GOVERNMENT OF BANGLADESH
MINISTRY OF ENVIRONMENT AND FORESTS

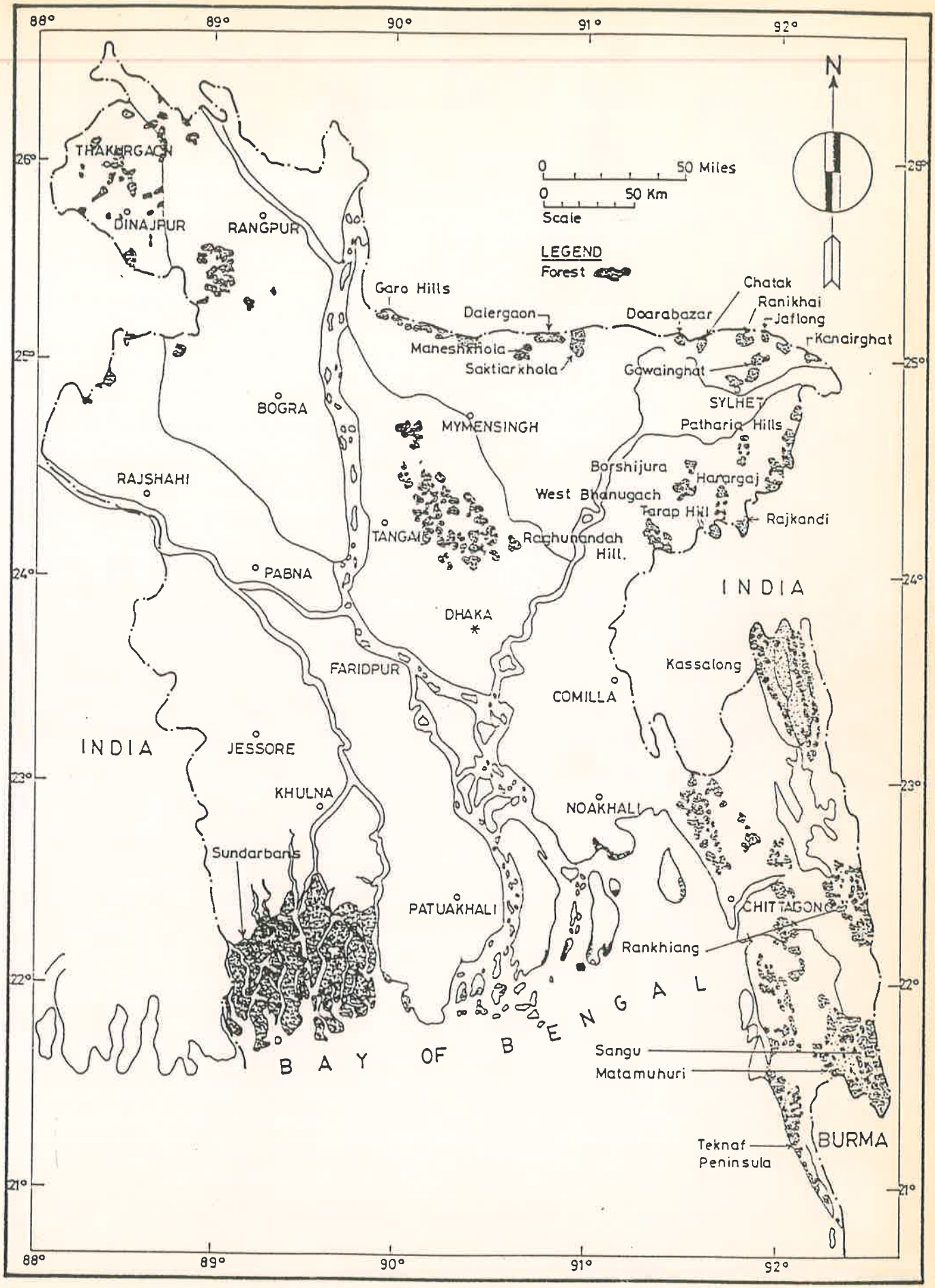
ENVIRONMENT AND LANDUSE

FORESTRY MASTER PLAN

ASIAN DEVELOPMENT BANK (TA NO. 1355-BAN)

UNDP/FAO BGD/88/025

1993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B A Y OF B E N G A L
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Teknaf Peninsula

KEY MAP

FARUQUE

PROJECT 372001/30
FORESTRY MASTER PLAN,
BANGLADESH (TA NO.1355-BAN)

ASIAN DEVELOPMENT BANK
MANILA PHILIPPINES
DATE: JANUARY 1993

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SUMMARY

The forestry sector has traditionally received very little government attention and as a result the policy, legislation, forest industries, research and forest institutions and management have been ineffective. Coupled with increasing landlessness, land fragmentation, and land use conflicts, there has been tremendous pressure on the forest resources of the country (both in forest reserves and in homestead forests) resulting in deforestation, encroachment, and unsustainable exploitation levels. There has been a permanent loss of biodiversity with extinction of wildlife species, and a growing list of threatened and endangered species of both flora and fauna. Natural recurrent disasters add to the list of constraints to the sound environmental management of Bangladesh's forest resources. Forest products supply/demand imbalance and the lack of community consultation and participation exacerbate the situation.

Major Issues

a. The conservation of ecological processes is critical for Bangladesh. These ecological processes include: (a) biogeochemical cycles; (b) production and energy flows; (c) mineralisation of organic matter in soils and sediments; (d) storage and transport of minerals and biomass. The regulation (particularly of the hydrologic cycle) of these processes by micro organisms, animal and humans has impacts on the complex relationships within species, between species, and within and between habitats and ecosystems. The dynamic nature of these processes in such an active deltaic region, and at the confluence of three major biotic regions in Asia has created much diversity in species. This diversity has been substantially threatened, particularly through man-induced changes.

b. Past and present forest resource use and exploitation patterns, if allowed to continue, will result in severe depletion of growing stock and biodiversity of flora and fauna. The sustainability of such patterns is not possible. To what extent can the remaining natural forests in the country be exploited, without causing irreversible and permanent damage to the natural heritage of the country? Given the pressures on land in Bangladesh how much can realistically be kept under a protected area system?

c. The net result of all the plantations over the last 100 years in Bangladesh is negative, as is the traditional approach of the Forest Department in designating reserves for revenue generation while not contributing to providing of basic needs for local people. The productivity of forest management techniques requires a dramatic increase. How can this best be achieved, given the existing severe social and institutional constraints?

d. The forestry sector has not fostered the full participation of people in planning, implementing, monitoring and evaluating sectoral programmes. Thus, social equity has not been addressed. Biomass production, development of nonwood forest products, and community participation and benefit-sharing have been inadequately addressed to date. To what extent can equity be addressed through participatory mechanisms?

e. Bangladesh has only recently created institutional mechanisms for environmental management through the Ministry of Environment and Forests and the Department of Environment. A major issue is how to buildup the institutional capacity and how to use

existing national level expertise more in environmental impact assessment, monitoring, and evaluation of the forest sector.

Findings

1. Conservation of Ecological Processes

a. Global climatic change poses a potential danger to the development efforts, ecosystems and the productive capacity of Bangladesh. The main global factors are fossil fuel emissions, industrial activities and deforestation. A one-metre rise in sea level would inundate 15-17% of the total area of Bangladesh particularly low-lying floodplains and coastal areas.

b. Floods, cyclones, and tidal surges, as well as seasonal droughts in winter are recurrent natural phenomena. Much damage is done to wildlife and vegetation cover in coastal areas as well as homesteads and forest reserves. Selection of plantation species for disaster prone sites becomes a matter of importance.

c. The stability of critical ecosystems is also affected by decreasing soil fertility, increasing erosion, conversion of wetlands to agriculture and by large scale flood control, drainage and irrigation projects within Bangladesh as well as in upper riparian countries. In some cases, inappropriate land use has devastated coastal mangroves. Conversion of forest lands to agriculture are a major threat to ecological stability as well.

d. The protected areas system of national parks and wildlife sanctuaries within the country is not functional, and is therefore susceptible to the same pressures as other areas. No management plans exist, and no staff are allocated for this purpose. Even some protected areas have become substantially degraded.

e. Areas of environmental concern, degraded through loss of a forest cover, include: (1) Barind Tract, (2) Tangail/Madhupur/Mymensingh, (3) South Sylhet Forest Division, (4) Lalmai Range, (5) Sitakunda, (6) Banshkhali to Harbang, (7) Chakaria Sundarbans, (8) Cox's Bazar and Teknaf tropical moist forests, (9) Chittagong Hill Tracts, (10) Unclassed State Forests of CHT, (11) Garo Hills Piedmont, (12) Freshwater swamp forests of Sylhet, and (13) Mangrove forests of Sundarbans.

Other areas of ecological sensitivity include: (1) the corals of Jinjiradwip, (2) wetlands throughout the country, especially the haor basin and coastal charlands, (3) the three natural lakes in the country, (4) reed lands of Sylhet, (5) watershed areas of the Sylhet hills, Sangu-Matamuhuri and Kaptai Lake. Designating special land use and managing some of these under protected area systems are essential.

2. Sustainability

a. Past Forest management was primarily for production purposes with little regard for watershed protection, preservation of gene pools, wildlife management, or needs of local people.

b. South Asia had an annual deforestation rate of .6% for the period 1981 - 1990. In comparison, Bangladesh, had a rate of 3.3% (excluding forest fallow and new plantations) or 37,600 ha annually. The projection is 3% annually to the year 2000.

c. Annual allowable cuts have exceeded the forests' ability to regenerate in sufficient quality and quantity. Removal of remaining natural forests for the creating of low-yielding plantations is not an effective mechanism for sustainable resource management.

d. Existing methods of clearfelling, followed by burning, cause soil erosion, loss of productivity, and depletion of biodiversity. Plantations with monocultures of exotic species on a large scale are not conducive to maintaining biodiversity, are susceptible to disease, and have not been planted with appropriate site and land suitability/ capability factors in mind.

3. Productivity

a. At present the forest reserves provide 57% of the timber fuelwood and bamboo used in Bangladesh, from an area of 2.2 million ha. Homestead and village woodlots, with only one-seventh the area of forest reserves, produce 43%. This suggests that forest resources under the ownership and management of independent small holders and private sector entrepreneurs are much more productive per unit area.

b. Many landuse conflicts exist, i.e., shrimp vs. agriculture vs. fisheries vs. forestry in low-lying floodplains, shifting cultivation vs. forestry in the Chittagong Hill Tracts. Areas particularly vulnerable are the Sundarbans, coastal areas and wetlands.

c. Forest plantations in Bangladesh have been overall a dismal failure. Not only has there been a net loss of forest cover over the years, the net yield per hectare of original planted area has actually been dropping, producing mean annual increments of growing stock extremely low by regional and international standards. Net productivity is so low in plantations, that felling of natural forests for the purpose of increasing productivity is not sufficient justification for such action.

d. Wastage in the forest industries sector is significant, particularly in sawmilling and high forest extraction. Techniques for seasoning, preservative treatment and utilization of more species, veneers and hardwood substitutes are not used. These factors combined with historically low royalties, inefficiency of parastatal corporations, and inadequate prices and taxation policies result in a very low economic contribution by the sector.

e. Management of forests areas for multi-use purposes is a major land use requirement. The establishment of buffer zones and intensive use areas for participatory forestry would be helpful to maintain core protected areas.

4. Equity

a. The forestry sector has been primarily focused on providing raw materials for industry and manufacturing, and has contributed very little to poverty alleviation and social equity. Through a shift to genuine participatory forestry, small holders and cooperatives (facilitated by non government organizations) can benefit from systems which offer quick return on investment, through agroforestry modules which are flexible and client-oriented.

b. Substantial areas of forest have, and more are, degrading through encroachment; the Forest Department's traditional approach has failed; changes to leases, tenurial arrangements, incentives for private enterprise and outright land titles need to be considered.

c. Fair and equitable involvement of women must recognize their dominant role in the establishment and maintenance of homesteads and village woodlots as well as special burdens imposed on them by the absence of readily available fuelwood.

5. **Environmental Management**

a. Environmental impact assessment experience is limited in Bangladesh, and legislation and policy are weak. Significant training and national capacity building is needed, within Forest Department and within Department of Environment.

b. Environmental impact guidelines for the forestry sector do not exist in Bangladesh and need developing.

c. There is an absence of effective policy, legislation, and implementation mechanisms for conservation, protected area management, wildlife management and biodiversity.

d. While there is substantial international agreement on the need for biodiversity protection, there remains the question of who should pay for such programmes, as well as pollution mitigation measures.

Recommendations

1. **Conservation of Ecological Processes**

a. Start a new institution for the conservation of biodiversity, wildlife, and protected area management.

b. Rationalization of boundaries and management plans for existing protected areas.

c. Action plans for endangered species.

d. Creation of new protected areas and new categories of historical/ cultural and recreational sites.

e. Changes to protected areas legislation.

f. Strengthening of national ex-situ facilities such as the botanical garden, zoo and herbarium.

2. **Sustainability**

a. Bangladesh to adopt, where appropriate, the International Tropical Timber Organisation guidelines for the sustainable management of natural tropical forests.

b. Bangladesh to implement convention on biodiversity.

c. Rewrite and update forest management plans to include effective measures for watershed protection, soil conservation and wildlife management.

d. Research on regeneration of specific species and continuous monitoring of permanent sample plots in different forest types.

e. Changes to existing silvicultural systems to minimize environmental impact of harvesting and plantation techniques.

3. **Productivity**

a. Unless productivity is dramatically improved, there will be no chance whatsoever of retaining existing natural forest. Through productivity increases, pressures on remaining forest can

be reduced, but emphasis focus on existing plantations, and new plantations on degraded or denuded land, rather than on natural forest.

b. Ban extensive, low-technology shrimp farming from expanding in coastal areas.

c. Keep coastal areas and charlands under mangrove shelterbelts, rather than allowing conversion for agriculture.

d. Increase productivity through underplanting, enrichment planting, increased use of fodder legumes, nitrogen-fixing species, NTWP, and multi-purpose species.

e. Multiple use management of forest reserves will require delineation of core-buffer zones, intensive use areas requiring extensive consultation with local communities.

4. Equity

a. A significant re-ordering of priorities, primarily through institutional change and a strong focus on participatory forestry will facilitate more equitable distribution of benefits.

b. Forest reserve areas need rationalized; particularly in the Chittagong Hill Tracts, models need developed which minimize impacts on tribal cultures.

c. Forestry activities are inseparable from people's basic needs; some projects integrating forestry into other rural development activities should be initiated; NGOs will play a major role in such projects.

5. Environmental Management

a. Provide Training for Forest and Environment Department staff in environmental impact assessment of forestry activities.

b. A national conservation strategy is underway. Review the national environmental management action plan, the ESCAP coastal environmental management plan for Bangladesh, and the Bangladesh's country report for UNCED, and appropriate recommendations accordingly endorsed and implemented.

c. From an autonomous coastal development and management authority to implement the coastal plan.

d. Upgrade the Resource Information Management System within Forest Department with an up-todate geographical information systems for monitoring forestry activities, including environmental impacts.

Investment Needs and Opportunities

a. Under a low investment Scenario 1, assuming minimal change in policy, management and institutions the investment required is $ 40.6 million of which Government's portion is 37%. Such an investment, however, would merely provide some additional time before the forest resource base is irretrievably lost.

b. Under a high-input investment under Scenario 2, significant changes in policy, management and institutions are made. Within a framework which eventually embraces an autonomous body, a new institution is created for the conservation and management of protected areas and natural resources. The Ministry of Environment and Forest, and its affiliated Departments are all accordingly upgraded. The investment costs under the Scenario are $122.2 million, of which the Government's share drops to 14%.

ENVIRONMENT AND LANDUSE

INTRODUCTION

General

The Asian Development Bank (ADB*), the United Nations Development Programme (UNDP) and the Government of Bangladesh (GOB) are financing the technical assistance services to prepare a twenty year Forestry Master Plan for Bangladesh. The plan aims to assist the GOB in deciding on priorities and in implementing programmes for the sustainable development and preservation of the country's forest resources. This report presents the Environment, Landuse and Conservation Specialist assessments and is part of the overall planning process for the Forestry Master Plan.

For consistency, this report uses standard metric units of measurement, terms, and abbreviations. It draws on extensive field visits throughout the country by the team, firsthand observations and data compilation, consultation with the public and special interest groups, a number of findings from other team members, and secondary sources as well. Recommended Programmes and Investment Costs are documented in Appendix 2.

This report comprised one of the six subteams of the Forestry Master report. The others are: institutions (FMPa); forest production and management (FMPb); forest industries (FMPc); economics (FMPd) and participatory forestry (FMPe).

The Global Environmental Imperatives

Environment in a global context was given an important impetus in 1972 by the mandate from the United Nations General Assembly to UNEP to assess the environmental situation on a worldwide basis. They were directed to monitor emerging environmental problems of international significance which could be brought to the attention of governments and global institutions for appropriate action.

A World Conservation Strategy (WCS) was developed in 1980 by the IUCN in cooperation with WWF, UNEP, FAO and UNESCO. Its three primary objectives were: (1) to maintain essential ecological processes and life support systems; (2) to preserve genetic diversity; and (3) to ensure the use of ecosystems and species in a sustainable manner.

The World Commission on Environment and Development (WCED) in 1987 stressed the concept of sustainable development, which concluded, inter alia, that: (a) consideration to intergenerational equity was paramount; (b) the priorities needed to be given to the basic needs of ther world's poor; (c) the environment's ability to meet future needs should be determined by both the state of technology and social factors; (d) the process of change must recognize the rights of traditional lifestyles of tribal and indigenous peoples; (e) political will was the ultimate arbiter for directing institutions and technology and investments towards sustainable development.

The UNEP, in a state of the environment report (1972-1992) prepared for the United Nations Conference on Environment and Development (UNCED) noted that:

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* For this and other terms or abbreviations, see Appendix 1

"There are still serious gaps in our understanding of the environment, our ability to estimate the cost of repairing the damage we have done to it, and our knowledge of the cost of failing to take rapid action to halt its degradation. Twenty years after Stockholm, it is still not possible to describe the state of the world environment comprehensively or to say with confidence that the Governments of the world have the knowledge or the political will to deal with the global problems which we already know exist."

