities will have to establish a good track record with their clientele before they are able to recover costs for services they deliver. A large part of the clientele is used to paying nothing or next to nothing for services, imposing a substantial burden on government budgets.



Sector needs

7.14 The United Nations Children's Fund, World Bank, and United Nations Development Program recently concluded that providing 90 percent of the population in developing countries with water and sanitation services would require a threefold increase in the average annual level of investment over the average sector (UN 1993). The government allocated Rs.47,364 million for urban water supply and sanitation during the 1980s. The Eighth Five-Year Plan Working Group recommended a provision of Rs.148,440 million for urban water supply and sanitation—about three times the investment in the 1980s—yet only Rs.57,573 million was allocated in the Eighth Five-Year Plan (1992-97). Clearly, the targets set out in the plan cannot be met with government financing, indicating a need to mobilize private resources. Even if investments in water were raised 50 percent and sanitation raised 30 percent, the number of people unserved might still increase. The most effective approach is a combination of policy reforms and accelerated investment.

7.15 The sector not only requires investments, but a management style that makes the water cycle work. Past investments have taken the form of large capital projects but little has been done for low-income groups at the community level. Without visible environmental improvements, communities will not support (politically or financially) any program for environmental improvements.

THE ENVIRONMENT ACTION PROGRAM

7.16 India's Environment Action Program (EAP) identifies urban environmental issues as one of its seven priorities. The EAP focuses on urban air pollution, especially in the metropolitan areas, and on river and coastal

water pollution, both due to industrial and municipal waste discharge. The EAP highlights the following urban water supply, sanitation, and sewage issues:

- Inadequate urban services.
- High levels of water pollution as a result of waste disposal, inadequate sewerage and drainage, and improper disposal of municipal and industrial effluent.
- Toxic or hazardous industrial or commercial wastes released in urban water bodies and land sites without proper treatment.
- Indiscriminate dumping of solid waste, leading to groundwater pollution of the aquifers underlying urban areas.

METROPOLITAN CITIES

7.17 With the number of cities with populations of more than one million projected to increase to forty by 2001, the EAP's focus is on the environmental problems faced by metropolitan areas. The high levels of water pollution and improper disposal of toxic and hazardous wastes have been mentioned. Other problems include dumping of refuse in low-lying areas, which contributes to land and groundwater pollution, and congested and unsanitary dwellings in slums, which lead to infant mortality rates that are almost four times as high in slums as in urban areas. According to the EAP, the deteriorating urban environment is a result of increasing and unevenly distributed urban growth, escalating per capita costs of providing services, the rapidly increasing number of urban poor, weak financial and organizational capacity, and inadequate wastewater collection, treatment, and sanitation facilities.



CLASS I CITIES AND SMALL TOWNS

7.18 The EAP identifies the main water supply, sanitation, and sewerage issue facing Class I cities (those with populations of more than 100,000) as inadequate treatment capacity for sewage outside the metropolitan centers. The EAP identifies water pollution as the main source of pollution in 241 small towns, with 90 percent of the water supply being polluted and just 1.6 percent of the municipal wastewater being treated before discharge.

RECOMMENDED STRATEGIES AND PRIORITIES

7.19 To tackle urban environmental issues related to water supply, sanitation, and sewerage, the EAP recommends the following:

- Updating information in the 1988 Report by the Central Pollution Control Board on sources of pollution.
- Finding solutions for community water supply to eliminate excessive salinity, pesticides, and nitrates.
- Developing water treatment plants for small communities.
- Research and development for application of genetic engineering for resource recovery-based wastewater treatment.
- Developing an objective method for assessing water quality.
- Treating sewage to remove pathogens, to reduce the risk of disease and to use wastewater for irrigation.
- Examining the economics of treatment and reuse of wastewater for urban agriculture or industry.
- Removing pollution caused by urban areas in order to encourage community

investment in water supply and sanitation based on sustainability and quality.

- Formulating city-level environmental action plans.
- Strengthening institutions responsible for pollution control, waste management, natural resource accounting, risk assessment, and environmental assessment in urban areas.
- Protecting natural water sources to meet the needs of water users.
- Managing storm water drains in cities.
- Protecting urban parks, beaches, and wetlands.
- Strengthening urban forests.

ASSESSMENT OF STRATEGIES AND PRIORITIES

7.20 The EAP recognizes that inadequacies and inequities in service levels are caused by weak organizational and financial capacity—but goes no further. It claims that the number of urban poor who cannot afford services is growing, while the cost of providing services is escalating. This is inconsistent with evidence from other developing countries, where data indicate a high willingness and ability to pay for improved services. The urban poor pay much more for a unit of water bought from private vendors than the urban rich pay for the same unit of water. Often, the success of revenue recovery programs depends to a great extent on how revenue is collected. The barrier often is not an inability to pay, but rather the lack of an innovative cost recovery program. Given people's reluctance to pay to government departments, alternative means of collecting and managing funds should be developed.



7.21 The EAP does point out that poor financial and organizational management has resulted in subsidized services. However, these subsidies accrue not to the poor, but to the rich. And while community investment in water supply and sanitation, based on principles of sustainability is encouraged, the EAP does not discuss how this might be done whether such a strategy would require substantial institutional changes.

7.22 The EAP's recommended strategies largely focus on water quality and resource recovery issues. The EAP recommends that the information on pollution sources should be updated, at the national level. But given the urgent need for such information, it is not clear that undertaking this exercise at the national level is the most expedient approach. Since water is a state issue, and pollution is concentrated in urban areas, cities may have a role to play in the collection of this information. Private industries and communities may also have a role to play. The EAP also does not address the environmental issues that affect the daily lives of most urban residents, particularly the urban poor. Despite the fact that the number of cities with more than 1 million residents is projected to increase to forty by 2001, none of the recommended actions will have a direct impact on these cities. The link between poverty and environmental degradation should be more explicit. Communities which are unlikely to benefit from water resource protection efforts in their lifetime, limit grassroots support for these initiatives.

7.23 A number of issues that are critical to sustainable and equitable development of water resources should also be addressed in the context of urban environmental issues. These are discussed in the following paragraphs.

Demand management

7.24 Without demand management, it is impossible to assess the need for increases in water supply to cope with population growth and economic activity. Unless prices are restructured to reflect sector demand, projections for future demand will continue to be overestimated, leading to flawed or premature investments. Demand management has the potential for enormous savings. In New Delhi, for example, introducing demand management and reducing water losses could save 55 percent of current production volume.

Lack of coverage of poor communities and inequities in distribution

7.25 *Water.* While the EAP recognizes that services are inadequate, it does not mention that half of the urban poor lack access to adequate and safe water supply. Nor does it emphasize that distribution systems are not in place. The poor usually obtain water from a public standpost. Women and children bear the brunt of water shortages, spending hours transporting water to their homes.

7.26 *Sanitation.* The EAP recognizes that removal and disposal of human feces is a critical health need in the 300 or so Class I towns but does not refer to sanitation needs in the metropolitan cities. This may be the result of inadequate data. Still, there has been even less progress in sanitation coverage than in water coverage: 125 million people defecate in open spaces. Urban poor settlements are generally extremely dense and located on environmentally hazardous land with no security of tenure. The lack of land imposes limits on infrastructure provision—neither water supply nor latrines can be provided when no land is available.

7.27 A low-cost pour-flush toilet



module based on twin leach pits has been the widely disseminated solution for sanitation in India. This module can, however, only be used where soil and density conditions permit leach pits—small and medium-size towns, and peri-urban areas. More research is needed on sanitation and waste disposal technologies appropriate for high-density low-income settlements. In addition, the various low-cost sanitation components implemented by state governments under the Ganga Action Plan and the Integrated Development of Small and Medium Towns Scheme should be assessed.

7.28 *Sewage.* The EAP does not recommend strategies for sewage disposal. Sewerage systems offer considerable economies of scale in densely populated areas, yet they exist mainly in less densely populated, upper-income areas. Despite large investments in these systems in the major cities, the threat of disease and the potential for destruction of aquatic organisms serving the food chain have limited their use. Distributional inequities are not the result of flawed technical design, but rather the result of political imperatives.

7.29 In Bombay the sewerage system covers the entire urban area, but slum dwellers (about 40 percent of the population) lack connections to the system. Conventional sewerage systems are inappropriate in low-income settlements because of their high costs, yet they continue to be advocated by local engineers. In Bombay, where water tables and population densities are high, it would be feasible to lay shallow, narrow pipes that could discharge into the sewer system or some other discharge point. Such systems are half as costly as conventional sewerage systems.

Inefficient service

7.30 Although urban water supply systems in India are designed for twenty-four-

hour water supply, it is generally limited to a few hours a day. Several problems arise from this intermittent supply: water quality deteriorates because pollutants are absorbed into the system from leakage points (because of shifts in flows and drops in water pressure); consumers hoard water (often discarding this supply as stale once service restarts); and meters do not rewind when water flow is reversed. The system's inefficiency is further exacerbated by the fact that intermittent supply systems require more staff. Developing countries with soundly run utilities typically have six to eight staff to 1,000 connections; in India the ratio is more than 20 employees per 1,000 connections.

7.31 The incidence of unaccounted-for water in distribution networks is high due to system leakage arising from poor construction, operations, and maintenance. This results in large financial losses for utility companies, clogs sewers and drains, and prematurely disables structures and equipment. The percentage of unaccounted-for water in New Delhi is estimated at 40 percent by the Department of Housing, Urban Development and Municipal Affairs. Formal control policies that reduce physical losses (through leakage detection and repair) and nonphysical losses (through improved management) cost \$5-10 per capita. Savings and increased revenues from such policies can pay for this cost within a reasonable period. Still, so long as water supply remains intermittent, metering and detection programs are technically impractical.

Private sector involvement

7.32 Given the limited resources, needed investments in water, sanitation, and sewerage, and the inefficiencies in construction, operations and maintenance, and billing and collection, there is tremendous



scope for private involvement in the formal and informal sectors. Water meters in Kerala are serviced by a private firm. New Delhi provides community toilets and showers run on a private concession. While wholesale privatization of water supply should be a long-term goal, in the near future selected functions should be privatized. Since water supply is currently a statutory service of local governments, private participation will require changes in the legal framework.

Weak regulatory and legal environments

7.33 None of the Indian states has legal control over groundwater development. The central government proposed a groundwater control bill to state governments in the 1970s, but only Gujarat passed the bill. Municipalities have laws for groundwater extraction but do not apply them.

Sociocultural barriers

7.34 *Water.* The popular perception that water is a free good adversely affects the implementation and sustainability of water investments. This perception also affects the political process through which goals, resource allocations, and programs are formulated. The institutional and financial conditions of the water sector reflect this perception—consumers would be less likely to hoard water if cost recovery mechanisms were in place.

7.35 As in most countries, an unmotivated and poorly paid bureaucracy is a barrier to better performance. Most local institutions are not oriented toward the provision of services. To some degree, Maharashtra and Gujarat are exceptions. There have been impressive changes in the Bombay Water Supply and Sewerage Department, which now recover most of its operational costs.

7.36 *Sanitation.* For hygienic reasons, bathrooms and toilets traditionally have been constructed away from the home. Because a large number of the urban poor are rural migrants who are used to open defecation, it is likely that this practice will persist. Clearly, any sanitation solution that does not take into account the social segregation and privacy requirements of women will be unsuccessful.

7.37 *Tragedy of the commons.* While indiscriminate dumping of solid waste and refuse in public areas is common, this pattern of behavior will likely cease once the urban poor have been provided with sanitation options that cater to their needs, with clear property rights. Studies of public toilets constructed in Mirzapur and Varanasi under the Ganga Action Plan found that levels of cleanliness varied depending on the toilet's location, level of use, quality of management, and the availability of water and electricity. Still, the study found that most toilets were clean and that conditions would improve if the water supply was not intermittent and if operations and maintenance were better. Some toilets were underused due to improper site selection, lack of water, or inadequate rehabilitation. While some of the problems of public toilets can be solved with user participation, design modifications and better management, other problems will require community education and involvement.

Economic and financial issues

7.38 *Insufficient data.* The absence of comprehensive, current data at the state level makes it difficult to estimate the magnitude of the investments that are required to address urban water supply sanitation and sewerage needs. As a result priority setting for investments is often flawed, with the most cost-effective measures being overlooked.

7.39 *Inadequate cost recovery.* With few exceptions, water and sewerage authorities recover less than half of their costs. There is little attempt to link cost recovery with service provision. A successful policy of charging by volume requires that connections be universally metered and read, that bills be issued and collected, and that rates be set on a sliding scale to induce water conservation. Since tariffs do not reflect the costs of water production and distribution, consumers perceive water as a free good, with little public awareness of its associated costs. Without an effective metering system, it is impossible to obtain information on consumption levels. Current tariffs are so low that only if the local urban bodies double the rates and improve collection levels to about 70 percent (from 30 to 40 percent) can they hope to meet operations and maintenance costs.

Technical issues

7.40 *Mishandling of equipment.* Large projects in the sector are executed by state agencies, with little involvement or training of the local municipalities that have to operate and maintain these investments. Sophisticated imported equipment becomes useless because utilities are ill-equipped to maintain it or to procure spare parts.

7.41 *Poor quality of construction.* The public sector has the advantage of being able to undertake and execute large civil works. However, the quality of construction should be monitored by an independent agency, in order to ensure compliance with predetermined standards. Civil works often require rehabilitation well before the end of their design life, leading to a premature deterioration in assets.

7.42 *Technically appropriate solutions.* For largely institutional reasons, the most technically appropriate solutions have not always been adopted in India. Engineers are familiar with modern solutions, governments pursue failure-proof and maintenance-free construction, and politicians wish to avoid being accused of demodernizing services. Taken together these tendencies lead toward unrealistically high standards.

RECOMMENDATIONS

7.43 A number of initiatives must be undertaken—supported by the government, private sector, nongovernmental organizations (NGOs), the World Bank, and other international organizations—to ensure that sector goals and priorities are addressed. The following are the major recommendations:

7.44 *Demand management*

- All large cities should develop a water policy and plan.
- Within states, comprehensive demand projections should be developed, with coordination across sectors.
- All costs for water-related services should be calculated.

7.45 *Strengthening institutional performance*

- In anticipation of increased private participation, water utilities (especially in the megacities) should inventory their assets and build up a bank of qualified, middle-level managers.
- Pilot privatization projects should be taken up in small and medium-size



towns.

7.46 *Lack of coverage of poorer communities*

- ❑ Efforts should be made to promote private community-based firms that can manage segments of operations requiring good community outreach and links.
- ❑ Cities should support the formation of water users groups that can own, operate, and maintain their facilities.
- ❑ With the help of NGOs, community groups should be encouraged to develop their own plans for service provision. The groups should be given technical support to evaluate technical options and make feasible choices.
- ❑ Municipal workers should be trained in participatory techniques to develop a service orientation toward poor communities so that they can develop site-specific cost recovery programs.
- ❑ Where sewerage coverage exists, community-based management initiatives should be encouraged with appropriate technical guidance from the sector institutions.

7.47 *Inefficient Service.* Water utilities must focus on leak detection programs and on reducing the incidence of unaccounted-for water. Utilities could decentralize their operations to manageable zones of perhaps 500 connections, with an individual caretaker that responds rapidly to leaks. This caretaker would become the utility's interface with consumers.

7.48 *Urban public relations campaign.* Cities should launch public awareness campaigns that employ various communication schemes (school curriculums,

community workers, NGOs, street theater) to better inform citizens of environmental protection needs, as well as the need for accountability.

7.49 *Piloting strategic planning for sanitation.* As has been successfully done in Ghana, a strategic sanitation plan should be piloted for a city in India. Such a plan has been developed with the assistance of the United Nations Development Program-World Bank Water and Sanitation Group. The plan recommends technical options for each type of housing in the city, considers user preferences and willingness to pay, uses a relatively short planning horizon (ten to fifteen years), and breaks the overall plan into projects that can be implemented independently but that together provide full coverage.

7.50 *Piloting a city environment management plan.* The EAP recommends that cities develop environment management plans. This recommendation holds promise and should be pursued with the help of an international agency experienced in the formulation of such plans.

7.52 *Inadequate cost recovery*

- ❑ A universal system of metering should be instituted, with meters designed specifically for intermittent supply. Sewerage charges should be set as a percentage of water consumption. Metering must be supported with stringent billing and collection practices—a segment of operations that could be contracted out to the private sector.
- ❑ Since it is not the inability of poor communities to pay that hinders cost recovery, an innovative cost recovery mechanism should be developed.



Urban Air Pollution Control

7.52 Although India has made great strides in recent years in managing environmental issues, urban environmental degradation is heading toward a crisis. Not only does India have three of the world's megacities (populations of more than 10 million), but the rate of urbanization is also rapidly increasing. The rate of urban population growth is projected to almost double—from 28 percent growth in 1990 to 51 percent in 2025, or from 238 million to 737 million people. World Bank analysis has found that India's economic policies are not only distorting, but they also effectively subsidize environmental degradation and increase the costs of environmental protection.

7.53 The Indian government has increased its efforts to analyze the issue of urban environmental degradation. Far-reaching public interest litigation on environmental matters has also led to serious policy reviews. The most famous example is the Supreme Court ruling on air quality in Delhi, where the national government was asked to clean up the city's air by April 1995. Despite these efforts, it has been difficult to get air pollution control activities moving.

7.54 The Environment Action Program (EAP) for India notes that air quality problems are particularly acute in New Delhi, Bombay, Calcutta, and Madras. The records of the Central Pollution Control Board show high incidences of solid particulate matter, sulfur dioxide, nitrogen dioxide, and heavy metals in New Delhi. The EAP further notes that the industrial deregulation initiated in recent years

Box 7.2. The Air (Prevention and Control of Pollution) Act, 1981

The objective of the Air Act is to prevent, control and reduce air pollution including noise pollution and to establish boards at the States/Union Territories to achieve this. This act prohibits the construction or operation of any industrial plant without the consent of the State Pollution Control Board (SPCB).

The act assigns powers and functions to the Central and SPCBs for prevention and control of air pollution and all other related matters. The act states that state boards for the prevention and control of water pollution are to be the state boards for the prevention and control of air pollution. In addition, the CPCB can exercise the power and perform the functions of a state board in the Union Territories.

For the prevention and control of air pollution, the state government in consultation with SPCB has the power to set standards for emissions from automobiles, impose restrictions on use of certain industrial plants, and prohibit emissions of air pollutants in excess of the standards laid down by the SPCB. It can also make an application to court for restraining persons from causing air pollution. In addition, it also has the power of entry and inspection, power to obtain information and power to take samples of air emissions and conduct the appropriate follow-up.

The CPCB as well as the SPCBs are eligible for contributions from the central government and state government, respectively, to perform their functions appropriately. The act also allows for appropriate penalties and procedures for noncompliance.

The Air (Prevention and Control of Pollution) Amendment Act, 1987

This act includes amendments to facilitate implementation of the 1981 act.

Source: Desai 1994; Pollution Control Act and Rules with Amendments, CPCB, 1989.



is accelerating industrialization and urbanization, with commensurate increases in air pollution.

7.55 The combination of urbanization, increasing urban poverty, and deterioration of urban air, land, and water quality necessitates a broadly based urban environmental strategy. The EAP identifies urban environmental issues as a priority for action, but it fails to address the issues explicitly or to set a schedule for their resolution. This chapter builds on the urban air pollution priorities identified in the EAP and suggests actions and projects deserving immediate consideration.

THE MAGNITUDE OF THE URBAN AIR POLLUTION PROBLEM

7.56 Six of the largest cities in India—Bombay, Calcutta, Delhi, Ahmedabad, Kanpur, and Nagpur—have severe air

pollution. Annual average levels of total suspended particulates in these cities are at least three times the World Health Organization (WHO) standard; in Delhi, Calcutta, and Kanpur, annual average values are more than five times the standard (Table 7.4). More than 90 percent of the national monitoring stations record particulate concentrations exceeding 75 micrograms per cubic meter, the midpoint of the WHO recommended standard. Average annual concentrations of sulfur dioxide and nitrogen dioxide, by contrast, are low in most cities compared with typical ambient standards.

7.57 Particulates are associated with premature death from respiratory illness and cardiovascular disease and increased sickness (increased prevalence of chronic obstructive lung disease, especially bronchitis, and increased incidence of upper and lower respiratory tract infections). With certain

Table 7.4. Average Annual Levels of Four Pollutants in Major Indian Cities, 1991

City	Sulfur dioxide	Nitrogen dioxide	Total suspended particulates	Lead
Recommended standard ¹	50.0	100.0	75	0.7500
Bombay	25.4	29.2	245	0.1158
Calcutta	63.3	40.8	392	0.3985
Delhi	20.8	34.8	390	0.2775
Hyderabad	11.0	19.0	152	0.2215
Madras	14.1	19.8	130	0.0718
Ahmedabad	26.7	30.6	306	0.0785
Kanpur	9.5	13.8	448	0.2450
Nagpur	8.3	15.5	265	
Cochin	6.1	14.4	106	

¹All standards are WHO standards except for nitrogen dioxide, which is the U.S. Environmental Protection Agency standards are expressed in terms of micrograms per cubic meter.

Source: Sulfur dioxide, nitrogen dioxide, and total suspended particulates: *National Ambient Air Quality Statistics of India, 1991*; Lead: *Air Quality Status*, National Environmental Engineering Research Institute.

technical caveats, extrapolations from epidemiological studies in industrialized sites are useful in estimating the magnitude of the health effects of particulate air pollution in India. Reducing particulate levels to the WHO standard would save nearly 37,000 lives in the ten major Indian cities. An economic valuation of these premature deaths, using a statistical life value of \$9,640 (derived using a human capital approach), suggests a value of \$350 million. In addition, reducing particulate levels would likely reduce the incidence of chronic lung disease and respiratory tract infections, especially in children. Asthma attacks also would be reduced. Preliminary estimates of the physical impact of reducing air pollution to

WHO standards in the same ten cities suggests:

- ❑ 975,000 fewer respiratory hospital admissions and emergency room visits.
- ❑ 85 million fewer restricted activity days.
- ❑ 721 million fewer “respiratory symptom” days.
- ❑ 3 million fewer lower respiratory illnesses in children.
- ❑ 9 million fewer asthma attacks.
- ❑ 240,000 fewer cases of chronic bronchitis.

Table 7.5. Particulate Levels and Premature Deaths, 1991

City	Population	Average annual total suspended particulate level ^a	Amount by which level exceeds WHO guidelines	Number of deaths by achieving guideline ^b	Deaths avoided as a percentage of total annual deaths
Bombay	12,571,720	244.7	154.7	6,263	8.17
Calcutta	10,916,272	391.0	301.0	11,797	15.89
Delhi	8,375,188	390.2	300.2	8,429	15.85
Hyderabad	5,361,468	152.3	62.3	1,146	3.29
Madras	5,361,468	130.3	40.3	752	2.13
Ahmedabad	3,297,655	306.3	216.3	3,314	11.42
Kanpur	2,111,284	448.2	358.2	3,274	18.91
Nagpur	1,661,409	235.2	145.2	776	7.66
Jaipur	1,514,425	265.3	175.3	1,079	9.25
Cochin	1,139,543	106.4	16.4	59	0.86
Total, 10 cities:	52,310,432			36,889	10.56

^a Arithmetic average of annual mean values at all monitoring stations.

^b Calculated using the following equation reported in Ostro (1994): change in mortality = 0.00096 x change in particulate matter₁₀ x crude mortality = rate x exposed population (assumes PM₁₀ = 0.55 x TSP).

Source: Central Statistical Organization, *Statistical Pocketbook: India*, 1992; National Ambient Air Quality Statistics of India, 1991.



SOURCES OF PARTICULATE AIR POLLUTION

7.58 The contributions of motor vehicles, industry, and domestic sources to air pollution—especially to particulate pollution—are not well understood. While studies have measured the total emissions of each major pollutant from each source, it is harder to determine the contribution of each source to ambient pollution levels. A dispersion model is used to link emissions from each source to ambient levels observed elsewhere.

7.59 The most careful study of source contributions to particulate emissions was commissioned for Bombay by the URBAIR program (Table 7.6). This study shows the relative importance of motor vehicles, the burning of refuse, and the industrial burning of fuels. Focusing on inhalable particulate matter (PM_{10}), which more easily penetrates the lung and is therefore more relevant for human health, it was estimated that refuse burning contributes 28 percent of pollution; vehicle exhaust, 25 percent; resuspended road dust, 17 percent; fuel burned by residences, 15 percent; fuel burned by industry and power, 12 percent; and other sources such as marine, 3 percent.

7.60 No similar emissions inventory has been produced for New Delhi. The Tata Energy Research Institute has compiled an emissions inventory for industrial sources of particulates, but the corresponding data on area sources are poor. It is possible, however, to assess the importance of various industries to total industrial particulate emissions. It also appears that coal burning is a more important source of particulates in New Delhi than in Bombay.

7.61 Given existing data, it is also

possible to assess the relative importance of various categories of vehicles to total vehicle emissions of particulate matter. In Bombay, for example, vehicles with two-stroke engines contribute 20 percent of particulates, whereas diesel-fueled vehicles contribute 67 percent. Scooters with two-stroke engines are likely to contribute a greater share in New Delhi and Madras since they constitute a much higher fraction of the vehicle fleet (approximately 70 percent, compared with 40 percent in Bombay and Calcutta).

TECHNICAL OPTIONS FOR CONTROLLING URBAN AIR POLLUTION

7.62 The large contributions of vehicles, refuse burning, and industry indicate that the government should consider a multifaceted approach to controlling particulate air pollution. Deciding which measures to implement requires first calculating the costs and associated reduction in pollutants for each option. The second step is to identify the policy instruments (taxes, emissions standards, inspection and maintenance schemes) needed to implement the technical solutions and the appropriate government level and agency for implementing the policy.

Control strategies for particulate emissions from two-stroke engines

7.63 *Replace two-stroke with four-stroke engines.* A four-stroke motorcycle engine of 250 cubic centimeters (cc) or less emits 90 percent less particulates and hydrocarbons than a two-stroke engine of the same size. A four-stroke engine motorcycle costs \$60 to \$80 more to manufacture than a two-stroke motorcycle. The four-stroke engine gets better gas mileage but it is less powerful than a two-stroke engine of the same size.

Table 7.6. Source Contributions to Air Pollution in Bombay, 1992

		Values		Percentage	
		TSP (tons)	Particulate matter ₁₀ (tons)	TSP	Particulate matter ₁₀ (tons)
<i>Vehicles</i>					
Gasoline	Cars	492.0	492.0	0.0158	0.0333
	Motorcycle	737.0	737.0	0.0237	0.0499
Diesel	Cars	765.0	765.0	0.0245	0.0518
	Buses	445.0	445.0	0.0143	0.0301
	Trucks	1,234.0	1,234.0	0.0396	0.0835
Sum of Vehicle Exhaust		3,673.0	3,673.0	0.1179	0.2485
Resuspension from Roads		10,200.0	2,500.0	0.3273	0.1691
<i>Fuel Combustion</i>					
<i>Industrial</i>	LSHS	167.0	84.0	0.0054	0.0057
	FO	1,646.0	1,399.0	0.0528	0.0947
	LDO	12.0	6.0	0.0004	0.0004
	Diesel	12.0	6.0	0.0004	0.0004
	LPG	0.5	0.5	0.0000	0.0000
Power plants		300.0	300.0	0.0096	0.0203
Sum of Industrial and Power		2,137.5	1,795.5	0.0686	0.1215
<i>Domestic</i>					
	Wood	4,395.0	2,198.0	0.1410	0.1487
	Kerosene	23.0	23.0	0.0007	0.0016
	LPG	14.0	14.0	0.0004	0.0009
Sum of Domestic		4,432.0	2,235.0	0.1422	0.1512
<i>Marine</i>					
	FO	540.0	459.0	0.0173	0.0311
	LSHS	16.0	8.0	0.0005	0.0005
	Diesel	2.0	1.0	0.0001	0.0001
	LDO	1.0	1.0	0.0000	0.0001
Sum of Marine		559.0	469.0	0.0179	0.0317
Refuse		4,108.0	4,108.0	0.1318	0.2779
Stone Crushers		6,053.0		0.1942	
Total		31,162.5	14,780.0	1.0000	1.0000

Source: URBAIR.



7.64 *Use smoke-free oil.* The particulates produced by two-stroke engines come from fuel additives and from the oil that is used to lubricate the engine. Because the oil must be mixed with the gasoline, it enters the vehicle's exhaust. Droplets of this oil produce the whitish-blue smoke emitted from two-stroke engines. Smokeless oil would reduce the total suspended particulates from most (but not all) of the oil consumed by two-stroke engines, but the possibility exists that its use would increase emissions of toxic air contaminants.

7.65 *Install catalytic converters on vehicles with two-stroke engines.* Catalytic converters reduce carbon monoxide and hydrocarbon emissions by more completely oxidizing these substances. Catalytic converters also reduce the smoke (particulate matter) coming from the exhaust of two-stroke engines by oxidizing the lubricating oil in the exhaust. Since catalytic converters are not designed to reduce particulate matter emissions, exact measurements of their effectiveness in reducing these pollutants are not available.

