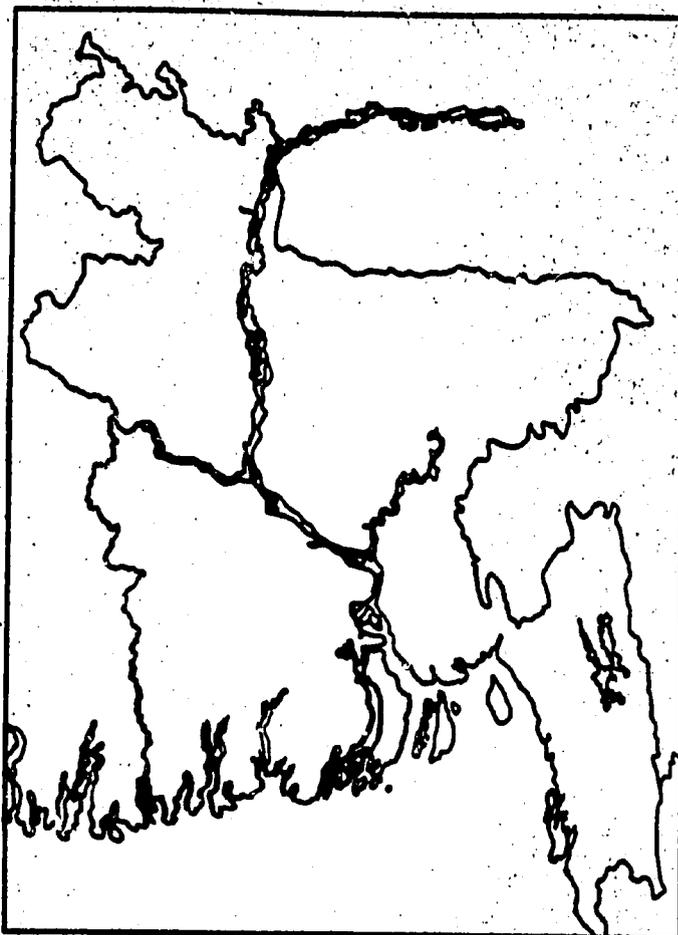


**FINAL REPORT**

**BANGLADESH:  
ENVIRONMENT AND  
NATURAL RESOURCE  
ASSESSMENT**



**Prepared for the U.S. Agency for International Development  
by the World Resources Institute  
Center for International Development and Environment  
Washington, D.C., USA  
September, 1990**

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## PREFACE

**This report summarizes the findings and recommendations of an preliminary analysis of current environmental and natural resource management issues in Bangladesh and their relation to the country's economic growth and development. The assessment is based on a review of the principal sources of information on this subject and consultations with government officials, donor agencies, the private sector and knowledgeable individuals in Bangladesh. Fieldwork for this assessment was carried out between May and July 1989, at the request of the USAID/Dhaka mission, with funding from the U.S. Agency for International Development (USAID) mission in Bangladesh, and the Asia/Near East Bureau of USAID.**

**The assessment was carried out by a team of specialists organized by the World Resources Institute's Center for International Development and Environment. The World Resources Institute (WRI) is a research and policy institute which aims to assist governments, the private sector, environmental and development organizations address a fundamental question: How can societies meet human needs and nurture economic growth while conserving the natural resources and environmental integrity on which life and economic vitality ultimately depend?**

**WRI's Center has conducted similar "assessments" as well as more comprehensive "environmental profiles" and longer-term policy reviews and planning exercises in a number of countries, and provides technical support in environmental planning and natural resource assessments to USAID missions worldwide, through a cooperative agreement with**

**S&T/FENR and the Environmental Planning and Management Project (EPM).**

**The final report of the assessment aims to provide information, analysis and preliminary recommendations for a wide range of organizations, agencies, and individuals with an interest in the "sustainable development" of Bangladesh. This assessment was undertaken not as an isolated effort to pinpoint environmental problems, but in response to a deepening concern with the relationship between success in alleviating poverty and achieving the development goals of Bangladesh, and in maintaining the productivity of natural resources and the quality of the environment in Bangladesh.**

**This report does not challenge the priority assigned to poverty alleviation and economic development in Bangladesh; rather, it is intended to facilitate a dialogue among the many people and institutions concerned with the sustainable development of Bangladesh, in order to better understand what interventions related to the use and management of natural resources and environmental conservation are necessary to resolve problems which may otherwise impede the achievement of Bangladesh's long term development goals.**

**The assessment was conducted by a team which included the following persons:**

**Mr. Robert Winterbottom, Team Leader,  
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**Dr. Louise Fallon, Resource Economist/Fisheries  
Specialist**

**Dr. Alan Potkin, Wetlands Ecologist**

**Mr. Marshall Berdan, Editor**

The opinions and analysis presented in this report are those of the staff members of the World Resources Institute, and do not necessarily represent those of USAID or the Government of Bangladesh. We have, however, endeavored to fairly and accurately represent to the maximum extent possible the information and viewpoints presented to the team, and to build on these facts and insights to produce our assessment of the current situation and recommended priorities for action. We have also tried to respond as fully as possible to comments and corrections made on draft reports for the assessment. We hope that the end result will continue to generate discussion, and more importantly, lead to effective action to address the critical issues identified in this report.

## ACKNOWLEDGMENTS

The team is especially grateful to the numerous representatives of various Bangladesh Government offices who gave their valuable time to be interviewed by team members. Many representatives of academic/research institutions and non-governmental organizations also provided ideas and direction for the report and the team thanks them for their time and guidance. (For a full listing of persons contacted, see Appendix A).

While in Bangladesh, the Center's team also made every effort to contact and listen to farmers, fishermen, school teachers, extension workers, and others working in the field. Their help in understanding the problems and possibilities associated with natural resources management was invaluable in conducting the assessment.

The team wishes to acknowledge the valuable assistance provided by a large number of people within USAID. Priscilla Boughton, former Director, and Malcolm Purvis, Deputy Director of the USAID Mission in Dhaka, participated in field excursions, reviewed preliminary drafts, and provided guidance and encouragement for the assessment team. The assessment could not have been done without the very effective and much appreciated support of Brad Fujimoto, Environmental Officer at the USAID Mission in Dhaka. Molly Kux, Environmental Coordinator for USAID's Asia and Near East Bureau was also a source of steady and constructive support for the effort. Many others within USAID, in both Washington and Dhaka, made substantial contributions to the process and content of the assessment, including Dean Alter, Bill Nance, Lou

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The team is indebted to our colleagues at WRI for their support and guidance, particularly Tom Fox, Walter Arensberg, David Richards, and those who provided useful comments during the review process. The team is also indebted to Haider Ahmed Iqbal, Administrative Assistant for the team and to Anu Sud, WRI Research Assistant. We are also grateful to Rita Cohen, Faye Kepner, and Pat Bradford for their assistance in producing the final report.

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**Syed Zahir Sadeque, consultant to the CIDA  
Agriculture Sector Team; W. T. Smith and Mohindar  
Manrai, World Bank; Hugh Brammer and Steve Jones**

**(World Bank consultants, Flood Action Plan), Dr.  
A.N.A. Abeyesundere, WHO/Dhaka.**

## GLOSSARY AND ACRONYMS

<b>ADAB</b>	Association of Development Agencies of Bangladesh	<b>BWDB</b>	Bangladesh Water Development Board
<b>AsDB</b>	Asian Development Bank	<b>CDA</b>	Chittagong Development Authority
<b>ADP</b>	Annual Development Program	<b>CHT</b>	Chittagong Hill Tracts
<b>aman</b>	rice planted just before (broadcast) or during (transplanted) the monsoon season and harvested in November and December (B. aman: broadcast aman; T. aman: transplanted aman)	<b>CIDA</b>	Canadian International Development Agency
<b>aus</b>	rice planted during the pre-monsoon period (March –April) and harvested during the summer	<b>DAE</b>	Department of Agricultural Extension
<b>baor</b>	ox-bow lake, cut-off stream channel	<b>DANIDA</b>	Danish International Development Agency
<b>BARC</b>	Bangladesh Agricultural Research Council	<b>DEPC</b>	Department of Environmental Pollution Control
<b>BARI</b>	Bangladesh Agricultural Research Institute	<b>DOE</b>	Department of Environment
<b>BBS</b>	Bangladesh Bureau of Statistics	<b>DOF</b>	Directorate of Fisheries
<b>beel</b>	see jheel	<b>DTW</b>	deep tubewell
<b>BEPP</b>	Bangladesh Energy Planning Project	<b>EIA</b>	environmental impact assessment
<b>BOD</b>	biochemical oxygen demand	<b>ERD</b>	External Resources Division
<b>boro</b>	rice planted in the dry season (December to February) and harvested in March and April (local varieties) or April and May (high-yielding varieties)	<b>ESCAP</b>	Economic and Social Commission for Asia and the Pacific
<b>BRRI</b>	Bangladesh Rice Research Institute	<b>FAO</b>	Food and Agriculture Organization of the United Nations
		<b>FRI</b>	Forestry Research Institute
		<b>GDP</b>	gross domestic product
		<b>GOB</b>	Government of Bangladesh
		<b>GUP</b>	Gono Unnayan Prochesta
		<b>ha</b>	hectare

<b>hilsha</b>	<b>river shad</b>	<b>mt</b>	<b>metric ton</b>
<b>hoar</b>	<b>deep lake formed by structural depression</b>	<b>NGO</b>	<b>non-government organization</b>
<b>HYV</b>	<b>high-yielding variety</b>	<b>ODA</b>	<b>British Overseas Development Administration</b>
<b>IPM</b>	<b>integrated pest management</b>	<b>POUSH</b>	<b>Polli Unnayan Sangstha</b>
<b>IRRI</b>	<b>International Rice Research Institute</b>	<b>rabi</b>	<b>dry season</b>
<b>jheel</b>	<b>swamp, seasonal lake</b>	<b>STW</b>	<b>shallow tubewell</b>
<b>khal</b>	<b>canal</b>	<b>TFYP</b>	<b>Third Five-Year Plan</b>
<b>kharif</b>	<b>wet season</b>	<b>Tk</b>	<b>taka (Bangladesh currency unit; US\$1 = 32 taka)</b>
<b>khas</b>	<b>unclassified public land</b>	<b>UNDP</b>	<b>United Nations Development Program</b>
<b>LLP</b>	<b>low lift pump</b>	<b>UNICEF</b>	<b>United Nations International Childrens Emergency Fund</b>
<b>MFL</b>	<b>Ministry of Fisheries and Livestock</b>	<b>union</b>	<b>smallest administrative unit in Bangladesh</b>
<b>MIWDFC</b>	<b>Ministry of Irrigation, Water Development and Flood Control</b>	<b>upazila</b>	<b>administrative unit above the union level</b>
<b>MLR</b>	<b>Ministry of Land Reform</b>		
<b>MPO</b>	<b>Master Plan Organization</b>		

## EXECUTIVE SUMMARY

**This report presents the findings of an assessment of the principal natural resource management and environmental conservation issues in Bangladesh, and their relationship to economic growth and the sustainable development of Bangladesh. This assessment is based on a rapid review of available information as well as in-country consultations with a broad range of organizations and agencies in Bangladesh. The review was conducted by a multidisciplinary team organized by the World Resources Institute, with the financial support of the U.S. Agency for International Development.**

**The research, fieldwork and drafting of the final report of the Environment and Natural Resource Assessment (ENRA) are intended to be only the first steps in a longer term planning and development process which mobilizes all interested institutions and individuals to undertake the actions needed to protect and manage the country's renewable natural resources. The improved management of these natural resources is essential for the successful implementation of sustainable development strategies in Bangladesh.**

**This report recommends a number of actions to minimize the degradation of Bangladesh's natural resources; fill in basic gaps in our understanding of the issues; re-assess the environmental impacts and sustainability of current and proposed development programs; adopt appropriate policy reforms; accelerate training and education; increase the support provided for the development of sustainable livelihoods for the poor and landless; and diversify agricultural production strategies.**

**This assessment recognizes the central importance of poverty alleviation, increased food production, and population stabilization in the long term development strategy for Bangladesh. The intense and rapidly increasing population pressure which one faces in Bangladesh underscores the need for stronger efforts to limit population growth, or one cannot hope to eventually balance the demands made upon the natural resource base and the productivity of those resources.**

**Population growth, in fact, is a constant factor in development planning in Bangladesh. The total population is now over 110 million, up from 90 million in 1981, and some 44 million in 1951. The population is expected to reach 140-145 million by the year 2000, and may not stabilize before exceeding some 340 million persons. Already, Bangladesh is the most densely populated country in the world (with the exception of city-states like Singapore). If the United States was as densely populated as Bangladesh, the entire population of the world would have to live within the borders of the U.S.**

**Clearly, the extremely high population density of Bangladesh is a major factor contributing to the intense use (and overuse) of forests, fisheries and to a certain extent even soil and water resources. A majority of households are already without sufficient areas of land to raise enough food to meet their needs; and fuelwood stocks have been depleted and diminished to the point where most of the total domestic energy requirements must be met by crop residues and dung with only a small fraction being met by fuelwood.**

The research for this report also revealed the complex and sometimes fragile nature of current life support systems and livelihoods for many rural households in Bangladesh. A significant fraction of the income of rural households is derived from "homestead gardens," although they generally amount to less than 0.15 hectares per household. Most families are dependent on a diverse array of products and income from horticulture, livestock, forestry, fisheries, and off-farm employment as well as cash crop and food grain production. The resource base for all of these productive activities needs to be conserved and better managed, particularly if these rural households are to have the resiliency to survive in the face of periodic floods and droughts. In the context of such interdependent agroecosystems, food production strategies must be based on careful and complete analysis of the environmental and socio-economic impacts associated with alternative development strategies, and fully assess the trade-offs between production in one sector and its impacts on another.

The prevailing nature of rural economies in Bangladesh and the intense population pressures require that more attention be given to the conservation and management of natural resources, as most households are still directly dependent on the continued productivity of soils, forests, and fisheries resources, and these resources are increasingly vulnerable to overuse and degradation. In such a densely-settled environment, heavy-handed interventions which affect the resource base can also have an impact on large number of households. Furthermore, poorly designed development activities, misguided policies, and inequitable access to these resources can also contribute to the degradation of natural resources, as much or more than population pressure. For example, industrial wood produced from government managed forest reserves is frequently sold for only a small fraction of its market value; the low royalties and fee structures contribute to the inefficient and wasteful use of these scarce forest products, and shortchanges government administration of badly needed revenues.

Until relatively recently, the need to cope with periodic disasters, and a preoccupation with increasing food production and reducing poverty in the face of continued population growth have overshadowed efforts to conserve and manage the natural resources of Bangladesh. However, the information compiled in this assessment points to serious problems of resource

depletion and environmental degradation which, if not addressed, could significantly undermine Bangladesh's long term economic development, and ultimately have a more severe impact than floods and cyclones.

Environmental degradation in Bangladesh is evident in terms of declining soil fertility (particularly deficiencies of sulphur and zinc); lowered water tables, especially in the northwest regions; and degradation of the remaining natural forests, wetlands, coastal environments and fisheries resources by a combination of factors. These factors include: a large and rapidly growing population; industrial development without sufficient controls on industrial pollution; improper use of agricultural chemicals and pesticides; poorly designed flood control, drainage and irrigation works; overcutting and clearfelling of forests, and artificially low stumpage prices and royalties for forest products; shortages of alternative sources of household energy in rural areas; urbanization; lack of community control over open-access resources; inadequate land use planning; and institutional weaknesses among the public agencies charged with environmental protection and natural resource management.

Overuse and destruction of natural resources is already, in fact, negatively impacting the welfare of millions of people in Bangladesh, and threatening their food security and quality of life. Over half the forested land of Bangladesh has been cleared in the past 20 years, to a point where tree cover amounts to less than 6 percent of the total land area. Some 78 percent of the fuelwood consumed now comes from homestead forests, although they account for only 15 percent of the forested area. Despite the importance of these homestead forests as a source of income and "savings" for rural households, they are being overcut and depleted, so that families now spend over 30 hours per week scavenging for twigs, leaves and other biomass fuels needed for cooking. One third of the cow dung which would otherwise be used to help maintain soil fertility is now burned as a household fuel. Fisheries have traditionally produced 70-80 percent of the protein consumed by Bangladeshi households, and have provided seasonal employment for millions of households; in recent years, however, the catch of inland fisheries has continued to decline.

Action is needed now to maintain the productivity of forest resources which continue to decline at a rate of nearly 10,000 hectares/year. There is a particular

need for more effective strategies and programs to support community-based efforts to protect, regenerate and manage remaining areas of natural forests, as well as private sector initiatives in tree-planting and improved management of homestead forests. Uneconomic and environmentally damaging policies regarding the pricing of forest products and the conversion of natural forest to plantations also need to be re-assessed and revised.

Vigorous efforts are needed to check further declines in the productivity of inland fisheries, stemming from over-fishing, environmental pollution, and poorly designed flood control, irrigation and drainage and infrastructure development projects. Non-sustainable development of shrimp production in coastal areas can be controlled better, and support can be increased for the development of small-scale aquaculture among rural communities and at the household level. More attention also needs to be focused on the conservation of biological diversity, particularly in the case of traditional crop germplasm, native fisheries, and remaining natural areas and wildlife populations.

Better use can be made of abundant natural gas resources, particularly as a source of energy for commercial uses such as brick-burning. At the same time, more effective regulation and monitoring of industrial and domestic waste disposal is needed, especially in view of rapid urbanization and the accompanying increase in congestion and dense settlement. The use, storage and disposal of pesticides also needs to be improved, as demand for these and other agricultural inputs increases in association with agricultural intensification.

A number of measures are needed to rationalize the use of land and water resources. Research and programs aimed at restoring and maintaining soil fertility have grown in recent years and need further support. Farming systems research oriented to an analysis of sustainability issues and net farm productivity, and NGO initiatives related to "regenerative agriculture," aquaculture, horticulture and homestead gardening also merit continued support. Above all, more in-depth studies and expanded efforts in environmental monitoring are needed in conjunction with the development of groundwater use, dry season irrigation, and flood control schemes.

Protection against flooding hazards should be insured, but not without maintaining the beneficial effects of "normal" seasonal flooding (in terms of renewal of soil fertility; maintenance of fisheries spawning and productivity, etc.) and with due regard to traditional strategies for coping with and adapting to floods.

Many of these problems and needs are increasingly being recognized by the government and development organizations in Bangladesh, and general awareness of environmental issues is growing. However, government efforts are often constrained by a lack of operational means and adequately trained manpower. Many laws and policies are outdated, poorly enforced, and in need of revision. Current mechanisms and institutional capability to assess likely adverse environmental and socio-economic impacts, and to analyze the economic trade-offs of alternative development strategies could be strengthened further.

NGOs are making a contribution in many areas related to improved natural resource management and sustainable land use, but they are also constrained by a lack of well-trained technical specialists, and limited access to information about past or ongoing development activities. Despite these constraints, the capabilities of NGOs to address the development needs of the rural poor and the landless has grown substantially in recent years, and their efforts can augment and complement those of the government and aid agencies.

Fortunately, in the face of such an urgent need to improve the conservation and management of natural resources in Bangladesh, a number of recent developments suggest that the political will to address environment and natural resource issues is steadily growing. In 1989, a Ministry of Environment and Forestry was established, and the mandate of the newly expanded Department of Environment was considerably broadened. The use of fuelwood in brick-burning and further cutting in forest reserves have been banned. But this political will to respond to a crisis needs to be translated into support for improved natural resource management and sustainable development strategies. People are dependent on natural resources and must be given the assistance needed to use these resources, but in ways that do not jeopardize their long term productivity.

The Bangladesh Agricultural Research Council is sponsoring the preparation of a National Conservation

Strategy and NGOs are collaborating on a Citizen's Report on the State of the Environment. The Forestry Department is about to re-assess its priorities and prepare a Forestry Master Plan, and the Forest Act of 1927 has recently been amended. Both the donors and the government are keen to support a number of environmentally-related studies as part of an ambitious program to reduce the hazards associated with monsoon floods. Public awareness of the issues is also growing, and contributing to a more careful assessment of the sustainability of proposed development activities. If this momentum and interest can be sustained and accompanied by effective programs and actions, the 1990s can indeed become the "Decade of the Environment," as recently declared by the President of Bangladesh.

## **The Concept of Sustainable Development<sup>1</sup>**

"Humanity has the ability to make development sustainable—to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development does imply limits—not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities. But technology and social organization can be both managed and improved to make way for a new era of economic growth."

"... widespread poverty is no longer inevitable. Poverty is not only an evil in itself, but sustainable

development requires meeting the basic needs of all and extending to all the opportunity to fulfil their aspirations for a better life. A world in which poverty is endemic will always be prone to ecological and other catastrophes."

"Meeting essential needs requires not only a new era of economic growth for nations in which the majority are poor, but an assurance that those poor get their fair share of the resources required to sustain that growth. Such equity would be aided by political systems that secure effective citizen participation in decision making and by greater democracy in international decision making."

"Sustainable global development requires that those who are more affluent adopt life-styles within the planet's ecological means—in their use of energy, for example. Further, rapidly growing populations can increase the pressure on resources and slow any rise in living standards; thus sustainable development can only be pursued if population size and growth are in harmony with the changing productive potential of the ecosystem."

"Yet in the end, sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs. We do not pretend that the process is easy or straightforward. Painful choices have to be made. Thus, in the final analysis, sustainable development must rest on political will."

A.

## INTRODUCTION

### Organization of the Report

The introductory section of this report describes the context and scope of work for this assessment, the assessment process, and the limitations inherent in this assessment. This is followed with an overview of economic development and environmental factors in Bangladesh, including a discussion of the linkages between population growth, environment and natural resource management, and development.

Specific problems and issues in a number of key areas or subsectors are then discussed, including land use, agriculture and water resources management, forestry, fisheries, biodiversity conservation, rural energy use, urbanization, and toxic substances. The institutional capacities and policy framework related to environment and natural resource management (in both the public and private sectors) are then discussed in general terms, together with a series of activities which are underway to promote "sustainable development" in Bangladesh. The concluding section of this report outlines a suggested strategy for dealing with the major environment and natural resource issues to be addressed, and summarizes short term and medium term priority actions.

The overview of natural resource management and institutional issues incorporates the principal findings which emerged for each subsector covered by the assessment. For each subsector, more detailed information on the resource base, its economic importance, current development programs as well as a more complete presentation of trends, linkages with other sectors, and specific recommended actions can

be found in the series of working papers prepared for the Environment and Natural Resource Assessment (ENRA). Abstracts for each of these working papers are included in the appendices of this report, together with lists of important references, and organizations and persons contacted.

### Context and Scope of Work for the Assessment

This report was prepared in response to a growing recognition that the Government of Bangladesh is indeed faced with difficult choices. Population growth is putting increasing pressure on Bangladesh's resource base. With an estimated population of some 120 million, there are already more than 700 people per square kilometer, and over 11 persons per hectare of arable land in Bangladesh.<sup>2</sup> And population pressures are expected to substantially increase before the population stabilizes at a level of about 38 persons per hectare of arable land in the next century. Sustainable management of soil, water, fisheries, and forests is critically important in the face of such population pressure and anticipated population growth. But even if the anticipated very large increases in the population could somehow be reduced, the demands of the current population on the natural resource base of Bangladesh are such that these resources are already being stressed, degraded, and depleted in many ways.

As Bangladesh moves forward into the next century and strives to provide the basic needs and even an improved quality of life for its people, it is vitally

important that current policies and programs be carefully reviewed to assess their contribution to the country's sustainable development (see separate box on the concept of sustainable development). Individual development assistance agencies have already begun to more carefully examine the relationship between their programs and a sustainable development agenda for Bangladesh, and there is widespread agreement that the capacity for planning and implementing environmentally sound development and improved natural resource management in Bangladesh should and can be strengthened.

To proceed in these areas will require an improved understanding of the conditions and trends of the natural resource base, and more deliberate assessment of the impact of current and anticipated development policies and programs on the environment as well as the national economy. Comprehensive and accurate information is essential for such policy analysis and program reviews. Donors and non-governmental organizations (NGOs) can assist government agencies in this information collection, analysis and decision-making process which is needed to advance Bangladesh along a pathway of sustainable development and improved natural resource management.