Significant concerns were expressed with the state of the art in the tools available for environmental management, viz.,: (a) an unreliable database, particularly from developing countries, where environmental planners are frequently constrained by "guesstimates"; (b) recent technical and scientific advances in environmental monitoring through techniques such as remote sensing are rarely applied due to the dearth of equipment and trained personnel in many developing economies; (c) standards for desirable socio-economic and environmental indicators have not been widely developed or applied; and (d) a definitive assessment of the earth's carrying capacity, or that of individual countries remains extremely difficult.

However, there is a broad scientific consensus (UNEP, 1992) that over the past two decades, the following observations represent the major global environmental issues: (i) urban air pollution, improving in many cities in the developed economies, is deteriorating sigificantly in developing countries; (ii) the causes and effects of ozone depletion are better understood, but remain critical; (iii) global climatic change remains a most complex and urgent problem; (iv) fresh water resources, quality, and management increasingly require cooperation on a watershed or aquifer basis; (v) coastal zones, seas and oceans, are increasingly degraded, used in an unsustainable manner, and remain endangered from landbased sources of pollution; (vi) desertification and degradation of arid lands is a serious problem and is on the increase; (vii) habitat loss through deforestation and conversion of wetlands, threaten the stability of local and regional environments; (viii) current rapid extinction of species and loss of biological diversity are irreplaceable; (ix) the risks from environmental disasters (particularly man-made ones) must be reduced; and (x) hazardous wastes (both production and disposal) and toxic chemicals are major threats to humanity and require urgent action.

The analysis also recognized that the concept of development is a multidisciplinary one, embracing social, economic, cultural and political dimensions of human society. The mutual interdependence of environment and development has been increasingly recognized. In particular it stresses that social and economic systems should be managed to "maintain or improve the resource, which does not necessitate preservation of the current stock of natural resources or any particular mix of human, physical and natural assets. Nor does it place artificial limits on economic growth, provided that such growth is both economically and environmentally sustainable" (UNEP,1992).

IUCN has also moved beyond its WCS, paying more attention to the human and social factors rather than only the natural resource base, i.e., integrating conservation and development. They have elucidated a number of principles for building and maintaining a sustainable society (IUCN et al, 1991): (i) respect and care for the community of life, implying intergenerational equity, recognition of different communities and interest groups, and inequity between people who are poor and those who are affluent; (ii) improve the quality of human life, including recognition that development is a process that enables human beings to realize their potential and dignity, and to live free from violence, access to basic needs such as education, a decent standard of living, political freedom and guaranteed human rights; (iii) conserve the planet's diversity and vitality through conservation of ecological processes, biodiversity, and sustainable use of renewable resources; (iv) minimize non-renewable resource depletion; (v) balance supply and demand within available carrying capacity; (vi) individual attitudes and practices should reflect the new ethic, i.e. think globally, act locally; (vii) encourage community-based environmental management; (viii) integrate development and conservation through a framework which recognizes intersectoral relationships at the national level through policy coordination and interventions, ensuring full

environmental and social costs are passed on to resource users; and (ix) foster global alliances to achieve these principles, recognizing our growing interdependence.

Similar global initiatives have been esposed in Agenda 21 which submitted a proposal to UNCED with 27 principles. Seven overall priority actions were identified, these being grouped into social themes which included a fertile, clean, equitably shared, just (sustainability for all) and habitable world which was to be achieved via wide public participation at local, national, and global levels. Its major observations regarding sustainable forest development include: (i) the recognition of the multiple role that forests play in local economies and quality of life; (ii) that temperate and boreal forests must be given attention as well as the tropical forests; (iii) that preserving natural forest areas is critical for biodiversity, but that afforestation through plantations has a unique contribution as well; (iv) the need to strengthen national institutions, policies, and programmes in the forestry sector; (v) that adequate attention must be given to forest protection and remedial measures; (vi) that multiple and efficient use of forests is a precondition for sustainable use; and (vii) systems for monitoring forest lands and programmes are needed.

While global actions are indeed necessary, it remains to be seen to what extent excellent intentions can be translated into reality. To date, results are elusive globally, or indeed within the region which remains generally encumbered with severe problems in the forestry sector compared to naturally better endowed and managed forests elsewhere. To date, few international fora have concretely addressed transnational problems in terms of specific programmes and projects for implementation, although many international conventions have been ratified throughout the world. Within the South Asian region, ESCAP has attempted to address regional problems, as has the UNEP South Asian Seas Programme. SACEP, meant to collaborate on environmental issues facing SAARC countries has been relatively ineffective, having achieved little of substance. In such a context, it is unsurprising that the forestry sector in Bangladesh has exhibited disappointing results. However, the situation need not remain dismal, provided GOB, and MOEF in particular commit themselves via action programmes to the conventions GOB has recently signed at UNCED.

The Global Environmental Facility (GEF), founded two years ago, has been designated as the main mechanism for channeling funds to environmentally proactive programmes. Since the fund has been dominated by the World Bank, developing country representatives lobbied vigourously but unsuccessfully for a greater role in decision-making. There was originally a membership fee and only several dozen countries were fully accredited members. The fee (in excess of $5 million) has restricted membership from the poorest countries and has been abolished recently. The GEF will be restructured via a resolution of the World Bank executive board and probably endorsed by the relevant bodies with UNEP and UNDP- the two other agencies involved in administering the fund.

Background

The geographical setting of Bangladesh, its population pressures within a very limited land area, extensive and persistent poverty and unemployment, and the complex interrelationships of its natural dynamic processes create extremely difficult conditions for environmental planning. It forms a drainage basin for the Ganges, Meghna, and Brahmaputra rivers, through which up to 2.4 billion tons of sediment have been estimated to surge annually. It is also vulnerable to regular seasonal flooding, cyclones and droughts. The country is an active deltaic region, situated between the foothills of the Himalayan massif and the Bay of Bengal. Inland, it is surrounded by India on three sides. Its area, about 144,000 square kilometres, is about the size of Nepal and one-twentieth the size of India. Geologically, the country is also in an active tectonic region, which has shifted the direction of flow of major rivers and contributed to ongoing uplift as well as depressions within different parts of the country.

Floods are an annual phenomenon, but were remarkably devastating in 1974, 1984, 1987 and 1988. During the latter year, up to 30 million people were affected. Cyclones are also pervasive, striking the Bangladesh coastal belt more than 50 times between 1975-1992. In the 1991 cyclone and tidal surge, estimated casualties were 138,000 lives (exceeded only by the 1970 cyclone which killed perhaps 300,000). Droughts were experienced in 1979, 1981, 1982 and 1989. Regional aspects are also a factor, whereby watershed management practices in upper riparian countries can have significant impacts on Bangladesh. The Farakka Barrage is an example, where restricting fresh water flows during the dry season, has caused serious problems in southwest Bangladesh. In the monsoon season, flooding is exacerbated by the high volumes of water released through Farakka. The patterns of flood and drought have been less predictable in more recent years, and more pronounced in their effects, according to numerous observers. Some scientists maintain that these may presage early symptoms of global warming and greenhouse effects.

Some ecological concerns are the result of poor policy, planning, and implementation of specific projects, for which both the GOB and donors must share the blame. For example, it has been widely acknowledged that some natural phenomena have been exacerbated due to man-made factors, such as a number of flood control, drainage and irrigation schemes. Deforestation, to some extent exacerbated by growing populations and shifting cultivation over a long period of time, is a result of innapropriate policies and regulations which have stressed state operation and commercial exploitation of forest products rather than conservation and community agroforestry.

Those affected most severely by negative environmental impacts tend to be the poorest men and women; those most marginalized are women. Contrary to widely held and promulgated misconceptions, they are largely the victims -rather than the perpetrators- of natural resource mismanagement (Treygo, 1991).

By far the the large majority of the population earns its livelihood from the agriculture sector, which contributes approximately 50% of the GDP, as opposed to only 4% of GDP for the forestry sector. Expenditure patterns of successive five year plans of GOB usually allocated less than 1% of total available funding towards forestry. The most recent plan is less than two percent. The economy is highly dependent on foreign aid (almost 90% of the annual development budget), and has increased disparities between rich and poor. The net result has particularly affected the traditional subsistence economy which relies heavily on natural resource use (such as forest products). The depletion or destruction of these resources threatens the impoverished rural and urban dwellers, tribals, artisans, fishing communities, nomadic or migrant people, and above all women, who are the most affected by their primary role in obtaining fuelwood and drinking water.

Approximately 50% of the land is owned by less than 10% of the population, and functionally landless families (owning less than .4 hectares) comprise at least two-thirds of the population. Unemployment and underemployment exceed 25%. Literacy rates are among the lowest in the world and infant mortality and malnutrition remain very high as well. Landuse, conservation and environment policies should reflect this stark reality.

Environment has become increasingly prominent in recent years on the development agenda, both globally and in Bangladesh as well. The number of conferences, workshops and seminars with environmental themes as the primary agenda have been increasing exponentially over the past several years in particular. Some publications on environment have been released, several Bangladeshi have been recipients of the UNEP Global 500 (The Roll of Honour for Environmental Achievement) in recent years, and a new Ministry of Environment and Forest (MOEF) was created in 1989. The Department of Environment (DOE), incorporated within MOEF also in 1989, has been accorded higher status than as a minor and ignominious entity (DEPC) under the ministry responsible for local government and cooperatives. A National Conservation Strategy (NCS), in its third draft since 1987, is on the verge of receiving formal approval at the highest levels of government. A new environment policy was drafted in 1992. A

National Environmental Management Action Plan (NEMAP), drafted in late 1991 is now undergoing scrutiny for possible implementation. A new environmental preservation ordinance (proposed by the DOE in 1989, and still "under consideration" by GOB) has also been the subject of considerable discussion for some time. Most of these initiatives have reached Cabinet level consideration and are also close to formal ratification. GOB representatives prepared a brief and attended the UNCED conference in Brazil in 1992, as did some local NGOs.

At the same time, there have been some setbacks. The list of endangered species has increased in the country, the Wildlife Circle within the Forest Department was abolished in 1983 (and not revived in any form to date). Staff training, facilities, outdated and contradictory legislation, capacity for EIA, and enforceability of environmental rules and regulations are conspicuously weak. There are no provisions in law for people affected by environmental pollution to charge offending industries. Polluting industries do so indiscriminately, without any regard to consequences, which to date, have been nil in any case. The capability of educational and research institutions to contribute to environmental endeavours has been limited. With the exception of some individuals and small faculties and research centres, the universities remain peripheral to any serious involvement in environmental initiatives. Private sector businesses have been conspicuous by their absence.

A number of NGOs have begun to undertake specific projects related to environment, in particular social forestry, while some groups focus on wildlife management, action research, forest protection, surveys of flora and fauna, and innovative attempts at involving local people in management of protected areas. In addition to individual undertakings, workshops have been held throughout the country to formulate a State of the Environment Report (SOER) which has been in the works for about 4 years but has yet to be published. Umbrella groups of NGOs concerned with environment have been formed, and there is an active Bangladesh Forum of Environmental Journalists. To date, such efforts have been sporadic, but have led to growing recognition by GOB and donors of the valuable role which NGOs have played. Such recognition, unfortunately has not been forthcoming from the Forest Department to any significant degree, until quite recently.

Multilateral assistance to the environment has been limited. Primarily, it has been dominated by investment proposals and projects in agriculture, water resources, industries, and infrastructure. However, the World Bank, ADB, UNDP and FAO have made some contributions to the forestry sector over the years, in the form of inventories, institutional support, training, upazila (now thana) afforestation, coastal plantations, and assisting the forest industries sector. Almost none of this assistance was targeted for environmental concerns until rather recently, as evidenced by the fact that there is no institution responsible for protected areas. There is no soil conservation or watershed management section within the Forest Department, and neither the BFD nor DOE has ever conducted EIAs on forestry projects. Nor is there any capacity to do so at this time. Both the World Bank and The ADB have completed environment strategy reviews within the past year or so. UNDP is assisting MOEF with an institutional needs assessment as well as collaborating on the Integrated Sundarbans Development Project. The UNDP is the lead agency of the Local Consultative Group on environment.

Bilateral assistance has been modest, limited to some early assistance to the Forest Department with resource inventories, establishing and assisting forest industries, etc. Within the past three to four years a number of environmental country studies have been produced by agencies such as SIDA, DANIDA, USAID, and CIDA. These did not specifically focus on the forest sector, but rather were overviews of the environmental status quo, along with recommendations for future programming. These concerns for the environment evolved as the result of a long process which began more than twenty years ago. They have finally been accorded the appropriate recognition in official development assistance policies only recently.

MAJOR ENVIRONMENTAL PLANNING INITIATIVES IN BANGLADESH

Governmental Strategies and Programmes

1. National Conservation Strategy

The National Conservation strategy (NCS) is a project of GOB and MOEF, executed by BARC with technical assistance from IUCN. The NCS Task Force and Secretariat were constituted in 1987, and the second draft was made available for government review in late 1991. To date the NCS is undergoing a third draft and has yet to be formally approved and distributed.

The following is an overview of the macro environmental setting within which the forestry master plan options need to be examined. Current trends in resource use clearly identify depletion of resources. The key variables are:

- population pressures on diminishing natural resources;
- the quality, control, and management of water for competing uses in agriculture, industry, fisheries, drinking and sanitation;
- the failure of land reform policies, increasing land fragmentation, declining land and soil fertility and productivity;
- declining fisheries production, through poorly planned FCDI projects and the conversion of wetlands to agriculture affecting spawning and migration;
- the limited legislative,institutional capacity within GOB and lack of public awareness;
- overexploitation of the forestry sector for fuel and timber products, resulting in the absence of effective community agroforestry, and degraded habitats for wildlife, less biodiversity and inadequate numbers and management of protected areas.

The cross sectoral interrelationships between these issues are complex and made even more so within different regions and specific ecological settings. The trends, nonetheless, show pervasive deterioration in the socioeconomic and natural environment.

The purpose of the NCS is to provide a framework for the efficient, economic, optimal and sustainable use of the country's limited resources. Particularly faced with conflicting and competing needs, a balance between conservation and exploitation is needed. The document describes the natural and cultural environment (physiography, climate, soils, flora and fauna, and ecosystems of importance. The latter has been identified as: (i) hill forests; (ii) Sundarbans; (iii) coastal region; (iv) Jinjiradwip; (v) the terraces of the Barind and Madhupur tracts; and (vi) wetlands. There is also a description of the historical and cultural context of the country.

Linkages are made within the three major objectives of the FFYP development planning context, viz.:

(1) enhanced self reliance; (2) a growth rate of 5% throughout the plan period; and (3) poverty alleviation and employment generation through human resource development. A discussion of the relationship between conservation and development places some emphasis on limits to resource use, utilizing appropriate technology, bridging modern scientific knowledge and traditional resource management systems, and including environmental considerations in the initial stage of the public and private planning process.The main body of the report describes the status, issues and strategy for the various sectors. Appendix 3 itemizes the forestry sector recommendations from the NCS.

2. National Environment Policy and Institutions

Some references were made to environment and sustainable development in Chapter IX of the Draft FFYP. Among the nine broad strategies for the forestry sector in the FFYP, several refer to environmental considerations, i.e.:

- creating a green belt of trees in the coastal areas for storm protection and stabilizing newly accreted areas;
- maintaining environmental and ecological balance as well as wildlife preservation.

During the process of formulating the NCS, the MOEF drafted an environment policy in 1990. The policy has been through a number of revisions. The latest draft available was dated March, 1992, and is itemized in Appendix 4. The objectives of the policy included active collaboration in international environmental initiatives. On the national level, this consisted of relevant guidelines for 15 different sectors with the goal of: (a) ensuring overall development while maintaining ecological balance; (b) protection from natural disasters; (c) identifying and regulating harmful and polluting activities; (d) ensuring sustainable resource use in all sectors and environmentally sound development. The applicable provisions under forest, wildlife and biodiversity were specified as follows:

- conserve, develop and expand forests to maintain ecological balance within socioeconomic realities and needs;
- all development programmes should have tree plantation where possible;
- create and promote substitutes for forest products;
- stop depletion of the permanent forest estate;
- protect and conserve migratory species and wetlands;
- through research and extension, conserve biodiversity and wildlife.

The institutional mechanisms suggested were: (1) MOEF to coordinate implementation; (2) overall direction would be given by a National Environment Committee (comprising some 80 persons) under the Chairpersonship of the Prime Minister; (3) future amendments would be made by MOEF; (4) DOE would be responsible for the review and approval of all EIAs. All existing laws and regulations are to be amended. New legislation is to be enacted where necessary. International conventions and protocols will also be amended accordingly.

Along with the creation of MOEF in 1989 and incorporating DOE within its structure, there are no viable environmental institutions within the government structure. DOE continues to maintain a focus on water and air pollution, in spite of a broader mandate assigned to it. The BFD has basically one scientific research officer (out of almost 10,000 staff) associated with wildlife management and protected areas. BFRI has one researcher with some experience in wildlife. BFIDC has no capacity whatsoever for such work.

The Planning Commission, with its role in coordinating development work among the line agencies has virtually no capacity for environmental planning. Within MOEF, there are only 16 officers, only two of whom have received any formal training in environmental sciences. Neither BFD nor DOE have the capacity to do EIAs in the forestry sector at the present time.

3. National Environment Management Plan

At the same time that the NCS and the national environment policy were being revised, another initiative was undertaken by a NEMAP team under the auspices of MOEF and UNDP. It was meant to be an action plan for Bangladesh, operationalizing both the policy and the strategy via a portfolio of projects for implementation. The most recent document available for review was dated November, 1991, and it has apparently been through a number of amendments as well.

NEMAP tentatively identified 31 environmentally critical areas on the basis of accumulated information from the NCS, GOB officials, donor agencies, development projects, NGOs, and other sources. There was recognition of the difficulty in prioritizing these areas, and it was evident more surveys are needed. Concerns were expressed and strategies suggested for a wide range of locations within various sectors. Selected recommendations for landuse, forests, wildlife, biodiversity, and coastal and marine management are itemized in Appendix 4. The plan specifically addressed the following items of relevance to the forestry sector:

- wetlands and coastal areas (Hakaluki Haor, saline polders in Khulna, the Matamuhuri delta, and Jinjira coral island);
- management of degraded watershed areas (Madhupur and Barind tracts, Garo Hills piedmont, Lalmai range, hills between Banshkhali and Harbang, and the Teknaf peninsula);
- floodplains of major and minor rivers;
- management of charlands;
- estuarine island accretions;

Institutional aspects included : (i) strengthening of MOEF, DOE and BFD; (ii) strengthening capacity for EIA; (iii) flora and fauna surveys; (iv) monitoring global and regional issues' impact on Bangladesh; (v) preparation of an environmental data base at DOE; (vi) public awareness creation and curriculum reviews; (vii) revising the legal framework for forest management, including the legal and institutional aspects of wildlife conservation and protection.