7.66 Catalytic converters for two-stroke engines are being installed on newly manufactured mopeds and motorcycles in order to meet Taiwan emission standards. Their use requires a heat shield because of the high temperatures (500 degrees Centigrade) reached. Researchers at the International Transport Research Institute have recently successfully retrofitted a 125 cc motorcycle engine with a catalytic converter. It should be noted that burning leaded gasoline with a catalytic converter will destroy the catalyst; hence, the use of catalytic converters requires unleaded gasoline. Researchers at the Indian Institute of Technology in New Delhi are trying to develop a catalytic converter that will work with leaded gasoline.

Control strategies for particulate emissions from diesel vehicles

7.67 *Reformulate diesel fuel.* One of the main sources of particulate matter in diesel exhaust is the sulfur in diesel fuel. Reducing the sulfur content of fuel from 0.7 percent to 0.5 percent reduces sulfate particulate matter by 30 percent; reducing sulfur content from 0.7 percent to 0.2 percent reduces sulfate particulate matter by 90 percent. The most effective method of reducing the sulfur content of fuel is by hydrodesulfurization, which is widely used by refineries. Diesel fuel additives (barium or manganese compounds) or newer compounds that do not rely on heavy metals may reduce particulate emissions by 40 to 60 percent.

7.68 *Proper engine maintenance and engine modifications.* Engine modifications that will reduce the amount of smoke produced by a diesel-fueled engine include high-pressure fuel injection systems that more precisely regulate the air-fuel mixture; turbocharging of the engine, which increases the air intake of the engine and allows fuel to be burned more completely; and preventing lubricating oil from mixing with fuel by improving piston rings and valve stem seals.

7.69 *Treat diesel exhaust.* It is possible to install a particulate matter trap system, which filters all exhaust gases through ceramic foam. The system continuously cleans the filter by burning accumulated particulate matter. Such systems can reduce particulate matter emissions by 80 to 90 percent. An alternative method of treating particulate emissions that can be used only in diesel vehicles that use low (less than 0.2 percent) sulfur fuel is an oxidation catalyst system. This is cheaper than a particulate matter trap system and requires less maintenance, but it also reduces a smaller



fraction of particles—60 to 80 percent of the soluble organic fraction of particles.

7.70 *Replace diesel-fueled engines with compressed natural gas-fueled engines.* For buses and other high-use vehicles, it may be cost-effective to replace diesel-fueled engines with natural gas-fueled engines. In a study of the cost-effectiveness of reducing particulate matter in Santiago, Chile, converting buses to compressed natural gas reduced particulate matter at a cost of \$17,000 a ton, about the same cost as reducing a ton of particulates by improving the performance of diesel engines on trucks.

Control strategies for particulates from industrial fuel combustion

7.71 Coal supplies almost 58 percent of total commercial energy consumption in India, while petroleum products contribute 32 percent. Indian coal, especially coal burned by power plants, has a high (25 to 40 percent) ash content. In the case of fuel oil, it is the high sulfur content that generates particulates (in the form of sulfates). There are a number of technical options for controlling particulates from industrial fuel consumption and policy instruments that might be used to implement these controls.

7.72 *Relocating industry.* Locating industry in less densely populated areas reduces the health risk of any pollution level. While it obviously is expensive to relocate existing firms, zoning laws can control the location of new firms. Policies can be used to discourage highly polluting industries if it is the country's intention to avoid the highly polluting stage of industrialization.

7.73 *Coal washing.* Washing coal prior to burning removes the nonburning mineral content that produces ash and will reduce the

sulfur content by 10 to 30 percent.

7.74 *End-of-smokestack controls.* Various end-of-smokestack controls, whether in the form of mechanical cleaning, fabric filters, or electrostatic precipitators, will reduce by 90 to 99 percent the particulate emissions produced by a conventional coal-fired boiler with no controls. These controls can be implemented at a relatively low-cost anywhere from 1 to 4 percent of generation costs. Additional controls for sulfur dioxide (such as flue gas desulfurization “scrubbers”) and nitrogen oxides add to the cost but can abate 90 percent of those emissions as well.

7.75 *Making boilers more energy efficient.* Changing the combustion method of the conventional boiler will abate almost all of the particulate matter at a minimal added generation cost and eliminate the need for sulfur dioxide controls. Two of these methods are fluidized bed combustion, in which crushed coal is fluidized with sand or limestone, and combined cycle technology, in which coal is gasified prior to burning to drive gas turbines and improve thermal efficiency. As with fuel switching, however, this approach is more easily implemented if it is introduced with new investment rather than through retrofitting.

Control strategies for particulates from domestic sources

7.76 *Switch to cleaner fuels.* Switching from wood-burning stoves to alternative fuels such as kerosene, oil, natural gas, or electricity will reduce both indoor and outdoor particulate emissions, but at a cost. Poor households could be encouraged to switch to cleaner fuels by subsidizing the cost of these fuels; this, however, may lead to unintended substitutions. Subsidized kerosene can be marketed as an alternative to diesel fuel, but it is more highly polluting than diesel fuel. More compact fuel



sources, such as charcoal or bundled wood, will burn more efficiently and thus produce less particulate matter.

7.77 *Use more energy-efficient stoves.* More energy-efficient stoves require less biomass fuel and thus will produce less particulate matter. These stoves must serve the individual's needs if they are to be adopted. For example, a kerosene stove may be a poor substitute for the more even heat of a wood-burning stove. The stoves also must be easily produced, suggesting the subsidization of mass production rather than of consumer purchases.

7.78 *Vent smoke outdoors.* Placing a chimney on the traditional Chula reduces the health risk of indoor particulate matter, but this approach simply pushes the problem outside.

7.79 *Improve garbage collection and disposal practices.* Refuse burning, particularly in urban areas, is a major contributor to particulate emissions. Improved garbage collection will reduce these emissions. If the garbage is being burned for heat, then a substitute should be found, especially since garbage is very inefficient in heat production compared with other types of fuel.

CALCULATING THE COSTS AND BENEFITS OF REDUCING URBAN AIR POLLUTION

7.80 To maximize the reduction in particulate emissions achieved for a given expenditure, it is important to know the cost per ton of particulate matter removed for each of the technical control options. These costs have not yet been computed for cities in India, but cost-effectiveness studies exist for air pollution control measures in Mexico City and Santiago, Chile. The basic approach is simple: calculate the annualized cost of a control option (say, retrofitting a bus with a natural gas

engine) and then compute the associated reduction in pollution. Computing the cost-effectiveness of reducing one pollutant can be complicated, however, if more than one pollutant is reduced. For example, retrofitting diesel buses with natural-gas engines will reduce carbon monoxide and nonmethane hydrocarbons, as well as particulates.

7.81 Since ambient concentrations of pollution affect human welfare, it is also necessary to compute the cost of reducing ambient pollution concentrations. This calculation requires knowing where (spatially) the reduction in emissions will occur and the effect on ambient air quality. From this, one can estimate the health and related benefits of the proposed measure. Determining how extensively to institute controls requires a comparison of the costs and benefits of reducing pollution levels. Certain data are still required to calculate more careful estimates for India.

THE POLICY AND INSTITUTIONAL SETTING

7.82 India already has taken some action on urban air pollution. The most important effort concerning vehicular pollution is the provision in the amended Central Motor Vehicles Rules (1993) that cars must be certified twice a year for compliance with prescribed standards. To date, however, these regulations have not been implemented. In addition, the Department of Petroleum will begin supplying low-lead gasoline in the four metropolitan cities by April 1995, although details on pricing and number of outlets are not known. For the metropolitan area of New Delhi, the Ministry of Environment and Forests has prepared an action plan that includes stricter vehicle inspections and traffic management, as well as other measures.

7.83 The planning and implementation



of pollution programs are complicated by the fact that the problem involves national, regional, and local agencies. While standards are laid down by the central authorities, activities like vehicle inspection, traffic management, and public transport are generally the responsibility of individual agencies at the state and municipal levels. In many cases, responsibilities overlap. This situation impedes the formulation and implementation of cost-effective air quality management policies.

7.84 Lack of technical skills and authority, particularly at the local level, is another impediment. For example, no metropolitan agency in any major Indian city is capable of taking an overall view of air quality and of planning and guiding implementation of a long-term program. Many municipalities do not even perceive air pollution as a problem requiring their attention. The increased decentralization of monitoring and enforcement responsibilities for air pollution, while worthwhile, will not be easy.

EFFORTS TO CONTROL URBAN AIR POLLUTION

7.85 The Indian government has undertaken a number of studies and projects—some with World Bank support—in an effort to arrest the urban air pollution problem.

Monitoring of air pollution levels

7.86 Total suspended particulate, sulfur dioxide, and nitrogen dioxide levels are monitored every three to four days at stations operated by the National Environmental Engineering Research Institute (NEERI), under the jurisdiction of the Central Pollution Control Board, and at other central monitoring stations. NEERI also analyzes the levels of lead and other metals in particulates. Carbon

monoxide and ozone are monitored only occasionally. Particulate matter is not monitored at all, although NEERI monitors respirable particles.

7.87 The regular monitoring of particulate matter, lead, carbon monoxide, and ozone should be instituted at all Central Pollution Control Board stations. Knowing particulate matter levels is crucial to measuring human health effects. Carbon monoxide and ozone may become serious problems as vehicle fleets grow. Loans to improve monitoring activity would be useful and appropriate.

Studies of health effects

7.88 Several studies are under way to measure the health effects of particulates on urban populations in India. In New Delhi, World Bank-supported work is calculating the first dose-response functions for all air pollutants in India. In Bombay, several health diary studies were undertaken by R.S. Kamat and Associates in the 1970s and 1980s, but current efforts (under the Indira Gandhi Institute) to revisit these studies in order to do more comprehensive analysis are not yet complete and may not contain enough information to be useful.

7.89 Epidemiological studies of the health effects of air pollution must be carried out to determine the benefits that will accrue from reducing urban air pollution. Extrapolations from U.S. studies are difficult because of differences in baseline health and pollution levels, and because people in the two countries die of different diseases and at different ages.

Source-receptor studies

7.90 The most successful attempt at measuring the contribution of different sources



of particulates to population exposures was commissioned by URBAIR in Bombay. Studies by the TATA Energy Research Institute and by H.B. Mathur at the Indian Institute of Technology in Delhi have attempted similar analyses, but with less success.

RECOMMENDATIONS

7.91 Efforts to control urban air pollution first require identifying current levels of pollution and their potential impacts. Studies can help the Indian government to set priorities and will be useful to donors that are interested in funding pollution abatement projects.

7.92 *Emissions inventories.* Setting priorities for controlling urban air pollution in India will require that emissions inventories be established for each major city. The emissions inventory locates (in a GIS data base) the major industrial, domestic, and mobile sources of common air pollutants and estimates the emissions from each source (based on the quantity of fuel burned and appropriate emissions factors).

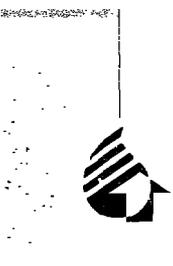
7.93 *Source-receptor studies.* Keeping the emissions inventory in GIS form facilitates the next link—from emissions to ambient air quality. Source-receptor (dispersion) models predict the effect of emitting a ton of a pollutant in a given location on ambient air quality at receptors throughout the city. Since ambient air quality affects human welfare, it is essential to establish this link. Most source-receptor studies make some assumption about the population distribution around the various receptors; hence the impact on the population of a change in emissions in a particular location can be determined.

7.94 The importance of source-receptor

studies cannot be overemphasized. Without information on the contribution of different sources to ambient pollution at population centers, policymakers may end up trying to control sources that really do not contribute significantly to the air pollution problem. URBAIR has initiated source-receptor modeling for Bombay, but no such studies exist for Delhi or Calcutta.

7.95 *Cost-effectiveness studies.* It is essential that the cost per ton of particulate matter removed be calculated for the various control strategies outlined for Delhi, Bombay, and Calcutta. After this initial step is taken and a source-receptor model is developed, it should be possible to translate the effect of a given control strategy into the associated reduction in ambient concentrations of particulates and, in turn, into reductions in population exposure.

7.96 *Studies of the health effects of air pollution.* To determine how far pollution control strategies should go, it is first necessary to compare the costs and benefits of these strategies. Once cost-effectiveness studies and source-receptor modeling have made it possible to predict reductions in population exposures to particulates that result from a given control strategy, it becomes possible to predict the reduction in morbidity and mortality that would result from the pollution control strategy. Linking the ultimate health benefit to the cost of pollution control implies a cost per life or workday saved. Whether such expenditure should be made depends on the value that the members of society attach to gaining an extra workday or year of life. At present such calculations cannot be made based on Indian data because no dose-response functions exist to link pollution levels in Indian cities to health effects in the population.



7.97 Urban air pollution abatement projects in India should have three components:

- ❑ A policy and regulatory component concentrating on the formulation of target-oriented action plans, covering several contributors to air pollution, and including cost-effectiveness analysis of options.
- ❑ A technical assistance component focusing on development of a pollution monitoring program, urban transport management systems, and enforcement of transport, refuse, and industry-related regulations.
- ❑ An investment component concentrating on such items as upgrading of monitoring equipment, vehicle fuel reformation (low-sulfur diesel and unleaded gasoline), retrofitting of existing vehicles (especially high-use vehicles such as buses and diesel trucks), improved solid waste management (including recycling, incineration, and landfill), cleaner coal, and smoke-free domestic wood-burning stoves.

7.98 As preconditions to an area-specific air pollution projects in one or more of India's metropolitan cities, concrete progress in the following areas is necessary:

- ❑ A detailed state and municipal agency plan for implementing the 1993 Central Motor Vehicles Rules concerning vehicle inspection and enforcement of standards.
- ❑ Clarification of the roles of central, state, and municipal agencies in setting such financial measures as fuel taxes, pollution charges, and penalty fines, as well as agreement over the spending of such resources.
- ❑ Evidence that state and municipal agencies are willing to tax polluters within the scope of current law.
- ❑ A time-bound Petroleum Ministry program for introducing unleaded gasoline.

7.99 Any air pollution control project will, by necessity, have to deal with more than one agency. One project implementation structure could be to work with the national-level standing committee on air pollution chaired by the Secretary, Ministry of Environment and Forests and comprising members from the ministries of Urban Development, Health, Transport, Industry, and Petroleum. The degree of lending and technical assistance to state and municipal-level implementing agencies will depend on the project design in each city. In general, implementation authority should be decentralized to each metropolitan area.



Municipal Solid Waste Management

7.100 Municipal solid waste management is a serious challenge for Indian cities. Most garbage that is collected from urban areas is disposed of in uncontrolled landfills. These sites are generally garbage dumps where waste is used to fill in low-lying areas without any consideration given to precautionary measures. The lack of specific environmental measures often results in surface and groundwater pollution. Other problems include odor, rodents, and unsightliness. As the urban population and population density increase, municipal solid waste collection and disposal will be critical to preventing the spread of disease and further pollution. The September 1994 plague in Surat is an example of the problem of poverty that afflict India's cities.

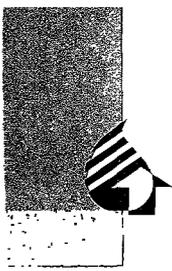
7.101 Almost all the slums in Indian cities have little or no garbage collection. Since 25 percent of the country's 217 million urban

dwellers live in slums, this is a significant problem. Even well-planned cities such as Chandigarh have problems with garbage collection. The city was planned for 500,000 people by 2000—and currently has a population of 770,000. This rapid expansion has left the city unable to cope with domestic refuse. In New Delhi, 1,500 tons of garbage remain uncollected every day. The quantities of municipal solid waste generated each day in some major Indian cities are shown in Table 7.7. Although many of these collection rates seem relatively high, the amount that is left uncollected piles up in and around the cities, creating a haven for rodents and a health hazard for people. To put this in perspective, following the plague in Surat a wave of cleanup efforts rippled through the states of India. The New Delhi government announced that the municipal corporation was collecting between

Table 7.7. Municipal Solid Waste Generation and Collection in Major Indian Cities, 1994

City	Solid Waste Generated (tons/day)	Solid Waste Cleared (tons/day)	Share Collected (percent)	Share Uncollected (tons/year)
Ahmedabad	1,500	1,200	80	109,500
Bangalore	2,130	1,800	85	120,450
Bombay	5,800	5,000	86	292,000
Calcutta	3,500	3,150	90	127,750
Delhi	3,880	2,420	62	532,900
Lucknow	1,500	1,000	67	182,500
Madras	2,675	2,140	80	195,275
Patna	1,000	300	30	255,500
Surat	1,250	1,000	80	91,250

Source : "Our Filthy Cities: Can We Clean Up the Mess?" *India Today*, pp.36-47. October 31, 1994.



5,000 and 7,000 tons of municipal solid waste each day. Considering that 3,800 tons of waste is generated each day, this is an alarming admission of the quantity of waste that had previously gone uncollected.

7.102 The collection and disposal of municipal solid waste remain pressing issues for the municipal corporations commissioned by the state to collect refuse. The responsibility for refuse collection often is delegated to the municipality's health officer rather than to municipal engineers, which results in public health or clinical orientation rather than in efficient operation, safe disposal, and disease prevention. Most of those working with solid waste are from the scheduled castes, since others refrain from this type of work. Municipal officers face many problems with regard to the management of workers, mainly because the public is not interested in sanitation issues and because state governments provide inadequate funding. Many municipal operations overlap, and it is difficult to determine the percentage of municipal funds that is spent on municipal solid waste management. It is estimated that this share is between 40 and 60 percent.

THE ENVIRONMENT ACTION PROGRAM

7.103 The Environment Action Program (EAP) identified poor solid waste management practices as a contributing factor to India's rising urban environmental problems. The EAP identified domestic solid waste (refuse), nonhazardous commercial and industrial solid wastes, and hazardous commercial and industrial waste as the three main types of waste generated in metropolitan areas.

7.104 The EAP identified the following municipal solid waste management issues:

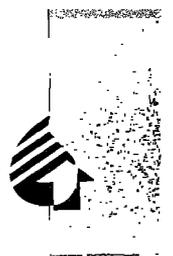
- Domestic, commercial, and industrial

waste are often mixed, creating a disposal problem and a health hazard.

- The practice of dumping solid waste in low-lying areas pollutes groundwater, is responsible for the emission of offensive odors over wide areas, and creates a breeding ground for disease vectors such as rats, pigs, and mosquitoes.
- Garbage collection poses a problem to municipal agencies because households do not separate dry and wet wastes.
- People are unaware of environmental sanitation and of the hazards of exposed garbage.

7.105 The EAP identified the following priority programs to address solid waste issues in the urban environment:

- Strengthen the platform for technology transfer and its application in the shelter sector.
- Promote the commercial production of innovative materials using fly ash, red mud, phosphogypsum, and agricultural waste for the appropriate design of houses in both rural and urban areas.
- Develop strategies to reduce the solid waste generated in cities, with an emphasis on wastes that impose disposal difficulties (such as tube lights and used battery cells).
- Develop biodegradable packaging materials through labeling schemes and fiscal incentives.
- Propose innovative designs for the improvement of refuse vehicles (garbage trucks).



- ❑ Formulate plans to assess space requirements for solid waste treatment.
- ❑ "Rehabilitate" ragpickers.
- ❑ Protect surface and groundwaters to meet the needs of water users.
- ❑ Provide health services that emphasize health education, awareness, and risk assessment.
- ❑ Manage stormdrains in cities.

MAJOR ISSUES

7.106 Like many other developing countries, India suffers from shortcomings in solid waste management. While the EAP identified some pressing issues, other areas also will require attention if solid waste management is to improve.

Institutional issues

7.107 *Lack of coverage of poor communities.* In some Indian cities as much as 30 percent of the population is not served by solid waste collection programs. Areas that are unserved almost always house the poor and are unincorporated, periurban settlements or slum communities with small or inaccessible streets. Residents in these areas have little political clout since most are of the lower castes. Prosperous residential areas, by contrast, are well served and cleared of garbage on a regular basis.

7.108 *Inefficient service.* Solid waste collection services are inefficient even in areas where the municipality furnishes garbage collection services. Considerable amounts of refuse are left uncollected around the communal bins. The refuse around the bins comes from residents who are reluctant to dump their household waste directly into the

bins. The areas surrounding the bins are generally strewn with waste, making it difficult to approach. This mess discourages workers from cleaning up, since it shows a lack of pride on the community's part. Solid waste that is left uncollected often finds its way into urban drainage systems, interfering with the flow and resulting in local flooding and health problems.

7.109 Inadequate or inappropriate equipment also adds to the inefficiency of garbage collection. In some cities garbage crews lack shovels for cleaning the area around communal bins. In other cities halfhearted attempts are made to clean these areas in order to minimize the handling of refuse, since it often contains feces. In cases where workers are supplied with protective clothing, they must pay the full cash value of these clothes. The lack of labor motivation and cultural issues adds to the inefficiency of service.

7.110 *Suspicion of the private sector.* Although privatization of solid waste management services remains an attractive solution, at least with respect to garbage collection, municipal officials are reluctant to implement this strategy. Indian unions are strong and they oppose the use of private garbage collectors. Even if private contractors took over parts of city collection, the municipality would be unable to lay off workers or to assign them other duties. Only through natural attrition would labor costs be reduced. An associated issue is the ability of private firms to recruit personnel for such work. Since workers hired directly by the municipalities receive many benefits and are protected by the unions, working for a private firm may not appear attractive at the outset.

7.111 *Benefits of recycling.* Recycling is practiced around many dumps and at refuse



collection points and is a source of income for a small portion of the urban population. Recycling efforts are badly organized, to the disadvantage of the scavengers and to the advantage of the municipalities and middlemen. Scavengers are paid very little for their toil considering the long hours spent at landfills and dumpsites. Because they are poor or belong to lower classes, these people usually have few rights and no benefits.

7.112 The impact of this type of recycling is not well understood by municipal officials, who consider it a minor activity with little impact on the final waste stream. Interviews with scavengers and recyclers at each dump, however, revealed that several families were able to earn a living from gathering materials. Furthermore, recycling was found to be quite prevalent among households, and visits to many poor neighborhoods indicated a lively trade in recycled materials.

7.113 *Weak regulatory and legal frameworks.* Little is done by municipalities or authorities to discourage indiscriminate dumping of refuse. Although municipal codes prohibiting such activities exist in most urban areas, municipal employees and authorities have other priorities—such as the provision of clean water—that require more of their attention and leave less time to enforce antidumping regulations.

7.114 *Weak municipal management.* Major decisions regarding solid waste are made by elected officials; as a result the decisionmaking process often becomes an exercise in protecting local interests. The operational aspects of daily management are usually the responsibility of the municipality's health department. The health departments tend to overemphasize health issues to the detriment

of technical and logistical components of waste management. If operational responsibility lies in the hands of the public works or engineering department, less thought is given to the health impacts. This institutional conflict provides no incentive for these departments to cooperate or coordinate with one another.

Sociocultural issues

7.115 *Cultural barriers.* Low community status is accorded to employees of the solid waste management industry. Although class and caste associations are illegal, these systems continue to govern the daily life of Indians. Cultural norms dictate which social classes are to be employed as sweepers, truck loaders, drivers, supervisors, and managers. These norms inhibit worker flexibility and municipal management with regard to efficient human resource allocation.

7.116 Workers who choose to work in areas not usually associated with their caste do so by keeping their identity anonymous. This is especially the case with recyclers, who for flexibility and earnings potential have chosen to do the task of scavenging while not belonging to the untouchable class.

7.117 *Tragedy of the commons.* Private interests are always more powerful than shared public interests. This fact is manifested in how people treat common areas outside their own households. Indians show little concern for common areas such as streets, sidewalks, and public toilets. Indiscriminate dumping and defecation near communal bins reflect disregard for public interests. Furthermore, unmanaged solid waste collection points often become a site not only for public defecation, but also for indiscriminate dumping of industrial waste.



Economic and financial issues

7.118 *Lack of data regarding real service costs.* The real cost to Indian municipalities of solid waste management is not well understood because many municipal costs for solid waste management overlap with water and sanitation activities. Although 40 to 60 percent of the municipal budget is allocated for solid waste issues, no serious consideration has been given to cost-cutting measures in solid waste management. A budget shortfall merely results in reduced service levels or in subsidies from state governments. State governments traditionally have provided small cities with the capital for new equipment, and municipalities have financed the operation from their revenue base.

7.119 Municipal managers fail to understand the tradeoffs among labor, capital, and economies of scale because they must spend their time dealing with daily crises and operational difficulties. Few analytical resources in municipal governments are capable of dealing with the efficient allocation of resources.

7.120 *Inadequate cost recovery.* The link between the delivery of and payment for solid waste management services is obscured. Tax revenue is generated based on a property's owners, not its inhabitants. Whereas residents can easily see the connection between water and electricity use and their monthly utility bills, the link between payment for refuse collection and disposal and property taxes is less clear. Inefficient tax collection practices worsen an already weak financial situation by not providing the maximum possible revenue. Some residents, especially the wealthy, have indicated a willingness to pay

a garbage tax provided that it improves the efficiency and timeliness of service. The specific level that they would be willing to pay is not known.

7.121 *Labor and capital dichotomy.* Municipal management is attempting to determine the optimal degree of mechanization in solid waste management. Although there is a surplus of available labor, few apply for conservancy positions due to their low status. Most workers in the sector favor mechanization as a way of reducing labor problems and physical contact with the refuse.

Technical issues

7.122 *Mishandling of equipment.* Most solid waste handling equipment is either under constant repair or permanently disabled. This is the result of neglected maintenance and repair expenditures, a budget item ignored by planners and managers. Half the refuse collection fleet in a typical municipal garage is out of service.

7.123 *Failure of experimental technology.* Solid waste technologies that have proven viable in other countries have failed in India for institutional, social, financial, and technical reasons. Lessons from these failures are not well documented. Some of the technologies explored without success include composting and incineration. The notion that composting is a natural process—and therefore does not require attention to process fundamentals or adequate equipment—has contributed to the failure of this process. Changes in refuse composition over the years and frequent breakdowns of windrow equipment, trucks, and mechanical separation equipment have contributed to the failure of composting plants.



RECOMMENDATIONS

7.124 The solid waste sector in India has many financial and technical needs. Most Bank assistance has been in the form of loans for equipment such as trucks and bins and the occasional incinerator. It has become clear that assistance to acquire technology is not sufficient and must be supplemented with assistance for institution-building and field technical assistance and monitoring. To broaden the scope of future investments, a comprehensive policy framework should be adopted that takes into account the physical, technical, legal, institutional, financial, environmental, and sociocultural aspects of municipal solid waste management in Indian cities. The following recommendations, developed after review with municipal officials, are intended to address the municipal solid waste management problems in India.

Institutional issues

7.125 *Private contracting in urban areas.* Consideration should be given to privatization of solid waste collection, at least on a pilot basis. Privatization would assist the municipality in selecting and procuring a contractor and in monitoring the contractor for a specified time, followed by a thorough evaluation. The evaluation should examine all aspects of the contracting arrangement, particularly institutional and economic issues and the potential for replication in other urban settings.

7.126 *Municipal solid waste planning manual for municipal managers.* Most municipal managers in India oversee a fixed number of employees and a limited capital equipment budget. These factors constrain planning and optimization. Hence, it is essential that a solid waste management training or planning manual be developed that

reflects the country's social, economic, and cultural conditions. Such a volume would help planners and municipal managers develop operational procedures at the least cost. It should introduce computer-based planning techniques, such as low-cost Geographical Information Systems (GIS), as a tool to enhance planning.

7.127 *Training institutes.* Officials should establish a centralized demonstration program in a single institution that trains municipal managers, engineers, and health officials on sound solid waste management practices. These professionals could, in turn, train others at the local level. Using this approach would eventually produce thousands of local officials prepared to face the technical, institutional, social, and financial challenges that cities face as they grow.

Sociocultural issues

7.128 *Community self-help projects.* Community self-help projects should be organized in the poor urban and periurban areas where solid waste management services are inadequate or nonexistent. These projects could be developed as pilots to aid in local collection, recycling, and transfer to a secondary municipal pickup point. It is imperative that drains be clear of refuse and that waste be collected in these areas to avoid unnecessary health problems.

7.129 *Urban public relations campaigns.* Cleaning up urban areas will require soliciting the help of social and political activists capable of spearheading an urban public relations campaign. These campaigns should educate the public regarding the health hazards involved in improper waste disposal practices and could include contests for the optimal design of, for example, dust bins. Winners would be given monetary awards or a contract



to supply the city with the bins. The public must learn that their participation is essential for clean cities.

Economic and financial issues

7.130 *In-depth evaluation of recycling activities.* Assessing recycling activities in specific municipalities will help to determine the impact of recycling on the waste stream, the economic benefits to ragpickers, and the potential for improvement and expansion to meet a broader range of urban objectives. Such an evaluation also would determine the amount of solid waste reduction potential.

7.131 *Improved municipal solid waste financial accounting.* Projects should be initiated that assist municipalities in developing a computer-driven municipal solid waste cost-accounting system. Concurrently, a training program should be developed emphasizing the importance of data gathering and the monitoring of operations. Up-to-date software and adequate training should improve financial forecasting and the deployment of labor and material resources.