To date, much useful information has already been assembled, and it has been used in the course of this assessment to the greatest degree possible.<sup>3</sup> Particularly useful existing sources of information include the Agriculture Sector Review sponsored by UNDP, the National Water Plan prepared by the Master Plan

Organization of the Ministry of Irrigation, Water Development and Flood Control, and publications on agricultural research supported by BARC and its various member institutions. The U.N. ESCAP program recently sponsored an extremely informative review of coastal zone management issues, and both DANIDA and CIDA have prepared overviews of environmental problems and recommended "environmental strategies" for Bangladesh. With support from SIDA and IIED, the Bangladesh Centre for Advanced Studies (BCAS) prepared an environmental profile of Bangladesh. BCAS is currently preparing, in cooperation with many national and local NGOs, a citizen's "State of the Environment" report for Bangladesh. And the IUCN, in cooperation with BARC, has prepared background

studies aimed at the development of a "National Conservation Strategy" for Bangladesh.

In addition to compiling information from the existing literature in order to make it more widely available, this assessment has aimed to build on that information to produce a report which:

- reviews the trends, policies and major problems associated with the use of renewable natural resources in Bangladesh;
- assesses the actions needed to conserve biological diversity and remaining natural forest resources of Bangladesh;
- analyzes the linkages between natural resource management issues, population growth and economic development;
- and outlines a strategy and preliminary recommendations for improving the management of natural resources and building the institutional capacity to implement more sustainable development programs.

## **The Assessment Process**

The assessment began with a 3-week "reconnaissance phase" which gathered available documentation, identified important institutions and sources of information to be contacted, and discussed the scope and timetable for the assessment. A team of some 14 specialists was then fielded over a two month period, with most team members contributing 2-4 weeks to the assessment fieldwork. The team made a concerted effort to meet with the large number of organizations in Bangladesh that are especially well informed about the various issues being addressed. Fieldwork was necessarily limited, but several trips were organized in the vicinity of Dhaka, Chittagong, Cox's Bazar, Sylhet, Mymensingh, and Tangail.

As working papers were drafted by individual team members, a series of preliminary findings and recommendations were formulated and presented in a series of informal debriefings with government officials, NGOs, the private sector and the press; with the donor agencies; and within the USAID mission in Dhaka. A "synthesis" report was then drafted, and circulated with the edited working papers for comments by a select group of reviewers. Over the next year, revised drafts were circulated more widely, and the comments received on these drafts have

contributed to the preparation of the final report of the assessment.

It is important to stress that this report and the assessment work completed to date are only the beginning of a longer term planning and development process which is needed to incorporate a concern with "sustainability" into national policies and development programs, and to otherwise address natural resource management issues and their relationship to economic development in Bangladesh. Additional study and analysis are needed in some areas (which are highlighted in this report), and the report's findings and recommendations should be broadly disseminated and discussed with a view towards stimulating specific actions.

## **Limitations of the Assessment**

This report is intended to be primarily a point of reference for existing information; it is not a complete "profile" of the environment of Bangladesh, nor does it embody a great deal of new research and analysis on environment/development issues. It does, however, set the stage for more in-depth discussion of the linkages between natural resources and development, and points to gaps in the information base which need to be addressed by further study and longer term monitoring and evaluation.<sup>4</sup>

The assessment concentrated on natural resource management issues which can be largely addressed by actions within the borders of Bangladesh. It does not examine water management issues from a basin-wide perspective, as was done in the Eastern Waters Study,

nor does it deal with the issue of global warming, and the impact of anticipated sea level rise in Bangladesh (which is being addressed to a degree by other studies and efforts within Bangladesh).<sup>5</sup> Population growth, and "natural" disasters such as cyclones, drought and exceptional monsoon floods are discussed as factors affecting the management of natural resources, but this assessment does not focus on specific strategies in these areas.

In the course of completing this assessment, the team faced a number of conflicts or trade-offs in the objectives and focus on the assessment effort which were accentuated by the limited time and resources allocated to the effort. Detailed assessments of the situation in a given sub-sector were constrained by the need to cover a large number of subsectors or issues. An in-depth analysis of the current condition and trends of a particular renewable natural resources (forests, soils, fisheries, water, etc.) was limited by the need to focus on the linkages among these various resources, and the interactions between current development activities (such as road building or development of irrigated agriculture) and the natural resource base. In addition, a desire for specific and detailed recommendations in many areas was frustrated to a degree by the need to develop a broad strategy and a short list of priority recommendations which would deal with the most important issues. In the end, the assessment attempts to both review the state of Bangladesh's natural resource base, and discuss how a broad concern with "sustainability" could be incorporated better into ongoing and anticipated development programs. Yet, there is clearly room to delve deeper in both respects.

B.

## OVERVIEW OF ECONOMIC DEVELOPMENT CONTEXT FOR BANGLADESH

### Environmental Factors

Bangladesh is a country of some 144,000 square kilometers, largely formed by the floodplain and delta of two major river systems of the south Asian continent, the Brahmaputra (called the Jamuna in Bangladesh) and the Ganges. (See Figure 2 in Appendix.) In a typical year, about one-tenth of the land is subject to severe flooding, and at least one-half to some inundation. One third of the land area is less than 20 feet above sea level.

In addition to seasonal flooding in the wake of the monsoon rains, much of Bangladesh is affected by the constantly shifting river channels and courses; such shifts can wipe out settlements, and complicate the construction of rural roads and other infrastructure development. Cyclones and tidal surges can also wreak havoc with settlements and crops, and cause significant property damage and loss of life.

Although the tropical climate does not limit the growing season, there is a distinct dry season, and periodic drought is a problem, especially in the northwest part of the country. Despite the historical expanse of forest cover, many generations of predominantly agricultural land use and expanding populations have reduced the natural forests to less than 6 percent of the total land area.

In response to these environmental factors, the people of Bangladesh have developed diversified and relatively resilient agroecological systems which

provide for their needs in most years. Intensively managed and densely planted "homestead forests" or gardens containing a large variety of annual as well as perennial crops are an important source of food and income. Fish are an important component of the Bangladeshi diet, and account for a large share of protein, as well as a source of income and livelihood for millions. An extensive system of country boats helps link settlements and supports a large volume of commercial traffic and trade. In recent years, the traditional sail-powered (or towed) boats have been supplanted to a great extent by motorized launches—powered in many cases by the same diesel engines used to pump irrigation water in the dry season.

### The Development Challenge for Bangladesh

Despite the adaptations and resourcefulness of the people of Bangladesh, the overall economic and development statistics for the country are daunting. With a per capita average annual income of just \$160 in 1986, and 80 percent of the people living below the poverty line, government policy is understandably oriented towards poverty alleviation as an overriding development objective. 60 percent of Bangladeshi households are without sufficient land to produce enough food for their families. 20 percent of Bangladeshi households do not even have enough land for a homestead.<sup>6</sup>

Some 60 percent of the total land area is cultivated, one of the highest percentages in Asia. Agriculture represented slightly less than half of the GDP in 1986, and average annual rate of growth in agricultural production was about 2.7 percent from 1980–1986, which was barely enough to keep pace with population growth. Food shortages affect more than half the population, and food imports are rising to keep abreast of demand. Exports volumes are relatively small, and not well diversified.

Access to clean water is problematic for many households, and as a result of contaminated drinking water, gastroenteritis and other water-borne diseases are common. The effect of these diseases, together with chronic malnutrition and inadequate health services is a high rate of infant mortality; 25 percent of infants die before the age of 5. Maternal mortality rates are nearly 100 times greater than the rates for Scandinavian countries.

Despite relatively high growth rates for urban areas (over 10 percent p.a.), 85 percent–90 percent of the population still resides in rural areas. Because of the relatively high population growth rates (2.2 to 2.6 percent p.a.)<sup>7</sup>, a large proportion of the population is young, and will soon greatly increase the ranks of those needing schooling and employment. Literacy rates are only 15 percent–18 percent for females and 25 percent–35 percent for males.

Population growth, in fact, is a constant factor in development planning in Bangladesh. The total population is now over 110 million, up from 90 million in 1981, and some 44 million in 1951. The population is expected to reach 140–145 million by the year 2000, and may not stabilize before exceeding some 340 million persons. Already, Bangladesh is the most densely populated country in the world (with the exception of city-states like Singapore; *See Figure 3*). If the United States was as densely populated as Bangladesh, the entire population of the world would have to live within the borders of the U.S.

## Linkages Between Population, Development and Environment

There are at least two major issues related to population, environment and development. In the first instance, one can reasonably ask if population pressures have not added to the stresses on natural

resources and prompted their overuse and a subsequent decline in the productivity of those resources, just at a time when increased demand for development and higher levels of production has grown—thereby exacerbating the problem of overuse and depletion of a finite resource base. Secondly, are there not definite limits or at least natural resource related constraints to continued population growth and development?

In the first case, it is evident that the extremely high population density of Bangladesh has contributed to the intense use (and overuse) of forests, fisheries and to a certain extent even soil and water resources. A majority of households are already without sufficient areas of land to raise enough food to meet their needs; and fuelwood stocks have been depleted and diminished to the point where over 84 percent of the total domestic energy requirements must be met by crop residues and dung with only 16 percent being met by fuelwood. Particularly when one considers the projected population levels of the year 2000 and beyond, it does appear that population density has clearly outstripped the potential for sustained yield production of fuelwood for domestic energy consumption from existing sources of supply.

Yet, forests, fisheries and other “renewable” resources are in much the same category as agriculture or food production: a condition of scarcity or shortages today does not necessarily imply that some absolute limit has been passed, and that the carrying capacity of the environment has been exceeded. Carrying capacity can be a useful concept for assessing the potential for supporting wildlife populations which cannot fundamentally “develop” their environment, alter their systems of social organization so as to change the “rules” or policies governing the access and use of resources, and make use of new technologies to better meet their increasing needs from a finite resource base. People, communities and governments can do all of the above. For example, in Rwanda, there are now more trees on the landscape than 20 years ago and fuelwood scarcities have diminished, although population has been increasing at a rate of more than 3 percent p.a. and FAO statistics indicated a severe fuelwood “deficit” existed in 1980. Private tree-planting on farms has increased sharply, in response to supportive government policies and programs, open markets, secure tenure, and a favorable environment for “tree culture.”

In Bangladesh, the current population pressures clearly argue for very careful assessment of the use and management of natural resources—primarily because so many people are already dependent on them. A proposed intervention which adversely affects the productivity of a remaining natural forest or fishery is more likely to impact the livelihood of someone in Bangladesh than in most other countries.

Similarly, the high density of population in Bangladesh requires a careful examination of the relationship between people and the land, and a frequent re-assessment of the potential for more productive (and equitable) use and sharing of natural resources. It would be incorrect, for example, to assume that population pressures have resulted in uniformly intensive land use; although some areas are inherently less productive or more marginal in terms of agricultural production, it does appear that there is still considerable scope in many areas for more intensive agricultural production, and for the development of more diversified and productive farming systems.

It would also be incorrect in a number of instances to assume that overuse or depletion of a resource is simply a function of population pressure; for example, forest reserves in the vicinity of pulp and paper mills are being overharvested to produce wood which is being sold well below its market value.

In Bangladesh, it is particularly unfortunate that so many should remain landless, and even without a homestead, when relatively large areas of "khas" lands and other expanses of degraded or moderately productive land are not intensively managed and utilized by government agencies which have jurisdiction over them. Government control presumably need not preclude leasing arrangements and other mechanisms to mobilize interested local communities in rehabilitation and improved management of lands that conceivably could be made more productive. In fact, given the momentum of continued population growth, such intensification of land use and resource management on degraded lands and underutilized areas is essential if pressures to overuse and deplete other more intensively exploited areas are to be held in check.<sup>8</sup>

In addition to population pressure, many observers and analysts also point to the contribution of poverty to resource overuse and environmental degradation. Clearly, there is a relationship between poverty and

environmental stresses; the poor are forced to address short term needs, even if their actions contribute to the long term depletion and degradation of the resource. And the poor are often the most vulnerable and least able to cope with environmental changes and the impacts of "natural" disasters and hazards. Poverty can also be seen to be a factor in continued high rates of population growth—owing to the associated lack of health care services, security, educational and employment opportunities.

The links between poverty, environment and development also argue for careful analysis of alternative means to alleviate poverty and promote development while safeguarding and even increasing the extent and productivity of natural resources which can be used and managed by the poor as they develop more sustainable and productive livelihoods. For example, Save the Children has supported an income-generation project based on aquaculture development; 5 ponds covering 5 acres have been developed, to yield an annual catch of 20,000 pounds of fish, which will generate an income of some \$7,000 to defray the costs of a primary health care center, extension activities and primary school. The project also provides employment, and the produce from fruit trees planted around the borders of the ponds.<sup>9</sup>

While it is beyond the scope of this assessment to attempt to define the upper limits for continued population growth which are related to natural resources, there are clearly both practical or near term (if not absolute) limits and costs associated with accommodating a growing population in a finite environment. Even the most carefully considered resource management plans cannot cope with ever-increasing populations; in this respect, it is vitally important to maintain a strong commitment to family planning and population stabilization, and to increase the effectiveness of programs in this area.

## **Development Objectives of the Government of Bangladesh**

Per capita development assistance amounted to about \$14/year in 1986, and now totals some \$2 billion/year, or about 10 percent of the GNP and 85 percent of the annual development program budget. Current development objectives as outlined in the Third Five Year Plan (1985–1990) stress the

importance of poverty alleviation through higher production, increased employment, and comprehensive programs for rural development. The promotion of self reliance is also an important objective, and is addressed in part by the decentralisation and devolution of administration and development to the local level. The Government also supports a "rational sharing" of development between the public and private sectors, and acknowledges the need for improved health services, education, the development of energy and other supporting programs, including family planning.

Concern over continued population growth, limited agricultural production, and the resulting chronic food shortages has lead to a preoccupation with increasing food grain production. The possible and likely impacts of large-scale expansion of irrigated agriculture on fisheries, groundwater supplies and rural livelihoods have only emerged as major concerns in the past few years. Industrial development has also been encouraged for some time, with little regard in the past for the effective regulation of industrial effluents or development of waste treatment facilities.

However, a variety of disturbing trends in environmental quality and a growing recognition of

the linkages between economic development prospects and natural resources management have prompted a definite change in the attention given to environment and natural resource issues. 1990 has been declared by the President to be the Year of the Environment, and the 1990's the Decade of the Environment. A new Ministry of Environment and Forests was established in mid-1989, and the mandate and resources of the Environment Department are being considerably upgraded and strengthened. The Government of Bangladesh has also committed itself to the preparation of a National Conservation Strategy and a Forestry Master Plan, and a series of environmentally related studies are to be carried out as part of an Action Plan for Flood Control. The increased interest and activity on the part of the Government has also been echoed by the press and the private sector, notably the NGO community.

Thus, while the economic context and development challenges for Bangladesh are formidable and overshadowed by the need to alleviate the poverty of millions of households, there is definitely a growing awareness of the need to address environmental and natural resource issues in the development process.

C.

# OVERVIEW OF ENVIRONMENTAL AND NATURAL RESOURCE MANAGEMENT ISSUES IN BANGLADESH

## Environmental Degradation

The principal areas and causes of environmental degradation have been identified in a number of recent studies, profiles and assessments.<sup>10</sup> Most of these areas are indicated in the map of the "main areas of environmental concern" which has been prepared by Haroun er Rashid. (See Figure 6.) As illustrated by the accompanying legend, there are a number of indicative environmental problem areas, including those which are more or less strongly influenced by human activities, and those which are more or less easily reversible. Declining soil fertility (particularly deficiencies of sulphur and zinc) may not be a major or insurmountable problem; however, degradation of the remaining natural forests and wetlands, and pollution of waterways and coastal environments are potentially very serious. The specific nature and extent of environmental degradation, as well as the associated natural resource management issues are reviewed in the following sections.

## Natural Resource Management Issues

The causes and impacts of environmental degradation are difficult to disassociate from a complex situation involving high rates of population growth, urbanization and industrialization, intensification of land use, social and gender issues, sectoral development strategies, non-sustainable

resource use, and shortcomings in programs aimed at the conservation and management of the resource. What follows is a summary of the current situation with regard to each of the major natural resource issues covered by this assessment.

## 1. Agriculture and Rural Livelihoods

### (A). Land Use and Productivity

The net cultivated area of Bangladesh encompasses 60 percent of the total land area, the highest percentage in Asia. The country's large population, however, means that there is less than 0.1 hectare (ha) of arable land per person. Of 13.8 million rural households, 45 percent have less than 0.2 ha. According to the 1983-84 Census of Agriculture and Livestock, about 9 percent of all rural households own no cultivable land and two percent have no access to a homestead.

Despite a large and growing population, Bangladesh has made impressive progress since independence in terms of increases in rice production. The expansion of irrigation for dry season agriculture and the planting of high-yield varieties contributed to an increase in food grain production of 37 percent from the mid-1970's to the mid-1980's.<sup>11</sup> This period

of growth was followed by a brief downturn in agricultural production in the mid-1980's, although food grain production has grown in recent years, and reached 19.5 million tonnes in 1989. Foodgrain production per capita appears to have fluctuated around 150 kg.

Non-cereal foods have grown at a slower pace, about 2 percent a year, but pulses are showing a steady decline in both the extent of cultivated area and in total production. White potato production is increasing faster than population growth, but oilseeds, sugar, and vegetables are not. Overall, rice dominates agricultural production, accounting for about 80 percent of the land area cultivated each year.

The unique deltaic characteristics of Bangladesh are not easily adapted to standard classifications for terrestrial systems because the productive potential is determined not only by the maximum water depth but also by the timing and duration of inundation. The National Water Plan estimates that 36 percent of the net cultivated area is "shallowly flooded" (30 to 90 cm deep in a normal year); 16 percent is "moderately flooded" (90 to 180 cm); and 12 percent is "deeply flooded" (over 180 cm). The remaining 36 percent is not flooded at all. The assessment of resource potential will require more careful documentation of existing resource use, different farming practices, changes in land productivity, and physical changes in land extent caused by annual inundation, flooding, and silt movement.

In parts of Bangladesh, the extraordinary variability in the timing of the rainy season, the unpredictable amounts of moisture, the timing and depth of inundation, and the incidence and timing of low winter temperatures all pose key limitations to increased production. Such uncertainties require extraordinary flexibility on the part of farmers to make appropriate adjustments in their cropping strategies. They also substantially affect the risk calculations associated with high-cost agricultural investments.

Resiliency is a vital feature of Bangladesh farming systems. Their consistent vulnerability to the wholesale losses that come from natural disasters and the great annual variability in climate, have prompted rural households to develop successful coping strategies. However, the ability of these households to recover their losses is declining as population growth pushes more rural people into those zones most

susceptible to natural disasters. Of particular importance is the vulnerability of coastal areas. Cyclones, storm surges, and/or droughts occur once or twice a decade in the coastal districts, leaving behind considerable loss of human life, livestock, and crops. Flash floods in Sylhet occurred four times during 1988 alone and are regular phenomena. Rice losses from drought has nearly equalled those from floods during the last 15 years.

It is particularly important to weigh agricultural policies and test different approaches for increasing this resiliency or, at the very least, to avoid decreasing it. Furthermore, the risks, and subsequent economic returns associated with different crops varies substantially, thus altering the comparative benefits of different cropping systems. The costs and benefits of alternative land uses are often not well-acknowledged in the national economy because the predominantly subsistence-based rural production disguises the contribution of different land, water, and biological resources to household livelihoods when a particular product or benefit from a given land use does not enter the formal marketplace. In particular, the contributions of activities other than foodgrain production, such as horticulture, animal husbandry, fishing and fishpond culture, and the collection of honey, fuelwood and other forest products are not fully documented or evaluated in analyses of alternative land use and development strategies.

A number of land use trends require better monitoring and documentation and merit integrated policy and program initiatives. The expansion of village settlements is converting elevated floodplain land into homesteads. The steady rise in rural population increases the land area under crops, but reduces the amount of fallow land and small waterbodies available for fish culture. Horticultural tree cropping lands are being converted into homesites and urban settlements. Poor road and embankment construction degrades the quality of nearby prime agricultural lands by removing top soil (used in construction) and decreasing drainage, thus inducing waterlogging. Obstructions to water drainage can also lead to concentrated water flows which cause erosion. Saltwater intrusion farther inland and subsequent decreasing agricultural production is perhaps linked to changes in surface and groundwater hydrology during the dry season. Inland capture fish harvests are declining.

These trends reflect the cross-sectoral conflicts over land and water resources that occur in the context of rapid population growth. Development activities often occur or are planned without a full understanding of what is lost and what is gained. Many of the productivity decreases that result from changing land and water use are felt by the users, but not by those responsible for development decisions. While a certain intervention, such as embanked road construction, may benefit some members of a community, others may lose productive land to waterlogging that results from the restriction of water movement.

### The Foodgrain Gap

In a number of respects, the attention devoted to closing the national "foodgrain gap" into the next century has narrowed the national focus to the immediate alleviation of hunger through rice production; as a result, there has not always been a full and sufficient consideration of longer range prospects and alternatives.<sup>12</sup> The resources required to close that gap by intensifying rice production have therefore not always been carefully weighed against the diverse needs of a household livelihood system, which include the resources required to cook the rice, eat it with fish and dal, and to purchase the pot to cook it in.

The focus on growing rice and wheat and on land-based production systems in Bangladesh may unduly restrict the potential productivity of agriculture. The prospects for increasing production of many food staples—such as corn, secondary foodcrops (vegetables, pulses, and oilseeds), horticultural species, multipurpose trees, aquaculture and livestock rearing should be more carefully assessed, and where appropriate, developed. Water conditions in Bangladesh in many cases allows for a diverse array of land and aquatic resource utilization schemes to meet the daunting needs of a steadily increasing population.

In order to fully capitalize on the long term potential for expanding boro (dry season) rice irrigation, more attention may need to be devoted to insuring that higher yields are indeed sustained. In a number of countries which have experienced the "green revolution," yields for irrigated rice appear to be declining. One major constraint may be declining soil quality: continuous rice cropping regimes without sufficient fertilization deplete soil nutrients and

organic matter, and may lead to sulphur and zinc deficiencies. The structure of irrigated soils is also deteriorating as plough pans develop and rice puddling inhibit the prospects for the cultivation of other crops.

Although rice has a long history in Bangladesh, continuous rice planting may not be sustainable in the future unless these issues are addressed. On the other hand, more diversified cropping systems and rotation practices can help maintain soil fertility. Results from the Farming Systems Research program, coordinated by the Bangladesh Agriculture Research Council (BARC), suggest that green manuring, mulching, and other soil management practices have substantial promise in maintaining soil fertility. Research on alternative crops has also indicated that there may be significant opportunities for intensifying land use and increasing agricultural production through integrated, multiple cropping systems which include such non-traditional crops as potatoes and maize<sup>13</sup>, in combination with greater efforts to maintain fisheries resources and increase the sustainability of rice cultivation.

### (B). Irrigation and Groundwater Development

Irrigation is widely considered to be the single most important factor for agricultural growth in Bangladesh, particularly for increasing the extent and intensity of rice production. Most notably, irrigation will provide more water during the dry season (rabi), thus boosting productivity significantly.

Agricultural uses must be weighed against the other contributions water resources make to the economy and to the quality of life in terms of: 1) supporting inland fisheries, 2) riverine transportation, 3) drinking water and other domestic needs, 4) manufacturing and industrial processing, 5) limited hydroelectric power. Also, an important environmental function of groundwater aquifers is to impede saltwater intrusion along the coast. The flushing action of the monsoon flood waters for coastal lands is dissipating and soils are becoming increasingly saline during the dry season in some regions.

### Irrigation Prospects

The National Water Plan reflects a concerted effort to address alternative uses of water and other trade-offs in a systematic way. The upcoming second

phase will include the collection of additional data to guide its strategy for water development. Nevertheless, foodgrain self-sufficiency remains the primary goal, and the Master Plan Organization (MPO) calculates that it is technically possible to expand irrigated land from 1.9 million hectares (mha) (1986) to 6.9 mha, including near-to-medium term development of surface irrigation on 1.2 mha, long-term development on an additional 1.5 mha; shallow tubewells (STW) on 1.2 mha; and deep tubewells (DTW) on 1.1 mha. The potential for irrigation expansion, however continues to be a source of dispute between the leading government agencies who feel that the MPO has favored rice production at the cost of other water uses.

The validity of MPO's assumptions are still in doubt, particularly: 1) the reliability of the annual recharge of groundwater, particularly where flood control embankments are combined with the spread of shallow tubewells, and 2) the minimal river flows that are necessary to serve other functions. Moreover, the extent of existing irrigation systems is uncertain as a major discrepancy exists between the Bangladesh Bureau of Statistics' (BBS) 1983-84 estimate of 2.07 mha and the agricultural census' estimate of only 1.62 mha.