Implementation of NEMAP was projected to take place over a period of 3-5 years. A cell within MOEF would be set up, consisting of a chief technical adviser and eight full time specialists. Short term specialists would be recruited locally and abroad, as necessary. A full time Project Director would be deputed from GOB, to which the CTA and specialist advisers would form an advisory panel. At the apex of this working structure there would be a technical committee consisting of about ten ministries comprised of members mostly at the Director General level, and at least Joint Secretary. Other members could be recruited as deemed necessary. The present status of NEMAP is uncertain. Several local short term consultants under the auspices of UNDP are presently attempting to prepare specific project portfolios for possible funding assistance by donor agencies.

4. Bangladesh Country Report for UNCED

In the above report, there was a macro analysis of environmental problems. For the purpose of this specialist report, sectoral development trends for forestry and biodiversity will be highlighted. The numbers quoted by GOB will be seen to differ from figures within the FMP report, as well as from numerous other GOB sources, and the Forest Department itself. The inadequacy of the data has constituted a major constraint in analyzing the current situation. However, where they indicate trends they are useful. The following were noted as significant considerations (GOB, 1991c):

- large declines in forest cover over the past 20 years, with actual tree cover about only nine per cent;

- fuelwood is the primary product of the forest, and between 1976-1986 output rose by 250 percent, while timber extraction increased 100 percent;

- about 60% of the harvest is fuelwood and 35% timber;

- coastal mangroves constitute about 60% of commercially productive forests;

- hill forests, covering 0.62 million ha, supply the remaining 40 percent of the commercial timber production;

- Bangladesh has a rich biological heritage of approximately 5,000 species of flowering plants, but many animal species are threatened, among which 50 are nearly extinct and 33 seriously threatened, as well as nearly 250 species of birds in danger;

Pilot demonstration projects were proposed, such as:

- community reforestation and afforestation to be carried out in the upstream zone of small watersheds, with implementation by the private sector and NGOs;

- forest protection in partnership with local communities;

- NGO and local community-based afforestation in the coastal belts;

- significant community involvement in wasteland plantation and nurseries;

The above would be supplemented with the appropriate policy instruments such as increased royalties for forest timber and pulp production, promotion of the use of natural gas rather than wood for brickfields, enforcement of legislation against encroachment and illegal felling, monitoring natural forest status and training extension workers.

Pilot demonstration projects for biodiversity were also suggested.

These would be accompanied by the proper institutional, legislative, training, policy, and EIA enhancement. Some of the gaps identified in the study included: (i) integration of family planning with poverty alleviation; (ii) mass literacy to ensure participation of women all environment and development programmes; (iii) regional watershed management; (iv) groundwater salinity; (v) land settlement in accreting coastal areas; (vi) destruction of inland capture fisheries; (vii) incorporation of environmental concerns in areas such as debt re-structuring, and structural adjustment programmes; (viii) restructuring inequitable trading arrangements, with special incentives for countries like Bangladesh (ix) the technical expertise and manpower to merely investigate, monitor, and participate in international conventions are lacking; (xi) resources for following up such conventions are frequently lacking.

Bangladesh expectations from UNCED were that additional financial resources would be made available to carry out such programmes and that access to environmental technology would be made available at concessional rates. "Green conditionalities" should not be applied to the country, since it has been minimally responsible for global degradation such as ozone depletion and global warming, while being a likely worst case victim. Bangladesh was a signatory to the forestry agreement (see Appendix 5). It also signed the biodiversity convertion (see Appendix 6 for salient features of this agreement).

Multilateral Institutions

1. General

Multilateral institutions have been involved in the forestry sector for some years in Bangladesh. In terms of total disbursements of development assistance exceeding $ 20 billion, it has been negligible (less than 1%). A cursory glance at statistics of expenditures reveals that the largest projects were for institutional development. Early projects set up infrastructure and were directed towards forest extraction and exploitation. Plantations were also given emphasis and lesser amounts went towards training, eduction, and planning. Virtually none (with the exception of the mangrove afforestation project) were targeted for environmental benefits and values. There has been a virtual absence of projects, for example, which had the objectives of improving watershed management, soil conservation or protected areas. The strategy has been to clearfell all natural forests and replace them with plantations of fast-growing exotics for fuelwood, as well as some long rotation indigenous species. Funds were not provided however, for proper thinning, and there was large scale plantation failure. Before the late 1980s, none of the projects went through initial environmental examinations, nor was a full environmental impact assessment conducted for any projects. Neither did mid-term or end of project evaluations address environmental issues.

2. The World Bank

The World Bank has been involved in forestry in Bangladesh for a number years. Some of the projects included: (1) Development of the Forest Research Institute (1976-79 $ 1.7 million); (2) Mangrove Afforestation (1980-86 $ 11.0 million); (3) Second Forestry Project (1985-92 $ 36.0 million).

Recent initiatives by the World Bank include the Forest Resources Management Project (approximately $ 49.0 million) and the Rehabilitation of Coastal Embankments. The agency recently undertook an environmental strategy review which covered: (a) the physical environment (including disasters and global warming); (b) pollution; (c) forestry, biodiversity and energy, and (d) agriculture and fisheries. The analysis and recommendations included:

(i) wood pricing should reflect real market rates and not subsidize inefficient industries; (ii) increased plantations are necessary, since there is currently over harvesting; the sustainable yield has been estimated at as about 5 million m^3 annually; (iii) benchmark studies of sea level change and coastal monitoring of erosion and accretion; (iv) a strong push to be made for social forestry; this must be done within good rates of return on investment in the case of homestead forestry; there should be involvement of women and NGOs; (v) increased attention to NWFP, species diversification, and development of substitutes for wood products; (vi) baseline inventories and monitoring of wetland species and surface areas; (vii) increase in the number of wildlife sanctuaries, balancing ecological benefits with economic or social costs; early implementation of a project to save the tiger in the Sundarbans.

3. UNDP/FAO

These agencies have long been involved in the forestry sector and have made a number of contributions, beginning in 1974 with a small project for natural rubber development. Other projects have included: (1) Inventory Survey of Chittagong and CHT (1981-1985 $ 2.7 million); (2) Strengthening the BFDTC, Kaptai (1981-1987 $ 1.7 million); (3) Assistance to the Forestry Sector (1981-1988 $ 4.3 million); (4) Development of Professional Forestry Eduction (1986-1990 $ 2.7 million);

UNDP has also been undertaking assistance to the Integrated Development of the Sundarbans project. It has prepared a preliminary needs assessment of a Coastal Area Resources

Management Plan, and has supported a small consultancy to identify project profiles for NEMAP. The agency is also providing institutional strengthening to MOEF, both with technical assistance and in creation of a planning cell within the Ministry. UNDP is the lead agency for the environment in the LCG based in Dhaka. It is updating a list of donor-assisted environmental projects and has supported an NGO directory of environmental agencies.

4. The Asian Development Bank

The agency completed an environmental and natural resources management sector review in 1990. The assessment covered a broad cross section of issues. Relevant issues reviewed included forest and wildlife as well as vital ecosystems. Forestry-related issues were noted as : (i) significant negative environmental impacts of improper logging practices are in evidence; (ii) encroachment, estimated at 76,600 ha -found primarily in Chittagong, CHT, and northern sal forests- is serious, especially when it occurs in watershed and reservoir catchments; (iii) shifting cultivation, especially in the Sangu and Matamuhuri basins, as well as Kassalong, contributes to soil erosion an negative hydrological impacts; tribal peope are said to have destroyed more than 900,000 ha of prime forests in the CHT; (iv) alienation of forest land for other purposes (more than 500,000 ha for agriculture, industry and defence) needs to be evaluated carefully; (v) over exploitation in the Sundarbans, and top-dying of Sundri are being accompanied by ecological changes in species composition; (vi) insufficient emphasis is being placed on the importance of homestead forests.

Wildlife-related issues are: habitat loss, extinction of species, commercial exploitation of reptiles and amphibians, and increasing threats to species estimated at 50% of all known species. Vital ecosystems are listed as the coastal zone, hill forests, Sundarbans,and wetlands. A review of legislative, legal and institutional capacity reveals major weaknesses in planning and implementation, particularly in cross-sectoral matters. The establishment of a cell in the Planning Commission is noted as a positive development. Major gaps are identified, these being: (i) a piecemeal approach, rather than integrated and comrehensive planning for incorporation of environmental activities; (ii) the need for national landuse planning; (iii) industrial pollution control requires soft loan financing; (iv) institutional strengthening in EIA capacity within a number of line agencies would be required; (v) donor seminars and workshops have had little impact, and more coordination is needed.

Bilateral Agencies

A number of macro environmental studies and strategies were done by bilateral agencies. Several will be briefly reviewed here for their observations in the forestry sector. One of the earliest of these was a Netherlands study conducted in 1980. Others were done within the last several years.

1. DANIDA

After a brief description of forest types and locations, the importance and major sources of timber were noted. An estimate was made of current consumption: timber - 2.4 million m^3, pulpwood - .18, firewood -7.4 million, and bamboo - 33.7 (sic; see DANIDA, 1989). Problems noted were: insufficient staff, illegal felling and ineffective protection, agricultural encroachment, damage to catchment areas, and siltation of rivers. It was suggested that the main source of damage in terms of siltation was due to conditions in upper riparian countries. A brief list is given of rare and indigenous wetland and aquatic fauna, there is mention of endangered species and the ineffective legislation and protected areas.

2. SIDA

The study was cross-sectoral, and covered a wide spectrum of issues. Among these, specific geographical areas of environmental concern were noted. Issues raised within SIDA's study

concerning forestry, wildlife and biodiversity, consist of (SIDA, 1991): (i) deforestation and forest depletion in the remaining 6% of the natural forest; (ii) 0.02 ha of forest land per person is one of the lowest ratios in the world; (iii) underpricing and inefficient subsidies for state-owned industries increase pressures on wood products; (iv) homestead forests account for most of the country production, standing volume estimated at about 79 million m^3, or seven times the volume of the government forests; (v) within the seven wildlife sanctuaries, there is an absence of forest department authority; no regulation of forest felling is done outside of government forests, progressively causing deterioration and clearing by farmers, immigrants, and the military; (vi) high population growth, illegal hunting, loss of wildlife habitat, and mismanagement of wetland areas; (vi) monoculture plantations of short rotation species are poor habitats for wildlife; the 350-600 estimated tigers are said to be largest genetically secure population.

The coastal areas, with 87,000 ha of brackish water aquaculture farms, are an area of landuse conflict. The Chokoria Sundarbans has been largely destroyed for shrimp farms. Biomass constituted 83.3% of the total energy use, of which 55.2% was agricultural residue. Domestic energy use in rural areas is estimated to be around 70% of the total energy consumption, placing increased presssure on village forests, and agricultural and animal residues which should be used as natural fertilizers instead of fuel. Fuelwood remains the primary source for brick production, and alternatives to bricks as building material should be explored.

Mention is made of natural hazards (floods and cyclones) and global warming is predicted to possibly have a major impact on Bangladesh through rising sea level, and increased frequency and magnitude of cyclonic storms.

3. CIDA

CIDA commissioned a study as part of its country programme review process. This covered natural and human resource features, the institutional setting, an overview of development assistance and an analysis of selected Canadian projects. The objective was to move towards a sustainable development strategy, by an examination of critical ecological issues, and potential options for reorienting the programme towards more environmentally proactive programmes and projects. Each chapter of the natural and human resource features listed major ecological concerns. Those associated with forests and wildlife consisted of the sections on (a) forest resources; (b) forest products; (c) hill forests; (d) the Sundarbans; (e) afforestation and social forestry; (f) wildlife conservation; and (g) forest reserves and sanctuaries. Major ecological concerns noted were (Treygo and Dean, 1989): (i) over exploitation of the forests; (ii) lack of watershed management, soil erosion and jhum cultivation in the hill tracts; (iii) Sundri top-dieback; (iv) threats to rare and endangered species through habitat loss; (v) loss of biodiversity and lack of biological pest control.

4. USAID

The World Resources Institute, Centre for International Development and Environment was commissioned in 1989 by USAID to prepare an environment and natural resource assessment of Bangladesh. The report analyzed, reviewed and assessed: (a) the trends , policies and major problems; (b) the actions needed to conserve biological diversity and natural forests; (c) intersectoral linkages between natural resources, economics and populatuion growth; (strategy and recommendations for sustainable development. The report, in its section on forestry highlighted the following issues (WRI, 1990): (i) actual areas of plantations are substantially less than the areas officially reported, and yields are only about 3 m^3/ha/year; (ii) more concerns need to be given to local people and community forestry; (iii) underpricing of forest products subsidizes parastatal inefficiency; (iv) forest research was directed towards wood technology and industrial forestry rather than the pressing needs for agroforestry and other areas; (v) accurate data on the forestry sector is not available.

Issues associated with biological diversity were: (i) much of the estimated annual $US 100 million market value of fuelwood in 1984 comes from multipurpose homestead species; (ii) over exploitation of reptile skins; (iii) need for more attention to NWFP; (iv) clearcutting and burning destroy secondary forest diversity; (v) the inability to quantify the value of biodiversity results in planners overlooking such values; (vi) inadequate support for wildlife management; (vii) a dysfunctional protected areas system; (viii) wetlands and seasonal water bodies are undervalued; (ix) more attention needed to preserve the unique ecosystems of the Sundarbans.

NGOs, Academic, and Research Institutions

There have been few longterm planning efforts related to environment in the private sector, and especially so with specific reference to forestry. Although many NGOs now have some environmerntal component in their programmes, this rarely goes beyond some minor plantation and nursery work, with the exception of several large NGOs with considerable experience. These exceptions will be covered later in this text. In terms of critical analysis of the environment sector, most of the efforts have been in the form of papers presented in symposia, conferences, and seminars. Much of the work is done by individuals, either through academic or research organizations, or on a consulting basis with local NGOs, GOB, and donors. Institutions such as Dhaka University or BUET, etc. have very limited hands on field experience related to forestry, wildlife, or biodiversity. Unquestionably, however, there has been more attention paid to environmental issues, and the widespread perception that social forestry must play a central role in the forestry sector is evidence of this. The hitherto controversial role of NGOs (seen by some in GOB as ineffective, unorganized, small scale, and over-rated) has by now chrystalized into a fait accompli. Some have received the positive recognition they deserve, and have undertaken innovative pilot projects. Multilateral institutions are increasingly tapping this source in their own development assistance programming. Some District and local level GOB officials have been cooperating with NGOs for quite some time with positive results.

A number of NGOs have been involved in social forestry and environmental issues for years. The South Asia Partnership prepared an environmental study in 1989, relying on extensive field visits with NGOs throughout Bangladesh. A questionnaire was administered to 300 respondents (beneficiaries associated with 56 NGOs) in seven major sectors. In the forestry sector, the following were noted (Ali, S.M.I. et al, 1989):

- about 85% of respondents felt forest cover had depleted, caused by indiscriminate felling, fuelwood needs, population and poverty, riverbank erosion, and increased numbers of brickfields and saw mills in rural areas;
- more than 90% noted scarcity of fuelwood, and 81% scarcity of housebuilding materials through the above reasons plus clearing of village scrub and brush;
- about 65% thought wildlife species had decreased, for reasons listed above plus the loss of wetlands and encroaching into wildlife habitats.

Local research and consulting firms, as well as NGOs have done specific studies related to the forestry and natural resources sectors. These are analyzed in detail later in the text. Appendix 7 is a selected list of environmental NGOs engaged in activities related to the forest sector. A National Forum of Environmental NGOs has been formed. There is a National Forum of Environmental Journalists. A number of NGOs have jointly undertaken a State Of the Environment Report in 1989, which has yet to be published. Public consultations and workshops have been held throughout Bangladesh over the past several years. The model was a "citizen's report" from grassroots perceptions such as the well known volume from the Centre for Science and Environment in India. A number of books with environmental themes have also been prepared in recent years, and several organizations have quarterly environmennt newsletters.

The ADAB Environment Advisory Group prepared a position paper a few years ago on environmental problems in Bangladesh. They cited (ADAB, 1990) several priority issues: (1) poorly planned and implemented large infrastructure projects; (2) the conversion of wetlands for agriculture; (3) the major decline in forest cover and failed plantations; and numerous serious obstacles for NGOs to participate in social forestry at a more significant level. Major recommendations were made for strengthening environmental awareness, legislation, and increasing cooperation between GOB and NGOs in social forestry. These recommendations may be found in Appendix 8.

ADAB has been continuing its work in the environmental sector. ADAB and a number of member agencies were invited to UNCED, where a paper prepared by the now renamed ADAB Coalition of Environmental NGOs was distributed (see ADAB, 1992b). A summary of the recommendations is included in Appendix 8 as well. They stressed the linkages between poverty and environment, the need for changes in the lifestyles of the developed countries, and the necessity for significant resource transfers to countries like Bangladesh who might be victims of pollution generated elsewhere. The latter three conclusions have wide support among developing countries, both within governments and NGOs.

Poverty and Environment - The Linkages

A seminar on environment and development was held in Malaysia in July 1991, attended by representatives from environment and development organizations in 23 countries. The following succinct resolutions were passed (Anon. 1991):

- the net result of all the development decades has been massive transfers of natural resources, commodities to the developed countries, and massive debt burdens, poverty and deteriorating environments in developing countries;

- the root causes are the unsustainable, over consumptive lifestyles of the north;

- while UNCED participants will be governments and formal institutions for the most part, the rights of ordinary farmers, forest dwellers, fisherfolk, and indigenous people to natural resources must be upheld;

- the industrialized countries have been responsible for the majority of problems, and must bear the major share of redressing the impacts of poor development priorities;

- since the main issues are the control over the scarce natural resources of the south, social, political, and development themes should take precedence over technical considerations;

- treating natural resources as "global commons" without provisions for access by rural societies effectively will transfer resources to corporations through increasing state control over such commons.

Such conclusions would apply to Bangladesh as well. Similar deliberations were made in the Beijing Declaration endorsed by ministers of 41 developing countries in June, 1991. Major restructuring of global institutions to reflect less control by the north was suggested, including: (a) reduction or annulment of developing countries' debts; (b) major reductions in military expenditures; (c) compensation for loss of income opportunities in undertaking steps to arrest resource depletion such as bans on commercial logging in tropical forests; (d) significant increases in commodity prices to reflect real social and environmental costs and values; (e) ban imports of hazardous products and wastes; (f) reject the patenting by corporations of life forms, seeds and natural medicines which are the heritage of humanity, etc.