7.132 *Research program in municipal solid waste financing.* New financing mechanisms should be developed to purchase capital equipment, which is currently funded by municipal and state taxes. Educating the public on the costs of municipal solid waste management will increase their willingness to pay for improved municipal services.

7.133 *Private financing of municipal solid waste services.* This option may be more successful in the more prosperous cities, since India is generally regarded as too poor to have an active market for municipal bonds or revenue-based financing.

Technical issues

7.134 *Composting evaluation.* Since

composting is a favorable disposal option, examining the performance of existing composting plants—and determining the reasons for failure of the many inoperative ones—may provide the insight needed to operate a successful plant.

7.135 *Demonstrations of new equipment and technology.* Municipal solid waste equipment can be made more efficient through field research by manufacturers of such equipment. Such projects forge links between private manufacturing companies and municipalities and aid in the development of equipment suited to local conditions. China, for example, has successfully developed collection bins and refuse collection trucks suited to local conditions, reducing collection problems in the country. A program to demonstrate the new types of equipment could be introduced in selected municipalities in collaboration with local manufacturers on a cost-sharing basis.

MEDICAL WASTE

7.136 Rapid urbanization is straining service delivery system in the largest Indian cities. Infrastructure systems are incapable of adequately collecting, transporting, and disposing of solid wastes. Each day, millions of tons of solid waste mixes with medical and other hazardous waste, creating health hazards and potentially disastrous public health crises. This section assesses and recommends strategies for dealing with the handling, storing, transfer, and disposal of medical waste in urban areas.

THE ENVIRONMENT ACTION PROGRAM

7.137 The EAP emphasizes the National Health Program's strategy of tackling urban environmental issues and safely disposing of hazardous wastes that are injurious to human health. One of the EAP's seven priority areas



is controlling biohazardous medical waste within the context of industrial and related pollution, particularly hazardous wastes.

7.138 More specific to hospitals and clinics are the 1989 Hazardous Waste Rules covering eighteen types of hazardous wastes and 434 flammable and explosive chemicals. Several of the chemicals listed—acetone, phenol oxide, toluene (blue), ammonia, and chlorine—are commonly found in hospitals. The rules also established a National Register for Potentially Toxic Chemicals.

7.139 The EAP defines two types of government programs: those related to environmental protection and those dedicated to natural resource conservation and protection. Hazardous waste management is categorized under environmental protection. Programs include financial assistance for research projects, and assistance to the State Pollution Control Boards to strengthen their capacities to regulate hazardous waste management. The EAP singles out hazardous waste from hospitals and research laboratories as contributing to the problem of water and land pollution.

Definitions and categories of medical waste

7.140 Categorizing medical waste is a complex task that must include defining the sources that generate the waste. For example, a focus on pathogens could include all waste and exudates from infected persons, while a focus on occupational worker safety would include work site hazards such as asbestos. Another area of ambiguity is the overlap of medical waste categories. One cause of the overlap concerns the different interests involved in medical waste management, including environmental protection agencies, worker safety groups, health and human services organization, civil codes, and

professional organizations such as medical certification and hospital accreditation groups. The World Health Organization (WHO) categorizes hospital and medical waste as:

- General, nonhazardous waste, similar to domestic wastes.
- Pathological waste, including tissues, organs, body parts, human fetuses, animal carcasses, and most blood and body fluids.
- Radioactive waste, including solids, liquids, and gases from analysis procedures, body organ imaging, and tumor localization and treatment.
- Chemical waste, including toxic, corrosive, flammable, reactive, genotoxic (capable of altering human genes), or nonhazardous.
- Infectious waste containing pathogens in sufficient quantity that they pose a serious threat.
- Sharps (any item that could cause a cut or puncture).
- Pharmaceutical waste, whether surplus, spilled, outdated, or contaminated.
- Pressurized containers.

EXTENT OF THE MEDICAL WASTE PROBLEM

7.141 Estimates of the volume of medical waste generated in India are imprecise. Engineers in Bombay, Delhi, and Madras estimate that medical solid waste ranges from 0.85 kilogram to 2.25 kilograms per hospital or clinic bed per day. Estimates vary because in most cases, medical waste is neither weighed nor segregated, and some estimates do not include small (fewer than ten beds) clinics and private clinicians. National government



guidelines for medical waste management being prepared by the MOEF include all sources generating potentially infectious waste, such as dispensaries, laboratories, veterinary clinics, blood banks, and hemodialysis centers.

7.142 The total amount of solid waste (including medical waste) generated in three municipalities i.e. Bombay, New Delhi, Madras, is estimated by sanitation engineers based on the average number and capacity of truckloads to disposal sites each day. In addition, the Central Pollution Control Board recently published estimates of the solid waste generated daily in eighty-four cities and towns. The two sets of estimates are similar and do not differentiate between hazardous and nonhazardous waste.

7.143 The share of infectious and potentially infectious medical waste in total hospital and clinic waste is unknown. Estimates made by hospital infection control committee members varied from 25 percent to 85 percent, depending on whether the hospital specialized in treating infectious diseases. The exact proportion of infectious and potentially infectious waste is unimportant, since the lack of waste segregation eventually contaminates all waste at either the pickup bins or the disposal sites. The 50 percent contamination estimate used in this exercise is based on discussions with hospital authorities and observation of disposal at disposal areas from twelve government, municipal, and private hospitals. About 98.3 metric tons (216,260 pounds) of contaminated and infectious materials are disposed of in the municipal disposal sites in the three municipalities each day.

7.144 A 1993 joint study by the government and UNDP–World Bank found

Table 7.8. Estimates of Medical and Infectious Waste in Three Municipalities (metric tons per day)

Municipality	Solid Waste	Medical Waste	Infectious ^a
Bombay	5,000	75.0	37.5
Delhi	4,600	69.0	34.5
Madras	3,500	52.5	26.3
Total	13,100	196.5	98.3

^a Half of medical waste.

Source: Solid waste: UNDP/World Bank; medical waste: Central Pollution Control Board and discussions in each city; infectious, waste: discussions with city sanitation engineers and World Bank estimates.

that 1.5 percent of total solid waste is generated by hospitals, nursing homes, and dispensaries. Estimates of medical waste as a part of total waste are based on this statistic (Table 7.8).

7.145 Medical waste in India is commonly categorized as solid waste. Excluded from this categorization are potentially infectious blood and body fluids, such as those entering the drainage system from postmortems. For example, one major hospital averages five postmortems a day. An estimated 2.5 liters of blood and body fluids are released during each procedure—releasing more than 4,000 liters of potentially infectious fluid into the drainage system each year. This estimate does not include the common practice observed in hospitals of rinsing into the sink or drain potentially infectious cultures, laboratory instruments, slides, and fabrics.

Policies and practices in medical waste disposal

7.146 Health officers, sanitation officials, and staff of Pollution Control Boards are alert to the dangers of hazardous medical waste and are aware that the daily amount of infections and contaminated waste is unknown. Of the 5,800 metric tons of solid waste

collected in Bombay each day, an estimated 800 tons remain uncollected.

7.147 Of immediate concern is the health threat to Class IV workers who are exposed to infectious and contaminated hospital waste. For example, more than 5,000 workers handle mixed hospital waste in Bombay, and another 10,000 “rag pickers” scavenge at the two transfer stations and four disposal sites. There are no estimates of the number of unofficial scavengers at risk from the public bins that include hazardous waste from small clinics, dispensaries, private clinics, and nursing homes. Madras has about 9,000 Class IV waste handlers and scavengers handling infectious waste on 330 trucks, eight transfer stations, and two disposal sites. The workers who are specially at high risk of infection are those working on the two trucks dedicated to the daily collection of human tissue, placentas, and body parts from four of the corporation hospitals that specialize infectious diseases. Despite separate collection, transport, and disposal of these infectious pathogens, tissue and materials all are infected after being mixed in the high temperatures and humidity typical of Madras.

7.148 It has been suggested that individual or regional incinerators be installed to solve the infectious waste problem. Incinerators in public hospitals however, are poorly maintained, insufficiently filtered for particulates, do not enable revolving or turbulence, and usually operate at too low a temperature. Madras recently issued a regulation that hospitals and clinics with more than fifty beds must have their own incinerator to dispose of infectious medical waste. Incinerator specifications (size, fuel type, filtration method, turbulence capabilities, and operating temperatures) have not been issued.

7.149 Uncollected hazardous medical waste outside the hospital premises is another problem. Sharps and other potentially infectious material are exposed regardless of whether an incinerator was available. It is not uncommon for contractors to pay hospitals for scavenging rights to mixed medical waste that included sharps, syringes, bags, plastic tubing, and fabrics—for resale. The potentially infectious materials are resold without sterilization. The sorters often do not use personal protective equipment, and the dressings, bandages and other materials which they scavenge tend to be scattered by shoes and other traffic. It also has been reported that Class IV handlers are selling scavenging rights at the back door.

7.150 There is a consensus at the municipal level that the volume of solid waste has overloaded infrastructure, budget, collection and disposal facilities, and that the hazardous medical waste problem is not yet fully appreciated. Medical waste is considered more of an engineering problem than a threat to public health.

Policies and practices in hospital waste management

7.151 Public and private hospitals employ a variety of safety measures. Their responsibility for infectious waste and other potentially infectious material, however, is considered to end at their back-door site. As a result, even pathogens and tissue that are bagged and separated for collection end up mixed at transfer stations and disposal sites.

7.152 The use of Universal Precautions varies in public and private hospitals with private hospitals having more written guidelines and procedures for managing hospital waste than public institutions. Most



hospitals have infection control committees that meet periodically to review infection statistics and observe infectious waste handling practices. Often, however, there is a discrepancy between guidelines and practice. In addition, monitoring and compliance for infection control are not viewed as an integral part of professional responsibility. Nonmedical bioengineering specialities are uncommon in hospitals and appear limited to environmental engineering faculty in professional engineering schools.

7.153 Safe practices often are limited to health professionals in infectious wards, operating theaters, and so on, and essentially ignore Class IV waste handlers. Budgets for personal protective equipment are so inadequate that availability usually is limited to professionals, and Class IV workers are not trained in the safe collection, handling, transfer, and disposal of hazardous waste within the hospital.

7.154 Class IV workers in hospitals rarely use masks, gloves, and coveralls as they collect and deliver reusables and disposables for decontamination, laundry, and disposal bins. Even when personal protective equipment is available, Class IV workers considered it burdensome and preferred not to wear it.

7.155 There is concern among medical staff about the risk of contracting infectious disease in the hospitals. This concern is caused by the incidence of tuberculosis, HBV, HCV, HIV, and meningitis in India. The need for training for hospital waste management is recognized. However, except for guidelines and materials covering radiological waste and materials, neither pre-service nor in-service training for physicians and matrons includes discrete modules on the management of infectious and other hazardous hospital waste.

Very few hospitals train Class IV workers in hazardous waste handling, and an even smaller number screen the health status of handlers before employment.

7.156 After many years of sponsoring and providing technical assistance for health programs—many of which generate considerable infectious waste, it is only in the most recent of Bank-assisted projects (Health Systems II Project in Karnataka, Punjab and West Bengal) that components for training in infectious waste management have been included. It was suggested that both the government and the international community have neglected infectious medical waste issues.

Government responses

7.157 The Indian government has initiated a number of activities to address the public health dangers of hazardous medical waste:

- A committee on urban solid waste management was formed in October 1994 to assess the impact of current solid waste management practices on community health. The interim meeting in April 1995 reported on technological options for the safe collection, transportation, and disposal of urban solid waste. The next task is to identify potential hazardous wastes, including hospital waste, and their associated public health risks.
- In April 1995 the Ministry of Health and Family Welfare collaborated with the World Health Organization for a workshop on sanitation and environmental health. Topics covered included urban low-cost sanitation, solid waste management, involving non-governmental organizations and



voluntary agencies in sanitation efforts, and technology for the disposal of hospital waste.

- The Central Pollution Control Board has published "Management of Municipal Solid Wastes—Status and Options," which identifies seven reasons that municipal waste disposal systems are poorly operated and maintained: inadequate finances, the multiplicity of agencies for operations and maintenance, inadequate training, lack of performance monitoring, inadequate emphasis on maintenance, lack of management, and lack of community appreciation of the importance of solid waste disposal.
- The Ministry of Environment and Forests has drafted rules for biomedical waste management and handling. The ministry is also surveying hazardous waste generation and tracking practices in hospitals, clinics, veterinary medical clinics, dentists, and bloods banks.

RECOMMENDATIONS

7.158 The volume of hazardous medical and nonsegregated infectious wastes has reached proportions that will cause public health crises if not addressed immediately. Medical waste management problems and potential solutions cross jurisdictions, sectors, and disciplines. Both public and private actions are required. Urban sanitary engineers are currently the sole decisionmakers for hazardous medical waste collection and disposal practices. This approach has many shortcomings.

7.159 Medical waste management must be comprehensive, and policies and regulations must be accompanied by budget, training, and monitoring for compliance. Requirements or

requests to purchase incinerators are but stopgap measures if budget, maintenance, infrastructure, and other elements of handling, collection, decontamination, and disposal are not also addressed.

7.160 The current high level of government and inter-jurisdictional attention to medical waste issues is an important first step. Well-known remedial steps, however, can be taken immediately and do not require extensive study. The following recommendations should be carefully considered by the government and by donors:

- Every hospital and clinic should be held responsible for the waste it deposits for collection and disposal. Hospital administrators should ensure that staff have the knowledge, skills, supplies and systems needed to segregate, decontaminate, and dispose of infectious wastes.
- Each institution should develop and implement a medical waste management plan.
- The private sector, consistent with the EAP, should forge a partnership with the government to collect and dispose of infectious waste from medical facilities that are unable to decontaminate their waste.
- Cost recovery from waste generators should be mandatory, and enabling legislation passed where appropriate.
- Collection and safe disposal should follow universal standards for closed and leakproof containers, collectors, and trucks.
- The Ministry of Environment and Forests and Central Pollution Control Board should remain responsible for

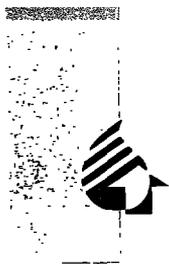


environmental policy, status, and regulations. The Ministry of Health and Family Welfare should remain responsible for overall scientific and clinical medical policy and regulations. The new Occupational Health and Safety entities should be responsible for ensuring provisions for personal protective equipment, training, and safe practices for workers, particularly Class IV handlers and scavengers.

- ❑ Municipal and State Pollution Control Boards should have the capacity to monitor compliance with medical waste transport and disposal guidelines, rules, and policies.
- ❑ Nongovernmental organizations and scientific organizations should be funded to study the infectious waste threats to public health; including the current TB

morbidity rates for hospital doctors. Costs and benefit studies of preventive measures undertaken now compared with expenditures required when plague and dire infectious episodes occur would be useful.

- ❑ Long-term environmental policies, guidelines, and statutes should be linked with immediate requirements to segregate and decontaminate medical waste at its source. This linkage should include appropriate technology for sustainable environmental and public health protection, rather than imported high-technology incinerators that are expensive to purchase and difficult to maintain.
- ❑ India's multilateral and bilateral partners should support programs for medical waste management in current and future health projects.



GOI Program Objectives

Category: *Water Supply, Sanitation, and Wastewater Collection and Treatment*
Government Objectives/Programs:¹

Protection of natural water sources, surface and sub-surface, to meet the needs of water users/usages; managing storm drains in cities; community participation, behavioral pattern and technology transfer aspects of water supply; evaluation and assessment of the rural water supply system; preventive maintenance of water distribution system with reference to leakages and carrying capacities of the mains; leak detection measures; hydraulic analysis and optimum design of water distribution systems etc. Use of solar energy in the rural water supply; hydraulic rams for the rural water supply in hilly areas. Development of package water treatment plants. R&D on the conversion of brackish water and sea water to drinking water. In sanitation, areas for research and development relate to sanitary latrines; integrated bio-gas system for the treatment of excreta and animal wastes and the utilization of gas; low-cost waste water collection. Improve the quality of life of the poor who do not have access to safe water; involvement of urban local bodies; privatization of implementation, operation and maintenance.

Donor Agency Support

Project	Donor	Funding
<i>Efficient Management</i>		
Urban Community Water Supply and Sanitation	WHO	US\$0.27 M
Urban City Water Supply	Japan (OECF)	US\$68.0 M equiv.
NGO Support Fund	Netherlands	US\$3.34 M equiv.
Ganga ICD Strengthening	Netherlands	US\$1.94 M equiv.
Kerala SPCB	Netherlands	US\$2.66 M equiv.
Environmental Sanitary Engineering, Kanpur I	Netherlands	US\$17.61 M equiv.
Environmental Sanitary Engineering, Kanpur II	Netherlands	US\$30 M equiv.
Environmental Sanitary Engineering, Kanpur III	Netherlands	US\$10.89 M equiv.
Ganga Action Plan Support	Netherlands	US\$27.78 M equiv.
UASB Bihar	Netherlands	US\$0.20 M equiv.
UASB Design Support	Netherlands	US\$0.19 M equiv.
<i>Low-cost Sanitation for Liberation of Scavengers</i>		
NGO Support Fund	Netherlands	US\$3.34 M equiv.
Madras Water Supply, Sanitation	World Bank	US\$ 53.0 M
		US\$16.0 M equiv.

¹ Programs are as identified in India's Environmental Action Plan, 1994-95. Annual Report of the Ministry of Urban Affairs and Employment, the Eighth Five-Year Plan.



Project	Donor	Funding
<i>Accelerated Urban Water Supply Program</i>		
Urban Infrastructure Development, Karnataka	ADB	US\$100.0 M
Madras Water Supply, Sewerage	Japan (OECF)	US\$171.0 M equiv.
Hyderabad Water Supply, Sewerage	World Bank	US\$53 M
		US\$79.9 M equiv.
Madras Water Supply, Sanitation	World Bank	US\$53.0 M
		US\$16.0 M equiv.
Third Bombay Water Supply, Sewerage	World Bank	US\$40.0 M
		US\$150.0M equiv.
Second Madras Water Supply	World Bank	US\$275.8 M equi.

Category: *Solid Waste-Related*

Government Objectives/Programs:

Strategies for bringing down the solid waste generation in cities with focus on those which are difficult to dispose of such as tube lights, used battery cells etc. Designing fiscal instruments for waste minimization of non-biodegradable and non-recyclable packaging materials used for packaging of food products, medicines, soft drinks, machine parts, oils, breakables, etc. Developing biodegradable packaging materials through the Eco-Mark scheme and through fiscal incentives. Design innovations for improving refuse vehicles. Formulation of plans for assessing space requirements for solid waste treatment. Rehabilitation of ragpickers.

Donor Agency Support

Project	Donor	Funding
NGO Support Fund	Netherlands	US\$3.34 M equiv.
Uttar Pradesh Urban Development.	World Bank	US\$150.0 M equiv.

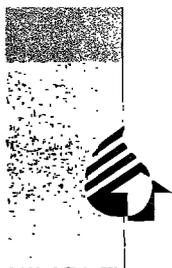
Category: *Transport-Related*

Government Objectives/Programs:

Policies to promote public transport. Introducing innovative fiscal instruments to finance the public transport projects to charge the entire range of beneficiaries rather than only the direct users. Road pricing practices for overcoming congestion. Setting up monitoring system for air pollution control.

Donor Agency Support

Project	Donor	Funding
Environmental Management of Road Projects	ADB	US\$0.24 M
Tamil Nadu Urban Development	World Bank	US\$300.2 M equiv
Uttar Pradesh Urban Development	World Bank	US\$150.0 M equi.



Category: Urban Development

Government Objectives/Programs:

Framing enabling housing policy. Strengthening of Building Materials and Technology Promotion Council to provide a platform for technology transfer and application in the shelter sector, and promoting commercial production of innovative materials, using fly-ash, red mud, phosphogypsum and agricultural wastes, and for appropriate design of houses both in urban and rural areas. Health services with focus on health education, awareness and health risk assessment. Protection of urban amenities such as public parks, beaches. Erection and strengthening of urban forests. Formulation of city-level environmental management plans. Important components of IDSMT are traffic and transportation, markets and mandis, tourist amenities, parks and playgrounds, slaughter houses, street lighting, localized drainage works, sites and services etc. Training Programs. Developing Urban Management Development Program. Nehru Rozgar Yojana; Urban Basic Services for the Poor . The Environmental Improvement of Urban Slums.

Donor Agency Support

Project	Donor	Funding
<i>Improved Management of Degraded Urban Living Areas, Slums, etc.</i>		
Urban Infrastructure Development, Karnataka	ADB	US\$100.0 M
Control of Environmental Health Hazards	WHO	US\$0.22 M
Calcutta Environmental Strategy	British-ODA	US\$3.2 M equiv.
NGO Support Fund	Netherlands	US\$3.34 M equiv.
Tamil Nadu Urban Development	World Bank	US\$300.2 M equiv.
Uttar Pradesh Urban Development	World Bank	US\$150.0 M equiv.
<i>Poverty Alleviation Programs</i>		
Urban Infrastructure Development, Karnataka	ADB	US\$100.0 M
Uttar Pradesh Urban Development	World Bank	US\$150.0 M
Family Welfare (Urban Slums)	World Bank	US\$79.0 M equiv.

Category: Energy-Related

Government Objectives/Programs:

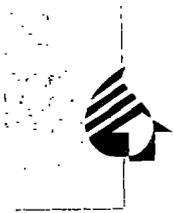
Programs for energy efficiency in street lighting; alternative energy programs and energy efficiency in urban areas; formulation of pricing policies for promoting energy conservation; improving public distribution system for kerosene; increasing the use of coal in urban areas through introduction of methods such as fluidized bed processing or pelletization for smoke reduction and improving the thermal properties. This program could be successfully linked to the proposed program of improved cookstoves. Preparation of energy audits for each city.



Category: *Urban Mapping*

Government Objectives/Programs:

Obtain aerial photographs, develop technical capabilities of town planning organizations, prepare base maps, generate digital graphic inputs for GIS for updating base maps.



World Bank Support

Project: **Hyderabad Water Supply and Sewerage**
Fiscal Year: 1990
Loan/Credit Amount: US\$10.0 million / US\$79.9 million (equivalent)
Description: Project would increase Hyderabad's water supply by about 23 percent. It would also help realize more benefits from prior investments in water supply and sanitary sewerage and expand capacities to meet future needs, through the rehabilitation and strengthening of the existing water supply and sewerage systems. The latter is seriously overloaded and this causes environmental pollution and health risks. The project would also address the safe excreta disposal needs of the community through a low-cost sanitation program. It would also strengthen Hyderabad Metropolitan Water Supply and Sanitation Board's management, financial and operational performance through technical assistance and personnel training components.

Project: **Madras Water Supply and Sanitation Project**
Fiscal Year: 1987
Loan/Credit Amount: US\$53.0 million/US\$16.0 million (equivalent)
Description: The project would finance about 60 percent of Madras Metropolitan Water Supply and Sanitation Board's 1987-1995 investment program aimed at increasing water supply and improving water distribution and sewerage services in metropolitan Madras. The project would make better use of existing resources and assist Madras in developing a plan to identify medium- and long-term water supply solutions of a larger scope. It would also significantly strengthen MMWSSB's financial and operational performance and improve its capacity to manage the sector. Specifically, the project would:

- (a) Augment water supply and extend distribution networks by about 35 percent of present supply.
- (b) Improve and extend sewage collection and treatment systems.
- (c) Initiate a program of low-cost sanitation.
- (d) Support improvements in operational and financial efficiency aimed at making MMWSSB commercially viable and more efficient.



- (e) Improve policy formulation, analysis and prioritization through improved planning and management.

Project: **Tamil Nadu Urban Development**

Fiscal Year: 1988

Loan/Credit Amount: US\$300.2 million (equivalent)

Description: The project aims to strengthen the functioning of urban institutions involved with the delivery of urban services and the implementation of urban investments; improve shelter for 176,000 families; and increase the efficiency of the urban transportation system. Toward these aims the project would include the following components for ten cities:

(a) *Institutional*

- (i) A new Municipal Urban Development Fund to fund equipment and civil works, maintenance and delivery of services and remunerative enterprises, primarily in eighty municipalities.
- (ii) Technical assistance, training and related equipment for project coordinating and implementing agencies.

(b) *Shelter*

- (i) Construction of services, residential plots, core housing and community facilities and provision of shelter loans for 70,000 low-income households.
- (ii) Guided development involving home expansion loans to low-income families and provision of off-site infrastructure and community facilities.
- (iii) Construction of on-land off-site infrastructure, provision of tenure and community facilities to improve neighborhoods containing about 94,000 households on public and private land.

(c) *Traffic management and transport*

- (i) Construction and improvement of roads, bridges, signals and pedestrian facilities.
- (ii) Support for the Pallavan Transport Corporation's Five-Year Investment program, to procure about 1,000 buses and related civil works and equipment including depots, terminals, a major workshop and passenger shelters.



Project: **Uttar Pradesh Urban Development**
Fiscal Year: 1987
Loan/Credit Amount: US\$150.0 million (equivalent)
Description: The government of Uttar Pradesh's objectives under the Uttar Pradesh component are to improve cost recovery and resource utilization and mobilization; strengthen sector organizations; and provide essential urban infrastructure and services. The Uttar Pradesh component includes sites and services, slum upgrading, area development, water supply, sewerage and sewage treatment, drainage, low-cost sanitation, solid wastes management, maintenance management and traffic engineering and management elements in each of up to sixteen towns, low-cost sanitation in up to eighteen towns, and technical assistance and training.

Project: **Third Bombay Water Supply and Sewerage Project**
Fiscal Year: 1986
Loan/Credit Amount: US\$40.0 million/US\$150.0 million (equivalent)
Description: The project would :
(a) Provide an increment of 455 million liters of water per day to help reduce Bombay's current deficit.
(b) Expand Bombay's sewerage system.
(c) Provide site specific sanitation and water supply facilities to serve the needs of the urban poor;
(d) Further strengthen the operational efficiency of BMC's Water Supply and Sewerage Department in areas, including revenue collection, financial planning and audit controls, waste water waste and leakage reduction. The project would have the following main impact: reduction of water shortage from present 36 percent to 18 percent of demand, with particular benefit to the poor; investment and operational designs and improvements in leakage detection, repair and financial management capacity.

Project: **Family Welfare (Urban Slums)**
Fiscal Year: 1992
Loan/Credit Amount: US\$79.0 million (equivalent)
Description: The project would include the following components in the cities of New Delhi, Calcutta, Hyderabad and Bangalore:
Increasing the supply of Family Welfare Services to slum populations through improvements in outreach services using volunteer female health workers recruited from the slum communities, and the



upgrading of existing and construction of new health facilities. Improving the quality of family welfare services provided to slum populations, by upgrading the supervisory, managerial, technical and interpersonal skills of all levels of workers. Increasing the demand for family welfare services through expanded information, education and communication activities. Improving the management and administration of the municipal health departments through appropriate upgrading of project supervision, management information systems (MIS), and information, education and communication (IEC) functions. Innovative schemes which cover a range of additional services including supplementary nutrition and environmental sanitation drives. Preparation of future projects which would support the detailed preparation and project launch activities in another fifteen designated cities.

Project:	Second Madras Water Supply
Fiscal Year:	1995
Loan/Credit Amount:	US\$275.8 million (equivalent)
Description:	<p>The project's major objectives are to:</p> <ul style="list-style-type: none"> (a) Provide water from a reliable source within the State of Madras on an urgent basis in order to provide health, economic efficiency and environmental benefits. (b) Improve the distribution of water within Madras. (c) Strengthen conservation. <p>The project would consist of the following components:</p> <ul style="list-style-type: none"> (a) Source works at the existing Veeranam irrigation tank on the Cauvery River system. (b) A transmission pipeline from Veeranam to Madras, with associated treatment and pumping facilities. (c) Continuation of distribution improvements within Madras being undertaken in the First Madras Water Supply Project (LN2846/CR1822-IN). (d) A water conservation program including tariff increases to encourage more efficient use of water. (e) Technical assistance in the form of project preparation and implementation support. Adequate steps would be taken to ensure that people adversely affected benefit from the project where this is possible and otherwise are made no worse off as a result.



Other Donor Support

- Project:** **Urban Infrastructure Development, Karnataka**
- Donor:** ADB
- Loan/Credit Amount:** US\$100 M
- Description:** The objectives of the TA is to assess the feasibility of an integrated urban development project in Karnataka State, focusing on development of the Bangalore-Mysore axis and of the counter-magnets to Bangalore, to:
- (a) Improve urban efficiencies through the provision of adequate infrastructure.
 - (b) Improve the urban environment.
 - (c) Reduce urban poverty.
 - (d) Improve the institutional and financial capacity of the urban sector agencies.
 - (e) Enhance the involvement of the private sector in urban development programs. The physical components of the projects may include Bangalore-Mysore road transport improvements, urban roads, drainage, water supply, sanitation, solid waste management, integrated area development and slum area upgrading. The Bank will finance US\$100 million.
- Project:** **Environmental Management of Road Projects (India-wide)**
- Donor:** ADB
- Loan/Credit Amount:** US\$240,000
- Description:** Technical assistance to strengthen the capability of MOST and the PWD's to carry out environmental assessment of road projects and to ensure that road projects in the country are planned, designed and implemented in accordance with the Bank's environmental guidelines and the government's relevant regulations. The TA will concentrate on preparation of environmental guidelines appropriate to road projects in India and on providing training to selected staff from the Ministry of Surface Transport, and the Public Works Department's in environmental impact assessment and environmental management of road projects.