Among the anticipated impacts of this irrigation program are a reduction of up to 2.3 billion cubic meters in regional stream flow during the dry season and a lowering of the watertable below the suction limit of hand tubewells which are a principle source of domestic water. A number of people have argued that the uncontrolled proliferation of DTW can lead to a draw down on the water table that renders STW ineffective. Similarly, the overabundance of STW runs the risk of increasing the costs of water withdrawal for all.

The focus of previous irrigation projects was on increasing surface water through flood control, drainage, and irrigation (FCDI) projects whereas the present focus is on "minor" irrigation using low lift pumps (LLP) for surface water, and deep and shallow tubewells for groundwater exploitation. These three types of "minor" irrigation have implications of their own on the other uses of water. Surface irrigation can conflict with river navigation and fisheries production, whereas groundwater withdrawals can lower the watertable during the dry season and seriously affect access to drinking water. These effects are especially felt by women who are responsible for domestic water

supplies; UNICEF has complained that its efforts to improve health in rural areas by installing handpumps is being undercut by the proliferation of DTW and STW.

Large-scale extraction of groundwater could also alter surface hydrology and subject aquatic ecological processes to significant stress. The chemical and thermal characteristics of many dry season waterways and tidal rivers could be altered. Damage to fisheries depends on the sensitivity of various species to environmental changes in the aquatic system. The current information base is inadequate in projecting these impacts.

### **C. Pesticide Use and Integrated Pest Management**

The use of pesticides in Bangladesh, while minor in comparison to other developing nations, is far from minimal and continues to be a source of environmental concern. Currently, 4-5,000 tons of commercial pesticides are used annually, primarily in the cultivation of rice, tea, jute, and sugarcane. Though banned for import, DDT and other highly toxic and environmentally persistent organochlorines are still formulated and used locally. The Pesticide Ordinance of 1971 (amended 1980) and the Agricultural Pesticide Ordinance of 1983 are designed to regulate the importation, manufacture, distribution, and usage of all agricultural and commercial pesticides so as to prevent immediate and long-term injury to the public as well as to native flora and fauna. Enforcement, however, is virtually nonexistent. Through its program of farmer education, the Department of Agricultural Extension (DAE) attempts to improve pesticide application practices, but the DAE suffers from considerable financial and logistical weaknesses and lacks the capability to effectively regulate pesticide use.

A number of pesticide usage problems already exist in Bangladesh and are in need of immediate attention. The sale, packaging, application and disposal of pesticides is one such problem; at present the lack of a return-deposit system for pesticide containers results in their frequent use for food and medicine storage. Nor is sufficient attention being paid to safety considerations: pesticide toxification to handlers is probably widespread, but records of such accidents are not available. Though pesticide labeling practices are generally adequate, the rural literacy rate of only 10

percent renders such procedures ineffective in preventing personal and environmental injury. The extent of environmental contamination is generally unknown as there have been no studies of the effects of pesticides on wildlife despite frequent complaints from the Department of Fisheries regarding agrochemical toxicity to fishes.

Given the extensive gaps in production, distribution, and usage much can be done to improve the current pesticide use situation in Bangladesh. Integrated Pest Management (IPM) needs to be developed beyond the conceptual phase and a sound research program based on agroecological analysis and crop-specific needs must be developed to lay the foundations for a national IPM strategy that has as its goal the overall reduction of pesticide usage. The 30,000 people presently employed by the Department of Agricultural Extension are a potentially great resource for disseminating IPM concepts.

As part of a concerted national effort to meet the food demands of a burgeoning population, the Bangladesh Government has adopted a policy advocating intensified cultivation and the use of high-yield variety (HYV) rice. This expanded agricultural production will require prudent pesticide management techniques and applications if it is to effectively curtail the prevalent abuse and misuse of pesticides.

## **2. Fisheries**

The fisheries resources of Bangladesh are among the richest in the world. While tremendous genetic diversity is embodied in the over 500 fish species which inhabit Bangladesh's inland, estuarine, and coastal waters, little substantive data on the ecology of these species is available.

Despite the importance of fisheries in terms of nutrition, employment, and its contribution as an open-access resource, Bangladesh's inland fisheries are being displaced or disrupted by agriculture, flood control and road embankments, and other land uses. As a result of these perturbations, inland capture landings have been declining at a steady rate since 1983. This economic loss has been offset at the national level by increased marine catches and strong growth in the aquaculture subsector, including increased shrimp exports. However, the decline in the inland capture fisheries has significant nutritional

consequences for many Bengalis, since capture fisheries are a major open-access resource for the poorer segments of the population.

The decline of the inland fisheries has been attributed to a combination of factors, including overfishing, pollution from agricultural chemicals and industrial waste, and flood control, irrigation and road construction. The paucity of substantive data has precluded comprehensive analysis, particularly with regard to the tradeoffs from increased rice production and other gains from flood control and irrigation.

Many people have argued that the recent spate of flood control projects has had a significant impact on fisheries resources. During the past few years, over 150 flood control projects have been implemented and additional projects are being planned. Not only do the embankments that are components of such projects interfere with natural recruitment and dispersal of inland fish stocks over the floodplain, they also disrupt fish and freshwater shrimp migratory patterns. Irrigation barrages in rivers similarly disrupt migratory movements of fish and shrimp. In addition, the increased use of low lift pumps for irrigation and drainage of surface water can contribute to a decline in fish stocks. It is estimated that the loss of one hectare of floodplain causes a reduction of 37–55 kg. in annual fish production.

### **Hilsha and Shrimp**

The single most important species to the inland capture fisheries is the hilsha, or river shad. This migratory (andromonous) species represents 40 percent of the inland capture production and 19 percent of total fish production. Approximately 200,000 full-time fishermen (2 percent of Bangladesh's total population or 11 percent of its fishery employment) are dependent upon the hilsha for their economic livelihood. Surprisingly little, however, is conclusively known about the hilsha's reproductive biology and no authoritative studies have been undertaken to determine the exact cause of the decline in productivity.

Bangladesh is the world's leading producer of freshwater shrimp, the great majority of which is caught by artisanal fisherman in the rivers, streams, and water impoundments of the lowlands. Coastal embankment projects to expand rice cultivation have caused a loss of nursery and feeding ground for estuarine fish and crustaceans, as well as interrupted

traditional brackish water aquaculture there. The reconversion of reclaimed paddy land to brackish water aquaculture by the breaching of embankments has caused conflicts over land tenure and use rights in some coastal areas. There have also been some concerns over localized changes in soil and groundwater salinity as a result of shrimp culture areas. The expansion of brackish water shrimp culture has also contributed to the clearance of mangrove forests in some areas. Approximately 41 percent of the Chakaria Sundarbans mangrove forest in Cox's Bazar was converted to low-yielding shrimp ponds. The lack of adequate socio-economic studies, however, has made it difficult to fully assess and evaluate these various impacts.

## Pollution and Reclamation

The direct contamination of aquatic systems by industry is widespread and a source of considerable concern. Tannery, urea, newsprint, paper, pulp, and jute mills are releasing untreated waste directly into rivers and water bodies. Among the pollutants known to be discharged are mercury, lead, chromium, arsenic, and iron. Even at relatively low concentrations, these pollutants are harmful to aquatic fauna. The biological oxygen demand created by concentrated sewage outfalls from densely populated areas is another source of water quality deterioration that adversely affects fish production.

It is possible that some of the viral epidemics among economic fish species are exacerbated or predisposed by water pollution. Reliable data is not available on the numerous large fish kills which have occurred to date, and food web disruptions have not yet been adequately studied. There is an immediate need to test fish for toxic contaminants. Although information on fish kills is frequently not well publicized, fish prices in some markets are based upon the site of the catch, in particular its location relative to any nearby industrial complexes. During periods of unusually high contamination, people have been known to stop buying fish altogether. And yet levels of toxic chemical accumulation in fish flesh have not been monitored, and there is little capacity to conduct such analyses.

The reclamation of wetlands for urban and agricultural use is a pervasive problem that also affects fisheries resources in Bangladesh. Low-lying areas in urban settings are increasingly being filled in to meet extremely strong demands for land. Boars

(ox-bow lakes) in particular are systematically filled with sediment in order to create new agricultural land.

As the shortage of good cropland intensifies, open-access resources such as capture fisheries become increasingly important to the livelihood of the rural poor. The consequences for local communities can be severe if these open-access resources are not well managed. It is already strikingly obvious that the capture fisheries, particularly the inland capture fisheries, are being overfished and are in need of improved management. Indications are that the marine capture fishery is being fished at or near the maximum sustainable yield, and is also in need of sound management policies.

## Institutional Arrangements

As the legal owner of all permanent water bodies, the Government of Bangladesh is responsible for fisheries management. Through the Ministry of Land Revenue and Reform (MLRR), the government leases fishing rights to the highest bidder. The leasee is usually a middleman who either hires fishermen to harvest the fish, or sells his right to do so. The yearly lease system for beels, haors, khas, and seasonal canals encourages lease holders to harvest completely during the lease period. As a result, fish are not allowed to mature sexually, broodstock numbers are diminished, and recruitment is impaired.

In addition to the pressures related to population growth and increased demand, and conflicts over land use, it would also appear that declining fish harvests are related to the weaknesses of the institutions which are responsible for the development and management of fisheries. The lack of mechanisms to deal with management issues that cut across sectoral lines in the existing governmental structure is also a problem. At present, there is insufficient coordination among the various ministries charged with fisheries and water issues to ensure that intersectoral trade-offs are adequately addressed. For example, there is no process whereby the Directorate of Fisheries can influence the policies of MLRR with respect to leasing public water bodies for fishing.

Fisheries research is currently inadequate and in need of both quantitative and qualitative improvement in order to effectively evaluate the impacts of proposed flood management plans, groundwater development plans, and irrigation schemes. The basic taxonomy, habitats, life cycles, and productivity of

freshwater biota have not yet been well researched and without this crucial information, no one can accurately predict or evaluate impacts, or design successful mitigation responses. At present, there are no research institutions actively gathering or analyzing significant amounts of this basic data, the dearth of which is seriously hampering the implementation of constructive fisheries policies.

A careful area-by-area evaluation of the contributions of agriculture and fishing should be the basis for deciding how much water (and land) should be allocated to fisheries and how much to dry season irrigation. In a similar way, flood control measures should be structured so as to minimize adverse effects on spawning patterns and food availability to fish.

### **3. Forest Resources**

Human well-being and livelihood continue to be closely linked to the availability of reasonably priced wood for fuel, home and boat construction, and a variety of other domestic uses. Equally important is the need for a large number of non-woody products that includes everything from fruits and nuts, to medicines, livestock fodder, and cropland mulching materials. The growing gap between supply and demand of forest products is exacerbated by the scarcity of trees in densely settled rural and urban areas where demand is concentrated, and the poor stocking of existing forest lands. A surprisingly large amount of land which could support a denser cover of tree has not yet been replanted or targeted for agroforestry activities. And forested lands, although overexploited, are not being utilized to their fullest because of a failure to effectively regenerate, protect, and manage them intensively on a sustained yield basis.

Actual forest cover in Bangladesh is approximately 1 million ha, or only 6 percent of the total land area, a reduction of more than 50 percent over the past 20 years. (See *Figure 8*.) As a result, Bangladesh has less than 0.02 ha of forest land per person, one of the lowest such ratios in the world. The decline from 0.035 ha/person in 1968-69 is primarily the result of the dramatic increase in population (from 65 to over 110 million people) and the decrease in forest area.

Though the effects of deforestation have been broadly felt, some areas, such as the inland sal forests in the vicinity of Tangail have been particularly hard-hit. In 1970 there were over 20,000 acres of sal forests here; twenty years later, roughly only 1,000 acres remain. The destruction of these officially reserved forests does not stop at overcutting; unauthorized timber merchants are actually digging out stumps and selling them because they are unwilling to wait for the trees to resprout. The land is then sold off to indigent settlers who convert it to agriculture, even though the relatively poor upland soils will only produce a crop for a few years.

### **Forest Resource Management**

The area of plantations officially reported is often substantially greater than the area successfully replanted. For example, the Forest Department reported that 56,800 ha of plantations had been established in the Cox's Bazar and Chittagong districts, but surveys based on aerial photos in 1985 revealed that the area of good or average quality plantations amounted to only 20,600 ha. Two-thirds of the area reported as plantations was actually in poor condition, had failed, or had been lost to encroachment. In the southern part of the Sylhet district, a number of plantations have been established, the best of which may be producing 11 m<sup>3</sup>/ha/yr. Most, however, are yielding only about 3 m<sup>3</sup>/ha/yr.

Given the constraints to successful plantation establishment and intensive management by the Forest Department, more attention to protection and management of natural regeneration may yield a more favorable cost/benefit ratio than that involved in clearfelling and replanting. Reliance on more effective protection and management of remaining forests would most likely also involve less risk of failure than an attempt to uniformly convert the remaining natural forests into plantations. At least some of the areas currently slated for clear-felling and conversion might be better managed as natural forests on a multiple-use, sustained yield basis. The ways and means of "improved management" and "higher productivity" need to be carefully evaluated, and in the process, more attention should be given to the concerns of local people and the potential for community forestry activities.

## Underpricing Forest Products

Government policies and regulations directly contribute to deforestation and declining productivity. Illicit felling is an ongoing problem. The extreme underpricing and inefficient use of wood products sold to government-owned industries is also a major factor in the mismanagement of forest resources. For example, bamboo royalties paid by industries to the government are only 2 taka per ton and 25 taka per ton for most categories of fuelwood. The royalty on pulpwood amounts to only 0.06 taka/ft<sup>3</sup>. In contrast, bamboo poles cost the ordinary consumer several hundred taka while market prices for fuelwood range between 650 and 900 taka per ton in the Khulna area. Thus, the government is greatly subsidizing industrial consumers (many of whom are state-owned as well) and providing no incentive for increased efficiency while individual consumers pay hundreds of times more for basic materials.

The end result of current priorities in forest management in combination with constantly escalating demands for forest products is a deceptive increase in "output." According to data from The Statistical Yearbook of Bangladesh, the production of timber, fuelwood, and bamboo within reserved forests increased by 93, 159, and 21 percent respectively, between 1976 and 1986. Although these figures undoubtedly do not capture the total output from forest lands, they accurately reflect a trend towards increased output in response to growing demand. However, this increased "output" is not being achieved on a sustained-yield basis, but rather by reducing the growing stock of "capital assets" of the forest resources of Bangladesh. This reality is reflected in the rapid increase in fuelwood prices between 1971–1978. During this period, fuelwood prices increased at an average annual rate of 40 percent, more than twice inflation's rate of 18 percent. At 1984 prices (700–900 Taka/ton), the estimated annual production of fuelwood had a market value of 3.2 billion taka or \$100 million.

## Homestead Forests

The low productivity and underutilization of Forest Department reserved forests and other government controlled lands contrasts with the high productivity and relatively efficient management of the homestead forests. Despite the fact that these homestead forests are the most productive component of the forestry sector, they have historically received little attention

from the Forest Department and the Directorate of Agricultural Extension. The total standing volume of trees on homestead lands is estimated to be about 79 million m<sup>3</sup>, or more than seven times the volume of the growing stock in the Sundarban forests which cover nearly twice the area.

The trees of the homestead forests account for the majority of the country's growing stock and production of forest products,<sup>14</sup> and are an important source of food and income. Trees make important contributions to farming systems which integrate agroforestry, horticulture, vegetable gardens, fisheries, and livestock production with annual crops to better satisfy the full range of a household's needs and to increase its income-generating capability.

Despite their importance to household economies, it appears that a combination of the need to use more of the homestead land for additional homesites, and the continued high level of extraction of wood and other products from the homestead gardens may be leading to a decline in their area. The Agricultural Census for 1977 reported some 304,000 ha of homestead forests, whereas the Third Five-Year Plan cited 271,000 ha in 1985, a decrease of 11 percent in only eight years. This decline may have been accelerated in recent years by the series of extremely severe floods. The trend toward overharvesting could be countered by increasing the support given to farmers to upgrade the quality and productivity of the growing stock on homestead lands.

## Research Priorities

Forestry research only recently emerged from a preoccupation with wood technology and industrial forestry to address agroforestry, the integration of trees into farming systems, and forest conservation. However, forestry research is still not part of a unified management system for forest resources. Nor is it well-funded or well linked with extension systems. In addition, the database for forest management is presently imbalanced. On the one hand, there are more inventory data and management prescriptions than can be effectively utilized given present staff capabilities and operational support. And yet basic, accurate data is lacking on the true extent of tree and forest cover, changes in the productivity of homestead forests, as well as the socio-economic factors affecting the expansion of community forestry programs and multiple-use management of natural forests.

Similarly, ongoing efforts to upgrade the technical skills and analytical capabilities of the staff of the Forest Department, NGOs and others with a growing interest in forestry and agroforestry need to be expanded, especially in the new areas of participatory forestry and joint management of forest resources by local communities. A number of initiatives are underway to provide assistance in these areas, including those supported by the Ford Foundation, Winrock International, the Swiss Development Cooperation, and others.<sup>15</sup>

Above all, the forestry sector needs to be reoriented and revitalized by the elaboration of a forest policy which recognizes the importance of the homestead forests and effective protection of the remaining areas of natural forests. Existing policies on clearfelling and constraints to expanding the role of local communities in forest protection, management, and harvesting operations need to be re-assessed and resolved. Substantial progress could be achieved by increased support for community forestry, the development of homestead forestry, the improved protection and management of remaining natural forests, and the accompanying research and extension activities for these areas. And finally, as one of its tangible goals, the Forest Department should seek to restore forest and tree cover (including trees integrated into farming systems and around homesteads) over a significantly greater area by the year 2000.

## **4. Energy**

Bangladesh currently faces two energy crises, one in the modern and the other in the traditional energy sector. Combined, the two sectors are unable to meet the country's present energy needs; the shortfall, equalling 10 percent of total consumption, is made up by petroleum imports. The share of Bangladesh's export earnings needed to cover the cost of importing commercial petroleum was 45 percent in 1985 (down from 90 percent of total export earnings in 1982).

Energy consumption in Bangladesh is overwhelmingly domestic, rural, and supplied from traditional sources. 88 percent of all energy is consumed in rural areas. Only 12 percent of rural consumption is supplied by outside commercial sources such as kerosene, diesel, and electricity. 73 percent of total energy is consumed by the household sector for subsistence purposes. 27 percent of total

energy was consumed for productive purposes, of which industry accounted for 17 percent.

Bangladesh's national endowment of commercial energy resources is modest but underexploited. These commercial fuels are found in isolated pockets and not generally available due to poor distribution facilities. Sylhet contains the one small deposit of the country's only known source of petroleum. Proven reserves of natural gas (12.17 trillion cubic feet) are substantially greater, but still not nearly enough to meet total petrochemical needs. An estimated 50–100 million tons of coal are known to exist in Jamalganj District, but commercial extraction is not yet feasible on a large scale. The same applies for the known sources of peat (600 million tons).

### **Biomass Energy**

Although consumption of domestic supplies of natural gas is increasing, a reliance on traditional biomass fuels is not likely to diminish in the near or medium term because of severe constraints on increasing the consumption of petroleum products and modern energy sources other than natural gas. Biomass fuels account for more than 80 percent of the energy consumed in Bangladesh.

As a result of a special study funded by UNDP and the Asian Development Bank, the status and trends in the use of biomass fuels have been extensively analyzed. According to the 1986 UNDP/AsDB report, agricultural residues, wood and tree litter, and dried cow dung provided 66 percent, 18 percent and 16 percent respectively, of the energy derived from traditional biomass fuels in 1981.

Estimates of fuelwood production are highly variable, due to the need to account for undocumented production from illegal logging and subsistence users. In 1981, the total fuelwood production was felt to be about 4 million tons (approximately 6 million m<sup>3</sup>). 54 percent of the fuelwood produced in 1981 was consumed by urban households, 20 percent by brick-burning kilns, 18 percent by rural households, and 8 percent by other industries. Since that time, fuelwood use by urban households has reportedly declined, as a result of increased access to electricity, and fuelwood use for brick-burning has risen to about 40 percent of total fuelwood consumption,<sup>16</sup> as a result of sharply increased demand for bricks for construction of buildings (and to a lesser extent) for roads.

On average, the construction of feeder roads requires about 341 bricks per meter, or 341,000 bricks per kilometer of road constructed. In order to reach a target of 7320 kms. of constructed feeder roads by 1998, some 2.5 billion bricks will be needed. However, the demand for bricks for road construction is estimated to represent only 6 percent of the total brick production of the country.

In recent years, brick-burning has consumed large amounts of fuelwood since only 156 out of 1089 brickfields are able to use natural gas. Most brickfields have traditionally used fuelwood, although a recently imposed ban on the use of fuelwood in brickfields has forced a shift to coal; the use of natural gas was also banned in brick fields in 1989. Research and testing, however, have clearly indicated that natural gas is the preferred fuel for brick-burning: it is more efficient, economical, and produces a better quality product. A policy change to promote the use of natural gas as a source of energy for brick-burning would significantly reduce the demand for fuelwood, and avoid the increase in air pollution associated with the increased use of coal in brick-fields.

Urban households prefer to use gas or electricity for cooking, since it is substantially cheaper than fuelwood. However, the poorest urban households with no access to gas or electricity have no choice but to pay the higher prices for fuelwood or scavenge whatever lower-grade biomass fuels they can find. In rural areas, surveys have indicated that 5–15 percent of the standing volume of trees on homesteads is annually harvested to meet the demand for fuelwood. In many areas, it appears that as much as 40 percent of the fuelwood supply may be obtained by overcutting and gradual depletion of both homestead and reserved forests.

Thirty-four percent of cow dung produced is used as fuel; lesser amounts are used in buildings, or wasted (too wet and impractical to use for fuel in the monsoon; or simply not collected and applied to fields). Half of the dung is reportedly applied to the fields as manure, but even this level of application has not been sufficient to prevent a decline in soil organic matter content (reportedly now less than 2 percent for more than 60 percent of the cultivated land area). Although there are serious constraints to the increased production of dung as a biomass fuel (lack of fodder for livestock, difficulty of drying dung in the monsoon season), its use as manure to replenish soil organic matter could be facilitated by increasing the supplies

of fuelwood and fodder from both reserved and homestead forests.

In retrospect, it appears that there has been little concerted effort to address energy and land use issues in an integrated fashion. The potential role of energy conservation and the possible means of augmenting the production (and sustainable use) of biomass fuels also merit more attention. Energy conservation could be achieved through mechanical innovations, particularly more efficient stoves and industrial furnaces, and the implementation of solar grain dryers.

The expected returns that can easily be gained through more efficient management of biomass energy sources will most likely not be sufficient to meet short-term demands. By their very nature, biomass fuel development programs require several years to produce results. As a result, commercial energy development is essential, not only as a short-term alternative to biomass sources, but as part of a longer term energy development strategy.

Natural gas, in particular, should be made more widely available and its use encouraged. However, as commercial energy resources are developed in such a densely populated country, close attention will need to be given to the impacts from construction and operation of transmission lines and new power plants, so as to minimize the problems associated with dislocation of families and with emissions and effluents.

## **5. Urbanization and Industrial Pollution**

The last national census (1981) revealed that only 15.5 percent of Bangladesh's population is urban (settlements of more than 5,000 people). While this figure is relatively low for developing countries, given Bangladesh's large population, it still translates into more than 15 million people in over 500 urban centers. (See *Figure 4*.) The effects of such numbers on a limited institutional capacity and resource infrastructure that is not equipped to accommodate them have resulted in severe shortages in housing, land, sanitation, and water resources despite the Government's efforts to provide adequate shelter, health care, and other services.

The present annual urbanization rate of 6.5 percent means that additional significant stresses will be

placed upon an already strained system. It also signifies a tremendous increase for a country that was less than 3 percent urban at the beginning of the present century. During the 1950s, Bangladesh experienced a 45 percent increase in its urban population. Over the next censal period (1961–74), the urban population grew 137 percent while for the most recent period, (1974–81), the increase was over 115 percent, although some of this increase can be accounted for by the extended definition of urban area formulated in conjunction with the 1981 census. If the present annual rate remains constant, however, urban population in the year 2000 will be between 35–40 million—an increase of over 20 million people.