A South Asian NGO summit, to which Bangladesh contributed, also prepared a statement to UNCED regarding the importance of addressing equity as well as sustainability. The dependence of the poor on dwindling natural resources virtually forces them exploit more and more marginal resouces and habitats. Poverty alleviation must therefore be given major attention, if sustainable resource management is to be achieved. The summit noted (Centre for Science and Environment, 1992):

> "For governments of South Asia, poverty alleviation has been a stated priority. Yet they have done little to insist that the UNCED address this crucial issue. It is essential that our governments impress upon those of the North that poverty is a consequence and not a cause of environmental degradation. It becomes a cause only in extremely desperate economic conditions, the trigger for which often lies in unequal and ecologically unsound economic strategies. A world in which a large proportion of the population lives in abject and dehumanising poverty can never be sustainable. Both the national and international causes of poverty must be clearly identified and eliminated if environmental disaster is to be averted and the poor of the world given a fair chance to survive as a matter of human right".

Participatory systems of governance are the key to resource management at community level. Examples of this are evident in Bangladesh through such programmes as the Grameen Bank and numerous NGOs. Wherever people have been given responsibility to manage their local environment, communities have often shown exemplary, and more equitable results. Similar results are evident on a small scale throughout the region wherever local and national governments have had the confidence and the foresight to invest in the creative potentials of the poor. If investments in natural resources such as forests are to be more productive and oriented towards poverty elimination, efforts to develop and strengthen democractic and participatory institutions at the grassroots can only reap sustainable benefits.

Women and Environment

Women, particularly among the poor, are often impacted the most by having to sustain families in environmentally degraded or hostile areas. Their role as fuelwood and water collectors is well documented, as is their role in primary agricultural production. Approximately 40% of women in Bangladesh are involved in activities such as seed storage, transplanting rice, harvesting, appplying pesticides and fertilizers, weeding, and harvesting. Women also play important roles in homestead forestry, but this aspect has been less well documented. The ADAB recommendations (referred to above) did not mention women and the statement to UNCED summary indicated only that "disadvantaged and vulnerable groups such as women and children must be brought into the focus of environment and development planning".

This is an area the BFD has performed poorly also. Although the difficulty of possible remote postings is well understood, there are only 4 professional women staff in the Department. Considering women's roles in the homestead, certainly one could expect women extension agents. MOEF and DOE are in similar situations, so the lack of gender analysis and gender-based considerations is apparent.

Often the description of women as more "nurturing" and "in harmony with nature" merely reinforces the sterotype that it is the sole responsibility of women to fetch firewood or water. Naripokkho, a local Bangladeshi feminist organization rejects such allegories. It creates the illusion that women are expected to conserve nature, but are often held responsible for degrading it through daily activities needed to survive. As said by the organization (Naripokkho, 1991):"Women will not play nature to men's culture".

While there is a substantiated women's role in in environmental activities such as planting trees and potecting them (see Isam, M., 1990, ADAB and UNIFEM, 1991, and Bangladesh Geographical Society, 1992) this often is neglected at the planning stage of projects, as well as implementation. In addition to the homestead role, many grow and conserve medicinal plants. Forest products are also used in cooking which uses between 40-60% of the energy budget of a typical Bangladeshi rural household. In social forestry programmes, selection of trees should be made by the women. Other considerations are (Musgrave, 1990):

- women's role needs to be considered at the design stage;
- men frequently overlook the fuelwood scarcity because women are the primary fuel managers;
- as many as 25% of households can be women-headed, particularly among the landless, so it is natural they must be consulted; women-headed households are frequent also because of the very high migratory patterns in the country on the part of men seeking labour;
- gathering accurate data means more careful interviews, which are not performed as well by men, thereby necessitating women survey staff;
- women and men can, and do, have different ideas of what species to plant;
- ensuring the involvement of women in decision-making committees about forestry is vital;
- employing women at management and professional levels is essential to successful community forestry programs.

The role of women has been vastly overlooked within the forestry sector. The ADB sector paper on forestry does not discuss women except for the observation that the agency adopts a strategy which (ADB, 1989): "protects the interests of women and the indigenous population to ensure their access to the common resuorces and to which they have traditional/ customary rights". Their Bangladesh natural resources assessment (ADB, 1990) ignores women entirely.

The World Bank has learned some lessons, however, which may be summarized as follows (World Bank, 1991a):

- evaluations generally show that the poorest of the poor benefit the least from forestry projects, particularly due to complexities of land tenure and access to productive resources;
- forestry projects have benefited the urban poor (author's note: this has not been documented in Bangladesh);
- women are frequently managers of herbs, fruits and nuts, edible and industrial oils and resins, and several other value-added commodities;
- forestry particularly requires close women's involvement in watershed development, management, and rehabilitation, as well as integrated rural development, resettlement, and agroforestry;
- experience documented in audit missions of social forestry projects shows that: (1) women do not benefit directly from those projects; (2) that there is no "trickle-down effect" ; and (3) there are very high transaction costs associated with flows from surplus to deficit areas, and from high income to low income families.

A number of NGOs in Bangladesh have specific policies to ensure women are involved in their programmes, including social forestry. It remains a fact, however, that women are conspicuously absent from the senior managerial levels in most NGOs. Some studies have been initiated examining the role of women in forestry. Some additional information on the role of women may also be found within the case studies in Appendix 9.

Review of Environmental Initiatives in the Forestry Sector

1. Selected Completed Projects

A cursory review of almost 50 externally funded forestry projects, as well as numerous projects funded within the revenue budget reveals that very few were concerned with environmental aspects. The large majority of expenditures were for extraction, forest management, planning, training and education, research, extension, industrial plantations, and institutional development. Mangrove plantations were an important exception to this pattern. Some of the larger and more important projects are briefly reviewed for relevant lessons learned. Projects are often continued purportedly on the basis of successful trial periods, when in fact project findings are negative. Important observations and recommendations were often overlooked or ignored, and the objectives frequently not reached, yet mistakes continue to be repeated, in spite of abundant documentation.

Development of Community Forestry - This project (costed at $13 million between 1981-1987) was designed to basically create community awareness, enhance institutional capacity of BFD extension services and accelerate homestead and strip plantations. The northwest of the country was selected, since tree cover was the lowest in the country and government forests constituted only 0.3 percent of the land area. The project could be summarized by the following (FAO/UNDP, 1988a):

- monitoring and evaluation were ineffective;
- forestry extension was relatively ineffective and there was a shortage of suitable communications software;
- training was successful based on participants' knowledge, awareness, attitude, skills and practice;
- GOB selection, nomination and procedural constraints limited benefits from overseas training;
- forestry education and training suffered from lack of motivated and experienced teaching staff, and absence of facilities;
- after six years, no firm recommendations could be made about suitable location-specific agroforestry modules;
- as long ago as 1988, the one year lease period was noted as "totally unsatisfactory", and benefit-sharing agreements were not yet approved;
- no progress was made in the introduction of improved fuelwood stoves;
- the major constraints were the "staffing, organizational structure, and planning procedures of the BFD", and the project "underscored the need for changes in the BFD's organizational structure to enable it to implement people-oriented forestry programmes and activities in the country".

A socioeconomic impact study indicated that an evaluation survey revealed that respondents who thought the programme was successful "were largely men, with tertiary education, and engaged in small business". Only 15% in upazilas without the Community Forestry Growth Centres had favourable responses. Most of the men (86%) believed the program was successful, whereas only 15% of the women thought so. Those who refused to answer or were from outside the target areas were "women, illiterates and farmers".

Such persons were the target group, or should have been, yet their opinion is treated as invalid compared to businessmen. This is ironic, to say the least. Recommendations were made to : (1) change forest policy, and the outdated "custodial approach"; (2) restructure the BFD with a community forestry and extension wing, and include personnel with social science training; (3) continuing education and in-service training for community forestry and sharing of experience with other rural development agencies was suggested; (4) long term leases and benefit-sharing schemes as incentives to provide security and encourage more productive and environmentally beneficial landuse were suggested; (5) extension and information with a development support communication unit were "a matter of urgency"; (6) undertaking baseline surveys after project completion (as was done in the case of this project) is a useless exercise; (7) economic quantification of comparative benefits and costs for agroforestry models was urgently required (it was not done in this project). The large majority of recommendations have not been implemented up to the present date.

Assistance to the Forestry Sector - This was a $4 million project from 1981-1988, primarily consisting of institution building. It was meant to overcome the following constraints: (1) serious shortage of trained professional and technical staff; (ii) no internal capacity within BFD to conduct economic analysis within the forestry sector; (iii) lack of inventory data; (iv) necessity for BFRI research into forest management and forest products. A summary of conclusions follows (FAO/UNDP, 1988b):

- the most serious constraint faced by the BFD was a shortage of staff, particularly technically trained persons;
- serious limitations in the capacity for investment analysis, whereby supporting financiasl and economic analyses in support of plantation programmes were weak and unconvincing;
- an investment planning unit at a senior level was considered essential, since the scarce availability of land for trees required rigourous investment analysis;
- inventories confirmed the forest estate was considerably below previous estimates in volume, area, and quality, requiring urgent intensive management;
- considerably more field research was needed in species/ site matching, genetically improved stock, and the need to apply research findings to specific problems in intensive forest management;
- reliable growth and yield data from the Sundarbans were lacking, and permanent sample plots were not monitored.

There was a wild animal capture and translocation project to prevent damage and loss of life by elephants. The necessity for revamping the forest legislation and restructuring the BFD was stressed. Landuse planning for forestry was put in abeyance pending "national policy goals". Recommendations to create and define boundaries for nature and wildlife reserves in Sitapahar Reserved Forest and Cox's Bazar Division and protect them from encroachment were never carried out. The suggestion for the BFD to take initiative to develop an integrated land use plan for the degraded Sal forest region resulted in a study which has not been implemented. Virtually none of the major deficiencies noted have been addressed by the BFD over the past five years.

Second Forestry Project - This was a $36 million project from 1986-1992 funded by the World Bank, in an area comprised the four coastal Divisions of Bhola, Chittagong, Noakhali and Patuakhali. In addition, it covered the Sylhet Division, Chittagong and Cox's Bazar, and included the following elements:

- establishment of about 40,000 ha of mangrove plantations and maintenance of 81,000 ha of existing plantations;
- conducting a mangrove afforestation research programme;
- development of resource management systems for mangrove plantations, as well as hill forests;
- establishment of 23,500 ha of industrial plantations and maintenance of 28,000 ha of existing plantations;
- development of institutional capacity through training and education facilities.

The original project design included plantations, logging and extraction facilities in the Chittagong Hill Tracts but was cancelled due to the security situation there. Thinning, designed to be carried out by BFD staff should likely have been contracted out. Delays in the release of funds by BFD (a chronic problem, ongoing for years) disrupted mangrove plantation monitoring, although BFD reported 96% planting targets achievement. Inadequate staffing from BFRI hindered mangrove research. Serious infestation of Keora with stem borer affected about half the plantings, and thinning was suspended in late 1991 as uneconomic. The cyclone of 1991 destroyed about 20% of young plantations. Allocation of newly accreted lands did not maintain the pace of planting, and there is uncertainty and concern over the final disposition of the lands accreted and afforested. Other observations include (FAO, 1992):

- the plantation trial unit has yet to show positive impact;
- heart rot and some top die-back in Acacia mangium resulted in silviculture recommendations to stop planting the species and replant with local species after clearcutting;
- Rohingya refugees were said to have destroyed 80 ha of forest for fuelwood (author's note: an estimate that likely understates the situation considerably);
- RIMS has made slow progress due to shortage of staff;
- it was observed that Eucalypts were planted to keep people out of the forests rather than to provide benefits such as from multipurpose trees;
- some training was hampered due to civil works problems, and rangers were not upgraded to full professional status;
- there was no environmental assessment for the project, but it assumed people benefited from coastal plantations as well as industrial plantations;
- growth and yield estimates for the project were not achieved, and MAIs of 10.0 to 8.3 m/ha respectively were considered realistic for poles and fuelwood in the mangrove areas; for industrial plantations for 40-year rotation, MAI has been reduced from 9.5 to 6.0 m/ha.

The BFD has met about 70% of ongoing operating costs, so it is possible to maintain the achievments. However, to achieve longer term sustainability, improvements would be necessary in : (a) environment and nature conservation; (b) improved forest landuse and participatory forestry; and (c) market pricing of forest products sold to parastatal organizations. Lessons learned included that more emphasis should have been placed on socio-economic considerations and people's participation, and that monocultures of untried species can present significant risk, as experienced with Keora, Acacia mangium and Albizia moluccana.

Second Rubber Development Project - This project was to follow up the $2.5 million Rubber Rehabilitation and Expansion project funded by the ADB from 1981-1989. BFIDC had planted about 8,000 ha of rubber on eleven estates since 1980. A feasibility study was granted in 1987, and consultants were fielded late in 1988, and a Phase I report was presented in February, 1989. The two major areas for growing rubber in Bangladesh have been Chittagong and Srimangal. The second project has been attempted at Madhupur, where about 6,000 ha were already planted. The proposed project would have increased rubber plantations to 26,000 ha. This was based on the assumption that BFIDC had improved the standards of rubber cultivation significantly and that its technical competence was of a high standard. Rubber was pointed out as stabilizing landuse in an economically and ecologically sound manner (Hassal et al., 1989) versus other unspecified field and tree crops that have environmental and marketing problems.

The appraisal of this project in June 1990 referred to a positive environmental impact, viz.:

> " A permanent renewable resource of high quality forest will be established on 17,500 ha (inclusive of 2,500 ha replanting) of otherwise denuded forest lands. That resource represents a stable ground cover which will consolidate top soils, improve catchment areas and overall soil fertility. Ongoing and potential future erosions of barren forest slopes will be stopped and prevented".

Social impacts were stated to have:

> " profound positive impacts on local populations who have taken up permanent settlement in the designated forest areas on the fringes of where the rubber plantations will be established. Presently, these people have no permanence of tenure in the designated forest lands they occupy and their basis for a living is very narrow since the forests have been denuded and they have no incentive to invest their labor or scarce capital resources in the land they occupy. The socially difficult position of these people have been the cause behind much of the deforestation and environmental degradation which have taken place in the past".

Women were to benefit as a result of the project:

> "A significant part of the above mentioned employment will be available for women. Socioeconomic surveys carried out during project preparation show that women in the project areas are interested in and prepared to seek employment on the rubber estates. Principally in the nurseries, as tappers and weeders, and a significant part of the employment generated by the Project are expected to be taken up by women. Moreover, the infrastructure provided on the plantations and supported by the plantations in nearby villages, simple clinics and health facilities will have a positive impact on women populations of project areas".

It was said that assessments of the microenvironments through detailed agronomic and social surveys showed that rubber planting represented the best possible use of the land, and that the local populations welcomed the rubber initiative. This was said in spite of earlier experience in the Hill Tracts, where blocks of 10 ha were allocated to mostly Dhaka and Chittagong businessmen

who promptly cut any and all trees on the land without planting rubber or any other crop for that matter. The project had many detractors, not the least of whom were the local Garo tribals. The project was harshly and rightly criticized for encroaching on tribal lands (some persons even had title deeds), misrepresenting local opinion, and for not validating so-called social surveys, as well as on a number of environmental grounds (see Gain, 1989a and 1989b, as well as Timm, 1992). Visits to the area by the author and other team members confirmed that doubts and suspicions still linger in the area, and there is little doubt that Garos suffered unduly due to this project. A short case study in Appendix 9 reviews the situation from another perspective. Other case studies in the same appendix document the benefits from maintaining Sal forests from environmental aspects, including productivity, sustainability, stability and equity.

To its credit, the ADB eventually pulled out of this project, having learned a lesson. Unfortunately, the BFD has yet to learn the same lesson, and the complicity of its own officers in ongoing problems is a well documented fact. This was also conveyed to FMP team members consistently and directly on reconnaissance missions to the locality.

2. Selected Ongoing Projects

Upazila Afforestation and Nursery Development Project - The primary purpose of the project (now called thana afforestation) is to halt deforestation of depleted Sal forest through enrichment planting, and to increase tree cover on all suitable and available lands in the rural areas with a focus on popular participation. The immediate objectives are: (1) to enhance the institutional capacity of the Forest Department and the thana-level (upazila) administration in the design, implementation and management of social forestry programmes in 61 districts of Bangladesh; and (2) to promote genuine community involvement and people's active participation in social forestry programmes.

The project has successfully met training targets, and institutional capacity was improved. The upazila component of the project was less successful. However, to varying degrees, functional infrastructure (tree nurseries, extension centres) was established, and are able to meet to some degree at least the rural demands for tree seedlings. Village leaders, women, NGO personnel and beneficiaries gained practical skills and benefits from the training. The concept of participatory forestry and nursery development was spread, and results were evident in increased numbers of private nurseries, and increased seedling demand.

Among the conclusions and lessons learned from a recent evaluation (UNDP, 1992a):

- due to a top-down approach by BFD, there has not been genuine participation in the project by the beneficiaries (landless labourers, marginal farmers, and women) in terms of taking decisions on planning and managing strip plantations, woodlots, and agroforestry;

- local people are often unaware of the objectives and benefits of strip tree plantation;

- the Forest Department is not at all committed to settling "encroachers" on degraded forest lands, and land tenure continues to be the single-most factor in longterm sustainability of success; to date it has been insensitively handled by BFD;

- roadside strip-planting programmes have had variable results, which could be improved by clarifying benefit-sharing agreements;

- the Department is unwilling to consider joint management of natural, degraded stands with beneficiaries, rather than focusing on woodlots and enrichment; the former would be more beneficial from a biodiversity viewpoint as well as more sustainable in the long run;

- the short tenure agreements do not produce the best, or sustainable results;

- women's involvement has been minimal in the programme, and could be improved through NGO participation.