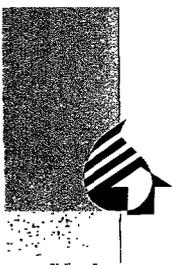
Project: Urban Community Water Supply and Sanitation
Donor: WHO
Loan/Credit Amount: US\$278,774
Description: To strengthen the infrastructure facilities of the sector, increase trained manpower, and keep abreast with technological developments in water supply and sanitation.

Project: Control of Environmental Health Hazards
Donor: WHO
Loan/Credit Amount: US\$220,513
Description: Recognition and control of environmental health hazards and conditions that affect health.

Project: Urban City Water Supply
Donor: Japan (OECF)
Loan/Credit Amount: ¥6,788 M (US\$68 M equivalent)
Description: To augment the water supply system in Solapur city and New Bombay to meet the growing demand of increasing population.

Project: Madras Water Supply and Sewerage System
Donor: Japan (OECF)
Loan/Credit Amount: ¥17,098 M (US\$171 M equivalent)
Description: To make functional improvements to the Madras City water and sewage transmission systems. To make sewage renovations for industrial uses on a wide scale and conserve precious groundwater and thus help the groundwater aquifer to recover to its undepleted level in this coastal city. This would help prevent possible environmental risks from salt water intrusion and land subsidence in the depleting aquifer region. Once this is achieved, the groundwater can again be made available for profile water supply.

Project: Calcutta Environmental Management Strategy and Action Plan.
Donor: British-ODA
Loan/Credit Amount: £2,000,000 (US\$3.2 M equivalent)
Description: This project aims to establish an environmental management system for Calcutta; the project will also aim to produce proposals for later infrastructure projects.



Project: **NGO Support Fund—Uttar Pradesh, Andhra Pradesh, Kerala and Gujarat**

Donor: Netherlands

Loan/Credit Amount: US\$3,340,000

Description: Support NGO initiatives for sustainable development of urban areas by financing small environmental projects in urban and semi-urban areas in education, water supply / sanitation, energy, waste management, pollution and local implications of global environmental issues.

Project: **Ganga ICD**

Donor: Netherlands

Loan/Credit Amount: US\$1,940,000

Description: Strengthen local authorities on state and municipality level in order to operate and maintain sanitary and drinking water facilities already implemented and to be implemented under the various Indo-Dutch integrated environmental and sanitary engineering projects in Uttar Pradesh.

Project: **Strengthening The Kerala State Pollution Control Board**

Donor: Netherlands

Loan/Credit Amount: US\$2,667,000 equivalent

Description: Strengthening of the Kerala State Pollution Control Board in the areas of monitoring, data analysis and reporting.

Project: **Kanpur/Mirzapur Environmental and Sanitary Engineering (Phase I and Phase II)**

Donor: Netherlands

Loan/Credit Amount: US\$17,610,000 equivalent

Description: Demonstration of the UASB wastewater treatment plants, combined with the application of an integrated urban sanitary/ drinking water approach an introduction of clean production techniques in polluting industry (tanneries).

Project: **Kanpur/Mirzapur Environmental and Sanitary Engineering (Phase III)**

Donor: Netherlands

Loan / Credit Amount: US\$3 M equivalent

Description: Technical assistance in the start-up phase of the constructed UASB water treatment plants, combined with a training course



for technicians in operation and maintenance of the plants.

- Project:** **Mirzapur Environmental and Sanitary Engineering**
Donor: Netherlands
Loan/Credit Amount: US\$10,889,000 equivalent
Description: Demonstration of the UASB wastewater treatment technology through the construction of a wastewater treatment plant and the application of an integrated sanitary engineering scheme.
- Project:** **Ganga Action Plan Program Support (Uttar Pradesh, Kanpur Municipality)**
Donor: Netherlands
Loan/Credit Amount: US\$27,778,000 equivalent
Description: Support of the Ganga Action Plan Phase II by financing integrated urban sanitation and drinking water projects.
- Project:** **UASB Chapra, Bihar**
Donor: Netherlands
Loan/Credit Amount: US\$200,000 equivalent
Description: Provide technical assistance to local organizations in design construction and start-up of UASB wastewater plant.
- Project:** **UASB Design Support**
Donor: Netherlands
Loan/Credit Amount: US\$195,000 equivalent
Description: Abatement of pollution by supplying technical assistance to several Indian state government bodies in the appraisal of and amendments to designs of twenty UASB wastewater treatment plants.

Chapter 8

Environmental Education and Training





Environmental Education and Training

8.01 Environmental education develops an environmentally literate, informed, and concerned citizenry, capable of making ecologically sound decisions. Much more than simply a process of raising awareness, environmental education requires education at all levels of society using flexible methods that come from within societies. Every society has a rich history of interaction with the land and the natural environment. From that interaction cultures developed that allowed humans to exist in harmony with the natural environment in a sustainable way.

8.02 Humans change as their relationship with the natural environment changes. In India, rapidly expanding populations, increased use of technology, and changing patterns of water, land, and energy use have altered the way that humans interact with their environment and with each other. Attitudes, knowledge, and skills must adapt to these changes in the environment. Environmental education forms the basis for adjusting to these changes.

8.03 In traditional societies environmental knowledge is the result of a close relationship with the environment. In modern and traditional societies impacted by rapid modernization, environmental education requires institutional efforts to impart awareness and skills that used to be an integral part of the traditional education process.

8.04 The First Intergovernmental Conference on Environmental Education

held in Tbilisi in 1977 established the following basic aims for environmental education:

A basic aim of environmental education is to succeed in making individuals and communities understand the complex nature of the natural and the built environments resulting from the interaction of their biological, physical, social, economic, and cultural aspects and acquire the knowledge, values, attitudes and practical skills to participate in a responsible and effective way in anticipating and solving social problems, and in the management of the quality of the environment.

8.05 The International Workshop on Environmental Education in Belgrade in 1975 defined the objective of environmental education as:

To develop a world population that is aware of and concerned about the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones.

8.06 The workshop also defined the following objectives:

- *Awareness*—to help individuals and groups acquire an awareness of and



sensitivity to the environment and its problems.

- ❑ *Knowledge*—to help individuals and groups acquire a basic understanding of the environment, its problems, and humanity's role in it.
- ❑ *Attitude*— to help individuals and groups acquire values and feelings of concern for the environment and the motivation to participate in its protection and improvement.
- ❑ *Skills*—to help individuals and groups evaluate environmental measures and education programs in terms of ecological, political, economic, social, aesthetic, and educational factors.
- ❑ *Participation*—to help individuals and groups develop a sense of responsibility regarding environmental problems to ensure appropriate action to solve these problems.

8.07 Environmental education varies among countries and cultures. In India the adverse effects of environmental degradation are felt most by the poor; poverty, in turn, causes degradation through resource depletion. The level of cultural diversity in India contributes to the need for flexible and location-specific environmental education.

ONGOING EFFORTS IN INDIA

8.08 Various governmental and nongovernmental organizations in India are responsible for the implementation of environmental education and training. These organizations carry out a wide variety of organizational and non-organizational functions. Organizational functions strengthen and coordinate the

organizational structures that implement environmental education, while nonorganizational functions implement programs.

8.09 India has developed a policy framework that serves as the basis for environmental education efforts. While the task of implementing a nationwide environmental education program is not complete, the basic elements of this effort are in place.

POLICY

8.10 Policy regarding environmental education can be found in documents of the Ministry of Environment and Forests and the Department of Education, Ministry of Human Resources Development. Finalized in 1992, the National Policy on Education declared that:

The National System of Education will be based on a national curricular framework which contains a common core along with other components which are flexible. The common core will include the history of India's freedom movement, the constitutional obligations, and other content essential to nurture national identity. These elements will cut across subject areas and will be designed to promote values such as India's common cultural heritage, egalitarianism, democracy and secularism, equality of the sexes, protection of the environment, removal of social barriers, observance of the small family norm and inculcation of the scientific temper.

8.11 The policy also states that within the reorientation of the educational process



there exists the "paramount need to create a consciousness of the environment" that must "permeate all ages and sections of society, beginning with the child. The environmental consciousness should inform teaching in schools and colleges, and should be integrated

in the entire education process" (MHRD 1992).

8.12 The various institutions involved in formal, informal, and training (semiformal) activities in environmental education are shown in Table 8.1.

Table 8.1. Environmental Education and Training Activities

Sector	Education Level	Institutions and Organizations	Institutional Role and Methods
Formal education	School education (primary, secondary and upper secondary)	<ul style="list-style-type: none"> ● National Council of Educational Research and Training (NCERT) and State Councils of Educational Research and Training (SCERT) ● Ministry of Environment and Forests ● Centers for Environmental Education and NGOs 	<ul style="list-style-type: none"> ● Central guidance and direction ● The environmental orientation to school education scheme ● Curriculum and materials development ● Eco-clubs ● Training of trainers ● Formal and informal teacher inservice training ● Curriculum development
	University education	<ul style="list-style-type: none"> ● Undergraduate colleges and graduate institutions 	<ul style="list-style-type: none"> ● Post-graduate programs ● Short-term courses ● Research programs ● Disciplines with environmental components ● Environmental courses
	Teacher education	<ul style="list-style-type: none"> ● NCERT ● Regional Colleges of Education ● State Institutes of Education ● NGOs ● Centers for Environmental Education 	<ul style="list-style-type: none"> ● Pre- and in-service training of teachers ● Contact programs ● Development of teacher guides and manuals ● Training of trainers
	Vocational and technical education	<ul style="list-style-type: none"> ● Vocational schools ● Indian Institutes of Technology 	<ul style="list-style-type: none"> ● Programs and courses in environmental sciences
Informal education	Government efforts	<ul style="list-style-type: none"> ● Primary and secondary schools ● Ministry of Environment and Forests 	<ul style="list-style-type: none"> ● Socially useful productive work or work experience sessions in schools ● School science clubs program ● Environmental Information System ● National Environmental Awareness Campaign ● Centers of Excellence ● National Museum of Natural History ● National literacy mission ● Wildlife Action Plan



Sector	Education Level	Institutions and Organizations	Institutional Role and Methods
	Citizen efforts	NGOs	<ul style="list-style-type: none"> ● Identification and awareness raising of local environmental issues ● Distribution of literature and other media ● Innovative methods such as the use of traditional art and drama to spread environmental messages
Training (Semiformal)	Government efforts	<p><i>General training</i></p> <ul style="list-style-type: none"> ● Administrative Staff College, Ahmedabad ● Indian Institute of Public Administration, Delhi ● Institutes of Management ● Wildlife Institute of India <p><i>Specialized training</i></p> <ul style="list-style-type: none"> ● National Environmental Engineering Research Institute ● Tata Energy Research Institute, Delhi ● Wildlife Institute of India, Dehradun ● Indian Institute of Forest Management, Bhopal ● Indian Council of Forestry Research and Training, Dehradun ● Indira Gandhi National Forest Academy, Dehradun ● Center for Environment Education, Ahmedabad 	<ul style="list-style-type: none"> ● Full courses on general aspects of the environment ● Specialized courses for professionals
	Citizen efforts	<ul style="list-style-type: none"> ● Bombay Natural History Society ● World Wide Fund for Nature ● Center for Science and Environment ● Center for Environmental Law ● Society for Promotion of Wasteland Development ● Bharat Industrial Agro Industrial Foundation ● Action for Food Production ● Development Alternatives 	<ul style="list-style-type: none"> ● Specialized courses for professionals



FORMAL ENVIRONMENTAL EDUCATION

8.13 Environmental education in the formal educational setting is critical to developing an environmentally literate citizenry. The EAP established that environmental education should be integrated in educational settings from the early school levels through university graduate and postgraduate programs and into professional training programs for everyone from government administrators and decisionmakers to business and NGO professionals.

SCHOOL EDUCATION

8.14 India integrates environmental education into formal education at the primary and secondary levels using the "infusion" method. Rather than identifying environmental education as a separate subject area, environmental concepts are infused into all subject areas when appropriate.

8.15 The National Council of Educational Research and Training (NCERT) provides guidance and direction to all schools and assists the Ministry of Human Resources Development in formulating and implementing educational programs. The National Curriculums for Elementary and Secondary Education developed by NCERT in 1988 provides a framework on which all schools can build curriculum that respond to local needs. The framework also provides the basis for the development of educational materials, assessment, and teacher training.

8.16 The framework provides a sufficient basis for environmental education in the classroom. But it remains the responsibility of the educational institutions

that train teachers to integrate environmental education into teacher training programs. In addition, environmental education is not an essential ingredient of student assessments, and teachers therefore do not see it as an essential component of the curriculum.

8.17 The Environmental Orientation to School Education scheme was launched by the Ministry of Human Resources Development to redefine learning in the context of the environment and local conditions. This program has not yet been evaluated. In addition, the program only targets middle schools, which leaves little environmental education content in the higher secondary level.

8.18 Eco-clubs, a concept put forth recently by the MOEF, are designed to encourage the participation of school children in activities relating to ecological conservation and environmental preservation. Targeted at students in standard VI to X, the clubs will provide a forum for the students to share their knowledge of environmental issues and will motivate the general public to participate in environmental preservation efforts.

8.19 In addition to the various government institutions, NGOs and the various centers for environmental education (such as the Center for Environment Education, Ahmedabad, and the CPR Environmental Education Center, Madras) also conduct regular teacher training courses and develop curriculum and training materials. The Center for Environment Education has established satellite offices in six regional centers where curriculum materials are based on local issues and



written in local languages. NGOs such as the World Wild Fund for Nature, India, also conduct regular teacher training seminars on such issues as biodiversity and resource conservation.

8.20 Despite these efforts, environmental education remains largely a voluntary or optional subject that is taught only by teachers with the inclination or concern to teach it. According to the Environment Action Program, "in the absence of drastic changes in the teaching environment, far more comprehensive and in-depth changes in teacher education, and changes in curricula, the incorporation of environmental concerns is likely to be slow". Efforts to increase the level of qualified training personnel in environmental education and a coordinated system of integration in teacher training institutions will be required to implement the proposed strategies at the primary and secondary levels.

UNIVERSITY EDUCATION

8.21 There has been a dramatic increase in the level of environmental education at the university level. By the end of 1991 there were forty-two institutions under the University Grants Commission offering post-graduate programs, five institutions offering short-term courses, twenty-seven research programs, and twenty-two disciplines with an environmental component. Another survey revealed the presence of environment-related courses in more than sixty universities and academic institutions, including technical institutes. Environmental science is the most common offering. Others include ecology, environmental biology, and environmental or public health engineering. Less frequent subjects

include ecological genetics, environmental planning, field ornithology, field mammalogy, and nonconventional energy.

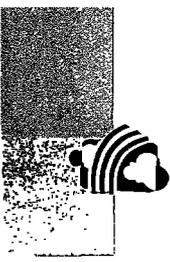
8.22 Unlike at the primary and secondary levels, the infusion method has been unsuccessful at the university level. Environment courses tend to be fragmented, resulting in graduates with little background in the range of economic, scientific, and social concerns relating to the environment. One reason for the limited number of interdisciplinary environment courses and programs at the university level is the lack of environmental employment opportunities for graduates.

TEACHER EDUCATION

8.23 Teacher education and training is essential to the implementation of environmental education. Teachers are ultimately responsible for implementing any environmental education program at the formal level. NCERT's Regional Colleges of Education and the State Institutes of Education (SIE) are responsible for organizing preservice and inservice teacher training. In addition, NGOs, citizens groups, and institutes, like the various environmental education centers, conduct teacher training.

8.24 According to the NCERT, environmental training of teachers should include:

- Basic training in ecology.
- Field or laboratory experience in environmental sciences.
- Knowledge of environmental issues and problems of resource management.
- Competence in environmental problem identification, investigation, evalua-



tion, and citizen action.

- ❑ Opportunities to develop value clarification skills and knowledge of the role of human values in environmental issues.

8.25 NCERT identifies the following requirements for teacher training:

- ❑ Pre- and inservice training of teachers.
- ❑ Contact programs.
- ❑ Development of teacher guides and manuals.
- ❑ Inservice environmental training through correspondence courses.
- ❑ Use of mass media.

8.26 Although NCERT has laid down these basic requirements, most institutions offering the bachelor of education degree do not offer independent courses or training related to environmental education. Some universities offer selective papers in environmental sciences, and the regional education colleges at Bhubaneshwar, Ajmer, Mysore, and Bhopal offer courses with environmental education components. But almost none has integrated environmental concerns into the conventional subject areas. Thus the infusion method that NCERT has chosen for the primary and secondary levels is not taught to teachers in their formal teacher education.

INFORMAL ENVIRONMENTAL EDUCATION

8.27 Environmental education efforts in informal education are much more complex and varied than those in formal education. Informal education involves every

form of education that is outside the traditional school setting. It includes, among others:

- ❑ Public awareness education.
- ❑ Professional training programs.
- ❑ Interpretation programs.
- ❑ Popular movements and community groups.

GOVERNMENT EFFORTS

8.28 The government has produced many informal environmental education programs, including the Socially Useful Productive Work and Work Experience sessions in schools and the School Science Clubs Program. Although government programs have only been introduced recently, community groups have been communicating environmental messages for decades. The MOEF, in support of the Ministry of Human Resources Development, established the Environmental Information System, a network of eleven centers that collects, collates, stores, and disseminates relevant information.

8.29 The National Environmental Awareness Campaign (NEAC) is the largest single effort to promote informal environmental education. Initiated by the MOEF in 1986,

the Campaign involves central funding to citizens' groups all over India, on the basis of proposals received from them. Every year, November 19 to December 18 is observed as National Environment Month, when the campaign is expected to pick up momentum. A special theme is selected each year though groups take up



activities unrelated to this theme also. The number of groups availing of this opportunity has steadily grown over the last few years, from 115 in 1986 to 555 in 1991. The list of funded agencies comprises not just citizens' groups, but also schools, colleges and universities, research institutes, professional bodies, women's and youth organisations, and government departments from various states and union territories. Programs conducted as part of the NEAC include seminars, workshops, training camps, public meetings, rallies, padayatras, jathas, audio-visuals, film shows, poster displays, drama, folk dances, street theatre, tree plantation drives, competitions for children including essays, debates and painting competitions, and preparation and distribution of resource material. The target groups covered are extremely diverse, and include students, youth, women, tribals, administrators, professionals, legislators, industrial workers, voluntary agency members, armed forces, and the general public.

8.30 The MOEF has identified several Centers of Excellence throughout the country. The Center for Environment Education (CEE), Ahmedabad, and the CPR Environment Education Center, Madras, produce environmental education resource material and curriculums and conduct training programs for various constituents. The CEE conducts programs in schools, generates environmental education materials, organizes teacher training programs, disseminates environmental education through the media, and develops interpretation programs in zoos, national

parks, and museums. The CEE also conducts one-day, week-long, and eight-month training programs in environmental education program and curriculum development. Both centers also serve as Regional Resource Agencies for the NEAC. Other government efforts to impart environmental education include programs of the National Museum of Natural History, the National Literacy Mission, and elements of the National Wildlife Action Plan.

CITIZEN EFFORTS

8.31 A vast array of citizens groups are working toward community action around environmental issues. India's diversity is represented in the variety of programs and methods being used, including identification and awareness-raising of local environmental issues, distribution of literature and other media for education about issues, and innovative methods such as the use of traditional art and drama forms to spread environmental messages. Groups range from the Chipko movement and the Narmada Bachao Andolan to smaller urban groups dealing with local issues.

8.32 There are also citizen efforts that target the masses. The Popular Science Movement and the Kerala Sastra Sahitya Parishad (KSSP) are examples of programs initiated by citizens groups that have used innovative methods to reach large groups of people. The Popular Science Movement "aims to demystify knowledge and popularize scientific issues" through a collection of groups. The KSSP aims to present various scientific issues in as simple a form as possible using presentations followed by the distribution of literature on local environment and development issues.



TRAINING ACTIVITIES IN ENVIRONMENTAL EDUCATION

8.33 Training activities in environmental education are generally more organized and specialized than informal education activities, but they generally do not result in a degree (although many result in a certificate of completion). Training programs range from courses lasting an hour or two to programs lasting a year or more. These programs are the most flexible method of providing environmental education. They can be conducted by almost any individual or group that can draw an audience of trainees to participate. They can be free of charge or can charge a market rate. They can be conducted by a single group or by a conglomerate of organizations. They can be targeted to a select group or available to the general public.

8.34 These variables make training programs one of the most effective methods of imparting environmental knowledge. The drawback is that there is also tremendous variety in the quality and effectiveness of programs. For example, in the area of environmental impact assessment training, there are accredited institutions like the National Environmental Engineering Research Institute, Nagpur, which set the standard for training quality and effectiveness. This does not, however, stop other groups that wish to offer a similar program, regardless of qualifications.

8.35 The MOEF has classified two categories of training activities:

- *General training*, which aims to raise levels of understanding and sensitivity to environmental issues. Such training is similar to the informal educational

activities described earlier, except that general training is more structured and formal.

- *Specialized training*, which is meant to develop the skills and capacity needed to perform specific tasks. These programs are similar to the formal education programs described earlier, except that specialized training does not lead to a degree based on an assessment or evaluation (MOEF 1993).

GOVERNMENTAL EFFORTS

8.36 The MOEF and the Department of Personnel and Training have been the main sponsors of courses on general aspects of the environment. The Administrative Staff College, Ahmedabad, and the Indian Institute of Public Administration, Delhi, pioneered such programs. Soon after, the various institutes of management and the Wildlife Institute of India began offering similar courses. These programs are offered primarily to middle- and senior-level officers, and the courses have not been standardized.

8.37 A variety of institutes produce specialized training courses targeting professionals within and outside the government. These courses develop specific skills in environmental monitoring, assessment, management, and planning, among others. Institutions such as the National Environmental Engineering Research Institute (Nagpur), the Tata Energy Research Institute (Delhi), the Wildlife Institute of India (Dehradun), the Indian Institute of Forest Management (Bhopal), the Indian Council of Forestry Research and Training (Dehradun), the Indira Gandhi



National Forest Academy (Dehradun), and the Center for Environment Education (Ahmedabad) provide specialized courses for professionals, including government and nongovernment employees.

8.38 Despite the range of training opportunities, there is still not adequate specialized training in terms of both the types of training and the number of positions available. In addition, because there is not adequate job placement in environmental professions, many people are reluctant to invest in training programs. Institutions conducting training are therefore reluctant to develop environmental training programs.

CITIZEN EFFORTS

8.39 Training of trainers, particularly from other NGOs, is a major method of promoting environmental education by citizen groups. The Bombay Natural History Society, the Worldwide Fund for Nature, the Center for Science and Environment, the Center for Environmental Law, the Society for Promotion of Wastelands Development, the Bharat Agro Industrial Foundations, Action for Food Production, and Development Alternatives are just a few of the organizations providing specialized courses for professionals.



India's Current Strategy for Environmental Education and Training

8.40 In addition to being identified as an individual priority area in the Environment Action Program, environmental education, training, and human resource development strategies cut across every sector of India's environmental management strategy. This section examines the EAP's diagnosis for human resource development in environmental education and training, the overall priorities outlined in the EAP, the environmental education and training strategies identified to develop human resources, and the program areas identified as priority activities.

8.41 According to the EAP, the following issues are of greatest concern regarding India's current environmental education and training activities:

Human resources formations for the scientific management of environmental problems have also been constrained because of inadequate research and development infrastructure, the absence of organizations, which are capable of imparting technical skills for environmental management (such as environmental impact assessment) at the local and regional levels, the limitations of environmental education at higher secondary, university, and non-formal levels in generating public awareness, and the insufficient spread of training in environmental sciences/management for policymakers, administrators, trainers, educators, students, local self-government authorities and grassroots

voluntary/activist individuals and organizations. There are also deficiencies of high-quality human resources and organizations to undertake the task of environmental protection at the local and regional levels. This is caused by the lack of an environmental education network in the country. Skilled human resources for tackling the problems of industrial pollution, hazardous substances management, and for implementing technologies for wastelands management have to be developed and nurtured.

OVERALL PRIORITIES IDENTIFIED IN THE ENVIRONMENT ACTION PROGRAM

8.42 The following areas have been identified as priority areas for environmental management efforts. Environmental education and training issues cut across all of these areas to varying degrees.

Conservation and sustainable use of biodiversity in selected ecosystems including forests, mangroves, wetlands, coral reefs, and mountain ecosystems

8.43 Priorities include:

- Conserving genetic, species, and ecosystem diversity for sustainable agriculture and associated activities.
- Developing biotechnology industries.
- Low-cost indigenous systems of medicine and treatment.



- Preserving the traditional lifestyles of tribal populations.

Afforestation, wastelands development, conservation of soil moisture, and ensuring that water sources are not polluted

8.44 Priorities include:

- Reversing trends of deforestation and overgrazing created by subsistence and industrial pressures on forests, including sustainable agriculture and water harvesting practices by small and marginal farmers.
- Evaluating the stress of soil and water conservation in relation to drought proofing and management of natural disasters.
- Ecorestoration of wetland.

Controlling industrial and related pollution, with an emphasis on reducing and managing wastes, particularly hazardous wastes

8.45 Priorities include:

- Extending the World Bank-assisted Industrial Pollution Control and Pollution Prevention Projects to cover all the critically polluting sectors in India.

Improving access to clean technologies

8.46 Priorities include:

- Adhering to global environmental standards with respect to products and processes, with an emphasis on energy-conserving technologies.

Tackling urban environmental issues

8.47 Priorities include:

- Establishing broadly based strategies for dealing with urban poverty, air and water

pollution, and rapidly deteriorating urban infrastructure (such as transport, electricity, sanitation, health and housing).

- Developing policies for citizen participation in environmental protection efforts.
- Extending the World Bank-assisted Metropolitan Environment Improvement Programmes in Madras and Bombay to other cities.
- Conserving wetlands, mangroves, and other unique habitats in cities and towns.
- Protecting water resources from pollution.

Strengthening scientific understanding of environmental issues, as well as structures for training, environmental orientation and awareness, resources assessment, water management problems, and so on

8.48 Priorities include:

- Integrating environmental education into all areas and levels of society, including schools and colleges.
- Establishing a legal, administrative, organizational, technical, and popular framework by developing human resources at the scientific, technical, policy- and decisionmaking, program implementation, and public levels.
- Environmental education to create public awareness.
- Environmental training for policy-makers, decisionmakers and administrators.
- Imparting environmental management and impact assessment skills to develop



technical personnel.

- Establishing research and development infrastructure for the collection of scientific and statistical data on natural and environmental resources.

Alternative energy plan

8.49 Priorities include:

- Developing alternative sources of energy, moving away from coal, oil, lignite, and other commercial fuels (notably oil).
- Developing alternatives for agriculture-based, noncommercial fuels that are not energy efficient and that cause health problems for users (predominantly the urban and rural poor).
- Reducing the use of forest resources for fuel.
- Reducing emissions from the non-stationary transport sector arising from the use of leaded gasoline.
- Limiting the use of high-speed diesel and electricity in irrigation operations.
- Developing programs for alternative energy sources such as improved cooking stoves, coal washing and beneficiation, and solar, windpower, and biogas.
- Reduced transmission and distribution losses in electricity supply systems.

OBJECTIVE FOR ENVIRONMENTAL EDUCATION AND TRAINING

8.50 Human resources should be developed for a local and regional system of environmental impact assessment based on environmental statistics collection and natural resource accounting. This program would

include environmental research, education, and training to develop the technical, administrative, and practical skills required for environmental impact assessments. The EAP states that its main objective is "strengthening the environment impact assessments process by creating the base for drawing up Regional Environmental Impact Assessment profiles based on studies of carrying capacity and regional/local siting plans through a process of popular participation".

8.51 This objective will be achieved by:

- Increasing scientific research and development institutions and technical institutes for studies in environmental sciences in order to increase the number of people with skills in environmental impact assessments and environmental management.
- Developing training programs for administrators, policymakers, trainers, and scientists in order to strengthen environmental management and decisionmaking.
- Establishing programs for environmental awareness in order to increase the effectiveness of program implementation at the local level and to improve the local information base on natural resources and systems of use.
- Standardizing environmental information-gathering strategies, including environmental impact assessments and other technical parameters.

NEW AREAS FOR ENVIRONMENTAL EDUCATION AND TRAINING

8.52 The MOEF has identified new program areas that focus on the seven priority issues in the EAP. Many of these new areas will require a human resource development

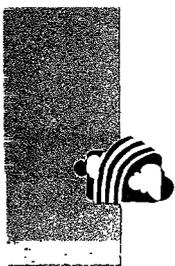


component for environmental education and training in order to be implemented. The EAP identifies specific new programs to strengthen scientific understanding of environmental issues, as well as to improve structures for training, orientation, and environmental awareness at different levels, but it does not

assess the capacity of various educational or training institutions to carry out the range of tasks outlined in the other six program areas. Table 8.2 therefore identifies those program areas that will require a human resource development component in environmental education or environmental training.