The urban growth rate exceeds the national population growth rate by nearly threefold. This is accounted for primarily by rural-urban migration which contributes an additional 1.8 million people to the urban areas each year. Rural-urban migration is a combination of “push” factors such as population pressure, land shortages, natural disasters (including river bank erosion) and a decrease in rural employment opportunities; these factors work in combination with “pull” factors such as perceived improved social opportunities, and the lure of urban amenities. Correctly or not, many impoverished rural people see their only hope for continued economic survival lying in urban centers.

Over 50 percent of the urban population is found in the thirteen largest metropolitan areas. The three largest, Dhaka, Chittagong, and Khulna, account for 26, 10, and 5 percent of the total urban population respectively. The capital of Dhaka, whose population more than doubled between 1974 and 1981, continues to be the single largest urban area with over 5 million inhabitants. The dramatic growth in urbanization, however, has not been limited to the three largest urban areas. The total number of urban centers has increased fivefold between 1974 and 1981, from 108 to 492. As of the last census, there were 129 urban centers with populations between 5,000 to 9,999 and 168 with less than 5,000 people. Because of their relative newness and rapid, often unchecked, expansion, these secondary and tertiary centers have also generated significant environmental pressures.

### **Environmental Problems of Urbanization**

Providing space for the newly emerging urban centers has already put pressure on valuable agricultural land. Good agricultural lands are

generally free of extensive flooding, and thus more suitable for human settlement. The increased demand for construction materials has led to the conversion of nearby agricultural lands to brick fields. Forest resources and fisheries in the vicinity of urban centers are becoming overexploited as a result of the pressures of urban demand. The filling of water bodies also reduces fish habitats.

The quality of life for urban dwellers, particularly the poor, deteriorates with continued growth. The rate of land appreciation is excessive. It is estimated that recently, land values in Dhaka have increased between 60 and 90 percent per year. This results in poor and middle income families being pushed to marginally serviced areas at the fringe of the cities. Housing shortages cause urban dwellers to live in high-density units, often without proper facilities such as piped water, sewage, drainage, and garbage removal. Living conditions among the urban poor are directly linked to their deteriorating health and nutritional status. The incidence of disease among slum and squatter settlement dwellers is high. The overall infant mortality rate in a central slum areas of Dhaka is 152 per 1000, compared to the national average of 124 per 1000.

Lack of adequate water supply and sanitation is most closely linked to the spread of water borne diseases and subsequent high rates of morbidity and mortality in urban slum and squatter areas. Water supplies are unable to keep pace with demand and in the case of Dhaka and Chittagong, are regularly disrupted by lowering of the groundwater levels in the dry season. Continued filling of canals and ponds in urban areas to create more land is also reducing access of the urban poor to water for washing and other uses.

The current Five-Year Plan recognizes the importance of urbanization issues by explicitly, though briefly, stating the potential environmental consequences of rapid urban growth. However, it does not set a national goal for urbanization and urban growth and outlines relatively modest targets to be achieved during the plan period. Upazila centers are presently preparing land use plans, and about half are complete. In addition to financial constraints, a major problem for preparing appropriate physical development plans is the lack of adequate trained human resources. Compared to the magnitude of the tasks at hand, the number of competent urban planners in the country is extremely small.

## Industrial Pollution

One consequence of the growth in urban centers and industries has been increasing levels of pollution. The government recognizes that pollution, especially vehicular, industrial, and sewage-related, is an ever-increasing problem. Air pollution is becoming a serious problem that requires analysis and monitoring particularly in Dhaka and Chittagong. Large moats of polluted water surround tanneries and textile mills which are separated from rice paddles only by low and narrow earthen berms; flood conditions result in the spread of polluted water across floodplains that are utilized for fishing and rice cultivation. Like many other industrial facilities, the DDT manufacturing plant near Chittagong dumps its waste directly into the bay.

Despite the existence of some pollution control laws and institutions, Bangladesh may continue to attract industrial investment, in part because of the country's difficulties in enforcing industrial pollution regulations. Laws regulating marine pollution are especially lax. 144 industries are active in the eight industrial zones of Chittagong, all of which discharge their untreated toxic wastes directly into the Karnaphuli River or the Bay of Bengal. Few if any industries have any pollution treatment facilities. Due to a lack of sanitation and waste collection systems, decomposing sewage and solid wastes for the entire city of Chittagong eventually reach the Karnaphuli River. During the dry season, the decreased flow reduces the capacity of the river to purify itself of biodegradable wastes. The total biodegradable load from domestic waste alone is estimated to be ca. 3.5 tons/day. The fish catch is diminishing yearly as a result of oxygen depletion from the decomposition processes.

More than 50 percent of the oil pollution in marine systems originates in urban areas and is delivered by rivers. Nearly 1,000 ships, including 50 oil tankers, ply the waters of Chittagong harbor every year, not to mention countless smaller craft. All of these ships are permitted to discharge ballast water and bilge washings, a policy which makes Bangladesh an exception to world maritime practices.

The key institution charged with addressing issues of environmental pollution is the Department of the Environment (DoE), formerly the Department of Environmental Pollution Control. Despite its recently expanded mandate as part of the newly established

Ministry of Environment and Forestry, the DoE has a relatively small staff of some 70 persons, and little political power. If the environmental pollution problems in Bangladesh are to be addressed with any degree of effectiveness, the DoE must develop both a stronger legislative mandate and greater powers of enforcement. Areas that demand immediate attention include waste monitoring procedures, the renovation of ecologically disturbed habitats, the installation of sewage systems, and the dissemination of pollution control technologies so that the private sector can directly participate in developing local solutions to a significant national problem.

## 6. Biological Diversity

Biological diversity provides immediate benefits to the rural population which is directly dependent on the productivity of the natural resource base. A rich diversity of native fish species are critical to the economy and diet of the people of Bangladesh, providing approximately 80 percent of protein consumed—an important supplement to the rice based diet. Over 70 percent of rural families participate in part-time fishing, and approximately 1.7 million people are directly engaged in commercial fisheries. Fishery exports (primarily pond-raised shrimp nurtured from fry gathered in the mangrove forests of the coast) are an important source of foreign exchange.

The estimated annual production of fuelwood had a market value of \$US 100 million dollars in 1984; much of the wood is produced from a diverse array of multi-purpose species tended in homestead gardens in rural areas. Estimates of annual fuelwood production/consumption range to over 8 million cubic meters.

Bangladesh has been one of the world's leading exporters of reptile skins, although over-exploitation has led to efforts to institute a ban of the export of some skins. Management of reptile and frog populations could result in sustained production of valuable exports. Other so-called "minor" or non-woody forest products, such as fruits, medicinal plants, fodder, rattan, bamboo and golpatta (nipa) palm figure prominently in local trade.

The substantial fertilizer value of the blue-green algae and other living organisms in floodwaters that annually renew agricultural lands has not been estimated. Genetic diversity important for improving

Bangladesh agricultural production includes some 10,000 local varieties of rice as well as local varieties of legumes, fruits, and vegetables cultivated for sale and household consumption. Homestead forest production (based on a wide variety of annual and perennial species) contributes between one-third and one-half of rural family incomes.

Biological diversity is threatened by deforestation, forest conversion, agrochemical and industrial pollution, large-scale development projects such as irrigation and flood control projects, land use changes, and overexploitation of biological resources. Clearcutting, burning, and overcutting contribute to the destruction of the native and secondary forest diversity, including indigenous species that could be profitably managed for timber and fuelwood production. Currently, there are no plans for managing the few remaining stands of natural forest as natural forests; instead, these stands are being cleared and converted to single-species tree plantations.

Threats to biological diversity can originate from a variety of sources, including some which are relatively indirect but nonetheless important. Macroeconomic and sectoral policies often fail to take into consideration impacts on biodiversity. Weak institutions, inadequate funding, and unclear ownership policies have contributed to the lack of protection of threatened biological resources. And finally, biological diversity suffers as a result of the minimal regard given its economic value. Owing in part to the incomplete data on the economic value of biodiversity which is currently available, its value is frequently underestimated (or ignored) by development planners.

## Wildlife

Most terrestrial wildlife is dependent upon Forest Department lands for habitat, but the Forest Department's institutional capacity to promote and administer wildlife management has not yet been developed to a significant degree. Compounding the government's lack of wildlife management activities on land managed by the Forest Department are the land use restrictions place on lease holders of public lands and the constraints on private forestry that severely limit private sector involvement in wildlife management.

Weak support for wildlife management activities threaten the survival of Bangladesh's most prominent

terrestrial species: the Royal Bengal tiger (*Panthera tigris*). The Sundarbans region in southwestern Bangladesh and eastern India is home to the world's only genetically viable tiger population: no other habitat is sufficient to sustain a large enough breeding population. An international Wildlife Refuge Management Plan<sup>17</sup> that calls for integrated management of the Sundarbans for multiple uses including timber extraction and tiger population maintenance has been proposed, but no action has yet been taken. The Forest Department has successfully maintained the Sundarbans ecosystem for over 100 years, and implemented a series of forest management plans, but new demands are threatening to undermine the long term sustainability of continued forest products extraction and habitat protection.<sup>18</sup>

Lack of public interest and leadership in wildlife conservation has led to neglect of the system of protected areas. (See Figure 7.) The reserve system that has been created was not planned with clear priorities defined by an overseeing body. Nor have sufficient funds been dedicated to the protection and management of parks and reserves.

Large populations of waterfowl pass the winter season in the haors and seasonal water bodies of northeast Bangladesh. A number of organizations are interested in the future of these waterfowl populations, as well as the remaining wildlife in the hill forests and adjacent to the tea estates, but their future remains uncertain.<sup>19</sup>

## Aquatic Diversity

Bangladesh's abundant fish population represents one of the country's most diverse biological resources. More than 500 species of fish inhabit Bangladesh waters, nearly twice the number native to the Mississippi basin. This resource is critical to the livelihoods of the rural poor. The productivity of natural fisheries relies heavily upon the availability of large nutrient-rich areas during annual monsoon flooding cycles when reproduction generally takes place. The continued presence of such widespread flooding is therefore crucial in maintaining large fish populations.

Increased river training, flood management activities, and groundwater development as well as overfishing directly threaten the open-catch inland fisheries and are believed to have an impact on coastal and marine species which spend part of their life cycle

inland. Increased fish and shrimp culture is unlikely to entirely mitigate the losses of open-catch fisheries. In addition, despite increasing supplies from hatcheries, aquaculture is still largely dependent on wild fry and larvae. Experience in other countries suggests that open-catch fisheries in Bangladesh have several advantages: biological diversity offers risk-spreading advantages against pathogens or susceptibility to pollutants, and numerous species establish niches in a way that makes maximum use of available habitats. Yet there is insufficient data specific to Bangladesh's aquatic resources upon which to test these hypotheses.

## Agricultural Diversity

Bangladesh has a rich diversity of agricultural genetic resources. Its crop germplasm is important domestically as well as internationally. Approximately 32 percent of the rice planted is made up of modern varieties, the remainder is traditional and improved traditional varieties. Some 10,000 traditional varieties of rice are currently planted in Bangladesh. Local agricultural scientists and the government are concerned about the conservation of germplasm. Timely action must be taken in light of apparent rates of depletion since Bangladesh's current capacity to conserve germplasm is limited. Reliable germplasm banks for *ex situ* conservation are expensive to maintain and will require long-term commitment of staff and funds from the Government of Bangladesh if they are to merit investment.

Institutions concerned with wild plant and animal diversity are weak. Yet, Bangladesh has a cadre of dedicated, hard-working and knowledgeable biologists, foresters, fishery experts, and other relevant professionals. Policy reform, commitment to policy implementation, improved enforcement of legislation, financial commitments to wise management of natural resources, and strengthened institutions may still be able to redress biodiversity depletion in Bangladesh. There are, in fact, indications of a growing appreciation of biodiversity that can be tapped to build a broader constituency.

More attention is needed to preserve the valuable and unique Sundarbans ecosystem (see separate section, below). Freshwater aquatic biota needs to be considered more carefully in major water development projects. Greater commitment to conserving the gene pool from which HYVs increases are derived is urgently needed. Government policies should reflect the importance of conserving genetic and biological

resources through maintaining channels for diversification of agricultural resources, improving institutional capacity for wildlife management, and reforming forest clearfelling policies in favor of natural forest management.

Historically, donor support for biodiversity projects has been very low, but there are indications that this is changing. The National Conservation Strategy for Bangladesh is now being prepared. This strategy offers an important opportunity for donors and the Bangladesh Government to support this process and the follow-up activities to identify long-term priorities for conserving the national heritage of biological wealth.

## 7. Flood Control

Society in Bangladesh has evolved in conjunction with the seasonal dynamics of the great Ganges-Brahmaputra-Meghna delta. Agriculture and fisheries are dependent on its annual inundation. The growth in rural population, however, has pushed human settlements and activities into increasingly hazardous flood zones. (See Figure 5.) The severe flooding of 1987 and 1988 has created a greater sense of urgency among the government and donors to develop and implement a major initiative to control flooding. In any discussion of major flood management strategies, however, it is important to recognize the technical limitations posed by a floodplain which is the outlet for three of the largest rivers in the world.<sup>20</sup>

Both the physical and biological risks of large embankment schemes are high, and need to be fully incorporated into a benefit-cost analysis for any major water engineering project. A thorough environmental impact assessment is, of course, necessary to ascertain potential environmental costs. The Government of Bangladesh and the international donor community have recently agreed upon an Action Plan for Flood Control. The first phase of this action plan entails some 25 detailed studies of the various physical and technical aspects of flood mitigation.

Both the Action Plan for Flood Control and the National Water Plan recognize the need to evaluate the possible effects of flood control and related infrastructure development in the floodplain on fisheries. The National Water Plan states that all water projects must recognize the basic fishery production systems, identify clearly those water development and

flood control choices that would adversely affect fishing, and propose area-specific balances to alleviate competing interests. It is increasingly being recognized that the inland capture fishery is in direct and unfavorable competition with agriculture for floodplain lands. Though economic analyses of the loss of fisheries production need to be incorporated into any flood control works evaluation, little biological and socio-economic data are available. This need for more complete data and analysis is recognized, however, in the proposed Fisheries Study of the Flood Control Action Plan.

The National Water Plan has focused most of its flood control and drainage projects on smaller scale interventions, such as small embankments and submersible dikes in the higher, low energy regions of the floodplain. It generally avoids river training projects. Although the government is considering major embankments proposals for flood diversion, it is also considering ways to alleviate flood damage. Such measures as improved warning systems and the creation of elevated refuge facilities near villages which will be equipped with food and medical supplies, are "flood proofing" strategies. Not only are they low cost, they also take advantage of local response methods already in effect.

## **8. Cross-Sectoral Linkages: A Case Study of the Sundarban Mangrove Ecosystem**

Most attempts to manage natural resources are organized under sectoral headings such as forestry, fisheries, wildlife, agriculture, energy, water management, and flood control. Government and donor management activities, professional training, development planning, and the marketing of natural resources are, with few exceptions, formulated in sector-specific ways. Too often, however, these sector-specific activities overlook important linkages between sectors.

The importance of cross-sectoral linkages in Bangladesh is perhaps best illustrated by the web of relationships between ecological processes, natural resources, people, and institutions in the Sundarbans. The importance of the area to Bangladesh extends substantially beyond the mangrove forests and network of waterways that spread along the coast of

southwestern Bangladesh and into eastern India. The maintenance of the Sundarbans as a healthy ecosystem is vital to the country's biological diversity, wildlife, fisheries, energy supplies, forest products, agriculture, coastal groundwater, and coastal flood control.

### **A Unique Resource**

The Sundarbans constitutes the largest natural habitat area in Bangladesh, and together with the adjacent Indian Sundarbans, forms the largest mangrove forest ecosystem in the world. Modification or degradation of this unique resource will not only be a tremendous loss with serious consequences for Bangladesh, but for the rest of the world as well.

The Sundarbans is home to the world's largest population of the Royal Bengal tiger (*Panthera tigris*). While there are approximately 4,000 individuals elsewhere in Asia, these animals all live in relatively small populations in isolated habitats. Only the Sundarbans provides a large enough natural habitat to ensure the long-term survival of the tiger in the wild. The Sundarbans is also considered to be some of the best habitat left for the globally endangered estuarine crocodile (*Crocodylus porosus*).

### **A Valuable and Irreplaceable Resource**

Covering an area of about 577,000 hectares, the Sundarbans has been managed as a forest reserve since 1817, thus making it one of the oldest, managed forest areas in the tropics. For decades it has been an important source of timber, fuelwood, and wood fiber for newsprint. In fact, the entire domestic demand for newsprint and hardboard is supplied from the Sundarbans, in addition to about 10 percent of the fuelwood used in Bangladesh. Wood is cut in a planned harvesting cycle, and the continued productivity of the forest historically has been assured entirely by natural regeneration. However, in recent years, increased pressures to harvest larger amounts of wood appear to have contributed to a gradual reduction in the total volume of the forest growing stock. In addition to wood, the forest produces a steady supply of rattans, thatching material, fish, honey, and beeswax.

At present, 300,000 families depend on gathering fuelwood and lumber, collecting honey, and fishing in the Sundarbans ecosystem under a permit system managed by the Forest Department. This figure, however, is probably a considerable underestimate since it is based on the number of permits issued, and

the number of actual users of the resource is undoubtedly greater. As many as 200,000 fishermen depend directly on Sundarbans fisheries from November until the onset of the monsoon.

It is estimated that an additional 50,000–100,000 are employed in processing and marketing raw materials from the Sundarbans. A considerable amount of economic activity in the nearby Khulna, Jessore, and Barisal areas are dependent on these activities. Small river ports serve as a base for a considerable volume of small-scale wood processing and fishing operations. Such ports are also embarkation sites from which people set out to collect fuelwood, golpatta (used primarily for thatch), hantal leaves, beeswax, lime, and honey.

### **An Open System**

One of the major characteristics of mangrove ecosystems is that they are open systems, linked upstream with the land, and downstream with the sea. Nutrients are derived primarily from upstream catchments or from tidal flooding while organic materials are transported seaward. This organic material is produced through a complex detrital-based food web and represents a major source of food for a variety of marine and brackish water organisms.

Because of their importance to fish species which spend most of their lives in other waters, the aquatic habitats of the Sundarbans are essential to the productivity of both inland and coastal fisheries. Nearly 400 fish species make use of the Sundarbans habitat for at least part of their life cycle. Many freshwater species use these habitats temporarily during periods of peak run-off, but spend most of their life cycle inland. Other species spend much of their life cycles in offshore waters, but depend on mangrove forests for nursery areas. Wild shrimp fry from these habitats are important to the success of shrimp farms in the Sathira, Khulna, and Bagerat areas.

The wider importance of an intact Sundarbans ecosystem is considerable as it serves to protect human settlements in adjacent areas from the ravages of cyclones. There is some evidence to suggest that the loss of life from cyclones is greater in the Barisal and Patuakhali areas than in the Khulna area which is more directly shielded from tidal surges by the Sundarbans. The Sundarbans ecosystem is also important in protecting adjacent inland groundwater

from salinization. This is vital to agricultural production and drinking water supplies in these areas.

### **The Necessity of Recognizing Cross-sectoral Linkages**

The contributions made by the Sundarbans ecosystem to the forestry, fisheries, energy, agricultural, and water management sectors in Bangladesh are being increasingly threatened by narrowly focused sectoral efforts both within and outside the area.

A steady decline in fish landings has been noted from many inland waters. The most likely causes are agricultural and industrial pollution and increased interventions in inland water resources. These factors also threaten to undermine the productivity of the fisheries in the Sundarbans. In addition, the Sundarbans is vulnerable to pollution from the Mongla shipping channel along the Passur River. If the Sundarbans fisheries habitat is degraded, it is likely to have serious consequences for the overall productivity of both inland and offshore fisheries in Bangladesh. This would constitute a serious threat to efforts to improve per capita nutritional intake.

Plans to intensively exploit groundwater supplies for agricultural purposes may result in a number of indirect and unintended impacts: surface water stream flow is likely to be reduced during the dry season as the aquifer is drawn down. The chemical characteristics of many tidal creeks will be altered. Salinity will increase, as will the concentration of chemical pollutants. Water resources development and flood control projects in Bangladesh must consider the impacts they might have on the health of the Sundarbans ecosystem.

The Sundarbans is a rich natural resource located in one of most densely populated parts of the world. The optimal value of the Sundarbans ecosystem is likely to depend on the maintenance of its integrity as a natural ecosystem. The most productive investments for many Bangladeshis, for international conservation, and for the tiger, are all likely to come from efforts to strengthen the sustainability of current resource uses in the Sundarbans. Such efforts, however, depend upon the careful consideration of policy-makers and government planners acting in an integrated, cross-sectoral manner that takes into full account all the factors that effect this complex and valuable ecosystem.

D.

## INSTITUTIONAL AND POLICY FRAMEWORK

### **Government Agencies: Administrative Structures and Capabilities**

The Government of Bangladesh employs over 1 million staff persons, with responsibilities dispersed among 17 Ministries, and a variety of commissions, nationalized agencies and other bodies.<sup>21</sup> From the standpoint of environmental protection and natural resource management issues, one of the most important administrative structures is the newly established Ministry of Environment and Forestry. This Ministry was formed in 1989 by the fusion of the Department of Environmental Pollution Control (DEPC), which had been in the Ministry of Local Government and Rural Development, and the Department of Forestry, formerly part of the Ministry of Agriculture.

The new Department of the Environment (DoE) has its roots in the 1977 Environmental Pollution Control Ordinance, which established an Environmental Board, later transformed into the DEPC. The DEPC (now the DoE) is the only agency specifically directed to exercise environmental regulatory authority in Bangladesh. Up until early 1989, the DEPC had a staff of some 70 persons, mostly engineers and chemists. They were primarily concerned with enforcement of legislation related to the discharge of industrial pollutants. They were also responsible for monitoring air and water quality, and solid waste.

The DEPC has been handicapped by inadequate numbers of well-trained staff, an annual budget of

only slightly more than \$100,000, and statutes which limit enforcement fines to 5,000 Taka (about \$150) for each violation. To strengthen the Department's hand in environmental pollution control, a revised law has been approved by Parliament to give the agency more authority, including the power to issue cease and desist orders against private and governmental violators, and the ability to levy fines of 25,000 Taka for each violation. In addition, the Dhaka Urban Infrastructure Improvement Project of the AsDB will over the next three years be providing resources needed to increase staffing, training, logistical support and improved laboratory and other facilities needed to strengthen the pollution control, regulatory and environmental assessment functions of the DoE.

Under the new Ministry, the mandate of the Department of Environment will continue to be responsible for regulation of industrial and other sources of pollution, and for monitoring environmental quality. But, the Department's mandate has been substantially broadened to include a stronger role in environmental impact assessment, and in formulating guidelines and advising line agencies involved in activities affecting soil and water conservation, afforestation, wildlife, critical habitats, fisheries and other natural resource issues. It is anticipated that the Department will assist in formulating "action plans" to deal with a number of high priority environmental issues, including: maintenance of water quality, control of deforestation, and improved regulation of industrial wastes. The staff of the DoE is projected to expand to over 670 persons,

many of whom would be assigned to the district level.<sup>22</sup>

Another important institutional resource for dealing with environmental and natural resource management issues in Bangladesh is the administrative structure for national development planning. The Planning Commission of the Ministry of Planning is charged with the preparation of Five-Year Plans. The Ministry goes beyond the function of a planning agency, and actually controls the allocation of funding to individual Ministries responsible for implementing specific projects under the Five Year Plan, in accordance with the Annual Development Program.

The Planning Commission has the authority to supervise and coordinate cross-sectoral and inter-ministerial activities affecting the use of natural resources and the environment. It has responsibility for preparing guidelines which must be respected by the line Ministries in their proposals for the next Five Year Plan. These proposals are reviewed by the Planning Commission, prior to submission to the National Economic Council (NEC) for approval. Once approved by the NEC and incorporated into the Annual Development Program, projects are to be periodically reviewed by the Implementation, Monitoring and Evaluation Department (IMED) of the Ministry of Planning.

Most actions related to environmental and natural resource management in the Third Five Year Plan (1985-1990) have been subsumed under plans for various sectors such as forestry, fisheries, water, energy, industry, and physical planning. A specific environmental component for the plan, as well as institutional linkages between potentially competing interests affecting the environment have been largely neglected. For example, little is said in the Third Five Year Plan about how housing and industrial development plans should protect high quality agricultural land; or how industrial development (and associated pollution) and ground water development may affect flood plain fisheries; or the environmental factors that should be considered in the development of extensive coal deposits or the estimated 11 trillion cubic feet of natural gas in Bangladesh.