Clearly, the Department has refused to accept or implement recommendations made over the past five years (in fact similar recommendations were made as long as ten years ago) by virtually every project and evaluation. There appears to be little reason to continue to work with the BFD under such entrenched and recalcitrant attitudes. There is a police-like mentality, officers do not view people as partners in so-called participatory schemes, and little credit is given to indigenous knowledge and innovations of the local farmers. The Department is still planting (frequently exotic, and monocultures) block fuelwood species, when expressed local participating villager needs are for fruit and multipurpose trees. Fodder trees and forage grasses are not being planted, and no attempts to plant medicinal plants, or bamboo, are made. Indigenous coppicing species besides sal are not used in BFD models. Many microenvironment innovations are being tried by local agroforesters, such as (Drilling, 1992):

- use of Ipomea, cactus and pineapple for live fences; Erythrina, Lannea, and Moringa species are also commonly used used, and the fences provide fodder, manure and fuelwood as well as protection from grazing;

- small patches (100-200m^2) of sal are maintained in Rangpur, and farmers would plant it in strips but the Department does not permit this;

- there is great species diversity in multi-storied homesteads;

- rice straw, water hyacinth are used as natural fertilizers;

- tumeric and ginger often perform poorly under shade, which is the advice given by BFD;

- no projects in Madhupur attempt the management and conservation of sal;

- wherever agricultural crops are interplanted with sal mulch between strip rows, the trees are inevitably taller and in better condition;

- same species grown on well-drained crests inevitably outperform those grown on poorly-drained slopes in Madhupur;

- soil erosion and site rehabilitation should be the primary objective of the project;

- in Comilla, date palm leaves around trellises protect cucumber stems from porcupines;

- cane growth under teak has promising qualities.

In summary, the Forest Department has much to learn from traditional village homestead management. The existing approach requires a dramatic reassessment, and not some small amount of tinkering around, as has been done in the past, and acquiesced to by donor agencies. As noted previously, there are many excellent, competent, staff at all levels within the Department from beat officer on upwards. They have the combination of professional, technical and social skills necessary to make programmes such as this effective. It was the experience of the FMP in the field that beat and range officers who recognized the need for change were given no encouragement or means to do so. Similarly, a number of staff at DFO level expressed their frustrations at the lack of delegation of authority and responsibilities given to them. A Department unwilling to embrace change will inevitably result in low morale among staff, as has been indicated by the

institutional survey conducted throughout the country. Nevertheless, there are indications that if the necessary restructuring of the institutional setup and attitudinal changes take place, particularly regarding participatory forestry, the implications for the environmental impacts would be positive.

Forest Resources Management Project - This project, funded by the World Bank in the amount of $49.6 million, has been just recently signed and initiated in 1992. It has the following objectives: (i) improving the RIMS management system; (ii) integrating environmental and socioeconomic factors into management; (iii) initiating pilot projects for participatory forestry; (iv) establishing about 60,000 ha of plantations; (v) supporting technical and professional education, training, and research; (vi) reorganizing the Forest Department and creating a new wing for environmental management; and (vii) preparing management plans and supporting physical and infrastructural development in selected nature conservation and protected areas.

Existing and new management plans would be prepared for hill forest areas (excepting the CHT) as well as the Sundarbans and coastal forest divisions. New inventories would be done for Chittagong, Cox's Bazar, Sylhet, Sundarbans and the four coastal divisions.The participatory forestry would be undertaken under a new forestry extension wing, and would work closely with NGOs in a pilot project. Training at IFCU would be expanded and upgraded, and in-service training at the Forest College in Chittagong would be complemented by a new forestry school in Chittagong which would offer a three year degree course. Long rotation species would be comprised of mostly Garjan (Dipterocarpus spp.), Dhakijam (Syzygium grande), Chapalish (Artocarpus chaplasha), Mahogany (Swietenia macrophylla), and teak (Tectona grandis), with teak reserved for the better sites only. The pricing policy (near prevailing market rates) would be a welcome and dramatic policy initiative. Subsidies to BCIC-operated mills would be phased out from 40% of market price to nil by mid-1994. The project has agreed that it would not support logging in the natural forests, and in the event that the ban on logging was lifted a full EIA would be required. The long-needed silvicultural treatments (climber cutting and thinning) will be done.

A DCCF would be responsible for developing and implementing management plans for all protected areas, establishing environmental standards for the forestry sector, initiating public awareness programmes for conservation, and developing procedures and implementing EIAs in the sector. The wing would include an information and planning branch to do surveys, management plans, and provide technical support to nature conservation centres. A conservation operations branch is suggested to operate protected areas. This environmental management component has been costed at $1.7 million.

A nature conservation component would be $2.3 million. The component for nature conservation would include facilities in the wildlife sanctuaries in the Sundarbans, as well as expanding the sanctuaries by two more units. The project would support infrastructure, personnel, prepare management plans for all the Sundarbans sanctuaries as well as manage tiger and deer populations.

All these are steps in the right direction and indicate a growing awareness and commitment on the part of both donors and GOB to good environmental practice within the forestry sector. However, the following cautionary observations and recommendations should be noted:

- short rotation species for peeler logs, poles, pulpwood and fuelwood would comprise primarily the Acacias, lesser amounts of Eucalypts, and Albizia falcataria; the unfortunate experience with some of these on some sites has been disappointing; they also provide poor habitats for wildlife;

- the yield estimates in the staff appraisal report were definitely too high, based on past experience and proposed management regimes;

- the project document suggests that although tribal groups residing in the project area "have a strong tribal identity, they have been relatively accultured to the dominant society"; more detailed socio-economic surveys might reveal otherwise, as experience elsewhere in Bangladesh has demonstrated;

- the suggested responsibilities of the environmental wing would clash strongly with the recommendations made by the FMP conservation planner, and indeed by this environment report; in particular, it is strongly recommended that a new Department is a sine qua non for the proper development of environmental conservation in Bangladesh, and authority and responsibility for existing and future protected areas of all kinds under IUCN classifications should be vested in this new Department;

- while the focus on the Sundarbans is intended to complement ongoing activities by the Integrated Resource Management of the Sundarbans project of UNDP, it is likely premature to construct facilities and deploy staff prior to the necessary surveys, boundary marking and boundary revisions which are being proposed by the FMP; furthermore, it is recommended here that the Sundarbans protected areas must be staffed by appropriately qualified personnel from the new Department;

- the amount of $500,000 for all protected areas outside the Sundarbans is clearly inadequate;

- it is strongly recommended that the environmental wing be retained, but that its functions be restricted to the activities identified in the environmental management component; the funds and activities suggested for the nature conservation component by the World Bank appraisal report could be reallocated with great value for functions such as soil conservation, watershed management, natural forest management, biodiversity in forestry operations, and establishing and monitoring protection forests in the permanent forest estate; existing and proposed protected areas should be excised by an act of parliament from the permanent forest estate and be vested in the new Department;

- the environment wing will be expected to cooperate closely with the new department, particularly in defining and producing management plans for buffer zones between core protection areas and the intensive participatory forestry.

Integrated Resources Development of the Sundarbans Reserved Forests - This project, funded by UNDP in the amount of $3.2 million, and executed by FAO, was originally scheduled to start much earlier. FAO/TCP Project BGD/2309(Mf) summarized the possibilities of a project in 1984. The project, essentially a planning project has just started in 1992 with the arrival of several experts and the setting up of an office in Khulna. Phase I of the programme involved a report by three experts in late 1991. Their goal was to identify the framework, through specific project components, of needs and opportunities for an integrated coastal zone planning and management strategy. They formulated the following major recommendations:

- the Coastal Zone Management Program (CZMP) should be formulated within clearly defined public policies, and reflect options for sustainable development through a systems approach to resource assessment with precisely defined socioeconomic benefits;

- a CZMP would require a Board or autonomous Authoritiy, mandated by the necessary level in government, which would be advised by a task force coordinated by the Planning Commission;

- the creation of a master plan by would be the responsibility of an interagency coastal task force;

- the plan would: (i) identify specific responsibilities and budgetary allocations for ministries and line agencies; (ii) define the planning and implementation structure; (iii) recommend detailed plans at the district and thana levels, along with implementation strategies; and (iv) provide legal, tenurial, and land use control guidelines and mechanisms;

- land use plans at local and thana level should be developed with full and genuine community participation.

A detailed environmental impact assessment would be necessary, taking into account net present value, internal rate of return, and benefit-cost ratio, through a process of comprehensively study of the resources, economic activities, and societal needs. This might include (Clark, 1991) objectives such as:

> "1) maintain a high quality coastal environment; 2) identify and protect valuable species (and their intra-specific variations); 3) identify and conserve critical coastal habitats and identify lands that are particularly suitable for development; 4) resolve conflicts among incompatible activities affecting coastal and ocean resources and the use of space; 5) identify and control activities that have an adverse impact upon the coastal and marine environment; 6) control pollution from "point sources" and from land runoff as well as accidental spills of pollutants; 7) restore damaged ecosystems; 8) coordinate governmental eforts to promote the sustainable development of coastal and ocean resources; 9) balance economic and environmental pressures as they affect development and conservation of coastal and ocean resources; 10) provide guidance for coastal development planning to reduce inadvertent side effects; analyze and prepare safer options for coastal development; and 11) raise public awareness.

Programme implementation needs and guidelines have been developed and it was suggested that some early pilot projects for multiple use be designed as soon as possible. A three year project to create the master plan has been suggested. Projects could include components such : updating the mean sea level datum for coastal zone; conduct test plantings of possible species with high tolerance for withstanding cyclones and tidal surges; predict coastal geomorphology for a specified number of years in the future;define mechanisms to preserve biodiversity;study coastal ecosystems, and measure pollution levels, etc.

An interministerial committee (called National Coordination Committee) has already been formed, and a meeting was held in October, 1992. There were some suggestions made by a number of agencies, and the project is continuing. There appear to be no conflicts between this project and FMP. However, the following recommendations are suggested:

- that the new Department of Conservation, when created, be represented on the Committee;

- that a member of the Wildlife Advisory Board, when reconstituted, be a member;

- that representatives from NGOs, and acknowledged experts from the scientific and academic community, be represented on the advisory task force; the Bangladesh Meterological Department, and CANSA should be represented also in view of possible global climatic change and impacts;

- that the CZMP give due consideration to the fact that the existing Reserved Forest in the Sundarbans should be declared a World Heritage Site, and that important surveys of wildlife and ecologically sensitive areas must be completed prior to definitive master plan recommendations;

- that the situation in the Indian Sundarbans should also be kept in consideration, particularly in terms of potential transboundary impacts and options for conservation.

PRESENT LANDUSE

The total area of Bangladesh is approximately 14.40 million hectares of which 12.46 million ha are land surface and 0.94 million hectares are rivers and other inland water bodies. The actual area fluctuates slightly from year to year due to changes taking place along the main rivers. The rivers are constantly in the process of change with accretion in some places and erosion in others. Table 1 summarizes the land area of Bangladesh according to Landuse Categories.

Table 1 - Summary of Land Area of Bangladesh by Landuse Categories

Landuse Category	Total Area in Millions of ha	% of Total
Agriculture	9.25	64.2
Classified Forests	1.49	10.3
Unclassified State Forests	0.73	5.1
Village Woodlots including Fruit Trees	0.27	1.9
Plantation Tea and Rubber	0.07	0.5
Housing and Settlement	1.16	8.1
Water Area	0.94	6.5
Other Uses	0.49	3.4
Total	14.40	100.0

Source: Hossain et.al. (1991)

Land Utilization

The land utilization picture of Bangladesh depicts reasonably intense use of this highly limited and important resource. Based on 1987 data, 59.8% is in crop production in a given year, with an additional 2.7% in fallow. These two categories constitute the total land area currently devoted to crops. Forest occupy 13.4% of the land. Homesteads, cities and inhabited land account for 22.3 per cent of all landuse. Only 1.8% of the land is considered waste and much of that is potentially reclaimable, but at a high economic cost.

Landuse has remained relatively constant over the years as shown in Table 2.

In the comparison, it appears that some lands changed from fallow to crop production and human settlement during the intervening period. There was also a slight reduction in forest area and a minimal increase in "not available for cultivation" lands. Landuse appears to be more or less in a state of equilibrium, and no dramatic shifts in land utilization are likely unless there are significant changes in the underlying technical and/or economic determinants of returns to the various landuses. This does not, however, rule out changes within uses, as farmers continue to make individual adjustments based on their best options.

Table 2 - Comparison of Land Utilization in Bangladesh, 1973 and 1987

Type of Landuse	1973		1987	
	Area in Thousand Ha	% of Total	Area in Thousand Ha	% of Total
Cultivated Cropland	8,438	59.1	8,857	59.8
Forest	2,230	15.6	1,988	13.4
Cultivable Waste	274	1.9	266	1.8
Current Fallow	680	4.8	400	2.7
Not Available for Cultivation	2,661	18.6	3,296	22.3
Total	14,283	100.0	14,802	100.0

Source: Mahtab et. al. (1991)

Pattern of Land Distribution in Rural Bangladesh

The pattern of land distribution in rural Bangladesh is characterized by increasing landlessness and the fragmentation of land holdings. According to the 1983/84 Agriculture and Livestock census, the figure for landlessness was 56.5% of rural households in 1983-84. Of them, 8.7% claimed ownership of no land at all, while 19.6 owned only homestead land and 28.2% had less than .2 ha of land in addition to homestead land.

Clearly there is a crisis facing agriculture in Bangladesh. The majority of the small farms are not viable. In all, 24.1% of the farms are below .2 ha in size. Another 16.4% lie between .21 ha and .40 ha. All farms below .6 ha constitute 53.7% of the total, but together account for only 14.8% of the total farm area. Even the so-called large farms are not very large, with farms as small as 3 ha being classed as large.

The distribution shows why land reform measures by themselves are an exercise in futility. It is unlikely that there would be even 1% of the cultivated area acquirable as per the Land Reforms Ordinance of 1984. In reality, much of that one percent also will remain unacquirable, as the process of its lawful redistribution within the family continues.

There is not much land above the 8.1 ha ceiling of farm holdings fixed by the government that may become acquirable after making allowance for perspective or retrospective redistribution within the family.

The Agricultural Census (1983/84) defines a farm household as one which has at least 0.02 ha of cultivated land. The farm households are divided by size into three categories: small, medium and large. A small farm has an operated area between 0.02 and 1.00 ha of land. A medium farm household has an operated areas between 1.01 and 3.03 ha of land. A large farm household is one with 3.04 ha or more of operational holdings. Table 3 shows the pattern of changes in size distribution of holdings since 1960.

In 1983/84, small farms represented 70.34% of all farms, up from 51.63% in 1960. The area under small farms also increased from 16.25% in 1960 to 28.98% in 1983/84. The percentage of medium farms decreased from 37.68% in 1960 to 24.72% in 1983/84, while the percentage of large farms decreased from 10.69% in 1960 to 4.94% in 1983/84. The average size of land holdings for all three classes declined over this period.

Table 3 - Size Distribution of Farm Households in Bangladesh: A Comparison

Farm Size by Census Year	Percentage of Total Farm Holding	Percentage of Area of Farm Holding	Average Size of Farm Holding
1960 Census			
Small	51.63	16.25	0.45 ha
Medium	37.68	45.69	1.74 ha
Large	10.69	38.06	4.86 ha
Total	100.0	100.00	1.43 ha
1983/84 Census			
Small	70.34	28.98	0.36 ha
Medium	24.72	45.09	1.66 ha
Large	4.94	25.92	4.82 ha
Total	100.00	100.00	0.93 ha

Source: Hossain (1991)

Two main trends have been identified. The first trend is that most of the present landowners prefer to keep all their land to themselves for cultivation, rather than sharecrop the land. The second trend is that land fragmentation and landlessness is gradually reducing the marginal farmers to labourers. Since sharecropping is being replaced by owner cultivation in the case of most farmers and farming is being done mostly under the own management of the landowners, landless labourers are earning their living more and more as day labourers undertaking any work they can find.

The number of large farms has come down about 24% between 1960 and 1983/84. In the case of medium farms, the absolute number of farms has not changed significantly. In the case of small farms, there has been a 123% increase in the number of farms between 1960 and 1983/84. Not only has the number of small farms gone up, but the area has also gone up sharply. It suggests that farmers in Bangladesh hold on to their tiny plots of land even when the farm size becomes non viable.

Since 95% of the farms are small or medium size, and these farms account for nearly 75% of the total cultivated lands, it follows that government policies and programmes in agriculture and social forestry must be designed primarily to help the small and medium farms to increase their productivity. For land reform to have any significant impact, the land ceiling would have to be reduced to 2 to 3 ha. This would make all landholdings medium and small. However, this would only speed up the process of fragmentation, since landholdings will continue to break into pieces in the natural course of subdivision among the inheritors.

As a result, by the end of the century, many of the large farms will be reduced to medium or small holdings, and almost all the farms will end up being too small to be economically viable. If things continue as they are, it is likely that over 90% of farm households will be small non viable units by the year 2013, the end of the Forestry Master Plan period. It is difficult to envisage any scenario which can stop this fragmentation, and reduce the rate of landlessness in Bangladesh. As a result, it is estimated that 90% of rural households will be functionally landless in 20 years time.

Implications for Forestry

The present pattern of landuse and land utilization has important implications for the forestry sector. First and foremost is the fact that the pressure on forest lands will increase in the future. This pressure cannot be met or resisted by force. Education and people's participation is the only hope for forestry in Bangladesh.

1. Need for Institutional Changes

The Forest Department will have to reorient itself to an education and facilitator role for participatory forestry. This reorientation will not be easy within the present institutional structure of the Forest Department.

The first question which must be asked is whether or not these changes can take place within the context of a government organization. Creating a new Department of Social Forestry within the Ministry of Environment and Forest is unlikely to overcome the institutional and attitudinal barriers to effective participatory forestry. The creativity, flexibility, dedication and humility necessary for effective participatory forestry are generally restricted by the government bureaucracy.

Another institutional approach is required. The first requirement is that the new institution is not a bureaucratic government institution, but a highly flexible umbrella institution which will allow smallholders to have long term leases to government forest lands, and be assisted by non government development organizations (NGOs) for their social organization. Extension services for the activities of these smallholders may come from government extension services, the NGOs or private enterprises which depend on the smallholders for their raw materials.

2. Maximizing Wood Resources

Approximately 53% of the timber, fuelwood and bamboo utilized in Bangladesh presently come from homesteads and village woodlots. This includes wood for local domestic use and cottage industries, and for large wood-based industries such as pulp and paper mills and sawmills. It is estimated that the total land area under homesteads and village woodlots is 270,000 ha. This is a relatively and restricted area, since the lands outside the homesteads are heavily utilized for food crops and grazing, and are not available for expansion of homesteads and village woodlots. Likely, this will result in a fragmentation of the land presently occupied by homesteads and village woodlot lands, as well as cultivated lands. The result will be more houses, and less space for trees. It is therefore dubious that the productivity of homesteads and village woodlots can be maintained.