Table 8.2. Priority Programs Requiring Environmental Education and Training

Priority Area	Nonformal Education Components	Formal Education Components
Conservation and sustainable use of biodiversity in selected ecosystems including forests, mangroves, wetlands, coral reefs, and mountain ecosystems	<ul style="list-style-type: none"> ● Conservation education on wetlands, mangroves, and coral reefs ● Capacity-building in natural resource accounting studies for coral reefs, forests mangroves, wetlands, protected areas, and biodiversity 	<ul style="list-style-type: none"> ● Extension support projects for agroforestry. ● Strengthening of Indian Council of Forestry Research and Education, Dehradun
Afforestation, wastelands development, conservation of soil moisture, and protection of water sources from pollution	<ul style="list-style-type: none"> ● Afforestation and wastelands development programs ● Promotion of energy forestry and efficient fuelwood use ● Development, demonstration, and promotion of bio fertilizers ● Capacity-building in natural resource accounting and environment impact assessment for river valley and agricultural development projects 	<ul style="list-style-type: none"> ● Strengthening of Indian Council of Forestry Research and Education, Dehradun
Control of industrial and related pollution with an emphasis on reducing and managing wastes, particularly hazardous wastes	<ul style="list-style-type: none"> ● Demonstration and dissemination of wastewater treatment recycling and reuse technologies for water conservation 	
Improving access to clean technologies	<ul style="list-style-type: none"> ● Establishing centers for cleaner technologies to gather and disseminate information to industry ● Capacity-building for environmental audit for pollution prevention. ● Capacity-building for environment impact assessment of clean technologies 	



Priority Area	Nonformal Education Components	Formal Education Components
Tackling urban environmental issues	<ul style="list-style-type: none"> ● Organizational strengthening for human resource development and capacity-building for pollution control, waste management, natural resource accounting, risk assessment, and environmental impact assessments in urban areas ● Strategies for lowering solid waste generation in urban areas 	
Strengthening scientific understanding of environmental issues, as well as structures for training, orientation, and environmental awareness, resources assessment, water management problems, and so on	<ul style="list-style-type: none"> ● Provide assistance and funding for NGOs to set up district and village training centers ● Develop training programs for trainers at all levels ● Strengthen environmental training activities in induction institutions for civil servants ● Capacity-building for collection and analysis of environment statistics for natural resource accounting ● Environmental education for professionals and government authorities in environmental impact assessments ● Develop environmental training programs for students and the general public, especially in townships located in or around areas of ecological significance ● Environmental education programs for new <i>Paryavaran Vahni</i> (voluntary environmental task forces) ● Urban environmental education for local authorities and NGOs ● Develop a scheme for practitioners, activists, professionals, civil servants and others to participate in regeneration activities 	<ul style="list-style-type: none"> ● Establish a network of regional institutes for training in environmental impact assessments and disaster management plans ● Establish a national center for long-term training in environmental impact assessments ● Initiate integrated and specific environment courses for students of all backgrounds ● Develop environmental education materials including teaching materials, environmental kits for students, and audiovisual materials.
Alternative energy plan <ul style="list-style-type: none"> ● Power sector ● Industrial sector ● Alternative energy sector 	<ul style="list-style-type: none"> ● Demonstration projects on energy-efficient lighting ● Programs to promote energy conservation in industries ● Capacity-building for environmental impact assessments for thermal and hydropower plants ● Demonstration of new and alternative sources of energy ● Capacity-building for environmental impact assessments of energy use in rural areas 	



The Environment Action Program

8.53 A review of the government's policies and programs is needed to determine how to overcome the training gap between the technical elite and local inhabitants. The EAP identifies environmental education and training as a major element in developing the human resource capacity and technical, institutional, and popular framework for environmental management.

8.54 Environmental education and training and human resource development efforts are coordinated by the MOEF with assistance from other ministries. In addition, numerous institutes, universities, and NGOs engage in education and training activities. The EAP identifies formal (ending in a certificate or degree), informal (outside of formal institutional structures), and training (semiformal activities that often result in a certificate) activities as the three types of environmental education.

8.55 The EAP emphasizes the following areas in environmental education program design:

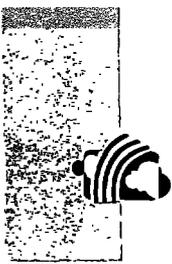
- ❑ *Awareness* to foster awareness of and sensitivity to the environment and its problems.
- ❑ *Knowledge* to develop a basic understanding of the environment, its problems and humanity's role in it.
- ❑ *Attitude* to acquire values and feelings of concern for the environment and to motivate active participation in its protection and improvement.
- ❑ *Skills* to evaluate environmental

measures and education programs in terms of ecological, political, economic, social, aesthetic, and educational factors.

- ❑ *Participation* to develop a sense of responsibility regarding environmental problems to ensure appropriate action to solve them (UNESCO 1986).

8.56 Human resource capacity for the scientific management of environmental problems has been constrained by inadequate resources and development infrastructure; insufficient institutional support for environmental management; inadequate environmental education at the secondary, university, and informal levels; insufficient training for policymakers, administrators, trainers, educators, local authorities, and grassroots organizations; and lack of funding for environmental activities. To improve human resource capacity, the EAP recommends:

- ❑ Developing a strong legal, administrative, and technical framework for environmental education and sustainable development.
- ❑ Nurturing human resources at the scientific, technical, policymaking, and program implementation levels.
- ❑ Improving public awareness of environmental education.
- ❑ Developing environmental training opportunities for policymakers and administrators.
- ❑ Introducing technical personnel to areas



of environmental management and impact assessment.

- ❑ Establishing research and development facilities to collect data on natural and environmental resources.

GOI PROGRAMS

8.57 The following GOI programs are identified in India's Environment Action Program.

CPCB PROGRAMS UNDER ENVIRONMENTAL RESEARCH

- ❑ Biological Monitoring and Assessment of Pollution (BIOMAP).
- ❑ Development of Methodology for Toxicity Testing.
- ❑ Studies on the Correlation of TOC and COD/BOD.
- ❑ Testing of Microbial Mixed Seed Culture in BOD Determination.
- ❑ Analytical Quality Control Exercise (AQC/Water)
- ❑ Microbiological Assessment of River Yamuna.
- ❑ Bench Scale Model for Treatment of Textile Waste.
- ❑ Treatability Studies of Drain Effluents Under Yamuna Action Plan.
- ❑ Sampling and Analysis of Polynuclear Aromatic Hydrocarbons in Ambient Air.
- ❑ Standardization of Method for Analysis of Absorbable Organic Halide.
- ❑ Standardization of Method for Pesticide Analysis.
- ❑ Wind Profile Studies.

- ❑ "SODAR" (Sound Detection and Ranging) Inversion Studies.

ENVIRONMENTAL TRAINING

- ❑ Consent management, monitoring of the effluents and emissions, use of scientific equipment, laboratory development, handling and interpretation of analytical data, environmental audit etc.
- ❑ Program for training of trainers at all levels.
- ❑ Training facilities for civil servants, especially those belonging to the Central and All-India Services, through the environmental training activities of their induction institutions, which also require significant strengthening.
- ❑ Environmental training programs for students and the general public, especially in townships located in or around areas of special ecological significance.

ENVIRONMENTAL EDUCATION AND CAPACITY BUILDING PROGRAMS

8.58 *Environmental education*

- ❑ A scheme to allow practitioners, activists, professionals, civil servants and others to participate in regeneration activities.
- ❑ Regular and sustained environment education programs for professionals, decisionmakers and local self-government authorities in environmental impact assessment.
- ❑ Infusion of environment-related subjects with larger social concerns.

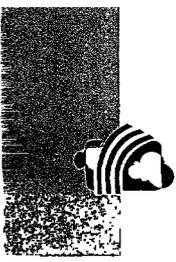


- ❑ New environmental courses, interdisciplinary in nature and accessible to students of all backgrounds.
- ❑ Development of a wide range of environmental education materials for mass distribution including modules and workbooks for teachers, low-cost environmental kits for students and audio-visual materials.
- ❑ Environmental education programs for the newly constituted Paryavaran Vahini (voluntary environmental task force).
- ❑ Education for local policymakers, voluntary agencies, technical depart-

ments of state governments and local authorities in urban environmental issues.

8.59 ***Capacity building***

- ❑ Evolve structures to strengthen the training, research and education activities through existing government and nongovernment organizations and institutions at different levels.
- ❑ Assistance and funding to NGOs to set up district and village training centers.
- ❑ Capacity building for collection and analysis of environmental statistics for natural resource accounting.



Major Issues and Recommendations

8.60 The EAP failed to identify several shortcomings and limitations in India's environmental education and training strategy.

POLICY ISSUES

8.61 Current policies prescribe the need for a national policy framework for environmental education. The problem is that national policy frameworks drive programs that are not necessarily the most effective or efficient when it comes to local activity. For example, the lack of flexibility in current policies has created a gap between government policy on environmental education and the reality of grassroots activity. In addition, most government programs focus either on highly technical and specific environmental sciences or on public awareness campaigns that are highly generalized and that lack action components and skills education.

8.62 Some institutes and NGOs are conducting high-quality environmental education outreach and training programs, but these activities are not sufficiently integrated into government policy. The national framework for environmental education should be more flexible, and should allow for experimentation and for the opportunity for a shared learning process among the various individuals implementing programs.

8.63 Institutions such as the World Wide Fund for Nature and other NGOs offer teacher workshops and training programs to disseminate information and programs on a local scale. Teachers are not required to attend these workshops and receive no credit from

their schools or the national or state Councils for Educational Research and Training, the bodies responsible for teacher preparation, curriculum development, and inservice training.

INSTITUTIONAL ISSUES

8.64 The different scales of organization in environmental education require significantly different approaches, including educational methods and supporting institutional arrangements, in order to achieve environmental objectives. Each of these dimensions exists in different "institutional envelopes."

8.65 Megasystems have major environmental implications in both their operations and their uses (hydroelectric power systems, expressways, large sewerage systems, and so on). These projects depend on an institutional framework of large corporate efforts supported by a mix of management, finance, technological, production, organization, and marketing agencies, all backed by government support. The environmental issues here depend on specialized technical experts who can perform environmental forecasting and assessment, and on laws and corporate policies to mitigate environmental damage. Critical decisions are made by the relatively few people in charge of corporations and public agencies or authorities.

8.66 Integrated technology systems raise environmental issues, particularly around end users of such urban systems as



transportation, sewerage and water, food, energy, and so on. These users can play a critical role in reducing energy consumption, choosing less-polluting modes of transportation, recycling resources, and other practices. Influencing these users may involve a mix of environmental awareness, structured incentives, and provision of alternative technologies. Such efforts require local groups and associations that stimulate innovations and support alternative practices.

8.67 Small-scale, village-level technologies are supported by communities and frequently are driven by survival needs. These technologies often impact directly on the natural environment to meet basic needs for food, energy, shelter, water, air, and waste, and may have disastrous consequences for the immediate environment (soil erosion) or remote environments (flooding near the mouths of rivers). Change requires strong community support and easily understood alternative practices, as well as external supports that share risks, provide information exchanges between people who are working on similar problems, and in some cases that allocate financial resources to create possibilities for innovation.

8.68 Major gaps exist among these three groups. Environmental education and donor activities (including those of the World Bank) focus on megasystems. Less consideration is given to environmental awareness and changing the behavior of end users. Even less activity is focused on small-scale, village development issues. For example, a number of programs focus on human resource development in environmental impact assessment and natural resource accounting, but there is almost nothing in the way of training local activists in small-scale, end-user

conservation strategies.

Raising awareness

8.69 Public awareness campaigns conducted through mass media may be useful to communicate the need for changes in some practices, but they must be used as an adjunct to other, more direct approaches if they are to have an impact. Unless they teach how to change practices, generalized mass media approaches have minimal impact. In addition, people such as local inhabitants, the poor, and other disenfranchised segments of the population are not reached by current environmental education and training activities. Developing programs for the range of cultures, languages, audiences, and needs that exist in India represents a challenge for educators, policymakers, and donor agencies. Top-down programs imposed without the involvement of local leadership often fail to reach local groups. Cultural diversity requires education and training that is flexible in its funding, strategies, methods, and technology.

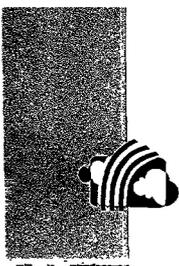
Weak incentives for teacher training

8.70 Teacher training in environmental education has been mandated by the courts in India. The MOEF has introduced the Environmental Orientation to School Education program to foster this activity. Nevertheless, teacher training institutions do not incorporate environmental concepts into teacher preparation and there is little incentive for teachers to pursue training on their own.

TECHNICAL AND SCIENTIFIC ISSUES

Lack of curriculum and technology

8.71 There is a shortage of environmental education materials for



teachers, teacher trainers, and community educators, including curriculum, video, computer, and demonstration technology. In addition, the materials that are available often fail to bridge language and cultural barriers. Some of the more effective uses of computer technology observed for this report included the Center for Environment Education's Environmental Education Bank, where teachers and teacher trainers have access to a computer data base of lessons and environmental education materials. Using materials gathered from the data base, participants develop training programs that are tailored to local needs.

Standardized training in environmental management tools

8.72 Training in environmental impact assessment, natural resource accounting, and environmental auditing is not standardized. A comprehensive, standardized accreditation program should be developed for the various institutes, professional organizations, and NGOs that provide training in these areas. Expanding human resource development activities in this area will enhance India's ability to monitor pollution and natural resources, as well as encourage businesses to adopt cost-saving conservation practices.

ECONOMIC AND FINANCIAL ISSUES

Improving the structure of financial incentives

8.73 Many environmental education programs concentrate on raising awareness of and concern for the environment in the hope that, once informed, people will make sound decisions. But economic forces and survival needs often dictate day-to-day lifestyle choices. People seldom choose to live an eco-friendly lifestyle if there are no cost savings

or personal benefits associated with that behavior. Successful environmental education efforts require that technologies, skills, and actions be shown to directly benefit the participants.

Funding shortfalls

8.74 Public awareness efforts have had minimal support from the government and from donor agencies. Increased funding of community-level organizations could both build public awareness and tie funding to specific objectives. Comprehensive national campaigns also should be considered.

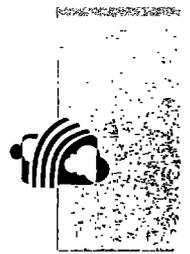
8.75 Little support has been given to integrating environmental issues into formal education. Although this has been identified as a priority, no plan has been developed to achieve this goal. In other countries environmental issues have been integrated into all levels of the educational system. In India, however, environmental issues have been integrated into the national learning objectives and some curriculum material at the primary and secondary levels, but are almost nonexistent at the higher secondary and university levels.

RECOMMENDATIONS

8.76 Some of the following recommendations for funding and priority programming in the environmental education and training sector expand on ideas discussed in the EAP; others are new.

Policy Recommendations

8.77 The government should establish a national task force on environmental education to integrate environmental education into formal education at all levels. The task force could include members of various



ministries involved in environmental education (the Ministries of Environment and Forests, Human Resource Development, Information and Broadcasting, and Science and Technology, and the Department of Personnel) and representatives from NGOs and the Centers for Environment Education. The task force could oversee teacher training, program development and funding, and technology and curriculum development. In addition, local entities at the state and district levels could assist with the development and implementation of programs.

Institutional Recommendations

Establish regional centers for training in environmental management

8.78 The government should establish regional centers for specialized training in environmental impact assessment, environmental auditing, and natural resource accounting, including establishment of standardized procedures and evaluation and assessment strategies. A comprehensive national program for training in these areas, involving the National Environmental Engineering Research Institute, the Tata Energy Research Institute, the Wildlife Institute of India, the Indian Institute of Forest Management, the Indian Council of Forestry Research and Training, the Indira Gandhi National Forest Academy, and the Center for Environment Education, could present a standardized certification of training that would greatly enhance human resource capacity for conducting environmental impact assessment and natural resource accounting.

Develop tools for local awareness and adaptation of environmentally sound technologies

8.79 Many NGOs in India have local constituencies who could become involved

in conservation activities. These NGOs often are in touch with local needs, languages, and cultures. It is essential that training be developed that adapts environmental education to local conditions. Training programs should provide a range of options so that local citizens can select actions that are most appropriate to local conditions.

Develop an environmental education extension program

8.80 The environmental education training activities that are being conducted in various parts of the country are not coordinated and are not reaching the entire population. An environmental extension program should link local educational institutions (such as universities) with local NGOs. This would allow an exchange where research information could be applied to local problems.

8.81 The extension program could also include:

- *Technology infrastructure.* Training institutions like the Center for Environment Education in Ahmedabad and the CPR Environmental Education Center in Madras are using advanced technology (including video and computer databanks) to impart curriculum and training materials to teachers, NGOs, industry professionals, and others. A nationwide network linking these institutions could enhance the capacity of local organizations to use state-of-the-art training materials.
- *Training capacity.* Training centers such as the Center for Environment Education and the CPR Environmental Education Center, which train primary and secondary teachers, NGOs and some industry professionals, should be



expanded. The Center for Environment Education already has started expanding its operations through six outreach centers. These centers need to be increased beyond the regional level to include state and district-level centers.

- ❑ *Funding.* According to many NGOs, the amount of capital investment needed to generate a local environmental action project is very small (as little as \$300). Small amounts of funding can leverage tremendous human capital if projects, design, and implementation are generated by the local community.

Technical and scientific recommendations

Develop a training program for the Paryavaran Vahini

8.82 The Paryavaran Vahini framework (the local, constituent-based watchdog groups responsible for oversight and action on environmental issues) for the participation of local constituents in environmental decision-making, dissemination of locally relevant environmental information, and the protection of environmental resources was launched in 1993. Members of the vahini are local representatives, either individuals or NGOs, who are familiar with local environmental issues. The groups meet once a month and report to the local district collector, who in turn reports to the regional office of the MOEF and the State Pollution Control Boards. The scheme is designed to:

- ❑ Create environmental awareness and actively involve local people.
- ❑ Report on illegal acts pertaining to forests, wildlife, pollution, environmental degradation, and cruelty to animals.

- ❑ Generate feedback regarding afforestation and survival of plants.
- ❑ Bolster monitoring efforts, including analysis of ambient air and water quality.

8.83 Training of the *Vahinis* has been minimal, consisting of disseminating water testing kits to twenty districts.

8.84 More extensive training should be organized by the district collector with the help of the regional office of the MOEF, the district forest officer, the State Pollution Control Board, and local NGOs. Training would involve:

- ❑ General information about environmental pollution and methods of controlling pollution.
- ❑ Information about the 1986 Environment Act and other relevant environmental acts.
- ❑ Local environmental awareness programs in districts, run by NGOs or district administration.
- ❑ Procedures for reporting environmental violations or acts of environmental degradation.
- ❑ Methods of gathering input from local community members.

Provide technical training for government and industry managers

8.85 Municipal and industrial managers play a critical role in environmental decisionmaking. Training programs that demonstrate cost-saving techniques for pollution prevention and methods of integrating environmental planning into overall management strategies have proven much more effective than end-of-the-pipe



approaches to control pollution. These programs should be expanded.

Economic and financial recommendations

Assess the costs and benefits of end-user conservation education

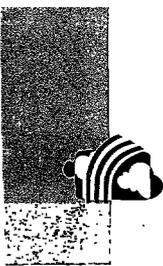
8.86 Assessing the costs and benefits of end-user conservation education activities in urban areas could determine the potential of small solutions to big problems. These activities could reduce the need for or strain on such megaprojects as hydroelectric dams, power plants, and municipal landfills.

Establish an endowment for environmental education and action

8.87 There would be some advantage

in having endowments for either regions or language groups. Endowments for environmental education could support a mix of studies of critical issues, including development of village centers for technology, sponsorship of networks for environmental education, and support for projects with potential for widespread adoption.

8.88 Such endowments could be funded jointly by the Government of India, regional governments, and private philanthropists. They might develop techniques for making mini-loans or grants similar to the extensions of credit provided by the Grameen Bank of Bangladesh. Grants are needed to support innovative projects and to provide opportunities for others to learn from them.



GOI Program Objectives

Category: *CPCB Programs under Environmental Research*

Government Objectives/Programs:

Biological Monitoring and Assessment of Pollution (BIOMAP); Development of Methodology for Toxicity Testing; Studies on the Correlation of TOC and COD / BOD; Testing of Microbial Mixed Seed Culture in BOD Determination; Analytical Quality Control Exercise (AQC/Water); Microbiological Assessment of River Yamuna; Bench Scale Model for Treatment of Textile Waste; Treatability Studies of Drain Effluents Under Yamuna Action Plan; Sampling and Analysis of Polynuclear Aromatic Hydrocarbons in Ambient Air; Standardization of Method for Analysis of Absorbable Organic Halide; Standardization of Method for Pesticide Analysis; Wind Profile Studies; "SODAR" (Sound Detection and Ranging) Inversion Studies.

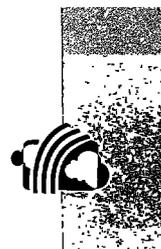
Category: *Environmental Training/Management*

Government Objectives/Programs:

Consent management, monitoring of effluents and emissions, use of scientific equipment, laboratory development, handling and interpretation of analytical data, environmental audit, etc. Program for training of trainers at all levels. Training facilities for civil servants, especially those belonging to the Central and All-India Services, through the environmental training activities of their induction institutions. Environmental training programs for students and the general public, especially in townships located in or around areas of special ecological significance.

Donor Agency Support

Project	Donor	Funding
Industrial Pollution Control with National Productivity Council	Germany	US\$3.43 M equiv. US\$5.47 M equiv. US\$5.47 M equiv.
Forestry Education/Training	British-ODA	US\$ 6.25 M equiv.
Center for Science and Technology	Netherlands	US\$0.43 M equiv.
Socio-Ecological Transformation	Netherlands	US\$0.98 M equiv.
Pollution Perception Studies	Netherlands	US\$1.11 M equiv.
UASB Training Facilities	Netherlands	US\$2.47 M equiv.
Environmental Master Plan Study	Denmark	US\$ 4.25 M equiv.
Environment Training Institutes	Denmark	US\$1.2 M equiv.
Environment Quality Management, Bihar	UNIDO	US\$0.01 M equiv.
Forestry Research Education and Extension	World Bank	US\$47.0 M equiv.



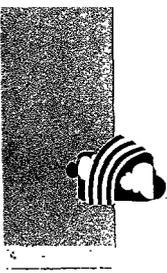
Category: *Environmental Education and Capacity Building Programs.*

Government Objectives/Programs:

Structures to strengthen training, research and education activities through existing government and nongovernment organizations and institutions at different levels; assistance to NGOs to set up district and village training centers; a scheme to allow practitioners, activists, professionals, civil servants and others to participate in regeneration activities; regular and sustained environment education programs for professionals, decision makers and local self-government authorities in EIA; new environmental courses, interdisciplinary in nature and accessible to students of all backgrounds; development of a wide range of environmental education materials for mass distribution including modules and workbooks for teachers, low-cost environmental kits for students and audiovisual materials; environmental education programs for the newly constituted Paryavaran Vahini (voluntary environmental task force); capacity building for collection and analysis of environmental statistics for natural resource accounting. Environmental education of local policy makers, voluntary agencies, technical departments of state governments and local authorities in urban environmental issues.

Donor Agency Support

Project	Donor	Funding
<i>Capacity Building</i>		
EIA & Environment Legislation	ADB	US\$0.5 M
India-Canada Environment Facility	Canada	US\$ 97.9 M equiv.
Upgradation of Environment Research Facilities, Madras	Germany	US\$ 6.86 M equiv.
Training in Env. Services and Technologies	USAID	US\$ 25 M
Center for Science and Technology	Netherlands	US\$0.43 M equiv.
Ecoemployment	Netherlands	US\$0.98 M equiv.
EIA Program	Netherlands	US\$0.17 M equiv.
		US\$1.7 M equiv.
GIS Karnataka	Netherlands	US\$1.14 M equiv.
GIS Andhra Pradesh	Netherlands	US\$0.10 M equiv.
Environment Action Programs	UNDP	US\$0.39 M
Forestry Research Education and Extension	World Bank	US\$ 47.0 M equiv.
<i>Environmental Education</i>		
Forestry Education / Training	British-ODA	US\$ 6.25 M equiv.



World Bank Support

- Project:** Forestry Research Education and Extension
- Fiscal Year:** 1994
- Loan/Credit Amount:** US\$47.0 M (equivalent)
- Description:** To be implemented over five-years and cover the following:
- (a) *Research management* based on the development of the Indian Council for Forestry Research and Education (ICFRE) to improve the management and coordination of forestry research and extension, through staff training, studies and consultancies to develop priority setting methodologies and a management information system, and provision of a headquarters, building and equipment.
 - (b) *Research program support* providing necessary infrastructure, equipment and operating expenses for selected research programs in ICFRE institutes, the establishment of a research grant fund to commission research by public and private sector agencies, measures to improve the quality of planting stock, human resource development through staff training, scientific review of institutes and programs, and the improvement of library and information systems and statistical services.
 - (c) *Forestry education* involving the development and validation of forestry curricula in formal education through provision of funds for review and revision work, and development of the Deemed Forestry University at Dehra Dun.
 - (d) *Forestry policy and preparation* to strengthen capabilities within the MOEF for the analysis of forest policies and preparation of future forestry projects through staff training and provision for studies and consultancies.
 - (e) *Conservation of biodiversity* to support development of programs for ecodevelopment around two protected areas, by involving communities in the planning and implementation of programs for creation of alternative natural or social resources or for income generation. Concurrent improvements in the planning and management of the protected areas would also be financed. The project would support research and monitoring and evaluation programs.



Project: **Technician Education**

Fiscal Year: 1990

Loan/Credit Amount: US\$25.0 million / US\$235.00 million (equivalent)

Description: The goal of the project is to support the National Policy on Education and more specifically, the Ten-Year Technician Education Investment Program (1990-99). Three major objectives are :

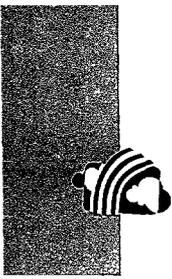
- (a) *Capacity expansion* to be achieved by expanding and diversifying programs in about 50 percent of the polytechnic system or about 230 new and existing institutions, so that they can undertake courses in new and emerging technologies, conventional and advanced technician engineering, and continuing education diploma courses.
- (b) *Quality improvement* would be achieved through modernizing the equipment and facilities of polytechnics, expanding teacher training by reorganizing the Technical Teacher Training Institutes and undertaking curriculum development activities through the respective State Boards of Technical Education in each of the eight states.
- (c) *Efficiency improvement* would result from strengthening the Bureau of Technical Education, granting academic autonomy to selected polytechnics, undertaking industry-institute programs in each polytechnic, encouraging internal revenue generation in polytechnics and establishing equipment and facility maintenance systems.

Project: **Second Technician Education**

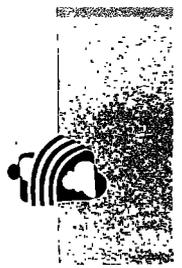
Fiscal Year: 1991

Loan/Credit Amount: US\$ 307.0 million (equivalent)

Description : The project goal is to support the National Policy on Education and more specifically, the Ten-Year Technician Education Investment Program (1990-99). The project is a second phase of IDA's commitment to support the national polytechnic system and the Ten-Year Investment Program which seeks its modernization and the reform of the policies which constrain the system's flexibility to respond to the changing needs of industry and society. The project would be identical to the First Technician Education Project and would have the same major objectives.

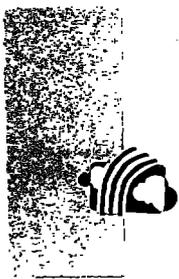


- Project:** **Seventh Population Project**
- Fiscal Year:** 1993
- Loan/Credit Amount:** US\$10.0 M/US\$86.7 M (equivalent)
- Description:** The project would support the government's objective of improving the efficiency and effectiveness by which family welfare (family planning and maternal and child health) services are delivered in the states of Bihar, Gujarat, Haryana, Jammu and Kashmir and Punjab. The project would comprise :
- (a) *Increasing the supply of services* through upgrading and expanding the number of primary health centers and subcenters.
 - (b) *Increasing demand* through the expansion of the social marketing of contraceptives, increasing the involvement of private voluntary organizations and strengthening the information, education and communication efforts of each state.
 - (c) *Improving the quality of family welfare services* by upgrading the training of all levels of family welfare workers.
 - (d) *Improving management* through the strengthening of each state's Directorate of Health and Family Welfare, upgrading of management information and evaluation and personnel management systems and expanding demographic and operational research directly relevant to program management and implementation.
-
- Project:** **National Family Welfare Training and Systems Development**
- Fiscal Year:** 1989
- Loan/Credit Amount:** US\$11.3 M/US\$113.3 M (equivalent)
- Description:** The project would support the government's goal of improving the efficiency and effectiveness by which family welfare services are delivered in the states. The project would be located in the states of Andhra Pradesh, Madhya Pradesh and Uttar Pradesh. Its specific objectives would be to improve the efficiency of the family welfare staff training system; expand existing training capacity to meet staffing requirements; improve the quality of training being imparted; and enhance the service delivery system in which the trained worker will operate.