The Plan does cite a number of significant environmental problems, however, including loss of arable land; need for a national land use policy; need for urban area master plans which address anticipated housing requirements for shelter; need for training of

farmers, fisherman and others to improve resource production and conservation; and needs for expanded educational programs in social forestry.

In order to increase the attention given to intersectoral linkages and to the anticipated environmental impacts of proposed development projects, a new "environmental cell" is being established within the Planning Commission. This cell is expected to aid in the initial screening of environmentally sensitive or significant development projects, and may also increase the support given to projects aimed at improved environmental monitoring, assessment, and management of natural resources.

Responsibility for management of forests, fisheries, and agriculture land are relatively focused within individual departments and ministries.<sup>23</sup> Water resources development, however, has been a responsibility of some 35 government agencies, although the Bangladesh Water Development Board has primary responsibility for water resources development, including irrigation, drainage, flood control, and land reclamation. The BWDB has been criticized for poor designs and maintenance, failure to carry out environmental planning, inadequate interagency coordination, and insufficient participation of local planners and intended beneficiaries.<sup>24</sup>

Recognizing the need for a more comprehensive National Water Plan to meet all water use demands, in 1983, with support from UNDP and the World Bank, the Government created the Master Plan Organization (MPO) under the Ministry of Irrigation, Water Development and Flood Control. As in the case of the BWDB, the MPO lacks regulatory or project development authority, but it has developed extensive technical and planning capabilities with local consultants, government staff, and other support personnel. By 1986, the MPO had evaluated alternative plans for the development of surface water and groundwater resources and presented its findings on the demands and potentials for water resources development, and its recommendations for a national water plan.<sup>25</sup>

The system of local government institutions was reorganized and strengthened between 1982 and 1984 to enhance responsibilities and effectiveness at the local level. There are now 4 administrative divisions, headed by a Presidentially appointed Commissioner; 64 zilas (formerly districts) headed by a Presidentially

appointed civil servant; 460 upazilas (village level administrative units) with a council chairman elected by the people; and 4339 unions (formerly blocks) with popularly elected councils which elect the upazila councils. There are also 87 municipalities, including the Municipal Corporations of Dhaka, Chittagong, and Khulna.

Under the Local Government Ordinance of 1982, each upazila council or parishad can carry out various delegated powers, including building regulations, and implementation of projects related to infrastructure development and environmental management. The major line agencies, such as the Department of Agricultural Extension, now have offices and function at the upazila level. The Ministry of Local Government and Rural Development supervises and administers funds to local government and other municipal entities, and represents them in Parliament.

Except for national laws and regulations affecting forests, land tenure and coastal resources, land use planning is largely carried out by local and municipal governments, under the supervision of central government. Municipalities have the authority to prepare master plans and site development schemes and to impose building controls, although the lack of trained personnel and funding limits such activity. Acts in the 1950's and 1960's established planning and development authorities in Dhaka, Chittagong and Khulna, but these have reportedly not proved successful.<sup>26</sup> For example, the Dhaka Improvement Trust (DIT) prepared a Master Plan in 1959, with designated single-purpose zones; but, urban population growth rates were underestimated, there were no restrictions on the use of floodplains and cultivated lowlands, and inadequate provision for effective controls over residential and commercial development. DIT's capabilities have been overwhelmed by the large number of construction projects that sprawl outward from Dhaka.

## **Environmental Laws and Enforcement Capacity**

Many of the environmental laws of Bangladesh were promulgated before independence and are only recently being revised and updated, or have yet to be updated. Urban planning laws of the 1950's and 1960's were passed when cities were growing at about half the present rate, and when population was half the present size. The Factories Act of 1965 and other

health protection laws were also designed before industrial pollution and hazardous substances became serious concerns. Currently, the capacity of local engineers and public health officials to anticipate, monitor and enforce laws intended to mitigate the risks from environmental hazards associated with the workplace are limited by lack of training and available resources.

The Forestry Act of 1927 created categories of forest lands when enforcement against deforestation was manageable; forestry laws have recently been revised to raise the level of fines and alter other provisions, but a comprehensive review and further reform of policies as well as the legal framework is still needed.

Air pollution from vehicles, the responsibility of the Ministry of Transport, is governed by the 1939 Motor Vehicle Ordinance, as modified in 1983 to curtail "black smoke." Air pollution in congested urban areas is now a serious problem, yet the legal and institutional framework to deal with it remain inadequate. The Pesticide Ordinance of 1971, as amended in the 1980's, establishes requirements for regulating imports and for testing, packaging, storing, transporting and disposing of pesticides. However, except for import controls, labeling and use restrictions are largely unenforced. Furthermore, responsibility for pesticide monitoring and law enforcement is diffused among many agencies, and interagency collaboration needs to be improved in this area.<sup>27</sup>

Since 1953, national tenure laws and customs have limited the size of a family's legal holdings to about 30 acres, although there are numerous legal exceptions and illegal abuses. Muslim laws of inheritance reportedly accelerate land division by giving all children a share of the land. Trends indicate increasing percentages of landlessness and marginally sustainable farms. The percentage of farms of less than one acre has grown from 24 percent in 1960 to 41 percent in 1984.<sup>28</sup>

Coastal waters and the sea are under state jurisdiction, as well as adjacent lands. Land may be leased to private individuals, as in the case of shrimp culture. Rights of fishing in the Bay of Bengal are not regulated by any established law, but some areas are zoned to restrict certain types of mechanized boats, and permits are needed for commercial fishing operators. Access and use of the reserved mangrove

forests of the Sundarbans are controlled by the Forest Department, which issues permits for fishing, wood collection, honey gathering and other extractive uses.

## **The Role of the Private Sector**

As industrial activity increases in Bangladesh, the private industrial sector will have a growing responsibility to utilize resources sustainably and mitigate environmental damage resulting from industrial processes. At present, accountability on the part of industries for the resource exploitation and pollution they generate is restricted to a few businesses. The growth of private groups that are concerned with monitoring industrial activity, coupled with the strengthened mandates and capabilities of government agencies which oversee private industry, have begun to raise public and private concern for improving the environmental record of Bangladesh's industries. A concomitant sense of professional responsibility is needed by the owners and managers of those industries.

Private sector enterprises do have an important role to play in improving natural resource management. Tea estate owners, for example, have demonstrated concern and capabilities for managing local resources for the public benefit. In the Sylhet area, tea estate owners have utilized agroforestry techniques to combat soil erosion and improve wildlife habitat. In several areas in the Northeast, tea-estates are the only viable wildlife 'corridors' and are being managed carefully to maintain endangered wildlife populations.

The press and media in Bangladesh are already making an impact in terms of increased public awareness of environment and natural resource issues. A Forum for Environmental Journalists has been organized with support from ESCAP, and provides encouragement and support to journalists writing articles on environmental topics for local and national newspapers. In addition, a Centre for Sustainable Development was formed in 1989 to provide information to local newspapers and periodicals. The Centre also conducts investigative journalism on environmental issues, and plans to begin a training program for journalists, especially women, in environmental reporting. The Community Development Library is another information organization concerned with environmental issues as well as human rights (particularly women's and tribal rights). The CDL has convened seminars, published

reports, and provides information to development field workers on environmental issues.

## **Environmental Research Institutions and Non-Governmental Organizations**

Several existing policy research and coordinating institutions have extensive capabilities which, if shared and augmented, could form the basis for sound environmentally related research. The Bangladesh Agricultural Research Council (BARC), within the Ministry of Agriculture, is in a strong position to incorporate a concern for sustainability into agricultural research and to significantly influence agricultural sector development programs. USAID and other donors have provided substantial assistance to BARC to strengthen its institutional capabilities and to support its programs, and are committed to respond to further needs for assistance to BARC.<sup>29</sup> While BARC still lacks sufficient staff expertise to undertake certain types of environmental research, it does provide research leadership, information, and analytical capabilities in many areas related to land use, natural resource management and environmental protection.

For example, BARC scientists and member institutions have investigated problems related to fertilizer use, expanded irrigation, use of groundwater, effects of poor drainage, social forestry and agroforestry techniques. BARC has provided critically important support for higher level training in agricultural research; it regularly produces, in cooperation with Winrock, "briefs" on the principal findings of graduate research and other studies related to agricultural development and natural resource management in Bangladesh. BARC also recently prepared a policy brief on "Floodplain Agriculture" which was based on a multidisciplinary review of the Action Plan for Flood Control sponsored by the World Bank.

BARC is also the lead agency for the development of a National Conservation Strategy (NCS) for Bangladesh, which is currently being prepared with assistance from the International Union for Conservation of Nature and Natural Resources (IUCN) and financial support from NORAD. The Bangladesh NCS will examine the actions needed within Bangladesh to support the goals of the World

**Conservation Strategy.** An extensive background document has already been prepared, and further work is proceeding under an 18-member inter-ministerial committee chaired by the Minister of Agriculture.

The Bangladesh Institute for Development Studies (BIDS) brings together over 50 researchers, predominantly economists and social scientists, and regularly publishes the *Bangladesh Development Studies Journal*. With strengthened capabilities in the physical sciences and natural resources management issues, BIDS could help fill a need for more comprehensive analysis of the economics of sustainable development options in Bangladesh, and pioneer studies in valuing environmental services and natural resources in national income accounts.

Other institutions, both in and out of government could also play a constructive role in information collection, analysis and policy reform. A new institution, the International Institute for Environmental Studies and Disaster Management (IIESDM) has recently been established at the initiative of the President of Bangladesh, to support research which would help in coping with recurrent threats from extreme monsoon floods, cyclones, and growing environmental problems. The Bangladesh Research Bureau (BRB) is an organization of professional academics which are conducting research and publicizing information on environmental problems as well as other issues. The BRB recently held a symposium on social and natural resource issues of the Chittagong Hill Tracts.

In 1987, members of Parliament from coastal districts formed an environmental interest group, the Coastal Area Resource Development and Management Association (CARDMA) to work with the special Parliamentary committee on coastal development. As a government registered NGO guided by a technical panel of experts, CARDMA has organized workshops and seminars, helped to disseminate information, mobilized support for improved resource management, and promoted the balanced development of the coastal region.

The Bangladesh Centre for Advanced Studies (BCAS) has conducted a number of interdisciplinary studies, including assessments of the environmental impact of groundwater removals, flood control and drainage projects, shrimp cultivation in coastal areas, and the impact of flood control embankments on fisheries. As mentioned in the introduction, BCAS has

also prepared an Environmental Profile for Bangladesh, and is sponsoring the preparation of a State of the Environment report by some 23 interested NGOs to better reflect village people's perceptions of environmental issues.

Organizations like BCAS have also played a role in bringing together government agencies and NGOs to develop recommendations about specific problem areas, such as deforestation. In February, 1989, BCAS organized a seminar on forestry and forest policy which included field visits to important remaining natural areas affected by deforestation. BCAS has also helped arrange internships of graduate students from abroad with NGOs and government agencies in Bangladesh. For example, several students from the Yale University School of Forestry and Environmental Studies have worked with the Forest Department and local NGOs such as Proshika, to assist in the analysis of land use changes, pressures on the use of forest reserves, and prospects for improved management of forest resources through increased community participation and social forestry programs.

A wide range of community and rural development NGOs are currently active in Bangladesh.<sup>30</sup> About 20,200 NGOs are registered with the Ministry of Social Welfare and Women's Affairs. Those receiving foreign funds are also required to register with the External Resources Division of the Ministry of Planning. Of the 222 NGOs registered with this Division, 77 are international and the remainder are national or local.

Although many NGOs are relatively fragile and manage only modest programs, it would be a mistake to characterize all NGOs in Bangladesh as small and relatively ineffective. The Bangladesh Rural Advancement Committee (BRAC), founded in 1972 to help rehabilitate refugees returning from the liberation war, now employs some 3,500 persons, and has programs in many parts of the country. Several NGOs in Bangladesh, such as the Grameen Bank, have achieved international notoriety as a result of their particularly innovative and successful programs which have benefitted tens or even hundreds of thousands of people.

NGO development programs have largely focused on rural credit, income-generation, and employment for the rural poor. Because of their commitment to improving the welfare of the poor and landless who are often directly dependent on extremely limited or

overexploited natural resources, many NGOs have in recent years expressed an interest in incorporating a concern for the sustainable use and improved management and conservation of natural resources into their development programs. In addition to addressing poverty issues, several NGOs are now active in discussions and fieldwork related to afforestation, social forestry, fisheries management, sustainable agriculture, homestead gardens and horticulture, as well as the impacts of sea level rise, groundwater depletion and recurrent drought in the northwest part of Bangladesh.

Homestead gardening is a major income-generating activity for many development NGOs. Women's programs in particular often include homestead horticulture activities. NGOs are also increasing their interest in regenerative agriculture, with little or no use of chemical inputs. NGOs have assisted groups and individuals lease and excavate lands for fish ponds, reclaim derelict fish ponds, and purchase nets and boats. Numerous NGOs are also supporting tree growing and some horticulture on the banks of the ponds. Only a few development NGOs, however, are active in promoting energy-saving cooking stoves or addressing other energy related issues.

A number of NGOs are also increasingly concerned with policy issues, particularly as they relate to tree and land tenure, and access and management of publicly controlled natural resources. Since December 1986, landless groups in Kaliakoir and Mirzapur organized by Proshika MUK have been protecting remnants of a sal forest on reserved forest land. Two local NGOs, Pothikrit and Polli Unnayan Sangstha (POUSH) are mobilizing support among surrounding villagers for the protection of remaining natural forest ecosystems in parts of Chittagong District and Cox's Bazar. This work is being assisted by environmental education and awareness-building activities organized by the Multi-disciplinary Action Research Centre (MARC). NGOs have also cooperated with the Fisheries Department to develop a new fisheries management policy which offers greater opportunities for social equity and improved management of open-access fisheries.

Reviews of NGO development programs indicate that they are concentrated in Dhaka, Savar, Manikganj, and Tangail, while many upazilas more distant from the capital have few active NGO assisted programs. Some 15-20 percent of landless holdholds are reportedly affected by NGO programs, although a

number of NGO programs are growing rapidly. For example, the Grameen Bank reported 556,682 members in May, 1989, an increase of about 200,000 members since 1987. NGOs are reportedly interested in expanding their activities in natural resource management; they have identified technical staffing, limited information exchange and coordination among NGOs, and burdensome government oversight procedures and inequitable or non-sustainable development policies as major constraints.

## **Critical Policy and Institutional Issues**

As indicated in the foregoing discussion, Bangladesh shares a number of the institutional constraints common to many countries. Intersectoral coordination of development planning is hampered by a multitude of specific agencies and frequently overlapping jurisdictions or conflicting mandates. Operating budgets are frequently inadequate, despite substantial and numerous programs of development assistance. For example, programs for establishing bird sanctuaries and completion of the tiger census were halted in 1982 for lack of funds. Human resources are sometimes deficient, as in the case of wildlife management and environmental impact assessment. As of early 1989, for example, responsibility for wildlife management and enforcement of the wildlife preservation law was vested in only one warden in the Forestry Department.

The legal framework in many instances needs to be further updated and better adapted to cope with current problems and projected demands. Enforcement of existing laws suffers from weak institutional capacity as well as inadequate sanctions and judicial procedures. New approaches for the use and management of open access resources such as inland and coastal fisheries and of state controlled resources such as forest reserves need to be explored further and supported by appropriate legal and policy reforms. Policies and incentives, particularly as they affect private enterprises and the line agencies charged with the management of forests, wildlife, fisheries, soils and water, need to be more carefully analysed from the standpoint of sustainable development and sound resource management.

A particularly critical issue is the strengthening of environmental monitoring capabilities and environmental impact assessment (EIA) procedures.

At a workshop recently co-sponsored by the Bangladesh University of Engineering and Technology, ESCAP, UNEP and AsDB, about 45 participants discussed the need to strengthen environmental impact assessment capabilities. As yet, no specific EIA procedure has been designed to fit the practical needs and institutional character of Bangladeshi agencies. However, the growing recognition that good engineering and sustainable development strategies require environmental impact assessment is an encouraging sign.

As discussed above, the newly established Environment Department within the Ministry of Environment and Forests is certain to play an important role in environmental impact assessment. But institutional capacity and procedures also need to be strengthened within the Ministry of Planning, particularly in the case of the Environment Cell of the Planning Commission, and in IMED. The five-year planning process is now driven primarily by traditional economic analysis and sectoral development objectives; yet, it could also be a forum for assessing economic trade-offs and environmental threats posed by sectoral development programs.

Line agencies also need to take the initiative in examining the anticipated impact of proposed projects on the environment, and on the development objectives of other sectors which may be adversely impacted. Similarly, the capacity, authority and opportunities for agencies which are impacted by proposed development policies and programs in other sectors to examine and influence such proposals need to be increased. For example, the Ministry of Fisheries needs to be more involved in assessing anticipated impacts of expanded irrigation, flood control embankments, rural road construction, or industrial development on fisheries; the Ministry of Agriculture should be consulted about the impact of industrial development and environmental pollution on food crop production, and needs to have more say about decisions to develop prime agricultural land for urban settlement or industries.

Only one EIA has been carried out to date in Bangladesh; the World Bank and UNDP assisted the Jamuna Bridge Authority in the preparation of an EIA for the proposed Jamuna Bridge. A number of donor agencies, including USAID, are increasing the attention given to reviews of anticipated environmental impacts of donor financed development projects. But these internal reviews are often too narrow in scope, and organized to respond to internal bureaucratic requirements more than an institutional development process. They also tend to deal inadequately with what are perhaps the most important aspects of such assessments: an analysis of the potential conflicts and economic trade-offs with other sectoral development programs, and a thorough review of possible alternatives which may provide for more complementarity and positive interactions among different sectors. In the future, such EIA's need to be better institutionalized, and prepared more openly, with greater participation and increased accessibility to the documentation by interested parties and institutions within Bangladesh.

Another important issue is cooperation between public agencies and the private sector, including both private enterprises and independent, voluntary, non-governmental organizations (NGOs). As indicated above, the current and potential contribution of private agencies to the sustainable development of Bangladesh is very significant, and can be better stimulated and facilitated by government. To this end, a more informed dialogue between government and the private sector could be supported by more in-depth reviews of the role of industry in environmental degradation and rehabilitation or protection. Similarly, a more complete evaluation of the contribution of NGOs to government development goals could be instrumental in increasing recognition of their achievements and capabilities, and in fostering greater support and cooperation with government agencies as well as among NGOs themselves.

## E.

# RECOMMENDED STRATEGY AND PRIORITY ACTIONS

## **Proposed Strategic Framework for the Sustainable Development of Bangladesh**

The following strategy is based on the premise that success in alleviating poverty and in achieving other economic development goals is being undermined by insufficient attention to the sustainable use and management of natural resources, and to the economic costs of environmental degradation. Even if development efforts were made more successful in extending family planning services and in stimulating irrigation-induced technological changes in agricultural production, it is questionable if the welfare of the poor majority of Bangladeshi would markedly improve and if long term economic growth could be sustained over the long term without substantially more attention to improved management of natural resources and protection of the environment. This is because people's livelihoods and the national economy are too dependent on the continued productivity and quality of the country's soil, water, forest, fisheries and other renewable natural resources; without vigorous action to prevent the further degradation of these resources and to maintain their productivity, increases in food production and the the economic development of Bangladesh cannot be sustained.

Economic development and improved natural resources management are inextricably linked; one cannot succeed in one area without success in the

other. Furthermore, these two goals must be addressed in an integrated fashion, as they cannot be pursued independently of one another. A concern for environmental conservation and improved natural resource management must be an integral part of development strategies and efforts aimed at increasing food production, income and employment generation and human resources development.

Bangladesh's substantial resource management needs would best be served by increased collaboration and interaction of all public and private institutions involved in the country's development. From the government would come the policy, regulatory and institutional framework and management essential for successful organizational implementation. NGOs, universities and research institutes could add to the analytical capacity and field experience necessary for successful practical implementation. And from the donor community would come the prerequisite funding and technical support crucial to carrying out natural resource management programs and policies. Of primary consideration to all these components, however, must be those ultimately responsible for arresting environmental degradation and natural resource depletion—the Bangladesh people themselves. Any conservation program ultimately depends upon those who use the resource on a daily basis. The Bangladeshis themselves, are thus the key to sustainable development and need to be fully involved in each and every program to which they are beneficiaries.

Environmental education must be dramatically improved across all parts of the society and particularly among policy-makers and those who farm the land and harvest its resources. To accomplish this requires substantial improvement at both ends of the educational chain, the research facilities that accumulate, process, and synthesize the pertinent information, and the ordinary citizen who must use that information in the performance of his everyday activities. The importance of this basic educational need cannot be overstated, particularly in light of the challenges presented by a high rate of population growth and low literacy rates. Environmental education which is directly relevant to improved natural resources management should be supported by all those concerned with making sustainable development a reality in Bangladesh.

In many respects, the proposed strategy is a continuation of recent initiatives by the Government of Bangladesh, donor agencies and the private sector in these areas, and a reinforcement of recent program developments that have already been identified and partially supported. Interest in addressing environmental issues and in supporting sustainable development is steadily building and many new activities are being contemplated; however, this rising level of concern has not been matched by a sufficient increase in the knowledge base related to environmental issues. Thus, action is needed to both directly address the need for improved resource management, and to generate the information needed to reform policies, reassess development strategies and more carefully design development activities. The following outline is offered as a guide to the

various actions that seem particularly important and worthy of continued support.

In order to adequately address the critical needs and important issues related to the environment and natural resources, a two-phase approach is proposed. In the **short term (1–2 years)**, a number of initiatives should be taken by the Government of Bangladesh, in concert with donors and other interested agencies, to reduce further environmental degradation, and to develop the technical skills and information base and institutional capacity needed to move forward with a sustainable development agenda. In the **medium and longer term (3–10 years)**, additional support would be targeted to institutional strengthening and to implement programs in designated priority areas.<sup>31</sup> In both the short and longer term, a firm and sustained commitment to a steady reduction in population growth rates and to population stabilization is needed as a precondition of success in improved natural resource management and environmental conservation.

Although the following actions represent something of a consensus which has emerged from both the existing documentation as well as interviews and discussion during the course of the ENRA, we would still recommend that a series of informal workshops and meetings be organized in order to provide a suitable forum for further discussion and reaction to these proposals. Such meetings could also help to define responsibilities for implementing the various actions which are proposed, coordinate donor support, and generate agreement on a more carefully considered implementation schedule.

## SHORT TERM PRIORITIES (1–2 years):

**1.0 Reduce further degradation of critically important natural resources and expand efforts to improve the management of natural resources:**

**1.1 sustain and reinforce the political support for a reduction in population growth rates; strengthen population policies to enhance program implementation and broaden the base of support provided by all donors in order to increase the attention given to the full range of actions needed to reduce the rate of population growth and to accelerate progress in population**

**stabilization, with particular attention given to those areas which have demonstrated the greatest returns on investment.**

**1.2 support policy reforms needed to promote the sustainable and efficient use of natural resources, such as the encouragement of the use of natural gas in brick-burning, the removal of artificially low stumpage fees for timber from government forest reserves and other disincentives for efficient use of**

- forest products, and a review of policies for clear-felling remaining natural forests;
- 1.3 provide greater incentives for improved waste treatment by private enterprises, and support measures aimed at increasing the accountability of the private sector for negative environmental impacts.
  - 1.4 increase the attention given to soil fertility maintenance, integrated cropping systems and development of sustainable livelihoods within the context of agroecosystem analysis, farming systems research and agricultural extension programs;
  - 1.5 remove the primary obstacles to private-sector reforestation and community-based management and use of forest lands so as to promote tree-planting on underutilized or vacant lands, the protection and regeneration of the remaining sal forests, and the development of multi-purpose homestead gardens/forests by local communities and the rural poor.
  - 1.6 provide training and other support needed to enable NGOs and the private sector to expand their role, in cooperation with government programs, in the reclamation and rehabilitation of degraded public lands, sustainable agriculture, aquaculture and fisheries management, environmentally sound industrial development; and in the use and marketing of products derived from renewable natural resources;
  - 1.7 increase the access of the private sector to pollution control and abatement technologies, and support programs aimed at building the awareness within the private sector of the need for more environmentally benign technologies; continue to strengthen the assessment and enforcement capability of agencies charged with the control of industrial effluents, and other sources of air and water pollution and solid waste.
  - 1.8 make greater use of food aid as a means to stimulate and support improved natural resources management, especially by the rural poor who are dependent on open-access resources vulnerable to overuse and depletion, and among rural communities with an interest in shared management of publicly controlled natural resources.
- 1.9 complete a rapid survey of threats to protected areas and other critical natural habitats, and define and pursue short term actions including policy reforms needed to protect these areas against those threats; and support the protection and restoration of unique forest habitats (such as the Teknaf, Chunati, Madhupur, and Rama-Kalenga forests) through a program for participatory community forestry and buffer-zone management, and an associated program in applied research on wildlife ecology.
- 2.0 Support the development of the technical skills, information base and institutional capacity needed for improved analysis of trade-offs and resolution of competing claims on the use of natural resources:
    - 2.1 clarify responsibilities and resolve conflicting mandates among the key government agencies with a role to play in environmental impact assessment, land use planning, and other areas of natural resources management; define realistic and appropriate roles for each of these government agencies, with due regard to the potential complementary and supportive role that institutions in the private, non-governmental, academic sector and media can also play.
    - 2.2 provide short term training and technical assistance in environmental economics, the economic analysis of natural resource management and environmental conservation, and in the assessment of sustainability issues in economic development planning, including the economic impact and environmental costs of interactions among sectoral development programs, such as flood control, irrigated agriculture, fisheries,

energy sector development and rural infrastructure development.