As a result, the opportunities for increasing the supply of wood produces from homesteads and village woodlots through social forestry programmes are limited, since most of these lands are presently intensely utilized. There may, however, be some opportunities for increasing the productivity of village woodlots through the introduction of genetically improved planting stock. This is likely to increase the economic return from woodlots, but may not increase the production of timber, fuelwood, and bamboo. For example, many existing mango trees produce low quality fruit which is difficult to market. These could be systematically replaced by improved grafted stock, and this would likely result in more income for the owner. However, it would also encourage the owner to keep the tree throughout its productive life, rather than sell it at maturity for timber.

There are already indications that the resources in the homesteads and village woodlots are being depleted. This is indicated by household surveys and personal observations. This depletion will place a severe burden on the rural poor, who depend on the homesteads and village woodlots for their wood and bamboo needs.

To reduce the impact of this depletion on the rural poor alternate strategies are needed for providing raw materials for the industries which presently depend on the homesteads for timber, fuelwood, and bamboo. This can be done by making the 1,400,000 ha of forest land controlled by the forest department more productive through a programme of participatory forestry. The strategy is smallholders enterprises focused on mixed species, multipurpose woodlots, where the most appropriate species is planted to each microsite. This strategy should provide the basis for participatory forestry activities on government-owned forest lands. This can be done using the Multiple Use Management Area model recommended in this Report.

3. Opportunities for Strip Plantations

Strip planting along roadsides, railway lines, and embankments has been a major focus of social forestry in Bangladesh, both by the government and NGOs. To date, such programmes have not been very successful. The majority of trees planted have since died. This indicates a lack of care and protection from free grazing livestock. Problems associated with land tenure and lease agreements have limited attempts at participatory forestry programmes. Thus, there are many social and technical problems which must be solved before these programmes can be made successful. However, it is important to understand the extent of the opportunities for such programmes.

According to the Statistical Yearbook of Bangladesh 1991, the length of roads in Bangladesh in 1989 by class is:

National Highways	2,834.86 km
Regional Highways	1,382.22 km
Feeder Roads	3,134.36 km
Upazila Connecting Roads	5,608.71 km
Total	12,960.15 km

Theoretically, if both sides of the roads are available for tree planting, the total length available for strip planting would be approximately 25,920 km. If trees could be planted at an average of 10m intervals, this would allow the planting of 2,592,000 trees. Approximately 156 trees planted in a strip would be equivalent to 1 ha planted at 8 x 8 m spacing. Thus, 25,920 km of roadside would be approximately equivalent to 16,615 ha of block planted trees.

Also, according to the Statistical Yearbook of Bangladesh 1991, the length of railways in 1989/90 was 2746 km. Using the same logic as used above, this would allow the planting of 549,200 trees, which would be equivalent to 3,521 ha of block planted trees.

ESCAP (1987) reported 4800 km of coastal embankments. Using the same logic, this would allow the planting of 960,000 trees, which would be equivalent of 6154 ha of block planted trees. No figures were readily available for other embankments.

Thus, strip planting along roadsides, railway lines, and coastal embankments could provide planting space equivalent to a total block area of 26,290 hectares. The greatest social benefit would be achieved by the planting of multipurpose trees, such as jackfruit which provides food for human consumption, fodder for livestock, quality timber, and fuelwood. Also, to be of social benefit, these multipurpose trees should be held on long term lease by the rural poor, with priority going to poor female-headed households, or to women in poor male-headed households.

The area between the trees could also be put to use for growing multiple purpose food and fodder crops. However, to get maximum benefits for the poor, it would be necessary to institute a policy requiring the pen feeding of livestock. Most other countries which have densely populated areas similar to rural Bangladesh are already implementing such policies. The policy has benefits for the livestock owner as well as the rural poor who will benefit from the land which will be made

available as a result of this policy. Livestock in Bangladesh are characterized as being undernourished and diseased, which results in very low work capabilities for ploughing animals. Pen feeding would result in healthier animals. Draught animals would be capable of more work, thus benefiting agricultural production. The rural poor could use their spare time to gather/grow fodder for pen feeding the animals.

4. Khas Lands

There are already land reform programmes aimed at transferring khas lands to landless people. It is better to facilitate such transfers before initiating social forestry activities, so that land tenure will no longer be an issue or constraint. Ownership of such lands would encourage people to plant trees, which are long-lived plants and require long term security of tenure. The total area of khas lands is 562,115 ha, of which 322,579 ha is suitable for agriculture and 239,536 ha is not suitable for agriculture.

However, 256,596 ha of the land is presently being utilized by approximately 308,000 landless families under lease agreements. Thus, care would have to be taken in the redistribution of the lands so that the landless people who are presently using the land under lease are not unduly disadvantaged by the distribution process. In many cases, the present lease holders should be given preference when distributing the land.

In the past, land distribution has discriminated against women, especially female heads of households. It is therefore important that this be rectified and women be given fair and equal access to the land, or even preference.

It is difficult to determine from the information provided what percentage of this khas lands would be best suited for tree crops. However, it is probably a very meaningful amount, given the fact that a total of 562,115 ha are involved.

A programme for land evaluation and suitability assessment should be carried out before a decision is make on the most appropriate landuse. Once the best species have been determined, participatory forestry programmes could be developed to assist the new smallholders develop their lands in a socioeconomic and environmentally appropriate manner.

5. Classified and Unclassified State Forests

From the above discussion, it is obvious that the classified and unclassified state forests hold out the most potential for increasing the supplies of wood and non wood products. Classified forest lands cover 1,461,538 ha and unclassified state forest cover 663,968 ha. This is far more than the total area available in homesteads and village woodlots, along roadsides, railway lines and embankments, and in khas lands.

At present, this vast area of classified and unclassified state forests have been relatively unproductive, yielding only 2.5 m^3 mean annual incremental growth.

A model has been developed for integrating participatory forestry activities with a strategy aimed at preserving biodiversity for future generations. The model is based on Multiple Use Management Areas, which are zoned for different functions. Core zones are designated for the preservation of biodiversity and the maintenance of the natural environment. These core zones are protected by buffer zones, which are managed for the sustainable production of wood and non wood products using a limited selection system. Outside the core zone and buffer zone is a multiple use zone, which is intensively management for wood and non wood products through a blend of participatory forestry activities and plantation forestry. This model is discussed in more detail later in this report.

NATIONAL LAND POLICY FOR BANGLADESH

There is a recognized need for an effective national land policy for Bangladesh. According to Hossain et. al. (1991), this derives from four major needs: (1) productivity; (2) equity; (3) social harmony; and (4) ecological sustainability. The same rationales are also applicable to forest land policy. Since the rural poor and landless are generally the target group for participatory forestry activities, their access to government land is a key forest sector consideration.

Since independence in 1971, there have been two major pieces of land reform legislation. The first of these consist of various land related Presidential Orders of 1972, whose main features were:

a. Land ceiling reduced from 375 bighas to 100 bighas;
b. Exemption of land tax for families owning less than 25 bighas;
c. Distribution of khas land among the landless;
d. Abolition of auction system in the management of government properties (i.e. bazaar, ferry, etc.) in favour of committee management; and
e. Newly formed or accreted land, brought under khas possession.

As a result, the landowning rural poor were given some relief from taxes. The transformation of newly formed and accreted land into khas land provided a legal deterrent to violent practices of jotedars who sought to establish claims of ownership on all newly risen land in their zones of influence. In 1973, the total quantity of khas land was 294,700 ha, of which 168,400 ha was readily available for settlement. However, progress on the distribution of khas land was extremely slow, as was the recovery of surplus land above the set ceiling. By 1976, only 25% of the available khas land had been distributed, and this slow pace of distribution activities opened avenues for misappropriation by local influentials in connivance with corrupt officials (see Siddiqui 1981).

The second legislation was the Land Reform Ordinance of 1984 whose main features were:

a. Legal recognition of the rights of Bargadars.
b. Benami transaction declared illegal.
c. Fixation of a minimum wage for agricultural labourers.
d. Priority distribution of khas land to landless families.
e. Eviction from homestead to realize loans legally disallowed.

Many aspects of this legislation have yet to be enforced. According to BIDS (1991), nearly 90% of the rural population were unaware of the tenancy reforms of 1984, and how the reforms should benefit them. There is still no effective enforcement of the legal bar on benami transactions and eviction from homesteads. There is no way to enforce the minimum wage for agricultural labourers.

From this, it is clear that the existing legislation has not been effective. There is still a need for major improvements.

Land Policy Constraints in Bangladesh

Four major constraints have been identified which must be overcome in order to develop an effective land policy for Bangladesh. These constraints are briefly outlined below.

1. Overall Land Constraint

The per capita availability of cultivable land for Bangladesh is less than .01 ha. As a result, there is very limited scope for any comprehensive redistribution of land. In many cases, policy makers

and politicians have failed to appreciate this constraint. As a result, they have tended to focus on redistributive land reforms, while in many cases neglecting the important issue of optimal utilization of public or state land resources. This includes khas lands, and the classified and unclassified state forest lands, which are the main focus of the forestry sector.

2. Variation for Land Resources and Problems

The land resources and land problems of Bangladesh are not uniformly distributed throughout the country. There is considerable regional variation. This is not always taken into consideration when policy makers and politicians are designing policies and strategies for land reform.

This is especially true in relation to the availability of khas land for redistribution to the rural poor. The bulk of the khas land available for redistribution is concentrated in a relatively few coastal and jotedar-dominated pockets around the country. Thus, successful implementation of khas land redistribution demands a concentration of effort and resources on these identifiable pockets rather than a routine administrative approach for the whole of the country.

The tendency has been to have one approach for the whole country, rather than a combination of approaches to suit specific regional needs. As a result, the benefits of land reform programmes have been very limited.

3. Institutional Constraints to Effective Land Reforms

The focus in the past has been on land ceilings and tenure reforms, but has failed to develop the institutional framework necessary for the successful implementation of such reforms. Implementation of land reforms have been frustrated by:

- the system of land administration
- the associated court process
- the bureaucracy with a preponderance of ex-officio authorities in key decision making positions on land reform programmes.

These weaknesses in the land administration system have contributed to the pervasive land violence which exists in rural areas, and the human misery associated with this land violence. This points to the need to focus on land administration reforms, as well as redistribution and tenure reforms.

4. Absence of a Centralized Information System

Information on land resources and land rights are scattered and duplicated in various land-related offices leading to overall confusion and conflicts. A good example is the fragmentation of information between the Upazilla Land Office or Tahsil Office and the registration office. The registration office records all land property transfers while information on ownership is maintained separately in the Upazila Land Office/Tahsil Office. As a result, no routine scrutiny of the ownership information takes place at the time of registration. This allows for the registration of numerous false land transfers. This results in numerous unnecessary court cases.

Thus, the absence of an up to date, systematic and universally accepted source of information on land resource availability and land rights is a limitation or barrier to the successful implementation of land reform programmes, as well as the effective adjudication of land disputes.

General Recommendations for Landuse Policy

Changes are required in order to facilitate land-based programmes in the forestry sector, both on land controlled by the Forest Department and lands controlled by the Land Ministry. In order to facilitate the necessary changes, it is recommended that the Government hold a national workshop on land reform policies. This workshop should be attended by a cross section of interest groups, including government officials, planners, NGOs, politicians, academics, representatives of the landless, representatives of farmers, agricultural workers organizations, and women's organizations. The workshop would address the issues of land reform, including the equal rights of women in land allocation and inheritance. Concrete proposals from this workshop could be presented to Cabinet for consideration and appropriate action.

1. Specific Issues and Recommendations in Relation to Women

The following are some recommendations which would benefit women:

- Female-headed households should be given priority in the distribution of khas lands. In the priority list, women should be included irrespective of whether they have an adult son or not. Male-headed households in which male members are incapacitated should also be included.

- Representatives of the Minister of Women Affairs and Secretary/ Director of Women Affairs should be included on all Land Reform Councils. At the District and Upazila level, Women Affairs Officers need to be included. Representatives of other women's organizations and NGOs should also be represented.

- Women should be allowed to take recourse to the Family Law Court to vindicate their land rights. This is in recognition of the lengthy and costly process resulting from fragmented land records and Civil Court procedures. Many women are denied their rightful inheritance by this process.

- After natural disasters, recovery programmes for house reconstruction should give women ownership of rebuilt houses and the housing materials.

- In government housing programmes, houses and housing materials should go to the wife, or in some cases jointly to the husband and wife.

- A policy should be developed requiring dwelling houses to be registered in the name of both the husband and wife. The heirs will get the house only after the death of both spouses.

- Government participatory forestry programmes should aim to include more women than men, since women are more efficient in planting and maintaining young trees. Leases provided to families taking part in such programmes should be given in the name of the wife. This would give the woman and her children a measure of security in case of widowhood or divorce.

2. Other Forest Policy Issues and Recommendations

The present approach to forest land resource management in Bangladesh is not working. As a result, the forest lands are being rapidly depleted. This is causing environmental degradation, and a loss of irreplaceable biodiversity and ecological diversity. The potential socioeconomic benefits of this forest land resource is not being developed for poverty alleviation, social justice and equity. In order to maximize the social, economic, and environmental benefits of the forest land resources of the country, new policies and approaches are needed. The policy should be based on a multiple use management strategy, where blocks of forest land are managed as a unit for conservation,

traditional forestry, and participatory forestry. The following are some suggestions for formulating a new forest policy.

- The forest policy should be based on a commitment to the conservation of biodiversity through conservation of natural ecosystems. This is an acknowledgement of this generation's responsibility to future generations.

- The forest policy should be focused on achieving social equity. This can be achieved through participatory forestry activities. To facilitate this, laws and legislation should allow the long term lease of government forest land to poor families, for carrying out long term participatory forestry activities.

- Forest policy should give priority to smallholders operating small family businesses, which may be linked to processing facilities and markets through cooperatives and joint-enterprises.

- The forest policy should be dedicated to the fair and equitable involvement of women in all forestry related activities. Women should have equal access to leases or permits for utilizing forest lands, and to any subsidies. In all forestry sector activities, women should be in decision-making positions, as well as being extension workers and trainers, to support female participants. The inheritance law should be replaced by a law which would give women equal rights under the law. Criteria used for land redistribution programmes should not discriminate against women, but should give them preference.

- The forest policy should be based on multiple use area management, which combines conservation of biodiversity and ecological diversity, with participatory forestry activities. Each Multiple Use Management Area should have its own integrated management plan, based on systematic land evaluation (land appraisal) and suitability assessment.

- The forest policy should respect tribal rights, and facilitate the involvement of tribal people in participatory forestry activities on forest land. This may in some cases involve the joint management of land resources.

- The forest policy should facilitate local participation in decision-making on issues relating to the environment and productive systems.

- The forest policy should facilitate a partnership between government and NGOs for human development. This would facilitate participatory forestry activities.

LAND RESOURCES APPRAISAL OF BANGLADESH

Biogeographical Resources of Bangladesh

Bangladesh occupies an area of 144,863 km^2 (FAO 1988). Within this relatively small area, there is considerable environmental variation. This environmental diversity occurs at all levels, from the national level to the village level. The present pattern of landuse is a response to small scale complexity of soil and hydrological conditions, and local response to annual variations in rainfall, temperature, and flooding.

This complexity must be taken into account when planning environment-specific agricultural and forestry development, research, and extension programmes. To help ensure the success of such programmes, an appraisal should be made of the land resources being developed. From this, a suitability assessment can be carried out.

In the Land Resources Appraisal of Bangladesh, four main parameters were used to prepare the Agroecological Regions Map and the Land Resources Inventory Map. These were:

- landforms;
- soils;
- inundation regime;
- climate.

Landforms

Bangladesh consists primarily of a large alluvial basin deposited by three major river systems, namely the Ganges, the Brahmaputra and the Meghna Rivers. Hill areas are mostly confined to the eastern part of the country.

1. Physiographic Regions

The country can be divided into three physiographic regions:

- Floodplain and piedmont plain units which occupy almost 80 percent of the land area.
- Slightly uplifted fault blocks (sometimes referred to as terraces) occupy about 8 percent.
- Hills occupy about 12 percent.

FAO (1988) describes these physiographic regions as follows.

Floodplains - The floodplains of the Ganges, Brahmaputra, Meghna and smaller river occupy smooth, very gently undulating relief comprising broad and narrow ridges (existing or old river banks) and depressions. Differences in elevation between adjoining ridges and depressions range from around 1 m on tidal floodplains near the coast to 2 to 4 m over much of the Ganges and Brahmaputra river floodplains and as much as 5 to 6 m in the Sylhet Basin in the northeast. Only in the extreme northwest do absolute elevations exceed 20 m above mean sea level (MSL). The Ganges and Brahmaputra sediments are rich in weatherable minerals which contribute to soil fertility. Ganges and Lower Meghna sediments also contain lime, but other sediments do not. Floodplain and piedmont sediments derived from the eastern hills generally have low contents of weatherable minerals.

Terraces - The terraces comprise the Madhupur and Barind Tracts. They are underlain by the Madhupur Clay, probably of Tertiary age. This materials is low in weatherable minerals. Both tracts mainly lie only 1 to 5 m above adjoining floodplain land and less than 20 m above sea level. However, the western edge of the Barind Tract reaches 42 m MSL at its highest point. This is about 25 m above the adjoining Mahananda Floodplain. Most of the Madhupur Tract is closely dissected by valleys, but there are some level upland areas. Valley sediments occupy about 30% of the tract. Most of the Barind Tract is almost level. However, the high western edge is strongly dissected. Valley sediments occupy only 10% of the whole area.

Hills - The hills occur along the northeastern and eastern borders of the country. They are formed in unconsolidated and consolidated sediments of Tertiary age which have been uplifted, folded, faulted and dissected to form linear ranges running mainly north-northwest/south-southeast (except near the northeastern border). The higher hill ranges reach 300-1000 m MSL. Lower hills adjoining them mainly lie below 100 m MSL. The slopes are generally steep. Most hill rocks have low contents of weatherable minerals.

Soils

1. General Soil Types

FAO (1988) identified and mapped 483 soil series, and described them in Report 3 of the series. However, for the Agroecological Regions Map, FAO (1988) used General Soil Types. A General Soil Type is a group of soils which are broadly similar in appearance and characteristics because they have developed in response to similar environmental factors such as physiography, climate and drainage. FAO (1988) noted that this is a local classification system, designed to make distinctions which appear significant for understanding the formation, distribution and use of the soils of Bangladesh.

2. Physiographic Soil Groups

FAO (1988) differentiated the General Soil Types into three physiographic groups: floodplain soils, terrace soils, and hill soils, and provided the following synopsis of the main properties of these groups.