Other Donor Support

- Project:** **Environmental Impact Assessment & Environmental Legislation (National Project)**
- Donor:** Asian Development Bank
- Loan/Credit Amount:** US\$500,000
- Description:** The technical assistance will assist the government to strengthen its overall capability to implement national environmental planning and management by improving its environmental impact assessment program, applications of regional environmental planning, as well as environmental law research and education. The TA will support an intensive effort by the government for institutional and human resource capacity building primarily by refining of environmental planning and EIA methodologies and procedures as well as related regulations to improve efficiency and training of an adequate number of administrators and environmental specialists through out the country.
-
- Project:** **India-Canada Environment Facility**
- Donor:** Canada
- Loan/Credit Amount:** C\$72.0 M (US\$97.9 M equivalent)
- Description:** Generated by the sale of Canadian commodities in India, the facility seeks to strengthen the environmental research and technology capabilities of key environmental organizations.
-
- Project:** **Assistance for Setting Up Pollution Control Boards (CPCB)**
- Donor:** Germany
- Loan/Credit Amount:** Phase I - DM 6.0 M (US\$8.23 M equivalent)
Phase II - DM 6.0 M (US\$8.23 M equivalent)
Phase III - DM 5.5 M (US\$7.54 M equivalent)
- Description:** It is the responsibility of the Central Pollution Control Board, and in the states of the respective State Boards, to lay down the norms and limits of environmental pollution. The aim of the project is to promote the Central Board and the participating State Boards to a position, so as to enable them to discharge the tasks of checking and evaluating the environmental conditions and developing strategies to improve the quality of the environment.



Project: **Industrial Pollution Control with the National Productivity Council (NPC)**

Donor: Germany

Loan/Credit Amount: Phase I - DM 2.5 M (US\$3.43 M equivalent)
Phase II - DM 4.0 M (US\$5.47 M equivalent)
Phase III - DM 4.0 M (US\$5.47 M equivalent)

Description: The project aims to set up a pollution control cell across the country with the National Productivity Council, New Delhi, to advise the small and medium industries in India in the field of ecological control (purification of sewage/waste water, preventing of air pollution, waste management). A training component for environmental control engineers to develop competence in the field is also envisaged, with training imparted in Madras.

Project: **Upgradation of Environmental Research Facilities at the Center for Environmental Studies, Anna University, Madras**

Donor: Germany

Loan/Credit Amount: DM 5.0 M (US\$6.86 M equivalent)

Description: Broad objectives of this technical cooperation are:

- (a) To develop a strong base for socially relevant advance-level research in environmental sciences and technology.
- (b) To develop facilities and serve as a data center for storage, retrieval and dissemination of environmental information and help users in meeting their information needs.
- (c) To enhance the capability to do relevant applied research and consultancy by developing linkages with other educational and research institutions, industries and user agencies in this area, and to thereby increase the cost-effectiveness of investment.

Project: **Forestry Education and Training**

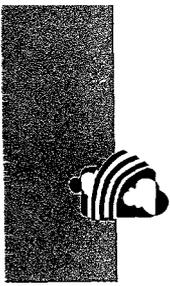
Donor: British-ODA

Loan/Credit Amount: £3,864,000 (US\$6.25 M equivalent)

Description: To effect reform of post-entry training for the Indian Forest Service and State Forest Service through revision of curriculum at IFS and SFS colleges and implementation of a formal system of staff training and development.



- Project:** Trade in Environmental Services and Technologies
Donor: USAID
Loan/Credit Amount: US\$25 M
Description: Help potential Indian business partners access information on more efficient environmental technologies and services available in the U.S., organize trade missions to the U.S. to review the range of technology/service options, provide technical collaboration to select appropriate technology/services, and provide financing to support business transactions and joint ventures with U.S. companies.
- Project:** CSE - Center for Science and Technology
Donor: Netherlands
Loan/Credit Amount: US\$438 000 equivalent
Description: Support NGOs to develop educational publications and general documentation on environmental issues, train journalists in reporting on environmental issues, organize seminars and coordinate South Asiatic NGO-network as a post-UNCED activity.
- Project:** Socio-Ecological Transformation
Donor: Netherlands
Loan/Credit Amount: US\$260,000 equivalent
Description: NGO support in actions to achieve socioecological sustainability in the region by organizing awareness dialogues between different user groups of natural resources in the rural sphere. Approach based on analysis of processes of sociocultural change affecting local ecology.
- Project:** Eco-Employment Program (Andhra Pradesh)
Donor: Netherlands
Loan/Credit Amount: US\$983,000 equivalent
Description: NGO support to projectwide strengthening of environmental awareness and support of the rural poor in the Anantapur district, with the aim of mitigating environmental degradation in a sustainable way.
- Project:** Pollution Perception Studies
Donor: Netherlands
Loan/Credit Amount: US\$1,110,000 equivalent



Description: The Dutch Institute for Environmental Studies will cooperate with a number of institutes and universities in selected states in India to strengthen sociological research on pollution awareness.

Project: **Indo-Dutch EIA Program**

Donor: Netherlands

Loan/Credit Amount: Phase I -US\$175,000 equivalent

Phase II- US\$1,750,000 equivalent

Description: Phase I - Organization of fifteen workshops and three high level seminars on environmental impact assessment (EIA) in water resources, land use planning and industrial sittings, ports and harbors.
Phase II - Activities to institutionalize EIA training in three major Indian technical institutes in cooperation with Ministry of Environment and Forests; potential selection: IIT Bombay, NEERI, ASCI-Hyderabad.

Project: **GIS Karnataka**

Donor: Netherlands

Loan/Credit Amount: US\$1,145,000 equivalent

Description: Support in development of data base on natural resources to be made available via GIS on district level for planning purposes in general and EIA studies in particular.

Project: **GIS Andhra Pradesh**

Donor: Netherlands

Loan/Credit Amount: US\$106,000 equivalent

Description: Institutional strengthening of the Andhra Pradesh State Remote Sensing Applications Center in Hyderabad by the International Training Center for Remote Sensing Techniques in Enschede, Netherlands.

Project: **UASB Training Facilities.**

Donor: Netherlands

Loan/Credit Amount: US\$2,470,000 equivalent

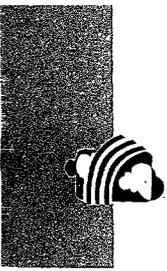
Description: Creation of training facilities aimed at knowledge transfer and research on wastewater treatment, specifically UASB technology and related environmental engineering topics.



Project: **Environmental Master Plan Study**
Donor: Denmark
Loan/Credit Amount: DK 27.66 M (US\$4.25 M equivalent)
Description: The project aims at:
(a) *Development of methodologies* for integrated environmental management in Dakshina Kannada District and preparation of environmental management systems and procedures for implementation.
(b) *An environment management plan* up to year 2002 for the district, including action plans for involved agencies and institutions at the district and state level to be ready for implementation.
(c) *Increased economic, political and institutional capacities* of agencies and other involved institutes at the district and state level for integrated environmental management planning and implementation.

Project: **Environmental Training Institutes**
Donor: Denmark
Loan/Credit Amount: DK 7.87 M (US\$1.2 M equivalent)
Description: Establish two training institutes, in Karnataka State Pollution Control Board and Tamil Nadu State Pollution Control Board, with a view to impart need based pollution control and prevention-related training to staff of the two pollution control boards and also to officers and staff of the municipalities, industries and NGO organizations. The project also has components on training of trainers and actual training based on the developed packages/modules.

Project: **Environmental Action Programs**
Donor: UNDP
Loan/Credit Amount: US\$390,000
Description: The project profiles technical assistance and investment proposals in the identified areas such as forestry, energy, institutional strengthening, human resources development, clean technologies, improved management of water quality, wetlands and environmental impact assessment as vital inputs for the country's preparation for seeking assistance from IDA and other donors.



Project: **Master Plan for Environmental Quality Management for Dhanbad-Bokaro (Bihar)**

Donor: UNIDO

Loan/Credit Amount: US\$10,000

Description: To devise an integrated areawide environmental quality management master plan for the region, adaptable by other states.

Chapter 9

Alternative Energy Plan





Alternative Energy Plan

Alternative Energy

9.01 For the past decade, development of alternate energy sources has been part of the Government of India's strategy for expanding the country's energy supply and meeting the decentralized energy needs of the rural sector. Its renewable energy program continues to be one of the largest among developing countries and is administered through the Ministry of Nonconventional Energy Sources (MNES). In addition, the Indian Renewable Energy Development Agency Limited was established to promote and finance private sector investments in the sector.

9.02 The government estimates that 50,000 MW of power capacity can be harnessed from wind, small hydro, co-gen and bio-energy sources alone. This is equivalent to power capacity additions required by the country for the coming five years. However, it was only recently that the government revised its development strategy for the sector in order to accelerate the development of this sizable energy potential and assist in mitigating the acute shortfall in power supply. The opening up in 1991 of India's power sector to private investors together with the incentives offered to developers of renewable energy systems have led to a surge of interest in the sector. Moreover, heightened awareness of the environmental benefits of renewable energy

relative to conventional forms and the short gestation period for developing small-scale, cost-effective renewable schemes have helped attract investor interest in renewables. Recognizing the opportunities afforded by private sector participation, the MNES revised its Eighth Plan priorities in July 1993 by giving greater emphasis to promoting renewable energy technologies for power generation. Accordingly, the MNES raised plan targets for power generation from 600 MW to 2,000 MW; this involved raising wind power targets from 100 MW to 500 MW, and small hydro from 200 MW to 600 MW, among others. Evidence of the initial success enjoyed by this revised plan is observed in the wind generation program. As of the end of March 1993, installed capacity in wind generation was 54 MW. By October 1994 it reached 160 MW, of which around 120 MW was being operated on a commercial basis by the private sector.

9.03 More extensive resource mapping and surveys are likely to lead to identification of greater potential for alternate sources of power including solar-based energy. But the sector's contribution to energy supply, while growing, is expected to remain a small fraction of the total requirements of India until cost recovery of investments in the sector becomes more widespread and sustainable.



The Environment Action Program

9.04 The EAP cites a significant potential for renewable energy utilization and energy conservation as alternative strategies for sustainable development of the energy sector. The major constraints identified in the EAP for implementing policies in these areas are:

- Availability of technology.
- Availability of capital.
- Institutional constraints.
- Pricing constraints.

9.05 The EAP views an alternate energy strategy against a backdrop of specific concerns currently facing India's energy sector—namely, unsustainable financial losses among the State Electricity Boards; irrational electricity prices; scarcity of capital resources in the public sector, and continued dominance of the public sector in energy development, which prevents the sector from benefiting from financing and innovative managerial skills offered by the private sector.

9.06 The EAP recommends an examination of the lifestyles and resource needs of India's large population as the basis for the development of a long-term energy policy and framework for evaluating policy instruments. The EAP also recommends an assessment of the impact of energy pricing on energy efficiency, energy supply, and energy mix. A host of other studies and institution-building activities to promote renewable energy are also suggested in the

EAP. These include:

- Improved demonstration, research, monitoring and dissemination programs of renewable energy programs.
- Facilitating windpower generation through formulation of policy and incentives, organizational strengthening, and indigenization of wind generation systems.
- Design and management of decentralized energy schemes.
- Promoting biogas utilization by developing new strategies for program implementation and system delivery.
- Resource accounting for noncommercial energy sources in rural areas.
- Product design and market research for improved cook stoves and solar hot water systems.
- Developing power capacity from small hydroelectric projects.

GOI PROGRAMS

9.07 The following programs identified in India's Environment Action Program focus on strengthening programs for rapid diffusion, demonstration research and monitoring of new and alternative sources of energy as well as enhancement of conventional energy sources by improving efficiency of energy production, conversion and use, managing energy demand,



and encouraging technology/process changes.

Part I : Conventional Energy

9.08 *Coal sector*

- Projects for coal beneficiation.
- Projects for coal bed methane.
- Projects for coal gasification.
- Project to tackle coal mine fires.

9.09 *Power sector*

- Reduction of transmission and distribution losses in power sector.
- Demonstration projects on energy-efficient lighting.
- Evaluation studies on performance of pollution control measures in thermal power stations.
- Assessment studies of ongoing R&M, uprating and life extension schemes.

9.10 *Transport sector*

- Programs for shifting from road to rail in freight movement.
- Promotion of mass rapid transport systems.
- Conversion of two-stroke to four-stroke engines in two-wheeler and three-wheeler vehicles.
- Introduction of compressed natural gas.

9.11 *Industrial sector*

- Programs for promotion of energy conservation in industries.
- Capacity building for environmental impact assessments and for thermal and

hydel power plants.

- Building natural resources accounting system for commercial fuels.

Part II : Renewable/Nonconventional Energy Sources

Rural Energy Group I

9.12 National Project on Biogas Development (NPBD)

- Research and development on biogas to improve the efficiency of methane production, enhance biodegradability of cattle dung, reduce the cost of biogas plants and diversify utilization of digested slurry.
- Formulation of an alternative strategy for biogas implementation.
- Designing effective biogas technology delivery systems.
- Community, institutional and night soil based biogas plants program.

9.13 National Program on Improved Chulha (NPIC)

- Evolving design criteria for improved cookstoves, capacity building for environment impact assessments of energy use in rural areas.

9.14 Biomass Program

- Biomass production and improvement program includes R&D activities to produce improved quality planting materials, both seed and seedling, on a mass scale, with a potential of producing 40 tons per hectare per year.
- Program of converting agriculture waste



to fertilizer.

9.15 Energy Plantation Program

- To test the performance of fast-growing fuelwood species and to screen the most potential species for plantation under a given set of agroclimatic conditions.

9.16 National Program on Briquetting Technology

- To ensure proper and efficient utilization of agroresidues and agroindustrial byproducts/wastes.

9.17 Urjagram Program

- To create model villages where most of the energy needs can be met using renewable energy systems.

Rural Energy Group II

9.18 Solar Photovoltaic Program

- To convert sunlight directly into electricity in an environmentally clean and reliable manner.
- Solar photovoltaic water pumping for agriculture and related uses.

9.19 Program on Wind Energy Conversion Systems for Rural and Remote Areas

- To promote the development of technologies for harnessing the vast wind energy potential for water pumping, wind battery charging and stand alone wind power generation.

9.20 Biomass Gasification Program

- Promote devices to convert biomass such as wood wastes, agricultural and agro-industrial residues to combustible gas

through thermochemical process.

9.21 Solar Thermal Energy for Rural Applications

- Using solar energy to supplement the energy requirements for agricultural activities, household activities and health care requirements.
- Product development and market research for solar hot water systems.
- Resource accounting systems for non-commercial energy sources in rural areas.

9.22 Human and Animal Energy Program

- To develop, demonstrate and popularize improved carts, cycle rickshaws, trailers and efficient irrigation devices, agricultural tools, and so on.

Power Group

9.23 Wind Power Program

- Catalyzing commercialization of wind power generation on a large scale.
- Collection of wind data, wind mapping and wind monitoring.
- Research for indigenization of wind electric generation system.
- Formulating policy measures and incentives to facilitate wind power generation.

9.24 Small Hydro Program

- Catalyzing development of micro, mini and small hydro schemes of up to 3 MW capacity for power generation from the otherwise dissipating energy in flowing waters at canal falls, irrigation dams,



runoff river and natural falls in the hilly areas.

- ❑ Development of power capacity from small hydel projects.

9.25 Solar Thermal Power Generation

- ❑ Setting up MW-scale thermal power plants including 35 MW facility in Rajasthan.

9.26 Biomass-Based Cogeneration

- ❑ Initial focus on bagasse-based cogeneration in sugar mills.

9.27 Grid Interactive Solar Photovoltaic Power Program

- ❑ Setting up of a MW-scale electricity power generation program through grid interactive solar photovoltaic projects.

Urban/Industrial Group

9.28 Urban/Municipal and Industrial Wastes Program

- ❑ Utilization of urban/municipal and industrial wastes for production of energy and power through appropriate conversion technologies (for example biomethanation, densification) in an economical and environment-friendly manner.
- ❑ Development of institutional framework at national level and R&D

organizations.

9.28 Solar Thermal Technologies and Applications

- ❑ Solar cookers, solar distillation (to purify brackish/dirty water into distilled water by thermal evaporation process), solar refrigeration, solar thermal pumps, solar passive architecture.

9.29 Energy Conservation and Efficiency

- ❑ Formulation of effective strategies to mitigate short supply of commercial energy and oil, and to minimize wasteful use of energy and in all sectors of economy.

New Technology Group

9.30 Geothermal Energy Alternative Fuels for Surface Transportation

- ❑ Technology development; demonstration and field evaluation; conservation of petroleum products by the large-scale use of battery-, alcohol-, and compressed natural gas-operated vehicles.

9.31 Ocean Energy Program

- ❑ Develop technologies on ocean thermal energy conversion, tidal energy and wave energy for use as alternate sources of energy.



Major Issues and Recommendations

9.32 A number of recommendations in the EAP, including the call for further studies on various technologies, have been overtaken by recent developments in the renewable energy sector. As mentioned before, the government reoriented its renewable energy program in July 1993, setting aside a technology-driven program involving myriad R&D activities and deploying numerous small-scale rural energy systems that gave little attention to consumer preference and feedback on quality and service. The current thrust is now towards commercialization of proven technologies, and priority is being given to demand-driven programs that will pave entry of renewables into the economic mainstream. Specifically, greater emphasis is now placed on commercializing larger-scale alternate energy systems for power generation, promoting private initiatives and investment, reducing subsidy support, and fostering competition in supply of systems.

9.33 The unavailability and slow adoption of state-of-the-art technology is no longer a major barrier to the development of renewable energy systems in India. The GOI's announcement of a revised industrial policy in September 1991 led to a progressive lowering of import tariffs and the lifting of cumbersome licensing procedures for technology transfer. This allowed the entry of the latest proven technologies and opened the sector to participation of private suppliers and manufacturers. The increased competition in supply is expected to result in higher performance specifications and lower costs. The lifting of regulatory disincentives to private investment in the energy sector created

opportunities for private sector participation in power, including renewable energy-based systems.

9.34 However, other barriers to commercialization of renewable energy systems remain. These include factors that are generally intrinsic to these systems, such as:

- The significant up-front capital investment required.
- Lack of access of renewable energy users to appropriate and affordable financing mechanisms.
- Systems tend to be small-scale in size, project sites dispersed and operations highly dependent on local conditions.
- Systems require greater end-user participation and, at early stages, greater organizational and technical promotions effort than conventional energy systems.

9.35 Within India, specific institutional and policy constraints continue to impede commercialization of renewables, namely:

- Subsidized energy prices for kerosene and electricity make it difficult for renewable energy schemes to compete financially, especially in rural and agricultural areas where renewable energy options are most often targeted.
- There is no commercial market base due to the traditional focus of suppliers' marketing efforts toward government-administered programs rather than to



consumers.

- The absence of after-sales service results in a proliferation of non-performing systems.

9.36 A number of states have issued policies to attract private development of renewable energy schemes, including “wheeling and banking” arrangements for power generated from these schemes. However, the growing interest in private development of larger grid-connected renewable systems requires that basic issues of power sales and delivery arrangements to the state grids must now be addressed. Moreover, the impact of tax and other fiscal incentives would have to be assessed to ensure that technical quality and performance reliability are not overlooked in the rush by private investors to take advantage of potential financial windfalls from the tax incentives.

RECOMMENDATIONS

9.37 To accelerate the development of the renewable energy sector in India and thus increase its contribution to the country's energy mix and help mitigate, albeit in modest terms, carbon and greenhouse gas emissions in the medium term, several areas of policy and program focus are recommended.

9.38 *Commercialize.* The current policy of the MNES to promote commercialization of mature technologies should be continued. The radical departure from past efforts to administer through government agencies the deployment of a targeted number of government-specified systems has started to yield positive results, particularly in power generation. Allowing the private sector and some state-owned corporations to set up the systems based on their own needs and specifications has resulted in more capacity

build-up. These investors are able to demand suitable arrangements for equipment warranty and system performance guarantees, operation and maintenance, and after-sales service. Such delivery and service arrangements help move the technologies into the economic mainstream in a significant way. The resulting improved systems designs and establishment of a service infrastructure have enhanced the overall credibility of the sector.

9.39 *Reduced subsidy support.* In consonance with commercialization objectives, subsidy support to mature technologies should be eliminated. Subsidy programs cause producers and investors to focus their efforts on serving the requirements of the government-administered programs rather than establishing their own commercial market base. Such subsidies stymie rather than promote growth of the sector.

9.40 *Establishment of local consultancy base.* The GOI's thrust to commercialize renewable energy systems has led to unprecedented investor interest in the sector. However, the development of investment prospects is slowed by the lack of technical know-how in the country and limited consultancy base in the sector. Serious investors normally engage the services of consultants to prepare the requisite preinvestment studies; however in India, there is a dearth of expertise in the fields of wind, solar photovoltaic and solar thermal energy, among others. Training and technical assistance support is needed for the development of a wider and stronger consultancy base on alternate energy technologies in India.

9.41 *Resource mapping and survey.* Investments on renewable energy schemes are generally situated in areas where good wind,



small hydro and solar resources have been indicated through resource surveys or meteorological data tracking performed by the government or government-supported entities. Except for larger-scale investments, the entrepreneurs do not commission micro-siting studies but instead rely heavily on earlier resource surveys. These surveys are normally an insufficient basis for system optimization studies. It is therefore important that a program for more extensive and intensive resource mapping be put in place which will incorporate the use of the latest available technology (e.g., GIS, satellite data) and tap the services of international experts (of which there are only a few). These data can then be made available, eventually on a commercial basis, to potential investors.

9.42 *Demonstration of commercial projects.* The beneficial impact of pilot projects which demonstrate the commercial application of mature technologies cannot be understated. In India, operation of renewable-based generating facilities in suitable resource-rich sites, usually set up by the state as demonstration projects, has attracted private investments initially to the adjacent sites and eventually to greenfield sites within the state. GOI and state support for such demonstration projects is considered vital to the development of the sector, provided they are pursued with the objective of attracting commercial operation and based on cost-recovery principles.

9.43 *Establishment of testing facilities.* The development and operation of testing facilities for the various alternate energy systems is necessary to meet the demands of the private sector for reliable and guaranteed performance. Although the MNES has

established a testing facility for solar equipment, it is not currently being operated as a service facility. A program should be established to support the creation on a commercial basis, of testing facilities and promotion of entities qualified to issue certifications on design performance, compliance with reliability standards, and other performance norms that are associated with energy and electronic equipment sales and supply.

9.44 *R&D activities and improved manufacturing base.* It is recommended that R&D activities be limited to moving the technologies closer to requirements of the market and users, adapting them to local operating conditions and improving manufacturing capabilities. The past tendency to reinvent technologies developed to higher performance levels abroad should be avoided. Policy and program support can instead be given to promoting transfer of technology and increasing local capacity to manufacture equipment and components of alternate energy systems.

9.45 *Export thrust.* The projected rise in energy demand offers opportunities for economies of scale in the production of alternate energy systems in India. Successful demonstration by India of commercial operation of these systems can lead to their adoption by other countries as well. The prospects of exporting these systems from India to other countries are promising. The multiplier effect resulting from deployment of alternate energy systems in other parts of Asia and the world can significantly contribute to the reduction of greenhouse gas emissions in the longer term.

Conventional Energy

9.46 India's Environment Action Program (EAP) covers the relevant issues in the energy sector and proposes many solutions for alleviating the deleterious effect of energy use on the environment: conservation of natural resources, use of clean coal technologies, reduction of transmission and distribution losses, promotion of energy efficiency in supply and demand, development and promotion of renewable energy technologies, and retrofitting and modernization of existing power plants. But the EAP does not differentiate among these activities in terms of their short-term and long-term impacts, nor does it prioritize the solutions in terms of their environmental impacts.

9.47 The immediate priority for solving short-term environmental problems is targeted action in coal-based power generation. The most important technologies for environmental protection are coal washeries, retrofitting and maintenance of existing power plants, demand-side management, reduced losses in transmission and distribution, and advanced-technology power generation projects. These measures must be accompanied by a strengthening of the environment divisions within the state electricity boards to ensure sustained environmental improvement. In addition, fiscal policies that encourage the efficient use and conservation of natural resources are required. Measures to raise the standard of indigenous coal also are needed; these could take the form of reduced tariffs on imported coal and the improvement of coal transportation infrastructure to enable the supply of imported, good-quality coal. From

the financial standpoint, lending for retrofitting and maintenance projects should be facilitated.

MAJOR ISSUES AND RECOMMENDATIONS

9.48 An alternative energy plan is one of the seven priorities noted in the EAP. The main issues facing the energy sector are:

- Absence of an integrated long-term energy policy.
- Lack of rational pricing for energy.
- Increasing foreign exchange outflows as a result of oil imports.
- Low levels of available energy.
- Increasing energy demand.
- Inefficient use.

9.49 The EAP describes two strategies to tackle these issues. First, the efficiency of energy production, conversion, and use should be improved; energy demand should be managed; and technology and process changes should be encouraged. Second, India should move toward more environmentally benign energy forms, that is, renewable energy resources. The priority programs under the alternative energy plan were discussed earlier.

DOMINANCE OF COAL

9.50 The government has decided to use coal as the main source of fuel for the power sector for the foreseeable future, based on the large quantity of coal reserves in India. Thus coal will continue to be the main source of pollution in the power sector, and short-term efforts to alleviate environmental



pollution should focus on this source. The development rate of renewable energy will have little effect on the magnitude of pollution and related environmental impacts imposed by the use of coal. The suggested mitigation measures—fiscal, administrative, or physical—will not altogether prevent these impacts, but they will moderate them to some extent.

9.51 Generation capacity by the end of the Seventh Five-Year Plan was 69,100 megawatts (MW), of which coal-fired thermal power plants accounted for about 46,000 MW. Power generation capacity is expected to increase by 30,500 MW during the Eighth Five-Year Plan, with coal accounting for 17,000 MW of this jump. Coal-fired thermal power plant capacity is expected to increase by 81,000 MW by 2010, to a total of 144,000 MW.

9.52 By comparison, renewable power generation capacity is estimated at 180 MW (mainly hydropower and wind), and the total installed capacity by 2010 is expected to be no more than 2,000 to 3,000 MW. Furthermore, the ultimate potential of renewable energy for India is estimated at 50,000 MW—well below the coal-fired capacity in 2010. Thus renewable energy will not replace coal-based power generation in the foreseeable future.

USING FISCAL INCENTIVES TO IMPROVE RESOURCE USE

9.53 Fiscal incentives and tax-based environmental protection measures are outlined as part of the strategy in the EAP. Current fiscal incentives are in the form of corporate tax exemptions for natural resource conservation and accelerated depreciation for energy-conserving devices. The tax-based measures emphasize water conservation. A

levy on water consumption is confined mainly to thermal power plants and other large-scale process industries. The water levy is the main source of revenue for the State Pollution Control Boards in India; the amount collected during 1991-92 in thirty-one states was Rs.76.3 million (about \$2.5 million). It seems, however, that the costs of collection exceeded the amount collected. No further changes in fiscal measures are suggested by the EAP.

9.54 The current fiscal measures have little effect on the power sector. The fact is that coal-fired thermal power plants are responsible for a massive abuse of natural resources (land, water, and air). The main reason is that the use of these resources is not charged at real value, and no incentives are offered for their conservation. While the power sector is not in a position to pay the actual costs of natural resources, it can be encouraged to conserve them.

9.55 *Water.* Water is used by thermal power plants in two forms—as makeup water and in open cooling systems. While a levy is paid for makeup water, no charges are imposed on the use of marine coastal water or inland water as sources of cooling water. As a result thermal and chemical pollution are degrading water quality in these areas. The water levy does not deter coal-fired thermal power plants from using large volumes of makeup water for ash disposal. Few efforts have been made to recycle ash disposal water, and it contaminates surface and underground water resources that are used for drinking and irrigation. The volume of makeup water and open-cycle cooling water required for efficient operation can be accurately determined for each thermal power plant. Thus fiscal incentives can be applied if conservation is practiced, and higher levies or other charges can be imposed if these limits are exceeded.



9.56 *Land.* Land for the power sector is heavily subsidized. Vast areas are used for ash disposal in most of the coal-fired thermal power plants, creating a major source of air and underground water pollution. Resettlement issues are usually associated with land acquisition for these ash ponds. In addition, land reclamation efforts are insufficient and delayed. As with water, land allocations for ash disposal and a timely land reclamation program can be predetermined for each thermal power plant. Real land prices can be charged for excessive land use and incentives paid for reclaimed land, returned over time, to public service.

9.57 *Air.* A carbon tax is the best tool

for improving fuel efficiency, but it may be a bit premature. Using the same logic applied to water and land, tax incentives and penalties can be imposed to encourage fuel efficiency. The success of using a carbon tax for coal-fired thermal power plants will depend on the availability of coal of consistently high quality. Hopefully this will be the outcome of the coal sector rehabilitation project.