- 2.3 complete a more in-depth assessment of the extent and economic costs (in terms of crop damage, health impairment, reduced resource productivity, loss of biodiversity, etc.) and ecological consequences of industrial pollution, agricultural runoff and pesticide use, sewage and human settlement wastes, and other sources of pollution and environmental degradation.
- 2.4 increase the support provided to BARC and other organizations carrying out research and policy analysis related to sustainable development, changing land use, farming systems, and environmental and natural resource issues; particular attention should be given to the sustainability and overall (net) economic benefits of alternative agricultural development strategies, especially as regards the use of water resources and biomass energy resources, the maintenance of soil fertility, the potential returns from homestead forestry and aquaculture, and the contributions to the well-being and security (amidst periodic natural disasters) of poor and landless rural households.
- 2.5 increase support for environmental investigative reporting, public debate and press coverage of natural resource management issues, environmental education, and for applied research and analysis related to sustainable development by universities, NGOs and the private

sector as well as interested government agencies; these actions and related initiatives in information dissemination and education could be facilitated by the establishment of an independent clearing house and depository for information on environment and sustainable development issues, including data generated by donor-assisted projects, which is accessible to all interested parties.

- 2.6 make full use of the opportunities presented by the preparation and implementation of a National Conservation Strategy, Forestry Master Plan, Flood Action Plan and National Water Plan to reform policies, reorient programs and otherwise increase the sustainability of sector development strategies; these planning and policy formulation exercises should also be used to improve the database and analysis related to changes in the productivity of such resources as homestead and natural forests, fisheries, and arable land.
- 2.7 intensify efforts to describe and analyze the linkages between people's well-being, fertility choices and population growth, land use pressures, and changes in environmental quality and in the productivity of natural resources; this information should be more actively disseminated to development planners, and to those involved in both natural resource management and population/health programs.

## **MEDIUM AND LONG TERM PRIORITIES (3–10 years):**

**3.0 Continue to build up efforts aimed at institution strengthening and program support for critical areas of natural resource management and environmental conservation:**

- 3.1 intensify family planning programs, including services and supplies along with educational and employment efforts targeted at women and designed to influence adoption of family planning, so

as to stabilize the population of Bangladesh as soon as feasible.

- 3.2 develop and institutionalize procedures for screening ongoing and proposed development projects to anticipate and mitigate adverse environmental impacts; the Environment Department and Planning Commission should provide leadership, guidance and technical oversight, but each

- line agencies should also assume increased responsibilities in this area; the Planning Commission should take the lead in assessment of trade-offs and resolution of inter-sectoral conflicts and for increasing the attention given to "sustainability" in development planning and proposed projects.
- 3.3 maintain support for training and institution strengthening in environmental monitoring and impact assessment, agroecosystem analysis, land use planning, environmental education, economic analysis of development and natural resource management, and natural resource accounting in national accounts.**
- 3.4 incorporate the findings and respond to the recommendations of the environmental studies completed in connection with the Action Plan for Flood Control; support the implementation of the National Water Plan and the Coastal Zone Management Plan.**
- 3.5 support increased research on the ecology, reproductive biology, life cycles and habitat requirements of inland fisheries, with emphasis given to those species**
- which are economically important, significant from the standpoint of biodiversity conservation, and/or highly threatened by overfishing or habitat destruction and degradation.**
- 3.6 complete the establishment of a protected areas system and implement management plans for protected areas, the wildlife management plan for the Sundarbans, the National Conservation Strategy, the Forestry Master Plan, and related action plans developed by the Department of the Environment and the Department of Forestry.**
- 3.7 support greater efforts in *in-situ* germplasm conservation for wild and local rice varieties as well as expanded *ex situ* germplasm conservation facilities for other important crops.**
- 3.8 support a comprehensive program to improve procedures government and private sector oversight of pesticide importation, registration, manufacture and formulation, storage, and retailing that parallels increased investments in agricultural intensification.**

## NOTES

1. Excerpt from *Our Common Future*, the report of the World Commission on Environment and Development, 1987, (pp. 8–9).

2. See information note by Janis B. Alcorn, AAAS Fellow, ANE/TR/ENR, entitled "Bangladesh Natural Resources Assessment", in ANE/TR/ARD News, July 22, 1989, pp. 10–11.

3. See Appendix B for list of principal references and bibliography for the report. Additional references are listed in the individual working papers as well. An annotated bibliography and review of references available from WRI, AID, the World Bank, and Winrock was also prepared by Anukriti Sud at the beginning of the assessment. 4. Two gaps in particular concern the gaps in data on the extent of industrial pollution; and in the inter-relationships between trends in fisheries productivity, and intensified land use, increased irrigation, road construction and industrial development.

5. See, for example, the work of Saleem Huq *et al.* at BCAS.

6. Data from IBRD, World Development Report, cited in WRI report on a natural resource strategy for the Asia/Near East region (December, 1989). See also paper presented by A. M. R. Chowdhury, on "Peace, Justice and Ecologically Sustainable Development: Views from BRAC in Bangladesh," June, 1989.

7. Lower estimated rate is from the Bangladesh Bureau of Statistics, and higher estimated rate according to USAID/Dhaka.

8. Schemes which are ostensibly aimed at intensifying land use, and improving the "management" and degree of government control over "degraded and underutilized" lands must take care, however, to recognize and protect the rights and traditional uses of certain lands by indigenous tribals and other groups; the sustainability of traditional land use practices by these groups needs to be acknowledged and the basis for their continued livelihood protected.

9. Pers. comm., Joy Carol, Save the Children, Sept., 1989.

10. See, for example, *Draft Environmental Report on Bangladesh*, USAID/Dept. of State, 1980; *Draft Environmental Profile of Bangladesh*, BCAS/IIED, 1987; *Draft Prospectus: Bangladesh National Conservation Strategy*, BARC/TUCN, 1987; *Draft Environmental Country Strategy for Bangladesh*, DANIDA, 1988; "Bangladesh Environmental Issues Country Orientation Paper", World Bank, 1988; *The Environment and Development in Bangladesh: an Overview and Strategy for the Future*, CIDA, 1989, and "Flood Plain Agriculture", BARC, 1989. Additional environmental studies related to the Flood Control Action Plan should also be forthcoming in 1990–1991.

11. Food grain production (3 year average) reportedly increased from 11.9 M tonnes in 1975/77 to 16.3 M tonnes in 1985/87. (H. Brammer and S. Jones, Comments on ENRA draft report, 1990)

12. It should be recognized that market demands have been among those factors favoring increasing

planting and production of rice in recent years; in the absence of sharply higher prices for pulses and oilseeds, farmers believe they can make more profit from irrigating HYV rice than many alternative crops.

13. The cropping pattern of maize-rice (transplanted aman HYV) -potato for partially irrigated highland area in Hathazari yielded 230 percent higher economic return, including double the grain production from the first crop, than that of rice (broadcast aus local variety) -rice (transplanted aman local variety) -potato. In general, maize production can double the yield of boro rice or wheat while making less demand on water resources. The great potential for maize for meeting caloric needs led a World Bank sector review for health and nutrition to call for initiatives to increase consumer acceptance by introducing maize into Food-For-Work programs.

14. See separate ENRA working paper on Forest Resources for a more complete discussion of forest production, including the difficulties in comparing production from homestead forests and other forest lands.

15. For details, see background paper on forestry, prepared by R. Winterbottom *et. al.*

16. Pers. comm., Dr. Nurul Islam, Institute of Appropriate Technology, Bangladesh University of Engineering and Technology, 1989.

17. See Seidensticker and Hai, 1983, cited in working paper on conservation of biological diversity in Bangladesh, by Janis Alcorn and Nels Johnson.

18. See working paper on Forest Resources in Bangladesh, by Robert Winterbottom, and Chaffey *et al.*, 1985 (ODA report cited in forestry paper).

19. A study of the overwintering waterfowl is to be supported by CIDA, and POUSH has been examining the status of wildlife populations in the southeastern forests.

20. See the *Eastern Waters Study*, (Rogers, *et al.*, 1989) for more information about flood control in Bangladesh.

21. For a more detailed review of governmental institutions, see working paper on the subject prepared for the assessment by Malcolm Baldwin, October, 1989. Other key references are *Land Use Planning in*

*Bangladesh*, by A.K. M. Kamaluddin Choudhury, National Institute of Local Government, 1985; Feroze Ahmed, 1989, Industrialization, "Modernization of Agriculture and Environmental Pollution in Bangladesh" and other papers for ADB sponsored Training Seminar on Environmental Management in Bangladesh; and Rashid Ahmed, 1989, "Agricultural Sector Institutional Analysis" prepared as part of the USAID-sponsored Agricultural Sector Report.

22. See "Proposal regarding expanded framework of the Department of Environment (DoE)," August 1989, prepared by the DoE.

23. See separate ENRA working papers on these subjects for more details.

24. See Baldwin, 1989, working paper on government laws and institutions, p. B-15.

25. See Summary Report, National Water Plan, prepared by MPO, December, 1986.

26. See Baldwin, ENRA working paper, 1989, p. B-10.

27. See separate working paper on pesticide use and environmental pollution, prepared by Alan Showler, October, 1989, for the ENRA.

28. See Baldwin, 1989, ENRA working paper on institutions, pp. B-10, B-11.

29. See Baldwin, ENRA working paper on institutions, p. B-19.

30. For more detailed information and an assessment of NGO activities related to sustainable development in Bangladesh, see ENRA working paper by Cheryl Cort, October, 1989. 27 pp. This paper also contains more detailed information about women's issues, tribal peoples, environmental advocacy organizations and NGO consortia.

31. For additional background and detail related to the proposed strategy and recommendations, see preliminary "general recommendations for government and aid agencies" as well as concluding sections of working papers prepared for the ENRA. The strategies proposed in the DANIDA, CIDA and World Bank environmental briefs and profiles also include a number of more specific recommendations and guidance for individual donor agencies.

## Appendix A

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## Appendix B

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## Appendix C

# ABSTRACTS OF BACKGROUND PAPERS

**Note:** The following abstracts refer to a series of background paper and technical reports prepared for the Bangladesh Environment and Natural Resource Assessment. These papers were researched and written by a team of specialists organized by the World Resources Institute, with the financial support of USAID/Bangladesh. Field work and research for the papers was carried out in May–July 1989 and drafting of the papers was completed in August 1989. The papers were reviewed and revised in September–December 1989. The responsibilities for the content of these abstracts/papers rests with the authors, however, and does not necessarily represent the views of WRI or USAID.

Abstracts have been prepared for the following background papers for the assessment.

- A. A Conceptual Framework for Sustainable Development: An Analysis of Economic and Policy Factors Affecting Natural Resource Management in Bangladesh
- B. An Assessment of Governmental Laws and Institutions Affecting Natural Resource Management in Bangladesh
- C. The Role of NGOs in the Sustainable Development of Natural Resources in Bangladesh
- D. Rural Resource Use: Emerging Issues for Sustainable Agriculture
- E. Pesticide Use and Environmental Pollution in Bangladesh.
- F. Aquatic Resources and Fisheries in Bangladesh
- G. Conservation of Biological Diversity in Bangladesh: Status, Trends, and Recommended Responses
- H. Sustainable Development of Forest Resources in Bangladesh: Challenges and Opportunities
- I. Environmental Issues Related to Rural Energy Use in Bangladesh
- J. Urbanization and Environmental Issues
- K. Towards Inclusions of Environmental Considerations in Water Development Planning for Bangladesh

## **“A Conceptual Framework for Sustainable Development: An Analysis of Economic and Policy Factors Affecting Natural Resource Management in Bangladesh”**

by Louise Fallon

**The market economy of Bangladesh is characterized by three salient features: 1) an overwhelming dependence on foreign aid, 2) domestic production which is dominated by an agricultural sector that is concentrated on foodgrain production, and 3) a small and extremely undiversified export sector. None of these characteristics is likely to substantially change in the near future. Donor funds represented over 85 percent of the 1989–90 Annual Development Plan. While forestry, livestock and fisheries grew to close to 15 percent of the relative share of GDP from 1981–86, both forests and fish stocks are in jeopardy of being overexploited. Exports are dominated by raw jute and its products, the demand for which has fallen sharply with the appearance of synthetic material substitutes, and shrimp production which has recently outstripped the world-wide growth in demand.**

**Bangladesh’s high population plays a crucial role in determining the trends of natural resource use. The rapid population growth exerts immense pressure on the resource base to meet short-term needs. It has also generated a preoccupation with intensive foodgrain production which, in turn, exacerbates the adverse effects on wooded areas (cleared for increased agriculture) and water resources (used for increased irrigation). It seems evident that sustainable development in Bangladesh will necessitate a structural transformation of the economy, involving rapid increases in the relative importance of sectors, other than agriculture, which can absorb the growing labor force. This will be the challenge for the future development and sustainable utilization of the country’s natural resources.**

# **“An Assessment of Governmental Laws and Institutions Affecting Natural Resource Management in Bangladesh”**

by Malcolm Forbes Baldwin

While Bangladesh has a modest array of policies, plans, and regulations to address major environmental topics such as forestry, fisheries, pesticides and pollution, its laws are generally weak or outdated. The majority of environmental laws were developed under substantially different population and industrial development conditions. Mechanisms for environmental assessment, regulation, and enforcement either do not exist or are simply ineffectual. No national programs exist to address the invaluable, but highly vulnerable coastal resources of the country. The mechanisms for addressing environmental problems created by competing sectors—such as water resources, agriculture, fisheries, and energy—are weak, as are procedures to ensure interagency review and coordination of environmentally important activities. Augmented staff capabilities in the full range of environmental sciences is badly needed within most Ministries (especially Planning), the line agencies, and within the major research and development institutes. Finally, corruption is widely acknowledged to be an increasingly costly constraint on the predictable, fair, and efficient implementation of laws and plans that directly affect environmental resources.

There are, however, several positive trends that suggest an improved institutional framework for Bangladesh's management of its natural resources. Interest in environmental management is on the increase in Bangladesh as is concern about the

country's severe environmental problems. The present five-year planning process is beginning to integrate environmental management activities and evaluate the serious environmental effects of major development projects. The creation of an environmental "cell" in the Ministry of Planning a useful step in this direction. More recently, the formation of the Ministry of Environment and Forests offers greater potential for stronger institutional attention to environmental management. The two agencies under the new Ministry—Department of Forestry and Department of Environment (formerly Department of Environmental Pollution Control), however, have not yet significantly changed their mandates.

The donor community, which plays such a crucial role in Bangladesh's development, has recently shown a strong commitment to improving its own record on environmental assessment for proposed funding projects and in providing financial and technical support for environmentally related projects and activities.

Recommendations include increased attention to and support for low-cost "catalytic" and information disseminating effort, training programs for government and non-government professionals in environmental assessment and environmental law, and environmental education programs for youth at all ages, as well as for donor and government agency personnel.

# **“The Role of NGOs in the Sustainable Development of Natural Resources in Bangladesh”**

**by Cheryl Cort  
with assistance from G. Monowar Kamal**

**This report is a preliminary attempt to explore the breadth of experience of NGOs and the benefits gained from the innovative initiatives of NGOs in the challenge to make economic and social development in Bangladesh environmentally sustainable. The report reviews the NGOs' relationship to the Government of Bangladesh, their coverage, and the types of NGOs concerned with sustainable development. The report focuses on the field activities of development NGOs and the environmental issues they identify. It also discusses weaknesses and strengths of NGOs, and concludes with recommendations for the Government of Bangladesh, donors, and USAID for supporting the work of NGOs.**

**Without consciously identifying their activities as environmentally oriented, development NGOs are engaged in a range of activities which promote the sustainable use and management of the natural resource base because the poor cannot afford to waste their meager resources. During the 1980s, NGOs have been conducting seminars, workshops, and village group discussions on issues such as the greenhouse**

**effect, deforestation, and a number of groups have plans for regional environment initiatives. Most importantly, NGOs are enthusiastically addressing issues of natural resource management through their field activities, in the areas of forestry, homestead gardening, especially with women's groups; regenerative agriculture, and fisheries. Individuals and organizations involved in environmental advocacy have identified a broader range of concerns which have potential for mobilizing public support for finding more sustainable patterns of resource use, and evaluating the environmental impact of development activities.**

**NGOs are interested in expanding their activities in natural resource management and have identified technical capabilities, greater exchange of information and coordination among NGOs, and government policies as major constraints. NGOs' interest and enthusiasm offers great opportunities to the Government of Bangladesh to support regeneration and management of degraded natural resources to provide income and livelihoods for the landless.**

## **“Rural Resource Use: Emerging Issues for Sustainable Agriculture”**

by Cynthia Mackie, Ph.D.

The purpose of this annex is to highlight natural resource management issues associated with agricultural development in Bangladesh. Current policies which promote food security and, more ambitiously, food self-sufficiency, rely primarily on the intensification of rice production through the expansion of irrigation. Although increased agricultural production is essential for Bangladesh, the risks and costs associated with concentrating investments and natural resources on increasing foodgrain production need to be anticipated and minimized as much as possible.

This report examines some of the emerging issues from two levels. The first reviews the contributions of natural resources to rural household livelihoods and the long-term sustainability of overall household production. The second examines the information available at the national level regarding agricultural potential given Bangladesh's natural resources, current trends in land use, and sectoral development policies.

The net cultivated area of Bangladesh encompasses 60 percent of the total land area, the highest percentage in Asia. Most of the country is part of an ecologically dynamic delta which has a wide array of agroecological conditions. The existing farming practices found within each agroecological zone need to be thoroughly documented, although it is clear that many rural households depend on a highly diversified strategy of homestead gardens, horticultural production, forestry product collection, livestock raising, fishing and off-farm employment, in addition to rice cultivation. It appears that such diversified livelihood strategies may be particularly important for poor households which have relatively small land-holdings and which are vulnerable to wholesale agricultural losses from natural disasters and from the annual variability in climatic conditions.

Sectoral policies often do not recognize the multiple uses of land and water resources and can inadvertently diminish the livelihoods of rural households by limiting resource availability. Examples in Bangladesh requiring better

documentation and monitoring are: a) declining access to drinking water during the dry season due to groundwater withdrawals for small-scale irrigation, b) declining inland fisheries from flood embankments, road construction and surface irrigation works, c) increasing risk of crop failures due to the displacement of hardy traditional rice varieties and non-cereal crops in favor of green revolution varieties, d) declining fertility of irrigated lands from poor water management and continuous monocropping, e) increased contamination of fisheries and domestic water from agricultural chemicals, and f) declining availability of off-farm sources of fuel and fodder leading to deteriorating soil fertility as crop residues are used increasingly for household energy needs.

One of the notable features of Bangladesh is that despite an extraordinary population density and high population growth rate, there are great opportunities for increasing agricultural production. However, the basic data regarding the status of land, water and biological resources are inadequate and are not accessible between government agencies or NGOs. The degradation of these resources is proceeding rapidly as a result of inadequate land use management planning, sectoral programs which do not protect the multiple uses of resources, in addition to the high rate of population growth. At the same time, limited access to resources, in terms of land tenure and proprietary rights to fish and trees, is reducing the agricultural options available to the rural poor. Out of 13.8 million rural households, 45 percent are landless or nearly landless, having less than 0.2 ha of land. As many as 25 percent of these landless households are headed by women.

Another constraint is that existing land resource assessments define agricultural suitability in narrow terms of the costs required for producing one particular crop. This is a misleading indicator of overall agricultural potential, because lands may be ideal for horticultural crops or for fisheries but are rated as having low suitability. More useful for planning purposes is the documentation of soil, water and biological resources, the productivity of existing

land and water use practices found in each agroecological zone, and the identification of the most productive improvements on these practices, based on both economic and nutritional criteria.

Recommendations for the donor community include the following: a) support for a land and agriculture master plan, b) a commitment by each donor to prepare assessments of the direct and indirect effects of their investments in agriculture on the natural resource base, c) establishment of a depository

at a major university for all agricultural and natural resource data to improve the exchange of information between government agencies and private institutions, d) greater investment in social science and natural resource management training and applied research, e) greater commitment in rural development projects to overcoming land tenure and resource access problems by providing usufruct rights to the rural poor.

## **“Pesticide Use and Environmental Pollution in Bangladesh”**

by Allan Showler  
USAID/Office of Foreign Disaster Assistance

A concerted national effort to meet the food demands for a burgeoning population has focused predominantly on intensified cultivation and the use of HYV (high-yield variety) rice. But extended and intensified agricultural production will require more prudent management and the application of ecological principles to preserve environmental stability for future agricultural development. The use of pesticides in Bangladesh, while minor in contrast to other developing countries, needs to be monitored to prevent an increase in contamination problems.

There are a number of current pesticide use problems that need to be addressed. These include: 1) pesticide storage and disposal: there is no system for return-deposit for pesticide containers and many subsequently are used for food and medicine; 2) safety: pesticide intoxication of handlers is widespread, but systematic records of chronic acute poisonings are not available; 3) there have been no studies of pesticide residues in water, food, and humans, and the environmental impact of pesticide use is unknown.

Much can be done to improve the use of pesticides in Bangladesh. Integrated pest management (IPM) needs to be developed beyond the conceptual phase. A sound research program based on agro-ecological analysis and crop-specific needs must be elaborated to lay the foundation for a national IPM strategy. To

reduce overall pesticide use, IPM concepts should be developed, researched and then disseminated to farmers through vigorous extension education programs. The 30,000 people currently employed by the Department of Agricultural Extension are a potential resource for carrying out this task. Radios, of which there are at least one million in Bangladesh, and other media forms can be utilized to improve education on proper pesticide use.

Pollution is already a major problem in Bangladesh and, with increasing industrialization, it threatens to overwhelm critical ecosystems. Most of the more than 900 industrial plants discharge untreated particulate, vapor, gaseous, liquid and solid wastes directly into aquatic systems and the atmosphere. Large moats of polluted water surround tanneries and textile mills and are separated from rice paddies only by alarmingly low and narrow earthen berms; flood conditions thus spread such noxious water across the flood plains that are used for fishing and rice cultivation. In most areas many sewage systems are inadequate or nonexistent.

Areas that need to be immediately assessed and improved include: enforcement of environmental legislation, waste monitoring procedures, renovation of ecologically disturbed habitats, sewage system installation, and technology transfer for pollution clean-up.

## “Aquatic Resources and Fisheries in Bangladesh”

by Louise Fallon  
with assistance from Alan Potkin

The fisheries resources of Bangladesh are among the richest in the world. Of the tremendous genetic diversity embodied in the over 500 aquatic species known to inhabit Bangladesh's waters, little substantive data on the ecology of these species is available. It is estimated that 70 percent of the rural population is engaged in seasonal part-time fishing, while 1.7 million people derive full-time employment from the capture fisheries.

The current steady decline in fish landings from inland waters can be attributed to a host of factors including: water pollution resulting from increased use of agricultural chemicals, fertilizers and pesticides; obstruction of fish migration routes by water control devices; and the draining and reclamation of cultivable floodplain land, and habitat degradation and loss as a result of hydrology alteration due to flood control, embanked roadways, and human settlements. Preventing a continuing decline in per capita domestic fish consumption presents a major challenge for the Government of

Bangladesh, particularly as population growth continues.

Although inappropriate institutional arrangements and management policies and practices are also exacerbating the overexploitation of Bangladesh's fisheries, the New Fisheries Management Policy offers opportunity for improved management of the open capture fishery and greater social equity. Growth in the aquaculture subsector also offers opportunities for greater productivity as it appears to be helping offset the decline in other parts of the fisheries sector.