Floodplain Soils - These soils have formed in alluvial sediments ranging from a few months to several thousand years in age. Their main characteristics are:

- There is a general pattern of sandy or loamy soils on the higher parts of floodplain ridges grading into clays in adjoining basins. The relative proportions of sandy, loamy and clayey soils vary between physiographic units and also between soil associations within physiographic units.
- All except the highest soils are seasonally inundated, mainly by accumulated rainwater but also by silty water close to river channels and near hill areas.
- Permeability is moderate or rapid in loamy ridge soils which are not puddled for transplanting paddy. It is also moderate or rapid in cracking clays on the Ganges River Floodplain. It is slow in other basin clays and in most loamy soils which are puddled for transplanting paddy and which have a plough pan.
- Moisture holding capacity is high in deep silt loams, especially on the Tista Meander Floodplain and the Old Meghna Estuarine Floodplain. It is moderate in most other loamy soils, and is low in sandy ridge soils, basin clays and most soils that are puddled for transplanted paddy cultivation. Capillary rise of moisture keeps some basin soils and deep silty soils moist for most or all of the dry season.
- Organic matter contents generally are low in recent alluvium (except near the eastern hills) and in most ridge soils. They are moderate (locally high) in basin soils and in Black Terai Soils.
- Topsoils mainly are acidic (when not submerged) except in some calcareous Ganges and Lower Meghna Floodplain soils and in recent alluvium. Subsurface layers mainly are between slightly acid and slightly alkaline. They are more acidic in some piedmont and basin soils, and are moderately alkaline in calcareous layers of soils formed in Ganges alluvium.
- Coastal parts of tidal and estuarine floodplains become saline to varying degrees in the dry season. Toxic Acid Sulphate Soils occur patchily in the southwest and southeast, as well.

- Most soils either are naturally fertile or have the capacity to respond satisfactorily to normal applications of fertilizers/ manures.

- The agricultural potential of floodplain soils is determined as much by hydrology - depth and duration of seasonal inundation and risk of flood damage - as it is by inherent soil properties. Availability of water for irrigation has become increasingly important in determining cropping patterns, productivity and potential in recent years.

Terrace Soils - These soils comprise a wide range of soils formed over the Madhupur Clay. Soil differences are due to differences in drainage and in the depth and degree of weathering. The main characteristics are outlined below:

- Shallow soils have grey, impervious, Madhupur Clay within 60 cm from the surface. Deep soils are underlain by red-mottled, pervious clay to a depth of several metres.

- Well drained and moderately well drained soils occurring extensively on the Madhupur Tract and locally in the northeast of the Barind Tract include both deep and shallow soils. They are strongly acid and have low organic matter contents and moisture-holding capacities.

- Poorly drained soils occur extensively on the Barind Tract and locally on the Madhupur Tract. Deep and shallow soils occur. Both have grey, silty, upper layers grading into clayey lower layers, and most have a strongly puddled topsoil and a plough pan. Organic matter contents generally are very low. Most soils are strongly acid, but shallow soils are less acid in the Madhupur Clay substratum and some contain lime nodules. Moisture-holding capacity is low.

- Valley soils within terrace areas range from deep, grey silts in shallow valleys to dark grey, very strongly acidic, heavy clays in broader, deep valleys.

- Fertility is generally low. The agricultural potential of deep red soils, deep and shallow grey soils, and most valley soils is moderate. Irrigation and adequate fertilizer use are the main requirements. Shallow red and brown soils have a low potential for both agriculture and forestry.

Hill Soils - These soils include a wide range of soils formed over consolidated and unconsolidated sandstones, siltstones and shales which underlie the Northern and Eastern Hills. They have the following characteristics.

- Most hill soils are deep, excessively or well drained, strong brown or yellow-brown, friable, sandy loams to clay loams. Shallow soils over hard rock occur locally.

- Steep or very steep slopes predominate. Some low hills have level to gently rolling summits.

- Permeability generally is rapid and moisture-holding capacity low.

- Organic matter contents are moderate or high under old forest or tree crops. They generally are low in soils repeatedly used for shifting ('jhum') cultivation.

- Almost all soils are strongly to extremely acid, and have a low nutrient-holding capacity.

- Agricultural potential is severely limited by the prevalent steep slopes, heavy monsoon rainfall and the associated erosion hazard. Most soils and slopes are unsuitable for bench terracing. Forestry and tree crop production are the most appropriate forms of landuse.

Inundation Land Types

As noted by FAO (1988), the cropping pattern on most floodplain and valley land is primarily determined by the seasonal flooding regime. This refers to the dates when inundation begins and ends, the depth of inundation at peak levels, and risk of damage to crop by early high or late floods.

In practice, the farmers' traditional cropping patterns are adapted to flooding regimes on a microtopographical scale. Differences of only a few centimetres between neighbouring fields may influence the choice of crops or varieties, and management practices.

Seasonal flooding regimes have been characterized by means of inundation land types, defined as follows:

Highland (H)	-	land above normal inundation level
Medium Highland (MH)	-	land normally inundated up to about 90 cm deep. For some purposes, this is divided into:
MH-1	-	inundated up to 30 cm deep
MH-2	-	inundated 30-90 cm deep
Medium Lowland (ML)	-	land normally inundated up to 90-180 cm deep
Lowland (L)	-	land normally inundated up to 180-300 cm deep
Very Lowland (VL)	-	land normally inundated deeper than 300 cm.

An additional class, termed Bottomland, is recognized for depression sites in any land type which remains wet or submerged throughout the year. Table 4 summarizes the extent of inundation land types.

Table 4 - Extent of Inundation Land Types

Land Type	Normal Flood Depth	Area in ha	% of Total Area
Highland	0-30 cm	4,199,952	29%
Medium Highland	30-90 cm	4,039,724	35%
Medium Lowland	90-128 cm	1,771,102	12%
Lowland	180-300 cm	1,101.560	8%
Very Lowland	Greater than 300 cm	193,243	1%
Total Soil Area		12,305,851	85%
River, Urban, Homesteads		2,178,045	15%
Total		14,483,626	100%

Climate

1. General Description

Bangladesh lies in the tropical monsoon region to the south of the Eastern Himalayas. These mountains act as a barrier and modify the climate of the country to a large extent. Due to the Himalayas, the country is saved from the rigours of the cold Siberian winds.

The tropical monsoon climate is characterized by heavy rainfall during the monsoon season and little or no rainfall during the dry winter months. The wind direction reverse from northeast in winter to southwest in summer.

The mean annual rainfall varies from as low as 1,250 mm in the western region to as high as 6,000 mm in the eastern region. However, the mean annual rainfall over much of the country is in the range of 1,500 to 3,000 mm. The coefficients of variation of mean annual rainfall are in the range 15% to 25%.

The seasonal moisture regime in Bangladesh is made up of:

- the transition period, from dry to wet;
- the wet period (kharif); and
- the dry period (rabi).

These are generally referred to as summer, monsoon, and winter season, respectively.

The summer covers the period from March to June. The average temperature during the summer months is 27.8° C. The maximum summer temperature ranges between 33° C and 35° C, although occasionally it rises up to 40° C or more. The weather remains hot and humid throughout the summer season. During the summer, Bangladesh is frequently visited by nor'westers. Cyclones and tornadoes are also quite common during this period. Cyclones are often very destructive. They sometimes move at speeds of over 150 km per hour and create tidal surges up to 9 m in height in the coastal belt. These cyclones may cause heavy loss of life, and heavy damage to property.

The monsoon season covers the period from June to October. Humid air coming from the southwest brings torrential rains. Depending on the part of the country, rainfall varies between 1,270 mm to 3,988 mm. Humidity levels generally remain over 80%. The sky remains mostly cloudy. Generally, 80% of the annual rainfall occurs during the monsoon months.

The winter season covers the period from November to February. The average temperature is 17.8° C, while the minimum temperature is 7.2° C. The minimum temperature can, however, have wide variation. In 1905, the minimum temperature recorded in Dinajpur was 1.1° C and in 1990 it was 1.5° C. There is hardly any rain during the winter months. Although there are occasional rains, these are usually less than 10 mm. The weather remains dry and the sky is mainly clear. Early morning fog and mist is a common phenomenon.

In mid-October and November, the monsoon winds change direction. Low pressures may develop in the Bay of Bengal and cyclones, at times with hurricane wind speed, build up. These travel towards the north and often strike the Bangladesh coast.

Global warming may be affecting Bangladesh. There appears to be change in climate. Severe drought, excessive rainfall, natural hazards like flood, nor'westers, tornadoes, cyclones and tidal surge appear to be more frequent than in the past.

2. Climatic Data and Agroclimatic Zones

FAO (1988) compiled, reviewed and analysed available climatic data for 30 principal stations of the Bangladesh Meteorological Department and for 177 rainfall stations of the Bangladesh Water Development Board. These are included recorded and analysed in Report 3 and Report 4 of the Land Resources Appraisal of Bangladesh for Agricultural Development.

Through the analyses of available data, FAO (1988) were able to determine moisture zones and

thermal zones. The superimposition of the moisture and thermal zones creates a total of 92 agroclimatic zones. When these are superimposed over the agroecological regions and subregions, the zones create a total of 535 agroecological units.

FAO (1988) also superimposed the agroclimatic zones over the soil associations shown on the Land Resources Inventory Map, and this provides the framework for the agroclimatic ratings of crop suitability.

Agroecological Regions

FAO (1988) prepared an Agroecological Regions Map for Bangladesh.

As a result, 30 agroecological regions were recognized in Bangladesh. These are further subdivided into 88 subregions and 535 agroecological zones. As noted by FAO (1988), there are no pure agroecological regions in Bangladesh. All include a more or less wide range of soils and inundation land types, and most regions include more than one agroclimatic zone. A wide range of soils and inundation land types usually occur within a distance less than the diameter of a single village's land.

FAO (1988) went on to note that such diversity and local complexity of ecological conditions provide exceptional opportunities for agricultural and tree crop diversification, both nationally and locally, as well as exceptional problems for agricultural and forestry research, extension and development planning. The wide range of conditions usually present within the area of a single village means that individual farmers usually cultivate several different crops and crop cultivars on the different kinds of land and soil which they own or farm. This complexity also implies the need for highly site-specific research trials, and agricultural and forestry extension advice to farmers.

Blanket programmes involving a limited range of species are not appropriate for social forestry and agroforestry programmes for rural areas. Programmes must be flexible, in order to have the right species planted on the right site, to give the greatest social, economic, and environmental benefits. This can partly explain why the Community Forestry Project and the Upazila Reforestation and Nursery Project have had limited success in their programmes.

To facilitate suitability assessment in Bangladesh, the Bangladesh Agroecological Zones Programme has been set up in the BARC Computer Centre. It is designed to provide a national system of data base management and land suitability assessments to serve the needs of agricultural and forestry research, extension and development planners at national, regional and local levels. The system is capable of being continually updated and extended as new information is provided by future soil and landuse surveys, agricultural and forestry research, and field experience with individual crops and management practices.

ECOLOGICAL ZONES FOR FORESTRY IN BANGLADESH

Dendrological Zones

Land capability can be defined as the inherent capacity to produce or support a combination of plants and animals according to the edaphic and environmental conditions of Bangladesh in a sustainable manner, under a particular set of management objectives and prescriptions. The land units have been assessed under various systems, the most recent being the FAO 1988 review. For forestry purposes, such a review constitutes only a broad hypothetical analysis and may not be used for assessing the suitability of a particular landscape (dendroecological region) for a wide range of tree species.

A land capability assessment for tree species has been made by using the FAO system "A Framework for Land Capability Evaluation" using a modified methodology . A field manual entitled "A Simplified Field Manual (FM) for Land Capability Assessment for Site Specific Species Selection in Bangladesh" was published and circulated amongst the field level foresters. About 500 field level professionals of Forest Department were trained in using the FM.

Bangladesh Forest Research Institute with the technical assistance of an FAO Landuse Planner were engaged in preparing this Simplified Field Manual for Site Species Selection (FAO 1987). The Framework of Land Evaluation (FAO 1976) has been employed in this manual in a simplified format. All parameters including climate, soil, socioeconomic condition of the beneficiaries, etc. have been considered to be uniform and the necessity of detailed field surveying and laboratory analysis has also been bypassed within the manual. The Simplified Field manual devised by BFRI-FAO for use of the parametric system measures/ assesses only five parameters. These are Land Component (LC), Effective Soil Depth (ESD), Soil Texture (T), Soil Moisture Regime (SMR) and Soil Fertility (SF). All these parameters are observable in the field. Soil Fertility can be measured by using a simple pH kit or can be assumed as pH 5.5 for soils of Terraces and Hills and pH 6.0 to 7.5 for the floodplain soils. These characteristics are rated according to a scale employed in the Field Manual. The ratings are organized collectively to obtain a Site Classifications Index which corresponds to a list of species to be recommended for a particular dendroecological region. Site indices and species suitability for different regions are given in the Table 5. This table includes the dendroecological regions, area, land component in terms of flooding, soil depth and drainage, land capability classes, suitable tree species and major limitations.

Internal qualities relate mainly to soil characteristics including moisture relationship, oxygen availability root hold, etc. In relation to land quality the major dendroecological regions of Bangladesh can be characterized as follows.

1. Water Availability

The soils of Estuarine floodplain (Fe), Gangetic floodplain (Fg), Non Gangetic floodplain (Fn) and partly of shallow terraces (Ts) are seasonally flooded and seasonally dry. Unless seasonally flooded, soils of these regions may be suitable for most tree species excepting the flood susceptible jackfruits. Soil of High hills (Hh), Low hills (Hl), and Terrace fans (Pf) and Deep terrace (Td) may be droughty for the same species. This is more true for shallow (<50 cm deep) soils of the High hills.

2. Oxygen Availability

Aeration of soil depends on drainage condition. Drainage is regulated by soil texture and structure in the root zone. Even the non flooded soils of the Estuarine floodplain (Fe), Gangetic floodplain (Fg), Non Gangetic floodplain (Fn), Himalayan Piedmont (Pp) etc. have imperfect to poor drainage conditions during the monsoons. Some tree species on these dendroecological regions may suffer from oxygen suffocation. Flooded soils are suitable only for some species not susceptible to saturation in the root zone. In soils of all other dendroecolgical regions oxygen availability may be considered adequate for most species.

3. Availability of Root Hold

Root hold for trees is restricted due to the presence of a permanent water table, a hardpan or/ and a drought pan at shallow (lm) depth. Permanent ground water tables may occur at shallow depths in soils of Estuarine floodplain (Fe), in flooded soils of Gangetic floodplain (Fg), Non Gangetic floodplains (Fn) and Himalayan piedmont (Pp). Hard pan may occur in shallow soils of steeply sloping denuded hills. The mesophytes in these regions fail to compete with shallow rooted pioneer grasses due to the presence of a drought pan at shallow depth on denuded hills.

Table 5 - Land Capability Classes/Suitable Tree Species for Different Land Components of the Aggregated Soil Groups

Suggested soil groups	Area (ha)	Land Component	Land Capability Class	Suitable tree Species	Limitations
Estuarine floodplain soils (Fe)	a. 43,339 b. 172,200 c. 706,945	No flood Int. * Seas *	Moderate	- Most mesophytic plants except bamboo and jackfruit - Suitable for flood tolerant tree species	- Salinity, poor, drainage - Flooding - Salinity
Gangetic floodplain soils (Fg)	a. 657,020 b. 240,370 c.1,404,593	No flood Int. * Seas *	Excellent Poor	- Ditto	- Imp drainage - Flooding
Non Gangetic floodplain soils (Fn)	608,694 635,338 3,513,139	No flood Int. * Seas *	Excellent Poor	- Ditto	- Imp drainage - Flooding
Deep terrace soils (Td)	418,573	Wd	Excellent	- All tree species except ipil-ipil	- Seasonal drought
Shallow terrace soil (Ts)	549,425 295,019 95,595	No flood Int. * Seas *	Moderate Poor	- Ditto	- Imp drainage - Flooding
High hill soils (Hh)	791,740	Shallow	Poor	- Shallow rooted drought resistant trees species	- Shallow soil depth - Steep slope
Low hill soil (Hl)	569,740	Deep	Excellent	- Most tree species except ipil-ipil - Tea, rubber, fruit trees	- Steep slope
Terrace fan soils (Pf)	578,241	Deep	Excellent	- Most tree species except ipil-ipil and teak - Tea, rubber, fruit trees	- Undulated relief - Phosphate fixation
Himalayan Piedmont soils (Pp)	233,347 22,865 112,385	No flood Int. * Seas *	Excellent Poor	- Most tree species - Tea with open drains - Suitable for flood tolerant tree species	- Imp. drainage - Flooding
Anthropogenetic soils (As)	103,070 1,440 1,768	No flood Int. * Seas *	Moderate Poor	- Most tree species - Suitable for flood tolerant tree species	- Irregular flat topped platforms - Scattered distribution - Flooding

Int. = intermittent flooding, Seas = seasonal flooding, Imp = imperfect drainage

4. Nutrient Availability

Plant nutrient availability depends on weathering stage, leaching conditions, percent of clay and organic matter content. Low organic matter is characteristic of all ten dendroecological regions in Bangladesh, although it remains in equilibrium with soil texture, climate, elevation and vegetation of a particular region. Generally speaking, there is a high natural fertility. The following proportions are found in agricultural land, for example:

Very Good Land	1.56%
Good Land	34.31%
Moderate Land	39.39%
Poor Land	15.84%
Very Poor Land	8.90%

There are eight categories of problem soils which limit crop production, these being: (1) soils on steep slopes; (2) acid sulphate soils; (3) peats; (4) coarse textured soils; (5) shallow soils; (6) poor drainage; (7) severe fertility limitations; (8) saline soils. Together these constitute about 5 million hectares. Micro nutrient deficiencies - notably sulphur and zinc also limit crop production.

Land capability for trees based on biophysical characteristics alone is therefore rather good and exceeds 3,000,000 ha in the excellent category alone, as noted below. Land suitability, however, requires factoring in social and political acceptability of designating lands for a particular purpose. To date, forestry has been consistently under pressure for conversion for agricultural purposes.

Dendroecological Zones and their Potential

The per capita growing stock in Bangladesh is approximately $0.9m^3$, due more to low yields rather than available forest land. Increasing productivity will have to come from improving existing forests. There has been speculation (from many sources, including MOEF in public pronouncements) that Bangladesh should be under 25% forest cover. This is clearly not possible under the given socioeconomic conditions, and future demand projections and population growth. Furthermore, given existing rates of BFD plantation (not accounting for loss through continued deforestation and encroachment) it would require in excess of 200 years to achieve such an objective.