ENVIRONMENTAL MITIGATION

9.58 The EAP describes several programs to address the short-term environmental problems arising from conventional energy. This section prioritizes these solutions based on their environmental

Table 9.1. Carbon Dioxide Emission Reduction Potential for Conventional Pulverized Coal Plants (Millions of tons a year)

Technology	1997				2010			
	No Change in Technology	Reduction due to change in Technology	Reduction as percent	Net Emissions	No Change in Technology	Reduction due to change in Technology	Reduction as percent	Net Emissions
Coal washeries		19	6.3			37	5.4	
Restructuring and modernization		15	4.9			-		
Demand-side management						85	12.4	
Reduction of transmission and distribution losses		14	4.6			25.5	3.7	
Advanced technology						12.5	1.8	
Improved pulverized coal plants						30	4.4	
Total	303	48	15.8	255	684	190	27.8	494

Source: Environment Duration, Asia Technical Department (ASTEN), World Bank, Washington D.C. 1995



impact. It also projects what can be achieved by 1997 and 2010 using these solutions. Assuming, for simplicity, that the level of greenhouse gas emissions is associated with other forms of pollution, environmental activities can be prioritized by their potential to reduce greenhouse gas emissions (Table 9.1). Reduced emissions are associated with more efficient operation, which eventually leads to a reduction in investment. The World Bank estimates that improvements in the efficiency of system operation could lower sector investment requirements by about 10 percent through the Eighth and Ninth Five-Year Plans.

9.59 The specific measures that should be undertaken to reduce pollution from coal-based power generation are listed below.

9.60 *Coal quality.* Higher and more consistent coal quality will increase generation efficiency and plant availability. Energy conservation resulting from reduced transportation load will be an additional benefit. Today, about 70 percent of India's steam coal is transported 500 kilometers or more. The action plan found that coal washeries should be located nearer to thermal power plants, which often receive large quantities of extraneous material as a result of poor mining methods. State electricity boards are willing to pay a premium for washed coal, or even for coal of consistent quality. Washed coal reduces carbon dioxide emissions from 0.983 to 0.866 kilograms per kilowatt-hour. Even a 1 percent improvement in plant capacity as a result of coal washeries will improve generation capacity by 600 megawatts by the end of the Eighth Five-Year Plan—a savings of \$720 million. Assuming 80 million tons a year of coal-washing capacity, the investment potential for coal washeries by 2000 is \$256 million. By 2010 this potential

could double. The equivalent annual generation from washed coal will be 320 million megawatts, which represents an annual carbon dioxide savings of 37 million tons by 2010.

9.61 *Modernization.* The Eighth Five-Year Plan estimated that restructuring and modernization of thermal power plants during the plan period would improve plant efficiency and capacity. The programs also included retrofitting of the plants to upgrade their environmental performance. These efforts would have realized a savings of 3,150 megawatts equivalent generation capacity, or about 5 percent of total generation capacity, by the end of the plan period. These efficiency plans, however, never fully materialized.

9.62 Discussions with the Power Finance Corporation of India revealed that plans for restructuring and modernization of twenty-one plants were not moving ahead because of the financial difficulties facing the state electricity boards. The electricity boards consider the power corporation's rates very high—a single restructuring and modernization plan may range between \$10 million and \$50 million. The investment potential for restructuring and modernization is estimated at more than \$500 million.

9.63 The carbon dioxide savings potential is estimated as 5 percent of the 63,000 megawatt coal-based generation capacity. It could have been 15 million tons (assuming 55 percent plant load factor and 0.983 kilograms of carbon dioxide emissions per kilowatt-hour). The potential investment savings would have been \$3.8 billion.

9.64 *Reduction in transmission and distribution losses.* Transmission and distribution losses are estimated between 12



and 15 percent of net generation. A 3 percent savings is a conservative, and achievable, goal. By the end of the Eighth Five-Year Plan total generation capacity was planned to be 100,000 megawatts. A 3 percent savings would be equivalent to a carbon dioxide reduction of 14 million tons a year. The potential investment savings would have been \$3.6 billion. By 2010, with total generation capacity estimated at 180,000 megawatts, a 3 percent savings would be equivalent to a greenhouse gas reduction potential of 25.5 million tons a year and a potential investment savings of \$6.5 billion.

9.65 *Demand-Side management.* The World Bank identified twenty-six end-use technologies that, if implemented, could have saved about 20 percent of total demand and 30 percent of peak demand. One can assume that these measures will not be applied during the Eighth Five-Year Plan and that, through 2010, only 10 percent savings will materialize. Accordingly, the generation capacity savings potential is 18,000 megawatts and the equivalent greenhouse gas savings is 85 million tons a year. The investment savings potential is \$21 billion.

9.66 *Advanced Technology.* Following improvements in coal quality and modernization of all coal-fired thermal power plants, the next logical step would be to introduce advanced power generation technologies. An additional 81,000 megawatts of coal-based production is envisaged by 2010. India is contemplating the installation of a 30-megawatt pilot project using integrated coal gasification/combined cycle technology. Assuming that 20 percent of the additional capacity is using this technology by 2010, overall efficiency will improve by 5 percent. Carbon dioxide emissions for this technology are estimated at 0.82 kilograms per kilowatt-

hour; if 16,000 megawatts (20 percent) are produced in this way carbon dioxide emissions will fall by 12.5 million tons (assuming a 55 percent plant load factor). The 5 percent efficiency improvement for conventional power plants will reduce emissions by 30 million tons a year.

RECOMMENDATIONS

9.67 An assistance program based on the Environment Action Program should be developed to help the government implement its energy improvement priorities. As mentioned earlier, the emphasis must be on improving the efficiency of conventional energy production and use while developing renewable energy resources to achieve long-term objectives. Emphasis should be placed on policy reforms, institutional strengthening, technical adaptation, and financial development to create a general framework that supports renewable energy efforts.

9.68 Conventional energy policies should encourage efficient use and conservation of natural resources, reduce tariffs on imported coal, and provide infrastructure to facilitate inland coal transportation.

9.69 To strengthen institutions, the government should create environmental management divisions in the state electricity boards to focus on environment-related activities and to provide training in environmental management and regulatory compliance.

9.70 Technology improvements must be adopted by conventional producers, both to increase efficiency and to decrease environmental impacts (see Table 9.1). In addition, all promising renewable technologies



should be promoted from an early stage of development.

9.71 Finally, to improve the financial capacity of sector institutions the government

should support lending policies of the Power Finance Corporation to facilitate lending for restructuring and modernization projects in the conventional energy-using state electricity boards.



GOI Program Objectives

Part I : Conventional Energy Sources

Category: *Coal Sector*

Government Objectives/Programs:¹

Coal beneficiation; coal bed methane; projects for coal gasification; projects to tackle coal mine fires.

Donor Agency Support

Project	Donor	Funding
<i>Coal beneficiation</i>		
Coal Beneficiation	ADB	US\$100.0 M
Greenhouse Gas Pollution Prevention	USAID	US\$19.0 M
Coal Mining and Coal Quality Improvement	World Bank	US\$340.0 M

Category: *Power Sector*

Government Objectives/Programs:

Reduction of transmission and distribution losses in power sector; demonstration projects on energy-efficient lighting; evaluation studies on performance of pollution control measures in thermal power stations; assessment studies of ongoing R&M, uprating and life extension schemes

Donor Agency Support

Project	Donor	Funding
KSEB Systems Enhancement	Canada	US\$46.23 M equiv.
Andhra Pradesh Energy Efficiency	British-ODA	US\$69.0 M equiv.
HVDC Chandrapur	British-ODA	US\$101.84M equiv.
National Capital Power Supply	World Bank	US\$485.0 M
Power Utilities Efficiency	World Bank	US\$265.0 M
Private Power Utilities (TEC)	World Bank	US\$98.0 M
NTPC Power Generation	World Bank	US\$400.0 M
Second Maharashtra Power	World Bank	US\$350.0 M

¹ Programs identified in India's Environmental Action Plan and the 1993-94 annual report of the Ministry of Nonconventional Energy Sources.



Category: Transport Sector

Government Objectives/Programs:

Programs for shifting from road to rail in freight movement; promotion of mass rapid transport systems; conversion of two-stroke to four-stroke engines in two-wheeler and three-wheeler vehicles; introduction of compressed natural gas in the transport sector.

Donor Agency Support

Project	Donor	Funding
Waste Minimization in Automotive Components	UNIDO	US\$43,000

Category: Industrial Sector

Government Objectives/Programs:

Programs for promotion of energy conservation in industries; capacity building for environmental impact assessment for thermal and hydel power plants. Building natural resources accounting system for commercial fuels.

Donor Agency Support

Project	Donor	Funding
Industrial Energy Conservation and Environmental Improvement	ADB	US\$38.0 M
Industrial Energy Conservation and Environmental Improvement II	ADB	US\$150.0 M
Industrial Energy Efficiency	Germany	US\$10.9 M equiv.
Industrial Energy Efficiency	British-ODA	US\$2.42 M equiv.
Acceleration of Commercial Energy Research	UNIDO	US\$20.0 M

Part II : Renewable/Nonconventional Energy Sources

Category: Rural Energy Group I

Government Objectives/Programs:

Research and development on biogas formulation of alternative strategy for biogas implementation. Designing effective biogas technology delivery systems. Community, institutional and night soil based biogas plants program. Evolving design criteria for improved cookstoves, capacity building for EIA of energy use in rural areas. Biomass production and improvement program includes R&D activities initiated to produce improved quality planting materials both seed and seedling on mass scale with a potential of producing 40 tons per hectare per year. Program of converting agriculture waste to fertilizer. To test the performance of fast-growing fuelwood species and to screen the most potential species for plantation under a given set of agroclimatic conditions.



To ensure proper and efficient utilization of agroresidues and agroindustrial by products/wastes. To create model villages where most of the energy needs can be met using renewable energy systems.

Donor Agency Support

Project	Donor	Funding
<i>National Project on Biogas Development (NPBD)</i>		
AFPRO / Biogas II	Canada	US\$6.7 M equiv.
<i>Biomass Program</i>		
Biomass Densification	Netherlands	US\$360,000 equiv.
<i>National Program on Briquetting Technology</i>		
Biomass Densification	Netherlands	US\$360,000 equiv.
Smokeless Coal Briquettes	UNIDO	US\$49,000

Category: *Rural Energy Group II*

Government Objectives/Programs:

Convert sunlight directly into electricity in an environmentally clean and reliable manner. Solar photovoltaic water pumping for agriculture and related uses. To promote the development of technologies for harnessing the vast wind energy potential for water pumping, wind battery charging and standalone wind power generation. Promote devices to convert biomass such as wood wastes, agricultural and agro-industrial residues to combustible gas through thermo-chemical process. Using solar energy to supplement the energy requirements for agricultural activities, household activities and health care requirements. Product development and market research for solar hot water systems. Resource accounting systems for noncommercial energy sources in rural areas. To develop, demonstrate and popularize improved carts, cycle rickshaws, trailers and efficient irrigation devices, agricultural tools, etc.

Donor Agency Support

Project	Donor	Funding
<i>Solar Photovoltaic</i>		
Renewable Resources Development	Switzerland	US\$6.8 M equiv.
Renewable Resources Development	World Bank	US\$75 M
		US\$13 M equiv.

Category: *Power Group*

Government Objectives/Programs:

Catalyzing commercialization of wind power generation on a large scale; wind resource assessment program - collection of wind data, wind mapping and wind



monitoring. Research for indigenization of wind electric generation system. Formulating policy measures and incentives to facilitate wind power generation. Catalyzing development of micro, mini and small hydro schemes of up to 3 MW capacity for power generation from the otherwise dissipating energy in flowing waters at canal falls, irrigation dams, run-off river and natural falls in the hilly areas. Development of power capacity from small hydel projects. Initial focus on bagasse-based cogeneration in sugar mills. Setting up of a MW-scale electricity power generation program through grid interactive solar photovoltaic projects.

Donor Agency Support

Project	Donor	Amount
<i>Wind Power Program</i>		
Renewable Resources Development	Global Environment Facility (GEF)	US\$13 M equiv.
	World Bank	US\$70 M
		US\$15 M equiv.
	Denmark	US\$50.0 M equiv.
Wind Renewable Energy Development	ADB	US\$60.0 M equiv.
<i>Small Hydro Program</i>		
Renewable Resources Development	World Bank	US\$70.0 M \$15 M equiv.
<i>Biomass Based Cogeneration (bagasse)</i>		
Renewable Energy Development	ADB	US\$50.0 M
Greenhouse Gas Pollution Prevention	USAID	US\$19.0 M

Category: *Urban / Industrial Group*

Government Objectives/Programs:

Utilization of urban/municipal and industrial wastes for production of energy and power through appropriate conversion technologies (for example biomethanation, densification) in an economical and environment friendly manner. Involves development of institutional framework at national level; R&D organizations; solar cookers, solar distillation, solar refrigeration, solar thermal pumps, solar passive architecture. Formulation of effective strategies to mitigate short supply of commercial energy and oil and to minimize wasteful use of energy in all sectors of economy.



Donor Agency Support

Project	Donor	Funding
<i>Urban / Municipal and Industrial Wastes Program</i>		
Renewable Energy Development	ADB	US\$20.0 M
<i>Solar Thermal Technologies and Applications</i>		
Renewable Energy Development	ADB	US\$5.0 M

Category: *New Technology Group*

Government Objectives/Programs:

Technology development; demonstration and field evaluation; conservation of petroleum products by the large-scale use of battery-, alcohol-, and compressed natural gas-operated vehicles. Develop technologies on ocean thermal energy conversion, tidal energy and wave energy for use as alternate sources of energy.



World Bank Support

- Project:** **Renewable Resources Development**
- Fiscal Year:** 1992
- Loan/Credit Amount:** US\$75 M/US\$115 M (equivalent)
- GEF Grant:** US\$26 M
- Description:** The project comprises:
- (a) Financing through Indian Renewable Energy Development Agency (IREDA) of private sector investments in renewable energy subprojects, namely, irrigation-based small hydros, wind farms and solar photovoltaic systems.
 - (b) Expansion of Tamil Nadu Paper Limited's bagasse-based paper mill.
 - (c) Technical assistance for institutional development of IREDA and promotion of renewable energy technologies.
- The main benefits of the project are:
- Demonstration on a commercial scale of renewable resource systems that could lead to their replication in other parts of India and the world.
 - Mobilization of private investments into the energy sector and newsprint industry.
 - Reduced reliance on fossil fuels and forest resources and thus less environmental degradation.
 - Increased availability and improved reliability of power supply to help meet the industrial and decentralized rural energy needs.
 - Increased domestic newsprint supply in India.

- Project:** **National Capital Power Supply**
- Fiscal Year:** 1987
- Loan/Credit Amount:** US\$485.0 M
- Description:** The main objective of the project is to assist in meeting electricity demand in the capital area through the addition of 840 MW of thermal capacity. The project comprises the installation of four



coal fired 210 MW units at Dadri (Uttar Pradesh), as well as the construction of about 110 km of 400-KV transmission lines and four associated 400-KV and 220-KV sub-stations to complete the 400 KV transmission around Delhi. Project also provides for the rehabilitation of an existing 710 MW thermal power station at Badarpur, near Delhi. In addition the project will provide for institutional strengthening of Delhi Electricity Supply Undertaking (DESU) through studies for reorganization and the development of a distribution master plan, and through the execution of a financial recovery plan. Consultancy support will be provided for these studies as well as for studies for the improvement of the quality of coal used in power generation, for rehabilitation of existing plant at Indraprastha, and for design and engineering of the main plant. The project will introduce dry ash disposal as a new technology in India. There are no unusual risks as the dual firing feature of the power plant minimizes the risk of plant unavailability that could result from the transportation of coal over a long distance. National Thermal Power Corporation (NTPC) is experienced in the design and construction of generation and transmission facilities, but will receive assistance from consultants on the design of the dry ash disposal system.

Project:	Power Utilities Efficiency Improvement
Fiscal Year:	1992
Loan/Credit Amount:	US\$265 M
Description:	The project objectives are to : <ul style="list-style-type: none">(a) Support GOI efforts to make Power Finance Corporation (PFC) a viable and effective instrument for improving the power sector.(b) Strengthen the operations of the beneficiary utilities by lending only to those willing to undertake acceptable reform programs.(c) Foster better use of existing power facilities by reducing constraints in the transmission and distribution systems.(d) Mitigate the adverse environmental impact of thermal plants in operation by providing adequate antipollution and monitoring facilities.(e) Improve the preparation of power projects and promote the development of the local consulting industry by funding pre-investment studies and engineering for power projects.

The project comprises a program to strengthen PFC's capabilities



to discharge its responsibilities, the creation of a pre-investment fund in PFC and five components to be financed by PFC:

- (a) Implementation of a pre-identified segment of the lending program of PFC.
- (b) Environmental upgrading of power plants.
- (c) Engineering studies for system renovation.
- (d) Institutional strengthening of power utilities.
- (e) Improvements in State Electricity Board's billing and collection.

Project:	Private Power Utilities (TEC)
Fiscal Year:	1990
Loan/Credit Amount:	IBRD US\$98 M (equivalent)
Description:	<p>The project's objectives are to increase Tata Electric Companies' peak generating capacity, reduce their dependence on the Maharashtra State Electricity Board, reduce the average cost of generation and improve system reliability and quality of supply to consumers in the Bombay area. The project has four components :</p> <ul style="list-style-type: none"> (a) A pumped storage unit at the existing Bhira hydroelectric station to generate 150 MW additional peak power by consuming off- peak power. (b) A 220 KV transmission line to carry this power to the license area. (c) A gas-based combined cycle unit of 180 MW at the Trombay thermal power plant. (d) A second flue-gas desulphurization (FGD) unit to control the sulfur dioxide emissions from the coal and oil burning unit no. 5 at Trombay. (e) Review of design and technical specifications and supervision of construction of the Bhira pumped storage scheme and acquisition of know-how for the extension of the FGD facility at Trombay.

Project:	Coal Mining and Coal Quality Improvement
Fiscal Year:	1987
Loan/Credit Amount:	US\$340 M



Description:

The main objectives of the project are to increase the supply of thermal coal and coking coal and to improve the quality of coal available to consumers. The project is also designed to support Coal India Limited in its efforts to develop and implement efficiency improvements and improve financial performance. The project consists of the development of:

- (a) The second phase of Gevra mining complex to reach a 10 million tons per year output of low-grade thermal coal to feed the Korba power plant.
- (b) Construction of the Sonapur-Bazari mining complex to produce 3 million tons per year of intermediate and superior grade thermal coal.
- (c) Importation of about 3 million tons of coking coal.

By developing large-scale open pit mines, India is pursuing a strategy of increasing coal supplies at least-cost while promoting diversification of mining technologies and improvements in productivity in the coal sector. By importing coking coal, India is making up for a shortfall in domestic supplies as well as improving the average quality of coking coal by blending low-ash imports with higher-ash domestic coals.

Project:

NTPC Power Generation

Fiscal Year:

1993

Loan/Credit Amount:

US\$400 M

Description:

The project comprises:

- (a) Generation of capacity additions: a five-year time slice of NTPC's least-cost investment program of new coal- and gas-based power stations for which full funding has not yet been arranged.
- (b) Private Sector Component: support to NTPC to undertake several joint venture operations.
- (c) Environmental strengthening and resettlement and rehabilitation: implementation of an environment action plan (EAP) which includes environmental upgrading projects, training and technical assistance for the strengthening of NTPC's environmental and resettlement and rehabilitation management capability and the implementation of the EAP.



Project: **Second Maharashtra Power**

Fiscal Year: 1992

Loan/Credit Amount: US\$350 M

Description: The proposed project comprises :

- (a) Construction of the last stage of Chandrapur thermal power station by the addition of a 500 MW coal-fired unit.
- (b) Construction of a 500 KV, 1,500 MW HVDC line from Chandrapur to Padghe, near Bombay, and the related terminal stations.
- (c) Implementation of an accelerated distribution reinforcement program aimed at reducing losses in selected areas.
- (d) Consulting services to be provided in the following four areas:
 - (i) Load research and preparation of electricity demand management measures.
 - (ii) Development of MSEB's environmental management capabilities at the corporate level.
 - (iii) Preparation of private power projects in Maharashtra.
 - (iv) Institutional review of the power sector in Maharashtra.



Other Donor Support

- Project:** **Biomass Densification**
Donor: Netherlands
Loan/Credit Amount: US\$360,000 equivalent
Description: Provide improved densification / briquetting technology to local producers to transform agricultural and forestry refuse into efficient fuel, in combination with related socioeconomical research.
- Project:** **Industrial Energy Conservation & Environmental Improvement (Maharashtra)**
Donor: Asian Development Bank
Loan/Credit Amount: US\$38 M
Description: The sector project includes adoption of energy-efficient production technologies, retrofitting of energy-saving equipment and improvement of energy management system in selected energy-intensive industries (BPCL and HPCL). The main objectives of the project are to:
- (a) Increase refinery efficiency through a reduction in energy consumption.
 - (b) Improve the quality of the environment in the vicinity of the refineries through appropriate in-plant pollution control measures.
 - (c) Contribute to improving air quality through a gradual reduction of lead and sulfur concentration in petroleum products by enabling the targeted refineries to produce low-lead gasoline and low-sulfur diesel fuel.
- Project:** **Renewable Energy Development**
Donor: Asian Development Bank
Loan/Credit Amount: US\$150 M
Description: The main objectives are to reduce the current energy shortages by promoting commercialization of renewable resources technology, mainly cogeneration based on sugar bagasse, industrial methane gas generation wind and solar thermal systems. The project will involve a line of credit with Indian Renewable Energy Development



(IREDA) to finance private sector development of energy-using renewable sources.

Project: **Industrial Energy Conservation & Environmental Improvement-II (India-wide)**

Donor: Asian Development Bank

Loan/Credit Amount: US\$150 M

Description: The project will support the government's strategy to foster sustainable industrial development in several ways :

- (a) Carry forward energy sector reforms into demand-side management of energy-intensive industries.
- (b) Assist the government's efforts to reduce energy shortages by increasing energy efficiency.
- (c) Improve the overall efficiency of the assisted enterprises.
- (d) Promote international competitiveness of the industrial sector.
- (e) Serve to integrate environmental considerations in project design and implementation.

The objective of the project is to promote energy efficiency in the industrial sector consistent with the ongoing market-oriented economic reforms in India. This objective is to be realized through supporting investments in the industrial sector that focus on energy-efficient and related environmental improvements that concurrently show return. These investments seek to improve the efficiency of India's energy-intensive industries through technological restructuring and improving productivity.

Project: **Coal Beneficiation (National Project)**

Donor: Asian Development Bank

Loan/Credit Amount: US\$100 M.

Description: As the beneficiation of non-coking coal will result in significant economic and environmental benefits by improving coal quality for power generation, the scope of the project is installation of coal preparation plants at selected coal fields.

Project: **Canadian Hunger Foundation/AFPRO Biogas II**

Donor: Canada

Loan/Credit Amount: C\$4,929,600 (US\$6.7 M equivalent)



Description: To support and strengthen the NGO network in its efforts to introduce and extend biogas technology and to develop sustainable partnerships between the government and NGO agencies involved in biogas programs.

Project: **KSEB Systems Enhancement**

Donor: Canada

Loan/Credit Amount: C\$34 M (US\$46.23M.)

Description: To assist Kerala State Electricity Board (KSEB) in reducing voltage losses in transmission and distribution, and improve operating efficiency through the enhancement of water management, fire protection and dam instrumentation systems.

Project: **Industrial Energy Conservation**

Donor: Germany

Loan/Credit Amount: DM8.0 M (US\$10.97 M equivalent)

Description: This technical cooperation project has the aim of establishing an information and advisory service in Bangalore for the implementation of measures for rational energy utilization in the state of Karnataka to improve industrial energy efficiency.

Project: **Andhra Pradesh Energy Efficiency**

Donor: British-ODA

Loan/Credit Amount: £42.7 M (US\$69.0 M equivalent)

Description: The Project aims to upgrade and strengthen electricity distribution systems.

Project: **Industrial Energy Efficiency**

Donor: British-ODA

Loan/Credit Amount: £1.5 M (US\$2.42 M equivalent)

Description: This project aims to help develop a portfolio of projects which will achieve high industrial energy efficiency benefits.

Project: **HVDC Chandrapur Back to Back. - Maharashtra/ Andhra Pradesh.**

Donor: British-ODA

Loan/Credit Amount: £63.0M (US\$101.84 M equivalent).



Description: Interconnection of western and southern grids to allow electricity to be shared between the two regions.

Project: **Greenhouse Gas Pollution Prevention**

Donor: USAID

Loan/Credit Amount: US\$19 M

Description: The project will demonstrate various power generation strategies which will result in reducing or eliminating emissions of greenhouse gases (principally carbon dioxide and methane). The project consists of two components.

- (a) *Alternative/bagasse cogeneration* will demonstrate and promote the commercialization of new technologies and the use of alternative biomass fuels at sugar mill cogeneration facilities.
- (b) *Efficient coal conversion* will set up a research and development center in conjunction with India's leading power generation utility to study ways to burn coal more efficiently and cleanly. Both components contain funding for demonstration projects.

Project: **Renewable Resources Development: Solar Photovoltaic**

Donor: Switzerland

Loan/Credit Amount: S Fr 6 M (US\$6.8 M) overall budget of S Fr60 M for the photovoltaic component cofinanced with GEF and IDA - Denmark US\$50 M for wind component.

Description: Environmentally sound investments to reduce energy sector dependence on fossil fuels.

Project: **ECOFRIG**

Donor: Switzerland

Loan/Credit Amount: S Fr 1.8 M (US\$2.04 M equivalent)

Description: To assist phase out of CFC in the Indian refrigerator industry and test for HC technology under Indian conditions.

Project: **Technology for Producing Smokeless Coal Briquettes**

Donor: UNIDO

Loan/Credit Amount: US\$49,000



Description: Assist Indian authorities to assess the suitability of a particular briquetting process and facilitate investment decision in the process.

Project: **Study on Waste Minimization in the Automotive Components Sector**

Donor: UNIDO

Loan/Credit Amount: US\$43,000

Description: Demonstrate financial and environmental benefits of cleaner production approach to industrial environmental management; demonstrate that pollution prevention is possible in the short term and that it has financial and environmental advantages; devise and test the usefulness and efficiency of a systematic approach to pollution prevention; identify obstacles to the introduction of pollution prevention options and formulate strategies to overcome these; disseminate results of the case studies by written reports and by industry seminars.

Project: **Program for the Acceleration of Commercial Energy Research (PACER)**

Donor: UNIDO

Loan/Credit Amount: US\$20 M

Description: To help overcome the energy constraints on India's economic development by promoting the development of new or innovative products or processes relevant to the Indian energy sector. Priority areas include:

- (a) Technologies to tap renewable energy.
- (b) Coal conversion technologies.
- (c) Technologies to improve energy efficiency.

Project: **Indian Private Power Initiative (IPPI)**

Donor: UNIDO

Loan/Credit Amount: US\$3 million

Description: To encourage private investment in the power sector by providing technical assistance to State Electricity Board's and the GOI to evaluate pending project proposals and assist in project formulation and documentation necessary for international financing.

Chapter 10

Estimating the Costs of Environmental Degradation





Estimating the Costs of Environmental Degradation

10.01 Comprehensive cost-benefit analysis of environmental problems and possible interventions is difficult in any country, but it is nearly impossible in developing countries. Optimal levels of intervention could be determined if all the social costs and benefits associated with each incidence of environmental degradation could be calculated, but neither available data nor current methodologies allow this determination and developing countries cannot afford an in-depth study of every environmental issue. Instead, policymakers must be provided with informed estimates of the economic costs of environmental problems so they can prioritize the issues. Governments must then decide what level of environmental quality is politically and financially feasible, and which instruments should be used to achieve environmental objectives. Finally, such factors as the feasibility of enforcement and the intensity of public concern must be considered.

10.02 This chapter estimates the magnitude of the economic costs associated with environmental degradation, measured by impacts on health and productivity. Quantifying these costs helps to improve understanding of various environmental problems—both in terms of each other and relative to other issues of economic management.

METHODOLOGY

10.03 The two types of environmental costs estimated here are public health impacts due to air and water pollution, and productivity impacts due to higher water costs, soil degradation, deforestation, and reduced tourism. India's priority environmental problems and the valuation methodology used to estimate the costs of these problems are shown in Table 10.1. In all cases, conservative approaches are used so as not to overstate the costs of degradation.

10.04 Environmental degradation and public health are most clearly linked in terms of air pollution and respiratory diseases, and water pollution and such waterborne diseases as diarrhea, dysentery, cholera, and typhoid. The results are divided into sickness (morbidity) and premature death (mortality). The value of premature death is based on the value of a statistical life, as determined using a human capital approach that values an individual's life according to the net present value of his or her productivity. (This approach requires substantially less data than willingness-to-pay or willingness-to-be-compensated approaches.) The costs of sickness are based on individual disutility (discomfort, suffering, and the opportunity cost of time), medical expenses, and lost wages



(Margulis 1992). Only medical expenses and lost wages are estimated here, since they are more easily monetized than individual disutility.

10.05 Environmental degradation and economic output are most clearly linked where

soil degradation reduces agriculture and rangeland output (or increases input costs); deforestation turns forests into land with little economic value; surface and groundwater pollution leads to local and regional scarcities, with commensurate increases in costs; and high ambient pollution levels inhibit tourism.