Donors have a number of opportunities to support the government in sustainably managing these huge and biologically diverse fisheries which are a vitally important resource to millions of people and national economic growth through supporting research to build a better information base for improved management. Better biological and socio-economic information will also help decision makers give greater value of the fisheries sector and improve analyses of intersectoral tradeoffs for development activities.

## **“Conservation of Biological Diversity in Bangladesh: Status, Trends and Recommended Responses”**

by Janis Alcorn and Nels Johnson

The status of Bangladesh's biodiversity is not well documented. Tropical forest associated biodiversity is most threatened as only 6 percent of the original terrestrial habitat remains. Fish diversity remains high, but proposed flood control activities and mangrove conversion may significantly reduce the diversity of open-catch fisheries. There are approximately 5,000 species of flowering plants, 500 species of fish, and over 550 species of birds.

Bangladesh has two claims to biodiversity of global importance —tigers and rice. The world's only genetically viable tiger population is found in the Sundarbans mangrove region. Unique varieties of wild and cultivated rices are also found in Bangladesh.

Conservation of biodiversity faces severe constraints in Bangladesh. The subsistence needs of millions of Bangladeshis for fuelwood, fish, and cash income (a need that increases exponentially with continuing population growth) coupled with a traditional attitude that biological resources are free for exploitation, creates a political climate inimical to sustainable development of natural resources and conservation of biological diversity. Protected areas

have been designated (0.8 percent of total land area), but they do not cover all habitat types, and no management plans have been implemented. Crop germplasm conservation institutions are weak. Lack of concern for biodiversity is evident in the weak support for institutions such as the Wildlife Circle and the National Herbarium. There are few efforts to educate the public in the existence and value of biological diversity.

Nonetheless, policy reform, commitment to policy implementation, improved legislation, financial commitments to wise management of natural resources, and strengthened institutions may still be able to turn the tide of biodiversity depletion in Bangladesh. There are indications of a grassroots-level appreciation of biodiversity, particularly for birds, that can be tapped to build a constituency.

Primary donor action priorities are the protection of the Sundarbans mangrove forest, improved knowledge of freshwater open-catch fisheries, wildlife management in multiple-use forests, and crop germplasm conservation.

# "Sustainable Development of Forest Resources In Bangladesh: Challenges and Opportunities"

by Robert Winterbottom  
with assistance from Haroun er Rashid and G. Monowar Kamal

The forested areas of Bangladesh include the areas of remaining natural forest in the Sundarban mangrove forests, the tropical forests in the southeastern hill tracts, and the remnant "sal" forest of the central and northwest plains area, as well as the "homestead forests" dispersed throughout the areas of rural settlement. People's well-being and livelihoods continue to be closely linked to the availability of reasonably priced fuelwood, home construction materials, raw materials for boats, as well as large number of non-woody products ranging from fruits and nuts, to medicines, livestock fodder and mulching materials for cropland.

Although comprehensive information on forest cover is lacking and official statistics are often inaccurate, it is likely that forest cover decreased from about 20 percent of the country's total area in the early 1960's to approximately 6 percent (1 million hectares) today. With a population of some 110 million people, Bangladesh has less than 0.02 ha. of forest land per person, one of the lowest such ratios in the world.

The extent of the country's forest resources is declining as a result of illicit felling and overuse, prompted in part by the extreme underpricing and inefficient use of wood products sold to

government-owned industries, and by the lack of incentives and technical support for reforestation and forest management by the private sector. Homestead forests are an important source of wood and other non-woody forest products. However, an estimated increase in "output" from these and other areas is not being achieved on a sustained-yield basis; rather it more likely reflects a reduction in the growing stock or "capital assets" of the forest resources of Bangladesh.

Many opportunities exist to reverse the current trends and to promote the sustainable management of the country's forests. The forestry sector could be reoriented and revitalized by the elaboration of a new forest policy, and a corresponding restructuring of the Forest Department itself. The Department staff's technical skills and analytical capabilities could be significantly upgraded. The primary role of the Forest Department should shift to give more emphasis to technical support for NGOs, local community organizations, and other groups able to assist with the protection and management of remaining forests so that these essential resources can better serve the needs of the landless and other disadvantaged groups who lack alternative means of livelihood.

## **“Environmental Issues Related to Rural Energy Use In Bangladesh”**

**Professor M. Nurul Islam  
Bangladesh University of Engineering and Technology**

**Domestic energy use in rural areas of Bangladesh accounts for 73.2 percent of total energy consumed. More than 80 percent of Bangladesh's energy sources are supplied by indigenous biomass fuels. Agricultural residues, fuelwood, tree residues and animal dung contribute 66.4 percent, 12.6 percent, 4.8 percent, and 16.2 percent respectively of total biomass fuels. Much of the 18 percent of woodfuels consumed was supplied through overcutting reserve and private forests. 37.8 percent of total agricultural residues was used as fuel, while 35 percent was used as fodder. The remainder was used for industrial raw materials. While it is not possible to assert that the use of agricultural residues for fuel is having a negative impact on soil fertility, this topic needs further assessment. Likewise, the effects of using animal dung as a fertilizer cannot be generalized, and are dependent on a variety of circumstances.**

**Bangladesh faces two energy crises: one in commercial and the other in traditional biomass fuels. Although petroleum imports contributed only about 20 percent of the total useful energy, import costs amounted to 90 percent of total export earnings in 1982 and 40 percent in 1985.**

**The use of a higher proportion of agricultural residues and animal dung instead of fuelwood indicates the scarcity of fuelwood in Bangladesh. This shortage cannot be solved exclusively by biomass fuel development programs. In some cases, such as the commercial use of biomass fuel for brick production, coal and natural gas should be made available and the use of fuelwood banned.**

**An integrated energy development plan is necessary to respond to short-term biomass shortages through appropriate commercial fuel substitutes, and to develop medium and long-term sustainable biomass energy sources.**

## “Urbanization and Environmental Issues”

Dr. Amanat Ullah Khan

While Bangladesh's overall proportion of urban population is still very low by world standards, the country has been experienced a tremendous surge in its rate of urbanization. According to the most recent census (1981), the urban population over the seven preceding years had risen 115 percent to over 13 million, an average annual growth rate of almost 11 percent. Although official statistics are not available for the last eight years, urbanization rates are thought to be accelerating even faster, and the urban population is expected to reach 35–40 million by the year 2000.

Urbanization results from both “push” factors (population pressure, environmental degradation, shortage of land, and lack of employment opportunities in rural areas) and “pull” factors (such as the lure of urban amenities). Rural-urban migration is the leading factor of urbanization. Environmental stresses (flood, cyclone, drought, salinity, and river erosion) experienced throughout Bangladesh are critical “push” factors in the accelerating trend towards urbanization. Unlike the completely natural hazards such as flood, drought or cyclone, the damage done by river erosion, which is caused in part by human activity, is total. In most cases the victims lose their entire land—the most essential resource for securing income, employment and habitation in rural

Bangladesh. A recent study of causes of migration in two Dhaka squatter settlements revealed that 44 percent of the migration was related to river bank erosion; over one million people are directly affected by this every year.

There has been a distinct lack of proper physical planning, policy analysis, and research concerning urbanization. Often, unplanned urban and industrial extensions are sprawling into the region's most fertile agricultural lands. Urbanization is creating new demands on the country's dwindling forest resources and causing the depletion of fish stocks through overfishing, industrial and sewage pollution, and the filling up of urban water bodies. The task at hand, to plan and implement a sound strategy for urban growth, is urgent and will require formidable engineering, planning, and training as well as a large outlay of financial resources. Key policy recommendations include: 1) the adoption of a National Settlement Policy in harmony with the natural environment, 2) expansion of government, university, and research institute physical planning training capabilities, 3) evaluation of urban land use plans for environmental impacts, 4) increasing NGO involvement in urban development issues, and 5) expanded research capabilities of urban research organizations.

# **“Towards Inclusion of Environmental Considerations in Water Development Planning for Bangladesh”<sup>1</sup>**

by Alan Potkin

Prevalent in Bangladesh is a mistaken perception that concern over the environment is a “luxury” inappropriate to that country’s desperate situation. Accordingly, several extremely ambitious water development and water management proposals currently under serious consideration have so far incorporated no substantive investigations of negative externalities that would potentially flow from massive manipulation of the regional hydrological regime. Other smaller-scale projects incorporating embankments may already be causing ecological problems, problems possibly manifesting in the recent serious decline of Bangladesh’s inshore fisheries.

In the absence of larger mechanisms of environmental planning, mandated preparation of environmental impact statements may be the best device to initiate research by ecologists or systems scientists into possible, unforeseen intersectoral linkages or “systemic effects” of proposed

development schemes. Ideally, such research would commence early in the design phases, both to assist in the evolution of environmentally-benign projects and to help assure that benefit/cost analyses are properly conducted, with a fuller view of externalities. A recommendation is made for an environmental assessment of embanked roadways now being constructed under the “Food for Work” program.

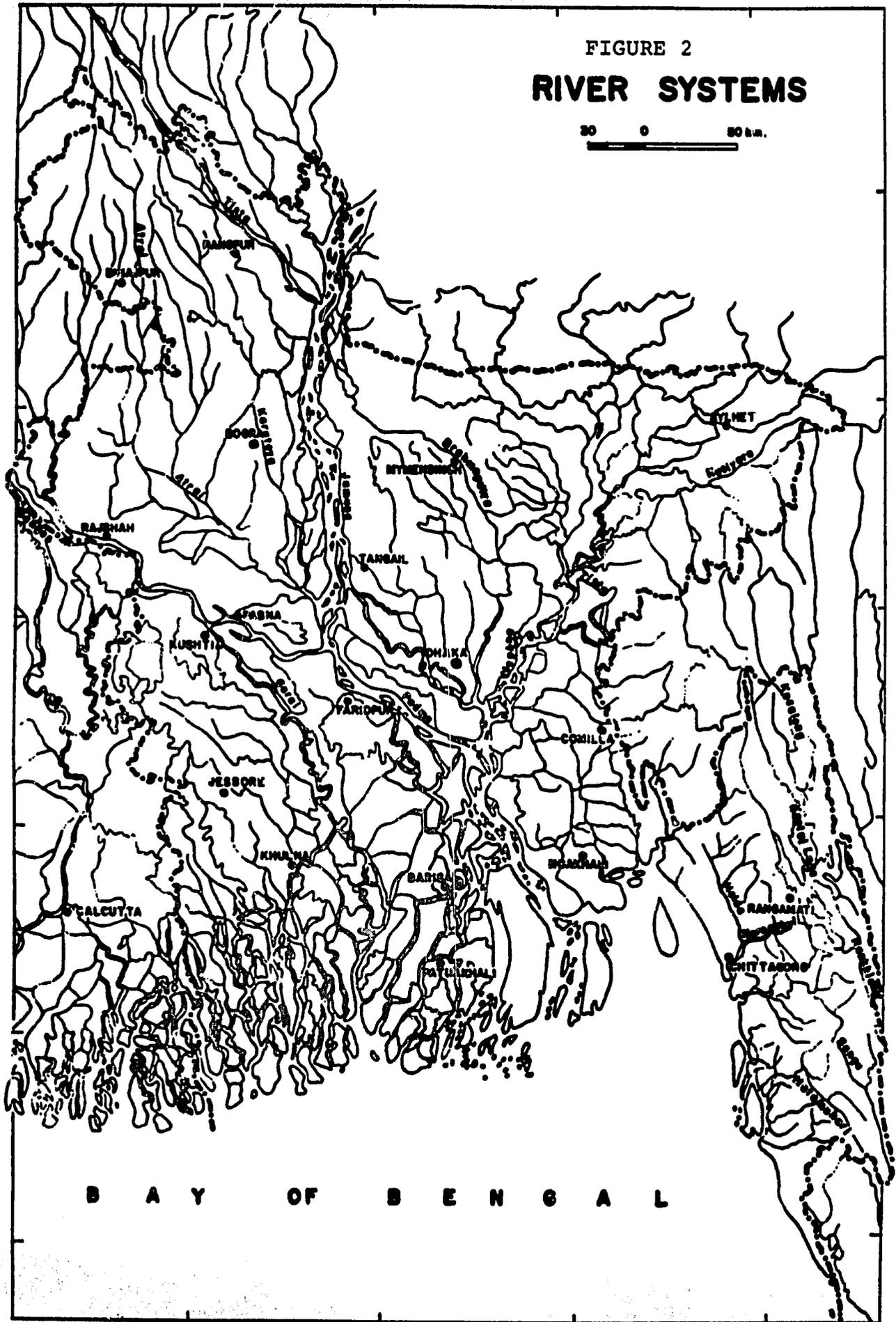
## **Note**

1. Note: This working paper was researched by Dr. Potkin in June 1989. Since that time, a number of new developments in flood control planning have occurred, and several important actions have been taken in the area of environmental assessments and environmental studies related to water resource use and infrastructure developments, by USAID and others.



FIGURE 2  
**RIVER SYSTEMS**

20 0 50 km.

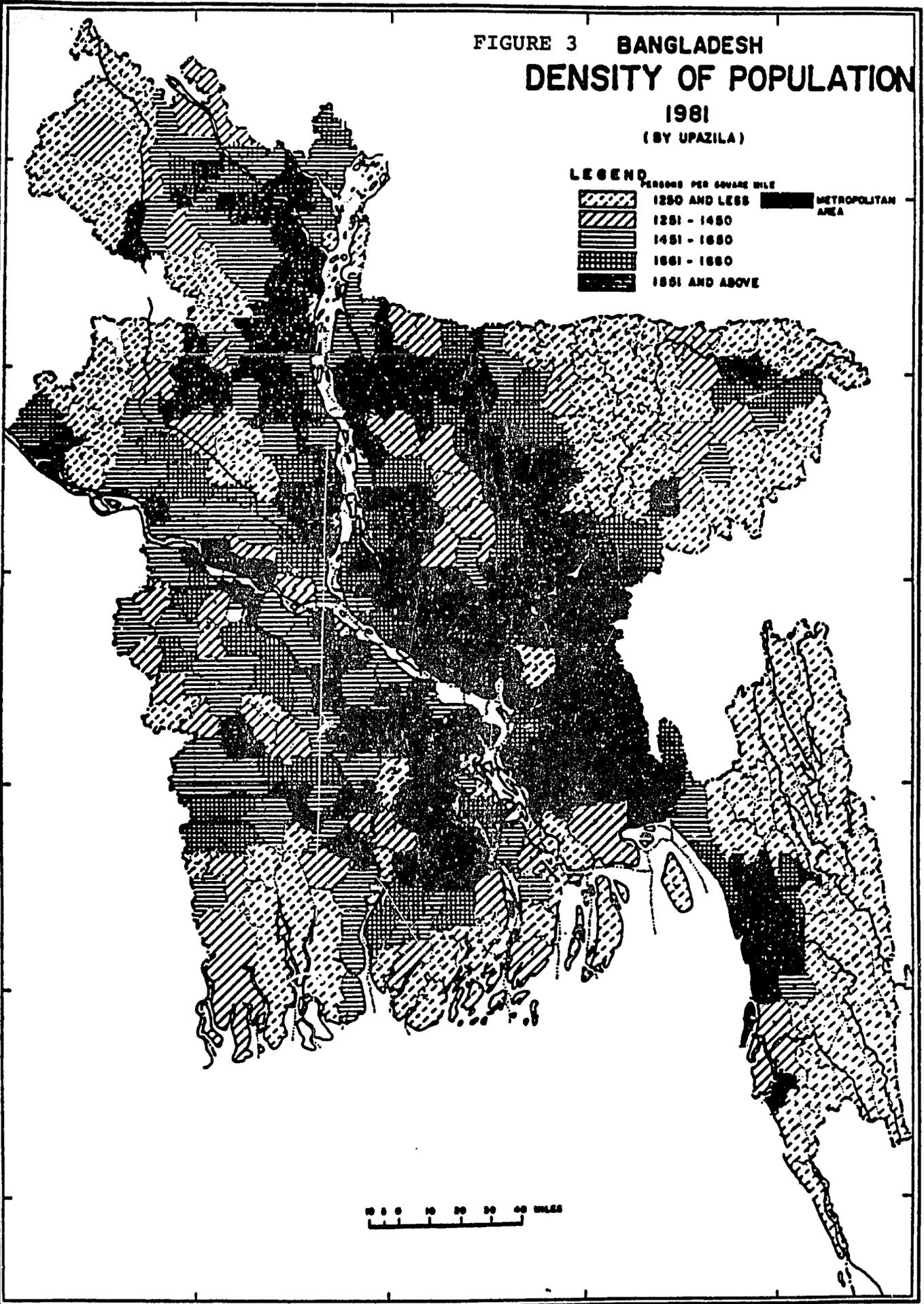


B A Y O F B E N G A L

**FIGURE 3 BANGLADESH  
DENSITY OF POPULATION  
1981  
(BY UPAZILA)**

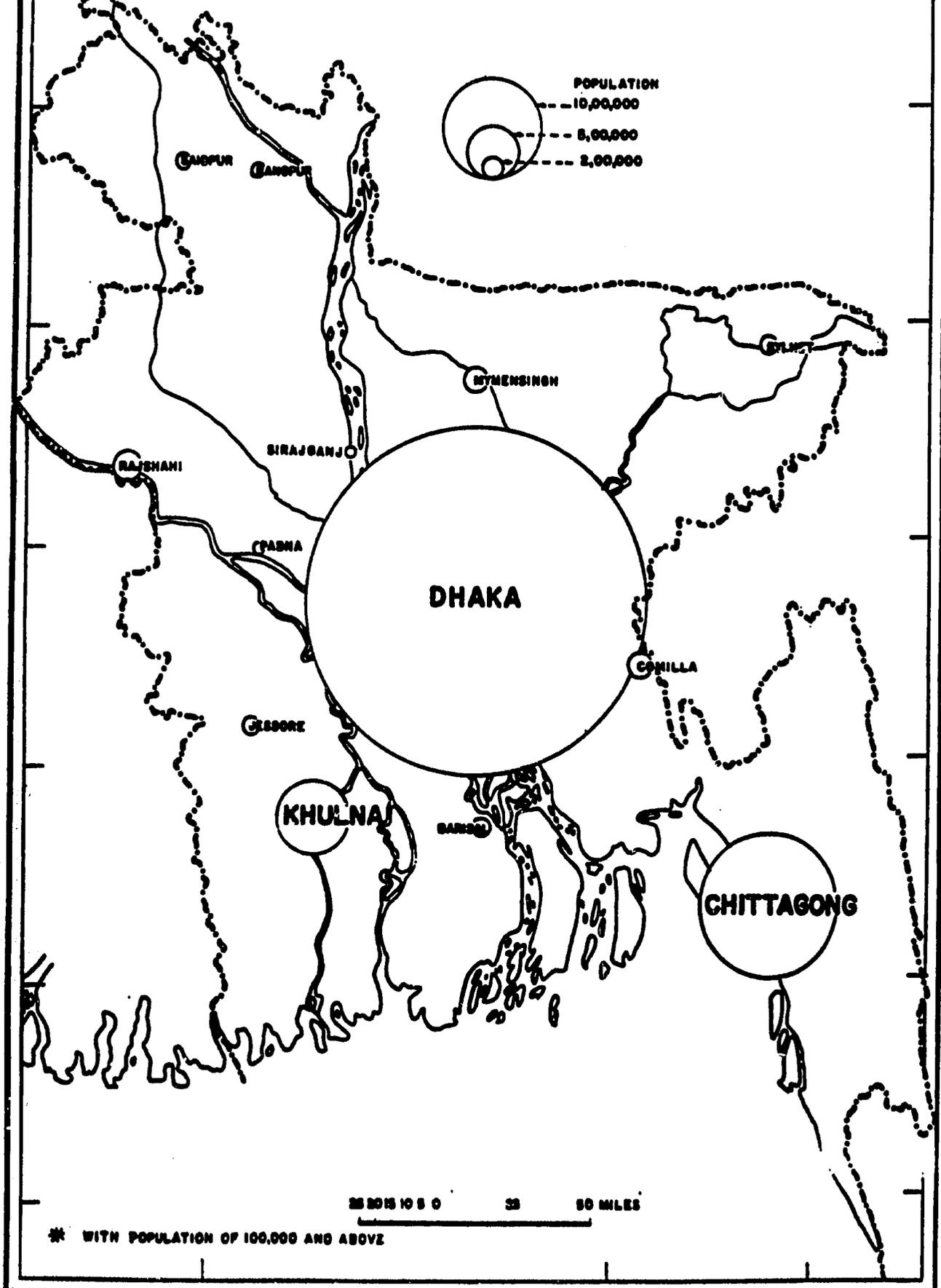
**LEGEND**  
PERSONS PER SQUARE MILE

	1250 AND LESS		METROPOLITAN AREA
	1251 - 1450		
	1451 - 1650		
	1651 - 1850		
	1851 AND ABOVE		



0 10 20 30 40 50 60 MILES

**FIGURE 4 DISTRIBUTION OF MAJOR URBAN CENTERS \* 1981**



Cartographer: Nail Ahmedul Islam, Deptt. of Geography, Dhaka University.

FIGURE 5 BANGLADESH

UPAZILAS AFFECTED BY RIVERBANK EROSION, 1983-1986

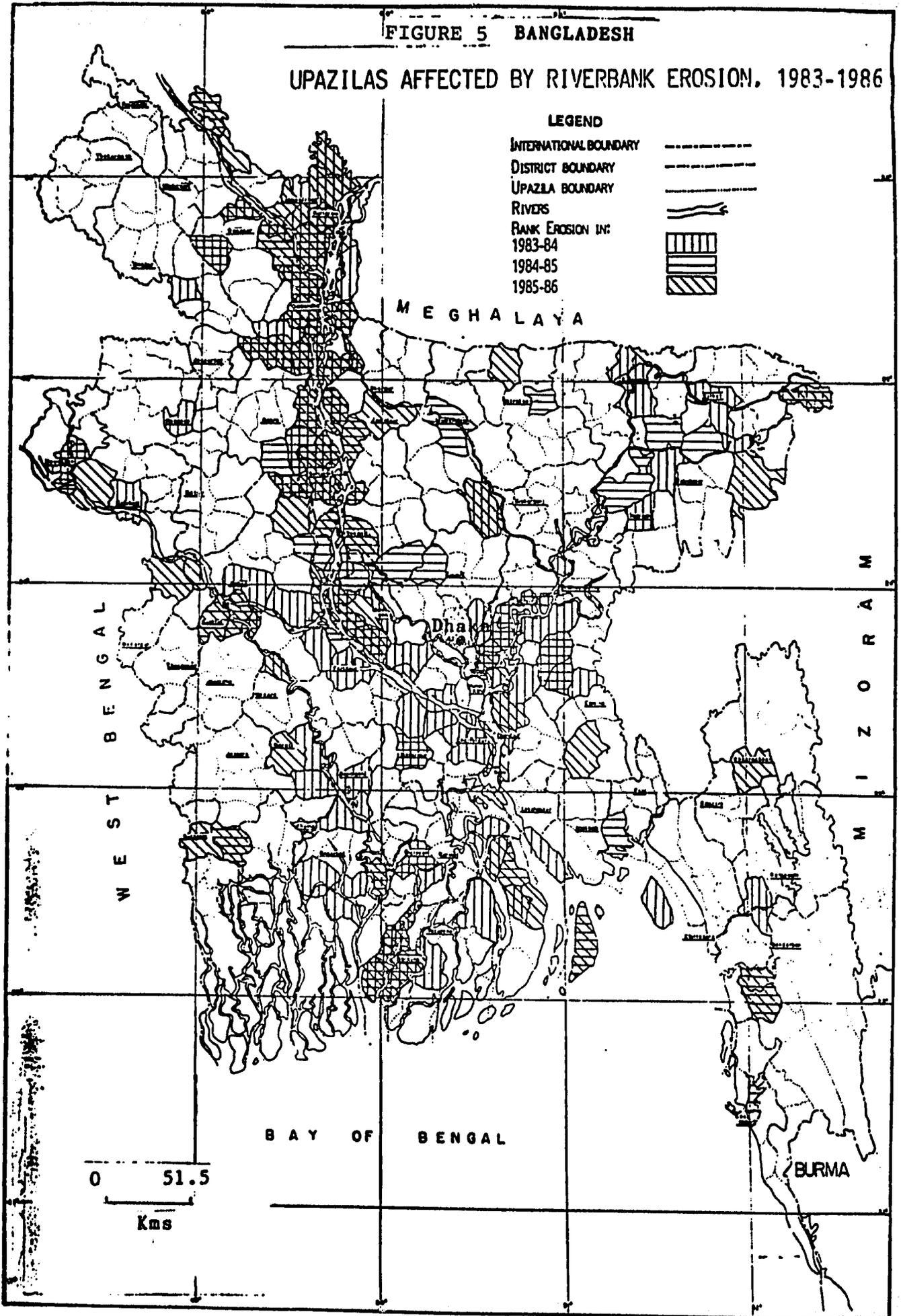
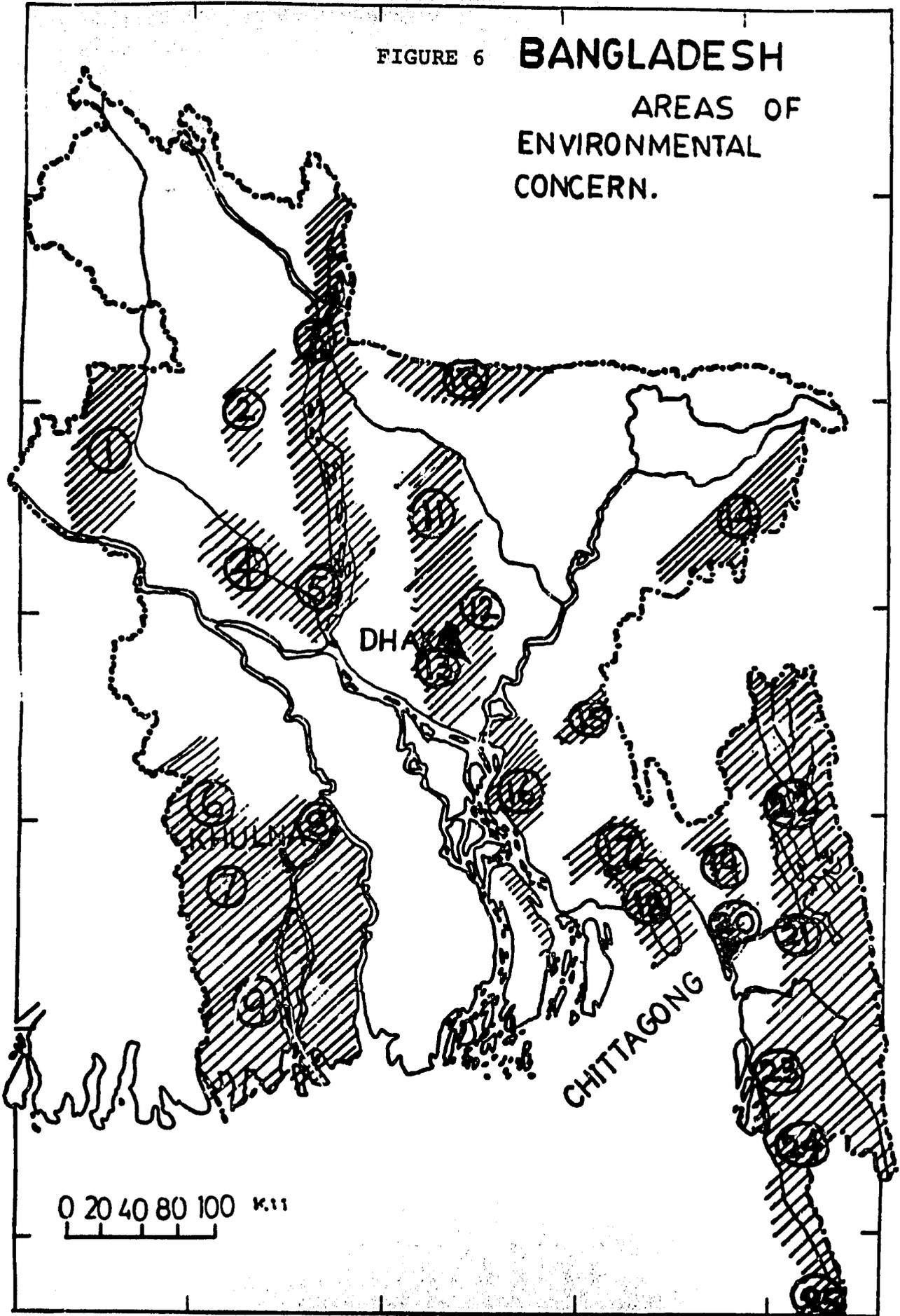


FIGURE 6

# BANGLADESH

AREAS OF ENVIRONMENTAL CONCERN.



0 20 40 80 100 km

# Areas of Environmental Concern in Bangladesh

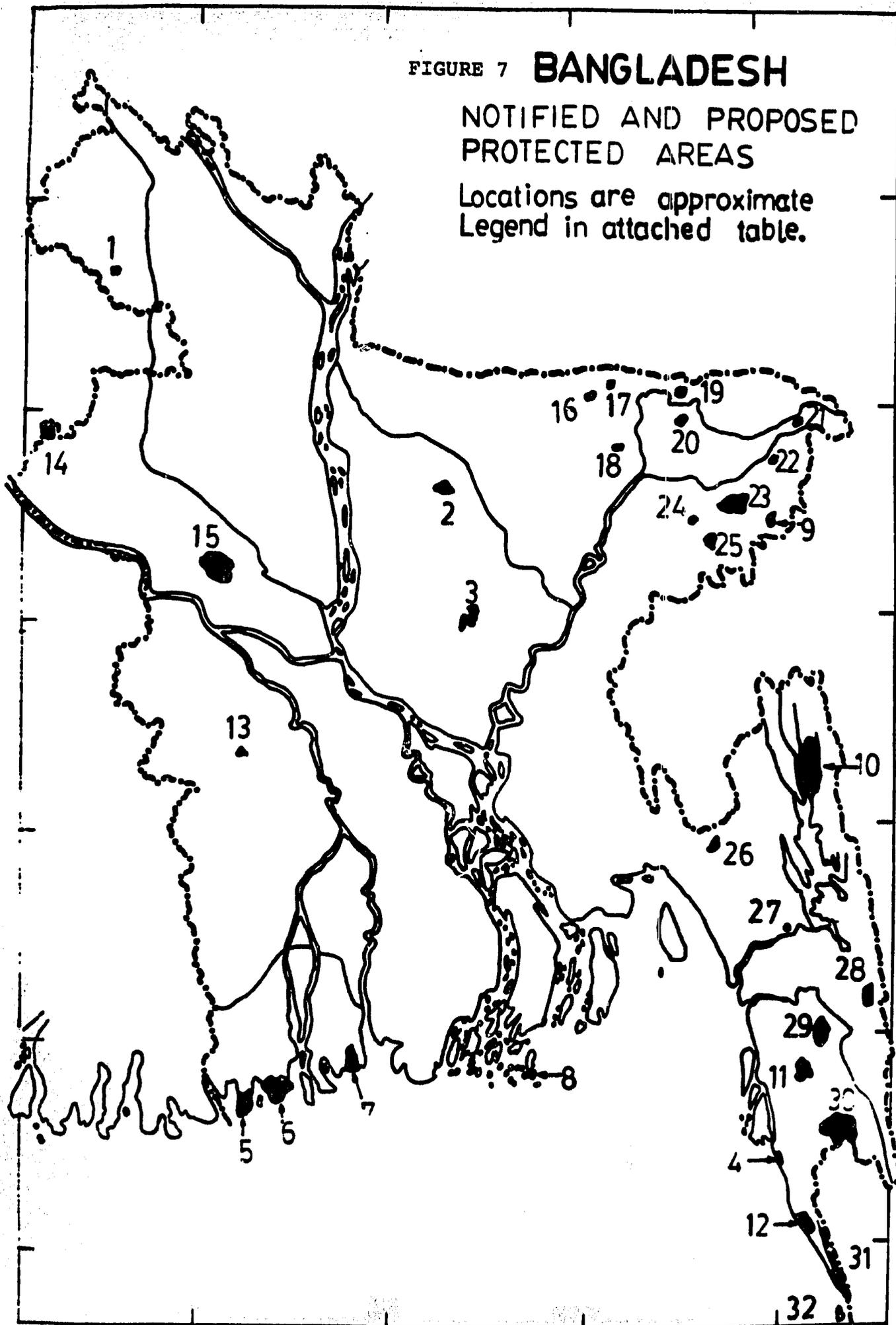
## Legend

1. **West-Central Barind:** vulnerable to land dessication through improper land-use. Low water-table, poor soils.
2. **Middle Karatoya floodplain:** Sulphur and zinc deficiencies in soils as a result of double-cropping of HYV Rice.
3. **Brahmaputra-Jamuna floodplain:** problems with Brahmaputra Right Bank embankment, which has breached 4 out of the last 5 years. Large population in the char-lands. Floods. Sand-deposit.
4. **Chalan Beel:** one of the richest wetland areas of Bangladesh, severely impacted by FCD/projects; need to re-assess polder development after 1987-1988 floods, and examine ways to combine agricultural production with fisheries production and wetland reserves.
5. **Atrai-Hurasagar drainage:** construction of embankments has impeded drainage and waterlogging has become a serious problem.
6. **South-west Jessore:** this area is vulnerable to low and variable rainfall and some soils are "droughty"; reduction in river flow from withdrawal at Farakka and irrigation uses has aggravated these natural conditions. Deep tube well irrigation in the south has drawn groundwater salinity inland.
7. **Northern Khulna:** large-scale shrimp farming has increased risk of salinization of soils, and competes with rice production.
8. **Khulna City and Mongla Town:** industrial pollution, oil spills from ships; urban congestion, etc.
9. **Sunderban:** increased salinity, increasing amounts of ship oil, industrial chemicals etc. has led to the top-dying of several species of trees. There has also been overcutting of the forest for industrial use.
10. **Garo Hills Piedmont:** erosion, flash floods, loss of agricultural productivity.
11. **Madhupur Tract:** deforestation and extensive degradation of remaining sal forests over the past 2 decades; improper use of sloping land leading to top soil erosion.
12. **Sitalakhya River:** industrial plants discharge toxic chemicals into this river: loss of fisheries and hazard for public health.
13. **Dhaka City:** industrial pollution; urban expansion destroying class 1 agricultural land.
14. **South Sylhet:** deforestation, flash floods, erosion.
15. **Gunti Basin:** flash floods.
16. **Lower Meghna:** floods, erosion, loss of fisheries. population pressure.
17. **Central Noakhali:** waterlogging in the wet season due to impeded drainage.
18. **Sandwip:** heavily populated island being eroded rapidly. Threat of natural hazards posed by non-consolidation of new alluvial land, and frequent cyclones and surges.
19. **Sitakunda Range:** deforestation, erosion, loss of productivity and major source of thatching grass; (urgently requires improved land use planning).
20. **Chittagong City and port:** industrial pollution, oil spills, cutting down of hill forests leading to increased erosion.
21. **Chandraghona:** industrial units discharge large quantities of chemicals into Karnafuli river, destroying fisheries and posing health hazard.
22. **Hill Tracts:** slash and burn cultivation and improper use of hill slopes has greatly increased erosion, and flooding of valleys and loss of productivity. Significant decline in tree-cover.
23. **Chakaria Sunderbans:** a forest area totally destroyed by fuelwood harvesting, cultivation and for use as shrimp farms. Shrimp yields are declining and soil acidity increasing.
24. **Cox's Bazar:** tropical moist forests with unique biodiversity being destroyed through conversion to plantations; heightened erosion and flood hazard from clear-felling and loss of forest cover.
25. **Jinjira Island and Reef (St. Martin's Island):** Coral reef being destroyed through overexploitation.

FIGURE 7 **BANGLADESH**

NOTIFIED AND PROPOSED  
PROTECTED AREAS

Locations are approximate  
Legend in attached table.

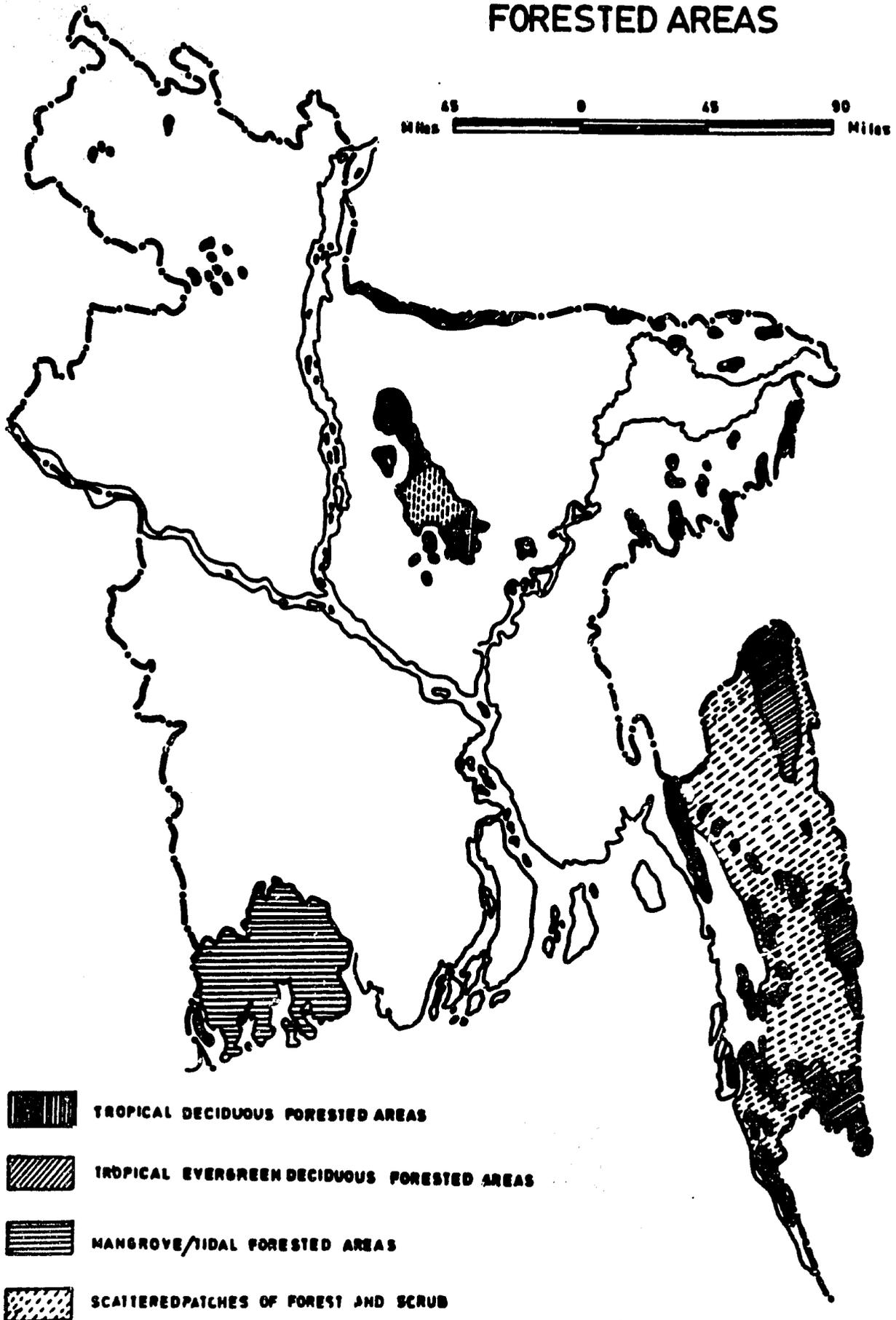


**POUSH**  
**List of Notified and Proposed Protected Areas in Bangladesh**  
**(Locations are Shown in Attached Map)**

Name of Area	Area (hectares)	Year	Name of Area	Area (hectares)	Year
<b>National Parks</b>			<b>Proposed Wildlife Sanctuaries</b>		
1. Ramsagar NP	52	1974	13. Ata Danga Baor		
2. Madhupur NP	8,436	1987	14. Bil Bhatia		
3. Bhawal NP	5,022	1987	15. Chalan Beel		
4. Himchari NP	1,729	1980	16. Meda Beel		
<b>Wildlife Sanctuaries</b>			17. Tanguar Haor		
			18. Aila Beel		
5. Sundarbans West WS	9,069	1977	19. Dakhar Haor		
6. Sundarbans South WS	17,878	1977	20. Kuri Beel		
7. Sundarbans East WS	5,439	1977	21. Erali Beel		
8. Char Kukri-Mukri WS	40	1981	22. Dubriar Haor		
9. Rema Kalenga WS	1,095	1981	23. Hakaluki Haor		
10. Pablakhali WS	42,087	1981	24. Kawadighi Haor		
11. Chunati WS	7,761	1986	25. Hail Haor WS	(1,427)	
<b>Game Reserves</b>			26. Hazarikhil WS	(2,903)	
			27. Rampahar-Sitaphar WS	(3,026)	
12. Teknaf GR	11,615	1981	28. Bogakine Lake (Rinkheong)		
<b>Note: List compiled by Haroun Er Rashid</b>			29. Chimbuk		
			30. Sangu-Matamuhari		
			31. Naaf River		
			32. Jinjiradwip (St. Martin's Island) and Jinjira Reefs		

FIGURE 8 BANGLADESH

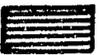
LOCATION OF THE FORESTED AREAS



TROPICAL DECIDUOUS FORESTED AREAS



TROPICAL EVERGREEN DECIDUOUS FORESTED AREAS



MANGROVE/TIDAL FORESTED AREAS



SCATTERED PATCHES OF FOREST AND SCRUB

SCALE 1:2000000

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**Table 1. Forest area by Region, 1985–1986**

<b>Region (Former District)</b>	<b>Square Kilometers</b>
Dhaka	262
Faridpur	—
Mymensingh	456
Tangail	326
Chittagong	3,300
Chittagong Hill Tracts	9,248
Comilla	8
Noakhali	1,841
Sylhet	756
Barisal	285
Jessore	—
Khulna	5,771
Kushtia	—
Patuakhali	176
Bogra	—
Dinajpur	101
Pabna	—
Rajshahi	28
Rangpur	26
<b>BANGLADESH—TOTAL</b>	<b>22,584</b>

Source: Forest Department

**Table 2. Area under different types of forests, 1985–1986**

<b>Forest Type</b>	<b>Total of All Government Forest (Sq. Km.)</b>	<b>State Forests (Sq. Km.)</b>	<b>Unclassed State Forests (Sq.Km.)</b>
Evergreen	15,253	8,925	6,328
Moist Deciduous	1,197	1,197	—
Mangrove	5,992	5,992	—
<b>TOTAL</b>	<b>22,442</b>	<b>16,114</b>	<b>6,328</b>

Source: Directorate of Forests  
Cited in BBS, 1987.

**Table 3. Forest Type Wise Tree Cover Area of State Forest Land  
(c. 1985)**

<b>Forest Type</b>	<b>Total Forest Land (<sup>'000</sup>ha)</b>	<b>Tree Cover (<sup>'000</sup>ha)</b>	<b>Percent Forest Land Under Tree Cover</b>
<b>Hill Forests/Tidal Forests</b>			
Chittagong Division	118.58	38.04	32
Cox's Bazar Division	152.97	104.82	69
Chittagong Hill Tracts (North Division)	164.31	114.12	69
Chittagong Hill Tracts (South Division)	95.91	46.14	48
Sylhet Division	74.87	29.95	40
<b>TOTAL HILL FOREST</b>	<b>606.64</b>	<b>333.07</b>	<b>55</b>
<b>Tidal Forests (other)</b>			
Sudarbans Forest	577.09	395.39	69
Coastal Afforestation	70.82	64.75	91
<b>TOTAL TIDAL FOREST</b>	<b>647.91</b>	<b>460.14</b>	<b>71</b>
<b>Plain Land Forests</b>			
Central Region	100.36	34.80	35
North-Western Region	13.76	2.02	15
<b>TOTAL PLAIN FOREST</b>	<b>114.12</b>	<b>36.82</b>	<b>32</b>
<b>ALL FOREST</b>	<b>1,368.57</b>	<b>830.03</b>	<b>61</b>

Source: Bangladesh Social Forests Project Preparation Mission. 1985. Vol 1, Anx. 2, p. 5.  
Cited in Chowdhury, 1989.

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**Table 4. Area of Plantations Raised During 1973–1985 by Forest Department**

Forest Land Type	1st Five Year Plan (1973–80)		2nd Five Year Plan (1980–85)		TOTAL (1973–85)	
	Target	Achievement	Target	Achievement	Target	Achievement
Reserve Forest	30,190	29,228	64,735	40,434	99,925	69,662
Unclassed State Forests	8,215	8,285	42,898	22,679	51,113	30,964
Coastal	35,076	30,969	40,469	40,398	75,545	71,367
<b>TOTAL</b>	<b>73,481</b>	<b>68,482</b>	<b>148,102</b>	<b>103,511</b>	<b>222,583</b>	<b>171,993</b>

1. First Five Year Plan also includes Two Year Plan (1978–80)

Source: Forest Department, cited in Chowdhury, 1989.

**Table 5. Government Controlled Forest Land 1983–1987 (1000 hectares)**

Class of Forest Land	Area		
	1983–84 (1)	1985–86 (2)	1987 (3)
Reserved Forest	1,267	1,481	1,265
Protected Forest	57	54	54
Acquired/Vested Forest	90	77	193
Unclassed State Forest	373	633	409
Khas/WDB Land	204	614	12
<b>TOTAL Government Land Classed as Forest</b>	<b>1,991</b>	<b>2,259</b>	<b>1,933</b>
<b>Percent of Total Area (14,400,000 ha)</b>	<b>13,8%</b>	<b>15,7%</b>	<b>13,4%</b>

**Sources:**

- (1) Forest Dept. data, cited in Statistical Pocket Book of Bangladesh, (1986), in C. Lai, ed. 1987.
- (2) Forest Department data cited in Bangladesh Bureau of Statistics, 1987. p. 217.
- (3) Appendix 1, Forest Land Area in Bangladesh, June 1987, from Bajracharya, 1989; includes area afforested with mangroves as acquired forest land.

**Table 6. Distribution of Cultivable Area by Land Types and Region in Bangladesh**

<b>Region</b>	<b>Cultivable* Area</b>	<b>F0</b>	<b>F1</b>	<b>F2</b>	<b>F3</b>	<b>F4</b>
Northwest	2.451 (100)	1.307 (53)	0.797 (33)	0.194 (8)	0.153 (5)	—
Northeast	2.573 (100)	0.789 (31)	0.568 (22)	0.529 (20)	0.068 (26)	0.019 (1)
Southeast	1.313 (100)	0.386 (29)	0.474 (36)	0.300 (23)	0.134 (10)	0.019 (2)
South Central	1.026 (100)	0.234 (23)	0.599 (58)	0.128 (13)	0.032 (3)	0.033 (3)
Southwest	1.666 (100)	0.545 (33)	0.713 (43)	0.281 (17)	0.120 (7)	0.007 —
<b>SUBTOTAL</b>	<b>9.029</b> (100)	<b>3.261</b> (36)	<b>3.151</b> (35)	<b>1.432</b> (16)	<b>1.107</b> (12)	<b>0.078</b> (1)
Active Floodplain	0.533 (100)	0.253 (47)	0.137 (26)	0.126 (24)	0.017 (3)	—
<b>Bangladesh TOTAL</b>	<b>9.562</b> (100)	<b>3.514</b> (37)	<b>3.288</b> (34)	<b>1.558</b> (16)	<b>1.124</b> (12)	<b>0.078</b> (1)

\* Figures in parentheses are percentage of cultivable area; active floodplain is the area in char lands. Islam, 1989. UNDP, Vol. II

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Table 7. Crop area averages in the period 1982–1984 (000 acres)

Crop	1983–84 Census	Comparable Annual Statistics	Column 1–Column 2 Percentage
Aus	7,705	7,777	99.07
B. Aman	3,309	3,719	88.97
T. Aman	8,685	11,106	78.20
Boro	3,139	3,503	89.61
Wheat	1,323	1,292	102.40
Minor Cereals	572	132	433.33
Oilseeds	1,439	727	197.94
Jute and Mesta	1,787	1,675	106.69
Sugarcane	396	410	96.59
Tobacco	148	128	115.62
Potato	330	272	121.32
Sweet Potato	146	162	90.12
Other Vegetables	680		
Chilli	378	186	203.22
Onion and Garlic	236	115	205.22
Major Fruits	1,067*	383	278.59

\* Horticultural area, derived from statistics given in Vol. 2 of the 1983-84 *Census of Agriculture and Livestock* (BBS, 1985).  
(From Rashid, 1989. UNDP ASR)

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