Table 10.1. Major Environmental Impacts in India

Problem	Impacts on health and production	Method of valuation used in the study	Comments
Urban air Pollution	Urban health impacts, especially from particulates, lead, and ozone	Incidence of death x value of life + incidence of sickness x (cost of treatment + lost wages)	Sources of urban air pollution include transport, industry, energy, and refuse burning. No attempt was made to differentiate impact by source of pollution.
Surface water pollution	Urban and rural health impacts, especially diarrhoeal diseases	Incidence of death x value of life + incidence of sickness x (cost of treatment + lost wages)	Sources of surface water pollution include municipal waste and industry. No attempt was made to differentiate impact by source of pollution.
Surface and groundwater pollution	Higher incremental costs for clean water supply	Projected incremental water supply requirements due to surface and groundwater pollution x higher incremental supply costs	Difficult to differentiate without more detailed city-specific study (to better determine what share of supply shortages are pollution-based).
Industrial hazardous waste	Long-term health impacts, especially cancer	Not estimated	Although significant, these health impacts not likely to be as large as the other air and water impacts.
Soil and rangeland degradation	Loss of agricultural output and livestock carrying capacity	Agricultural output x marginal productivity loss due to degradation. Same methodology applied to rangelands and livestock	Soil degradation includes erosion, salinization, water-logging, and loss of nutrients.
Deforestation	Loss of timber and nontimber ecological services	Forest replacement cost only	Cost estimates are quite conservative since several nontimber values are not included.
Loss of coastal and marine resources	Unsustainable harvesting of marine resources	Not estimated	Insufficient data.
Loss of biodiversity	Loss of use, option, and existence values	Not estimated	Insufficient data.
Decline in tourism	Loss of international tourism revenues	Marginal negative impact due to environmental degradation and health impacts	Estimates kept conservative in the absence of survey work.



Air Pollution

10.06 India has twenty-three cities with population of more than 1 million people, and ambient air pollution levels exceed World Health Organization (WHO) health standards in many of them. Many smaller cities have ambient air pollution levels that exceed WHO guidelines as well. Urban air pollution is worsening due to increasing power consumption, industrialization, vehicle ownership and use, and refuse burning. Six of the ten largest cities—Bombay, Calcutta, Delhi, Ahmedabad, Kanpur, and Nagpur—have severe air pollution problems, with annual average levels of total suspended particulates at least three times the WHO standard (see Table 7.5). In Delhi, Calcutta, and Kanpur, annual average values of total suspended particulates are more than five times the standard. Nationwide, more than 90 percent of the monitoring stations for which annual mean concentrations are reported by the Central Pollution Control Board exceed 75 micrograms per cubic meter of particulates, the midpoint of the WHO recommended standard. Annual average concentrations of sulfur dioxide and nitrogen dioxide, however, are low in relation to typical ambient standards.

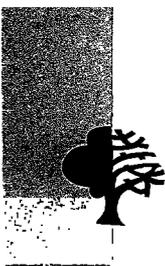
10.07 There does not appear to be a clear correlation between city size and air pollution in terms of either population or geographic area. The relative contributions of motor vehicles, industry, and domestic sources to air pollution, especially to particulate pollution, have not been well studied in India. While there are often estimates of total emissions from each source by city, it is harder to determine the contribution of each source

to ambient pollution levels. For example, a recent study for Bombay estimated the relative contributors to particulate matter pollution (particles less than 10 microns in diameter, which more easily penetrate the lungs and are therefore more relevant than total particulate matter for human health) as refuse burning, 28 percent; vehicle exhaust, 25 percent; resuspended road dust, 17 percent; fuel burned by residences, 15 percent; fuel burned by industry and power, 12 percent; and other (including marine), 3 percent. Comparable emission inventories and dispersion studies for other Indian cities would assist in the formulation of pollution mitigation strategies.

ANALYSIS

10.8 The primary air pollution-related health impacts estimated here are those relating to particulates, sulfur dioxide, nitrogen oxides, and lead. Air monitoring data collected by the National Environmental Engineering Research Institute (NEERI) for ten of India's largest cities and Central Pollution Control Board data for twenty-six other cities are used. The lack of ozone monitoring prevents estimates of its health impacts. Similarly, the impact of indoor air pollution is not considered here due to the absence of data.

10.9 The health impacts of air pollutants are most easily estimated using dose-response functions drawn from various epidemiological studies. A recent World Bank review of such studies is used here to estimate the health impacts in India (Ostro 1994). By using dose-response functions estimated in cities in industrial countries, the estimates derived here



are likely to be conservative: since developing countries have lower standards of living, nutrition, and health, a higher percentage of the population is in marginal health—making them more susceptible to the negative health impacts of air pollution.

10.10 In terms of specific pollutants, total suspended particulates and particulate matter measuring less than 10 microns in diameter are both associated with premature mortality (from respiratory illness and cardiovascular disease) and increased morbidity (increased incidence of chronic obstructive lung disease, especially bronchitis, and increased incidence of upper and lower respiratory tract infections). Ozone increases respiratory hospital admissions, restricts activity, and raises the incidences of asthma, eye irritation, and heart disease (Ostro 1994). Carbon monoxide reduces the amount of oxygen carried by the blood, but it dissipates rapidly in the environment and its effects are reversible. High levels of atmospheric lead contribute to hypertension and neurological damage in children.

RESULTS

10.11 Table 10.2 summarizes the estimated reductions in sickness and premature death that would occur in thirty-six cities if pollutant levels in these cities were reduced to the WHO standard. The number of preventable deaths exceeds 40,000, with 7,500 in Delhi, 5,700 in Calcutta, and 4,500 in Bombay. As a percentage of total annual deaths, the reduced mortality would represent at least a 15 percent reduction in these cities. An economic valuation of these premature deaths suggests a potential savings of between \$170 million and \$1,615 million.

10.12 In addition, reducing particulate levels would likely reduce new cases of chronic lung disease and reduce respiratory tract infections, especially in children. Asthma attacks also would be reduced. Preliminary estimates of the physical impact of lowering air pollution to WHO standards in the same thirty-six cities suggests almost 20 million fewer respiratory hospital admissions, emergency room visits, and sicknesses

Table 10.2. Annual Costs of Ambient Air Pollution Levels Exceeding WHO Guidelines in Thirty-six Indian Cities, 1991-92

Health Impacts	Number	Cost valuation (millions of U.S. dollars)
Premature deaths	40,351	170-1,615
Hospital admissions and sickness requiring medical treatment	9,800,000	25-50
Minor sicknesses (including restricted activity days and respiratory symptom days)	1,201,300,000	322-437
Total	—	517-2,102

Source: Author's estimate based on NEERI 1994 and Central Pollution Control Board 1992.



requiring medical treatment; and 1.2 billion fewer restricted activity days, respiratory symptom days, cases of lower respiratory illnesses in children, and other minor sicknesses.

10.13 A low estimate of the social value of these impacts, using a cost-of-treatment approach (which includes medical costs and the value of productive time lost but does not include suffering) is \$350 million to \$490 million a year. Of total impact costs, premature death represents 68 percent of the total value, and sickness represents 32 percent.

10.14 Particulate matter measuring less than 10 microns in diameter and sulfur dioxide are responsible for more than 95 percent of the health impact damages. The rest is contributed by the high levels of lead in large cities such as Calcutta, Bombay, and Delhi. High lead levels increase the incidence of heart attacks, hypertension, and brain damage in children. Estimates of the impact of the currently low average ambient lead levels are

200,000 cases of hospitalization a year and 2.5 million lost intelligence quotient (IQ) points in children. The monetary valuation of these impacts is \$7 million to \$18 million a year in lost potential earnings. These estimates, however, may be very low due to incomplete data on ambient lead levels.

10.15 Carbon monoxide and ozone, two pollutants with potentially significant health impacts, are not routinely monitored at the stations where the other pollutants are measured. Carbon monoxide readings taken at traffic intersections often exceed 5,000 micrograms per cubic meter; the one-hour WHO standard is 100 micrograms per cubic meter. While carbon monoxide pollution is of concern, it is probably of less concern than the high total suspended particulate levels to which people are exposed. Still, carbon monoxide, ozone, lead, and hydrocarbons are all closely related to vehicle use, and ambient levels may accelerate quickly with the rapid growth and use of urban vehicle populations.



Water Pollution

10.16 Contamination of water supplies in rural and urban areas poses significant problems, with almost all surface water (except in mountainous areas) unfit for human consumption. Water pollution has three major sources: domestic wastewater, industrial wastewater, and agricultural runoff. Water pollution from domestic and human wastewater is the most problematic, and the cause of many waterborne diseases. Recent World Bank and WHO studies found that about 21 percent of communicable diseases (11.5 percent of all diseases) are water-related (World Bank 1993). A much higher percentage of infant mortality is associated with these diseases. Major cities often dispose of largely untreated sewage into the irrigation streams that are used to irrigate crops, some of which are eaten raw. Sewage and wastewater is also channeled into rivers and streams without consideration of the rivers' assimilative capacity.

10.17 The other sources of water pollution are industry and agriculture. The major water-polluting industries are chemicals, textiles, pharmaceuticals, cement, electrical and electronic equipment, glass and ceramics, pulp and paper board, leather tanning, food processing, and petroleum refining. Indiscriminate use of agricultural chemicals also has contaminated surface and groundwater. The health impacts of industrial and agricultural pollutants cannot easily be separated from overall health impacts, and no attempt is made to do so here.

ANALYSIS

10.18 About 30.5 million disability-adjusted life-years (DALYs) are lost each year due to poor water quality, sanitation, and hygiene (Table 10.3). (DALYs are a combination of discounted and weighted years of life lost as a result of death at a given age and disability as a result of morbidity, adjusted by severity; see World Bank 1993.) The specific diseases included in this number are diarrhea, trachoma, intestinal worms, hepatitis, and the "tropical cluster" of diseases.

10.19 A WHO review of 144 studies found that improved water supply and sanitation reduced sickness by an average of 25 percent, and premature death by an average of 65 percent (Esrey and others 1991). These averages are used here to estimate the reduction in the incidence of waterborne diseases achievable through feasible interventions in water, sanitation, and hygiene. Using a weighted average of the overall mortality and morbidity components of DALYs for communicable diseases (World Bank 1993), it is estimated that an overall reduction of 52.4

Table 10.3 Burden of Waterborne Diseases, 1990
(hundreds of thousands DALYs)

Disease	Female	Male	Total
Diarrhoeal Diseases	143.9	136.4	280.3
Intestinal Helminths	10.0	10.6	20.6
Trachoma	0.7	0.4	1.1
Hepatitis	1.7	1.4	3.1
Total	156.3	148.8	305.1

Source: World Bank 1993.



percent in DALYs is possible with the provision of safe water and sanitation. The causes of DALYs lost are complex and the interactions of water quality and quantity, sanitation, and hygiene in improving health are inadequately understood due to the empirical problems of observing actual practices and conditions. In addition, the incidence of waterborne diseases among population groups very much depends on the income level of the group: high-income groups are more likely to have access to clean water supplies or the ability to purify water or purchase bottled water.

RESULTS

10.20 Between 10.6 million and 17.9 million DALYs a year could be saved if water and sanitation services were improved for all portions of the population now underserved. If safe water and sanitation were accompanied by broadly based hygiene and health education improvements, the reductions would be even greater. Assuming an average reduction of 14.3 million DALYs, the value of these interventions is between \$3.1 billion and \$8.3 billion a year, depending on the assumed value of one DALY (between \$215 and \$583).

HIGHER INCREMENTAL COSTS OF WATER SUPPLY

10.21 Urban water supply systems require periodic expansion in response to supply shortfalls. There are several reasons for supply shortages, including urban growth,

income growth (which leads to higher per capita demand), excess demand (due to underpricing or low collection rates), and pollution (which constrains existing supplies). Municipalities often incur higher supply costs in order to compensate for local pollution; typically, either local surface water supplies have become too polluted or groundwater aquifers have become contaminated or brackish.

10.22 A recent World Bank study found that in many urban water supply projects a unit of water from the "next project" is often two to three times the cost of a unit from the current project (Bhatia and Falkenmark 1993). This is due to the need to pump water longer distances, use additional treatment, and invest in water transfer schemes. Since pollution and environmental degradation contribute to the need for more expansive and expensive water supply systems, this incremental cost can be directly attributed to the cost of environmental degradation.

10.23 It is beyond the scope of this study to estimate the incremental cost of rising water supply costs in India, and to allocate some share of that cost to pollution. But given that public investments in municipal and industrial water supplies in developing countries average 5 to 6 percent of total public investment, even a small cost factor associated with environmental degradation is likely to be significant. And with the high rate of urbanization taking place in India, these costs are rising very rapidly.



Industrial Pollution and Hazardous Waste

10.24 No comprehensive data exist on either total industrial pollution loads or pollution intensities (pollution emitted per unit of output) in India—a constraint to fully understanding the extent and cost of the industrial pollution problem. Partly in response to this constraint, the World Bank developed the Industrial Pollution Projection System (IPPS) to provide a means of estimating trends in industrial pollution. The IPPS uses pollution coefficients from U.S. manufacturing concerns for 1988 and applies them to industrial output in developing countries. The system captures shifts in subsectoral output, but not shifts in technology, over time.

10.25 The resulting trends for industrial pollution in India are shown in Figure 5.1. The six pollutants shown are two indicators each of water pollution (BODs and suspended solids), air pollution (sulfur oxides and

particulates), and toxic wastes (heavy metals and a composite index of various toxins emitted into the air and water or found in solid wastes). With the exception of toxic pollutants, pollution intensities were roughly stable for most major forms of pollution between 1963 and 1988. This implies that the increase in total output of industrial pollution over these years is due more to a scale effect (industrial growth) than to a shift effect (strong growth in the more-polluting industries).

10.26 It is not possible, using current data, to estimate the adverse health impacts caused by industrial pollution separately from those caused by municipal and transport-related pollution. But the absolute growth in industrial pollutant emissions is proceeding as rapidly as the economy—and probably far exceeding the assimilative capacity of the environment.



Land Degradation

10.27 Land degradation, whether caused by water erosion, wind erosion, salinization, waterlogging, nutrient loss, compaction, or overgrazing, is extensive. About 163 million hectares—half of India's total area—has some degree of degradation. A United Nations Development Programme (UNDP) survey of agricultural land found that 83.4 million hectares of agricultural land are degraded, with 35 percent being slightly degraded, 31 percent moderately degraded, and 34 percent severely degraded (Table 10.4).

10.28 These data include several kinds of land degradation. Water erosion is accelerating because of human activity, such as destruction of natural vegetation by removal for fuel, timber, and forage, and cultivation on steep slopes. Similarly, while wind erosion occurs naturally due to dry conditions and high winds, human activities such as overgrazing, burning, and felling of plants exacerbate the problem. Soil salinity and sodicity are serious problems on agricultural land, particularly on

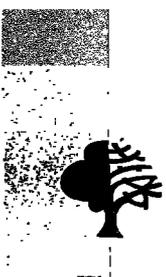
mismanaged irrigated lands. Waterlogging (defined as watertables that have risen to within 1.5 meters of the surface) also occurs in long-irrigated areas. Although data are lacking—largely due to the overlap between fallow agricultural lands, rangelands, degraded forests, and wastelands—much of the rangeland in India is threatened by overgrazing and overharvesting of natural vegetation.

10.29 This analysis draws on two land degradation data sets. The first is Food and Agricultural Organization (FAO) data, which divide India into humid and dry regions. The second is a set of tables on Indian land degradation, disaggregated mostly at the state level but for some categories (salinity and waterlogging) presented only at the national level (Bansil 1990). The two data sets are quite different in their estimates of total degraded land, partly because the FAO data look only at agricultural land, while the Indian data also look at other nonwasteland and

Table 10.4. Soil Erosion in India (millions of hectares)

	Dry Region	Humid Region	All India
Total erosion	13.7 - 70.2	29.9 - 50.9	43.6 - 121.1
Waterlogging	3.1 - 3.9	0.0 - 4.6	3.1 - 8.5
Salinization	3.3 - 7.0	0.3 - 3.9	7.2 - 7.3
Nutrients depletion	2.2 - 16.4	9.7 - 27.2	26.1 - 29.4
Total	26.0 - 93.8	57.4 - 69.1	83.4 - 162.9

Source: United Nations Development Programme, Food and Agricultural Organization, and United Nations Environment Programme 1993 and Techno-Economic Research Institute, New Delhi (1990)..



nonforest areas (such as fallow land, rangeland, and potentially arable land not cropped within the past five years). Both data sets are used here to estimate the impact of degradation on agricultural output (Table 10.5).

ANALYSIS

10.30 The primary on-site costs associated with soil degradation are reduced yields and the downgrading of land to crops of lesser value. Off-site costs include siltation of drainage canals, irrigation canals, and reservoirs, and changes in the hydrology of watersheds, which can increase flood frequency and severity, or reduce availability in the dry seasons. The estimates made here of the cost of degradation are based on reduced on-site yields, and thus are underestimates.

10.31 Experience from other parts of the world shows that yield impacts from soil erosion become severe in marginal lands and rainfed areas, reaching as high as 70 percent over several years (Wolman 1985). But it is difficult to generalize about the impact of soil degradation on agricultural yields, since the contribution of soil fertility to yields is mingled with—and masked by—other production variables such as inputs (including labor), and climatic conditions. Farmer responses to soil degradation vary widely: one farmer might use additional inputs to compensate for lower soil fertility, whereas another might use fewer inputs, shift to a different crop, or leave the land fallow. For valuation purposes, this study uses approximations of negative yield impacts attributable to land degradation as a basis for impact analysis.

Table 10.5. Yield-reducing Factors by Crop and by Extent of Degradation (percent)

	Paddy	Wheat	Barley	Ground -nut	Gram	Rapeseed and mustard	Jowar	Bajra	Cotton	Maize	Sugar cane
Erosion											
Light	2	2	2	2	2	2	2	2	2	2	2
Moderate	5	5	5	5	5	5	5	5	5	5	5
Severe	10	10	10	10	10	10	10	10	10	10	10
Salinity											
Light	20	16	10	10	20	5	20	20	20	20	20
Moderate	46	30	30	30	40	25	40	40	40	40	40
Severe	60	42	50	50	60	45	60	60	60	60	60
Water-logging											
Light	1	1	1	1	1	1	1	1	5	1	1
Moderate	26	29	29	29	29	29	29	29	38	29	42
Severe	60	79	79	79	79	79	79	79	98	79	91
Nutrient depletion											
Light	1	1	1	1	1	1	1	1	1	1	1
Moderate	3	3	3	3	3	3	3	3	3	3	3
Severe	5	5	5	5	5	5	5	5	5	5	5



10.32 The analysis started with data on twelve categories of land degradation: water and wind erosion (light, moderate, and severe); salinity (light, moderate, and severe); waterlogging (light, moderate, and severe); and nutrient loss (light, moderate, and severe). Then yield reduction factors were estimated for India's eleven main crops using estimates drawn from land degradation impact studies from India and Pakistan covering erosion, salinity, and waterlogging, and World Bank surveys of the national costs of land degradation in Africa (Bojo, 1994) and the U.S.A. (Crosson and Stout 1983, cited in Margulis 1992). (No comparable survey of yield impacts was found for Asia.) Each type of degraded land was then prorated across the cropping pattern for India's dry and humid regions, and the corresponding yield reduction factor was applied to the product of the eroded area for that region and average crop yields for that region (Table 10.6). The results were estimates of the amount of production

foregone, by crop and region. The impact of degradation on all other crops was estimated by applying the average yield loss factor resulting from the more detailed analysis.

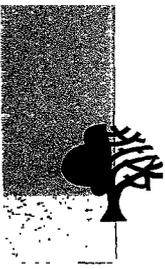
10.33 For losses attributable to degraded rangeland, the share of India's total livestock population that could live on the country's natural rangeland was estimated based on livestock nutrient requirements, average rangeland nutrient yields, and average rangeland utilization rates. This carrying capacity was subject to reduction factors due to rangeland degradation. The estimated amount forgone represents the value of rangeland degradation.

RESULTS

10.34 Productivity losses due to land degradation are between 4.0 percent and 6.3 percent of production per year, which represents total annual lost production of \$1.5 billion to \$2.4 billion (Table 10.6). (This

Table 10.6. Estimated Impact of Soil Degradation on Eleven Main Crops, 1991-92

Crop	Loss (percent)	Value of loss (millions of US dollars)
Paddy	2.7-4.8	190
Wheat	3.9-6.4	248
Barley	4.5-7.1	8
Groundnut	2.8-4.4	110
Gram	5.7-7.9	60
Rapeseed and mustard	5.8-8.6	155
Jowar	5.7-7.7	40
Bajra	6.8-8.5	25
Cotton	5.3-7.0	140
Maize	3.2-4.9	25
Sugarcane	4.5-7.9	200
All other crops	4.0-6.3	750
Total, main crops	4.0-6.3	1,950

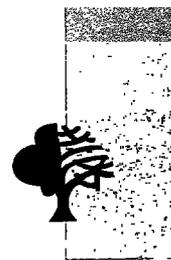


amount represents yields that would have occurred, with no change in inputs, had the land not been degraded.) The estimated losses are fairly evenly divided between the dry and humid regions. For rangelands, the annual losses fall in the range of \$238 million to \$417 million per year, based on a 20 percent to 35 percent decline over time in the carrying capacity of natural rangelands.

10.35 These are estimates of the current annual loss in agricultural output caused by soil degradation that may have taken many years to develop. Current (one-year) assessments of soil degradation undervalue the total loss resulting from that degradation

because erosion-induced productivity losses are not confined to a specific year, but accumulate over a period of time (Crosson and Stout 1983, cited in Margulis 1992).

10.36 Assuming a 5 percent discount rate, the present value of India's agricultural losses due to degradation totals \$30 billion to \$50 billion. These losses should be considered when contemplating land conservation investments. If the present value of mitigation investments is less than this range, the cost-benefit ratio would be greater than one, and further feasibility analysis would be warranted.



Deforestation

10.37 The FAO estimates India's rate of deforestation at 0.6 percent a year between 1981 and 1990, implying a loss of 3,369,000 hectares. This deforested area consists of 15 percent tropical rain forest, 11 percent moist deciduous forest, 64 percent dry deciduous forest, and 11 percent hill and mountain areas. In 1990 the forested area in India totaled 70.6 million hectares, of which 27 percent was under commercial plantations consisting mainly of eucalyptus but also of teak and pine trees. The area allotted to forestry plantations has increased by an average of 15.5 percent a year since 1981 (FAO 1993).

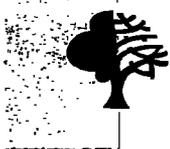
10.38 As a result of this rapid reforestation, the total area of Indian forests is increasing even while areas of natural forest cover are decreasing. This is confirmed in assessments made by the Indian government: between 1991 and 1993 most states showed a net increase in actual forest cover when plantations are included, even while the degradation of valuable and unique natural forests in the northeastern region (Arunachal, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura) has continued (Government of India 1993). Only about half of India's forests have a crown density of 40 percent or more; the rest consists of degraded and unproductive forests (World Bank 1992). Thus forest resources that are rich in flora and fauna are decreasing. Short, shifting cultivation cycles and encroachment for agricultural production and population settlement are the main contributors to this development.

ANALYSIS

10.39 Forests provide a wide range of economic and environmental services. In addition to timber, they provide firewood and plant and animal nontimber products; recreation and ecotourism opportunities; watershed protection, waterflow regulation, flood protection, and soil retention; carbon sequestration; and habitat for biodiversity. By using the "user cost" approach to forestry valuation, this study values only the commercial timber that is depleted by deforestation and does not assign value to the other economic losses resulting from deforestation.

10.40 The user cost represents forgone future income—in this case, from the exploitation of a renewable resource. The user cost approach uses the present value of the discounted stream of production costs required to generate an area of forest equal to the area deforested (adapted from Sadoff 1992). The replacement forest is a plantation forest with a maximum of two or three tree species, not a natural forest with a more complex ecosystem. Since, this approach captures only the economic value of the timber lost through deforestation, total costs of deforestation are underestimated.

10.41 Two methods are used to approximate the user cost: replacement cost and market value of the sustainable yield of the reforested land. The first approach uses plantation production cost data taken from



recent World Bank appraisals of plantation forestry in India. These costs, estimated to be indicative of reforestation costs in India, do not take into account risk or profit, and thus are a low estimate of the full replacement cost. The second approach, multiplying the average price for wood products by average forest yields by the type of forest area deforested, gives a higher estimate. This estimate is the annual value of a sustainable forest yield.

RESULTS

10.42 The range of estimates for the annualized replacement cost of India's deforestation over 1980-90 is \$183 million to \$244 million (Table 10.7). The user cost and market value estimates are comparable because the lower values consider only the direct cost of reforestation efforts and do not consider profit or the risk of forest destruction.

10.43 As with soil degradation, deforestation-related losses are largely irreversible over a ten-year period. Using a 5 percent discount rate, the full discounted value of the ten-year losses range from \$1.4 billion to \$1.9 billion. These costs will grow higher over time, with continued deforestation and the absence of adequate maintenance of existing forest areas.

TOURISM

10.44 Tourism and travel is a small but measurable source of foreign exchange earnings in India: tourism receipts from international travelers totaled \$1.42 billion in 1992, or 7.1 percent of total exports (World Tourism Organization 1993). As with all of South Asia, India's international tourism receipts have fallen slightly in real terms since 1988. Poor environmental quality threatens future growth in tourism through the perceived negative health impacts of ambient air and

Table 10.7. Annual Cost of Deforestation

Replacement Cost Approach					
Forest Type	Area Deforested 1981-90 (thousands of hectares)	Rangeland Conversion Factor	Average Annual Reforestation Cost per hectare	Annual Reforestation Cost (millions of U.S. dollars)	
Tropical Rain Forest	495.0	0.0	75	37.1	
Moist Deciduous Forest	378.0	0.0	75	28.4	
Dry Deciduous Forest	2,141.0	0.4	75	96.3	
Hill and Montane	355.0	0.2	75	21.3	
Market Value Approach					
Forest Type	Area Deforested, 1981-90 (thousands of hectares)	Rangeland Conversion Factor	Net Value (U.S. dollars per cubic meter)	Average Annual Sustainable Yield (cubic meters per hectare)	Annual Reforestation Cost (millions of US dollars)
Tropical Rain Forest	495.0	0.0	75	1.25	37.1
Moist Deciduous Forest	378.0	0.0	75	2	28.4
Dry Deciduous Forest	2,141.0	0.4	75	1	96.3
Hill and Montane	355.0	0.2	75	1.5	21.3
Total	3,369.0				183.1



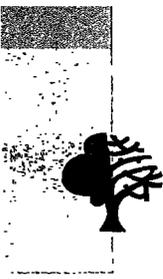
Summary of Results and Policy Implications

10.46 Although the total costs of environmental degradation and pollution are unknown, the estimates calculated here total \$9.7 billion a year, or 4.5 percent of India's 1992 gross domestic product (GDP) (Table 10.8). As mentioned earlier, there are limitations to the methods and data used here to value environmental costs. Still, this figure provides an idea of the magnitude of the environmental challenges facing India and a departure point for remedial policies and programs.

10.47 The policy and investment implications of these findings are fairly clear. Surface water degradation takes the highest health toll across the country and requires immediate attention. No one sector dominates the environmental agenda; many sectors need attention, and the setting of priorities and sequencing of mitigation measures requires careful analysis of the costs and benefits of various mitigation strategies. Environmental investments, like those for any other sector, should be approached with the goal of

Table 10.8. Annual Costs of Environmental Degradation in India

Problem	Impacts on health and/or production	Low Estimate (millions US\$)	High Estimate (million US\$)
Urban air pollution	Urban health impacts	735	2,102
Surface water pollution	Urban and rural health impacts, esp. diarrheal diseases	3,311	8,344
Surface and groundwater pollution	Higher incremental costs for clean water supply.	Not estimated	Not estimated
Industrial hazardous waste	Long-term health impacts, esp. cancer.	Not estimated	Not estimated
Soil degradation	Loss of agricultural output.	1,516	2,368
Rangeland degradation	Loss of livestock carrying capacity.	238	417
Deforestation	Loss of sustainable timber supply	183	244
Coastal and marine resources	Unsustainable harvesting of marine resources.	Not estimated	Not estimated
Loss of biodiversity	Loss of use, option, and existence values.	Not estimated	Not estimated
Tourism	Decline in tourism revenues.	142	283
Total Costs of Environmental Degradation		5,672	13,758
Total cost, as percentage of GDP		2.64%	6.4%
Average cost - US\$		9,715	
percentage of GDP		4.53%	



achieving the highest possible rate of return.

10.48 This exercise completes only half of the cost-benefit framework. A similar approach should be used to estimate mitigation costs. The following areas, in particular, require careful cost-benefit analysis:

- Water resource management, including urban water supplies, industrial regulation, and reforms in agricultural input pricing policies.
- Soil conservation and irrigation

management.

- Urban air pollution, including urban transport, solid waste management, fuel reformulation, and industrial regulation.

10.49 In addition to measurable savings in economic well-being to the sum of 5 percent of GDP per year, the economic and social savings gained through improved environmental management are highly progressive, in that the beneficiaries are primarily the urban poor and small, rural farmers.

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