The general distribution of forests is dependent upon a number of environmental factors which warrant a brief introduction. Figure 1 illustrates the locations of forest areas in Bangladesh. A striking observation is that the area is neither extensive, nor distributed evenly throughout the country. In the southeastern hills (and their extension in northeast Sylhet) the tropical moist evergreen and semi-evergreen forests are located. The once extensive moist deciduous Sal forests of central and northwestern Bangladesh are remnant patches, as are some areas in the piedmont below the Meghalaya plateau of India. Formerly more extensive freshwater swamp forests and reedlands remain in scattered small areas of the northeast. The mangrove forests of the Sundarbans Reserved Forest -managed for more than 100 years- and coastal plain are estuarine floodplain soils. These are tidally flooded soils and can support only a special type of vegetation. However, the anthropogenic (man-made) soils of the coastal region which are above the tidal level can support a wide range of tree species.

Land capability is determined on an ecological basis through biophysical characteristics such as landforms, vegetation, soils, geology, climate, etc. This determination should include both the structure but also the functional processes of the ecosystem represented by the land type, including the impacts of altering the structure or processes under alternative land uses. Such land capability may change through environmental degradation, (or improvement through technical manipulation), and the definition or parameters of what is considered an acceptable consequence by the government of the day.

Land suitability, however, is a measure of the social acceptability or desirability of using land for a particular purpose, and changes with socioeconomic conditions. This would include factors such as profitability, levels of inputs required (infrastructure, services, management etc.) versus expected outputs, location, and conflicts with other land uses. The land use ultimately selected is not necessarily the one with the highest capability rating, but rather might be based on social, economic or political considerations within a range of acceptable consequences.

Rainfall and temperature differences throughout the country, for example, would not exert much influence on growth rates. By aggregating various categories used in the AEZ system, a simplified dendroecological capability classification has been delineated. For instance, the following environmental factors have been analyzed (Richards and Hassan, 1989) : Edaphic factors such as: (i) permeability; (ii) effective soil depth; (iii) available moisture holding capacity; (iv) availability of nutrients; (v) soil reaction and salinity; (vi) drainage conditions and topsoil consistency. Inundations factors (depth and flood hazard) and landform factors (degree of slope) would also be considered. The matching of individual soils to physiographic, hydrological and edaphic factors thereby assigned site capability classes for each soil. This was calculated for 22 horticultural species, 17 fuelwood and 26 industrial tree species, and the areal extent was

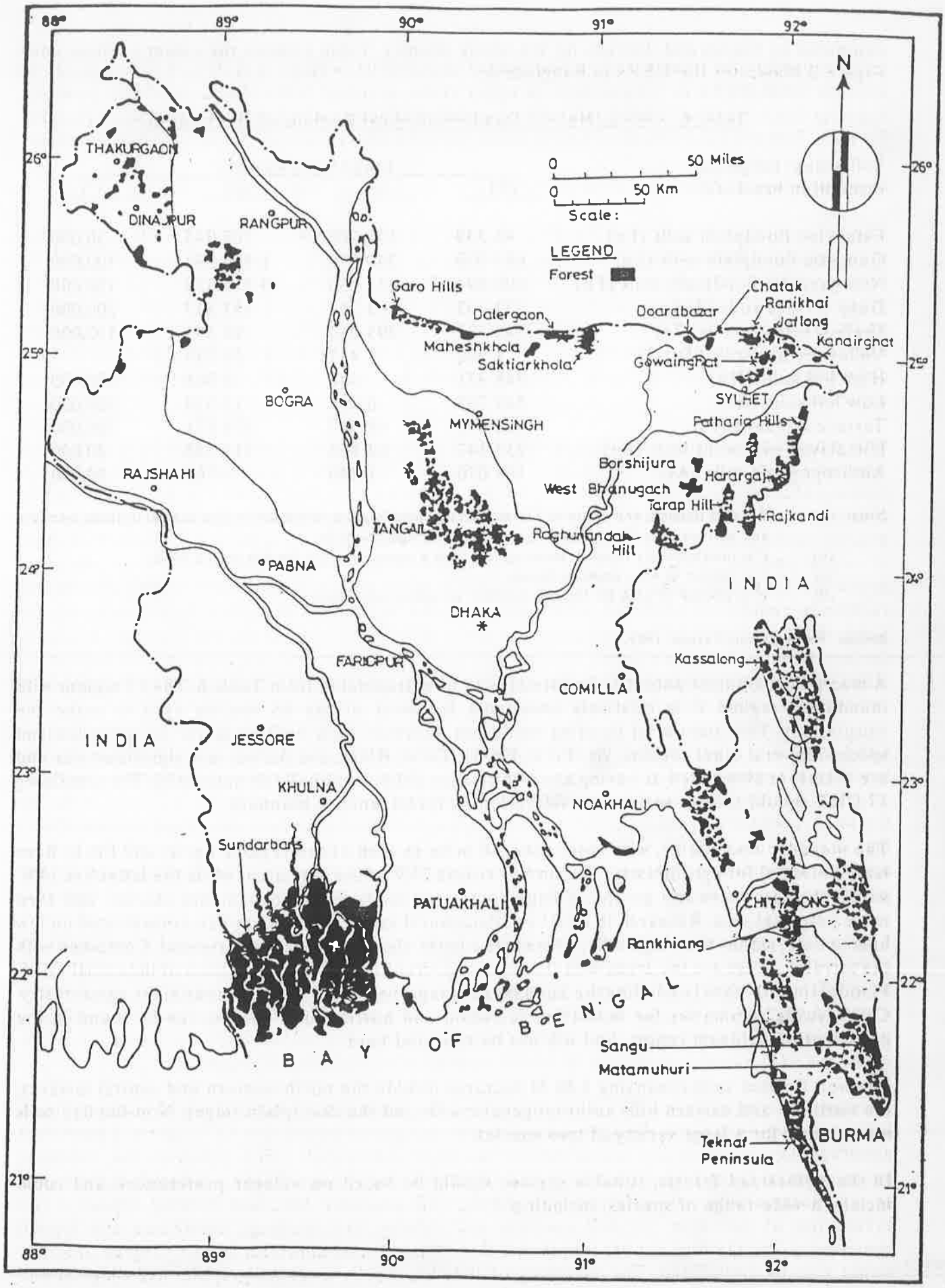


Figure 1 - Generalized Location of Forest Areas

computed by thanas and districts for the whole country. Table 6 shows the extent of these units. Figure 2 illustrates the DEZs in Bangladesh.

Table 6 - Area (Ha) Of Dendroecological Regions of Bangladesh

Soil group/subgroup (symbol in brackets)	Inundation Regime			
	(i^0)	(i^1)	(i^2)	(1^3)
Estaurine floodplain soils (Fe)	43 339	172 200	705 945	30,000
Gangetic floodplain soils (Fg)	657 020	240 370	1 404 593	100,000
Non-gangetic floodplain soils (Fn)	608 694	635 338	3 513 139	120,000
Deep terrace soils (Td)	172 462	92 294	153 817	200,000
Shallow terrace soils (Ts)	540 425	295 019	95 595	100,000
Valley terrace soils (Tv)	4 902	1 447	19 733	-
High hill soils (Hh)	788 921	438	2 366	600,000
Low hill soils (Hl)	549 705	6 497	13 538	500,000
Terrace fan soils (Pf)	158 673	48 547	371 021	200,000
Himalayan piedmont soils (Pp)	233 347	22 865	114 385	20,000
Anthropogenic soils (As)	103 070	1 440	1 768	50,000

Note: (a) i^0 is non-flooded, and occupies 3.86 million ha, including the northwestern and central terraces, northern and eastwer hills, floodplain ridges and anthropogenetic soils.
(b) i^1 is intermittently flooded, meaning less than a metre in depth for less than a week.
(c) i^2 is subject to long seasonal floods.
(d) 1^3 is amount of area for likely suitability, as well as capability.

Source: Richards and Hassan, 1989.

A macro development potential for forestry can be extrapolated from Table 6. The 11 regions with inundation regime i^2 is relatively unsuitable for most of the 65 species used to make the calculations. This amount of flooding would not, however, be a limiting factor for many lowland species. Several other regions, viz. Tv/ic, Hh/il, Tv/il, Hl/il, and As/ol, lack significant size and are therefore eliminated as having any significance either regionally or nationally. The remaining 17 DEZ should receive serious consideration by forest landuse planners.

The meander floodplains, with more than 0.6 m ha in each of the regions Fg/ic, and Fn/ic, have large potential for agroforestry. The former covers 24% of the land area, while the latter has 14%. within the respective soil groups. Village homestead lands and embankments (As/ic) add even more potential area. Research in BFRI on silvicultural aspects of forestry has concentrated on low hills to date, rather than high hills, whereas the latter clearly have larger potential. Combined with the terraces, these are the areas with the most opportunities for the production of industrial wood. Floodplain soils have (excluding the Sundarban mangroves) much better potential for agroforestry. Countrywide summaries for industrial, fuelwood and horticultural species can be found in the participatory subteam report, and will not be repeated here.

The non-flooded soils occupying 3.86 M hectares include the north-western and central terraces, the northern and eastern hills anthropogenetic soils and the floodplain ridges. Non-flooded soils are suitable for a large variety of tree species.

In the homestead forests, suitable species should be based on villager preferences, and could include a wide range of species, including:

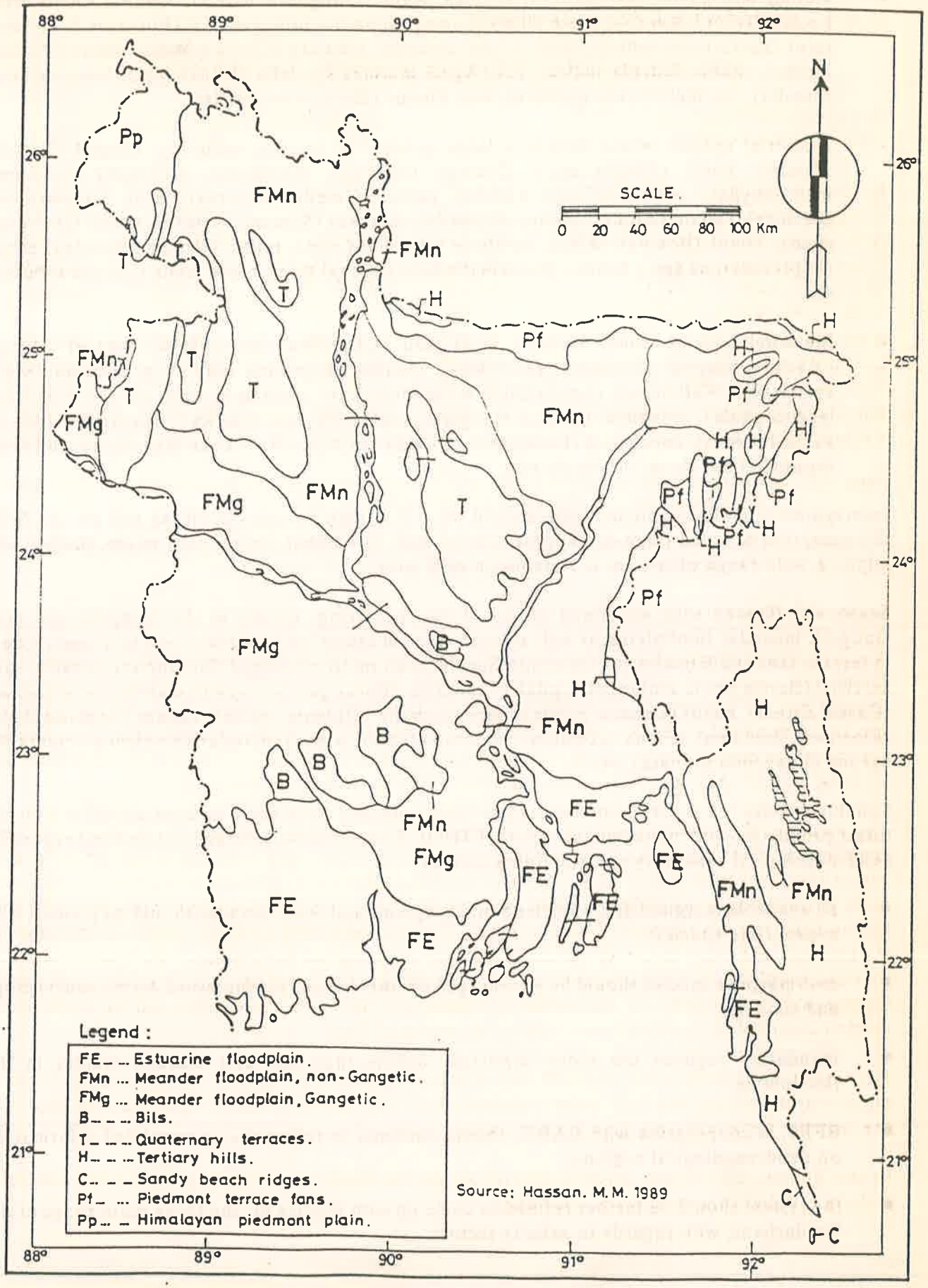


Figure 2 - Dendroecological Zones of Bangladesh

- among well-known horticultural species: Aam (Mangifera indica), kanthal (Artocarpus heterophyllus), jam (Syzygium cumini) amra (Spondias pinnata), Tal (Borassus flabellifen) tetul (Tamarindus indica), litchi (Litchi chinesis), jambura (Citrus grandis), peara (Psidium indica), chalta (Dilenia indica), bel (Agele marmelos), lebu (Citrus spp.), Supari (Areca catechu), Narikel (Cocos nucifera), and Khejur (Phoenix sylvestris).

- industrial species would include a large number of species, including: Shegun (Tectona grandis), koroi (Albizia spp.), Champa (Michelia champaca), mahogany (Swietenia macrophylla), minjiri (Cassia siamea), gamar (Gmelina arborea), jarul (Lagestroemia speciosa), kadam (Anthocephalus chinensis), rain tree (Samanea saman), sissoo (Dalbergia sisso), Simul (Bombax ceiba), bamboos (Bambusa spp), telsur (Hopea odorata), garjan (Dipterocarpus spp,) behera (Terminalis belerica), sal on terrrace lands (Shorea robusta), etc.

- fuelwood species would include: local jhau (Casuarina equisetifolia), khayer (Acacia catechu), bakphul (Sesbania grandiflora), mandar (Erythrina indica), gora-neem (Melia azedarach), Kathbadam (Anacardium occidentalis) etc.; exotics include ipil-ipil (Leucaena leucocephala), mangium (Acacia mangium), babla (Acacia nilotica), akashmoni (Acacia auriculiformis), eucalyptus (Eucalyptus camaldulensis),etc. have been introduced, and some farmers adapt them; others do not.

Intermittently shallowly flooded soils extend for 1.5 million hectares in all the soil groups. With the exception of some flood-susceptible species such as kanthal, neem, gora neem, shegun, and jalpai, a wide range of species is suitable on such soils.

Seasonally flooded soils are found on 6.4 M ha, occurring mainly in the Gangetic and non-Gangetic meander floodplains, as well as large areas in estaurine floodplain, and to a lesser extent in terrace fans and Himalayan piedmonts. Species tolerant to prolonged flooding are suitable, such as: Hijal (Barringtonia acutangula), pitali (Trewia nudiflora), gab (Diospyros embryopteris), sonalu (Cassia fistula), bhadi (Lannea coromandelica), chalta (Dillenia indica), kadam (Anthocephalus chinensis), jogdumur (Fious racemosa), sheora (Streblus asper), mandar (Erythrina orientalis), kerong (Pongamia pinnata), etc.

Suitable species for government forests are numerous, and have been covered extensively in the forest production and management report (FMPb). Some observations and conclusions regarding dendroecological capability and suitability include:

- all available marginal and wasteland in floodplains and level terraces should be planted with appropriate species;

- multipurpose species should be encouraged on homesteads for fuelwood, horticultural crops and timber;

- inundation regimes are more important factors than soil and climatic factors in the floodplains;

- BFRI, in cooperation with BARC, should continue to refine the accumulated information on dendroecological regions;

- the system should be further refined to come up with species for the three main zones of the Sundarbans, with regards to salinity factors;

- the system should also calculate and identify those areas where steep slopes, i.e., more than 40 degrees would mitigate against planting of deciduous species, clearcutting for either harvesting or site preparation in plantation establishment, etc.

Soil Conservation and Watershed Management

1. Soil Conservation

Land degradation is a major concern in the forest areas of Bangladesh. It results in poor water quality, reduces land productivity, and erodes soils. If the process of degradation continues for long enough, the results can be difficult to mitigate or reverse. Such land degradation through erosion varies with flooding depth, topography and slope of land, and the amount and type of vegetative cover, particularly during peak seasonal monsoon rainfall.

Seventy percent of the fourteen million hectares of arable land in Bangladesh is plain. The major monsoon crop is rice. This is grown in flooded fields by ponding of rain water, and in winter, by irrigation. There is negligible runoff from this activity, since percolation is reduced during the dry season through the ponding and there is surface groundwater on the lowlands throughout the wet season. Neither is there much loss of soil or nutrients from leaching under the rice cultivation techniques used here in the plains. Any loss of topsoil due to intense rain has usually been replaced later in the season by new and fertile sediments.

River erosion is a very serious hazard in Bangladesh, since in the alluvial deposits, silts and sandy clays predominate. These rivers cover some 3.4 million ha. The constant shifting of the braided channels, both creates and submerges shoals, and destroys riverbanks, physical infrastructure, and human settlements both inland and in the southern coastal area. For example, the island of Sandwip has shrunk from more than 1000 square km in 1780 to less than 240 square km in 1984. Chandpur town on the Meghna and Sirajganj on the Jamuna are constantly under threat from river erosion. There is erosion in 150 Thanas of 50 Districts which affect about one million persons annually. They are de facto environmental refugees. River erosion is also a contributory cause to landlessness and migration to cities, to seek employment opportunities after lands and homesteads are washed away. However, this is a subject area in itself and is being dealt with under the Flood Action Plan, which is under the responsibility of various ministries other than MOEF. However, DOE has been monitoring the environmental impact assessments under FAP 16, and therefore has a responsibility to ensure the schemes are properly screened prior to the feasibility stage.

The situation is different in the northern and eastern hills. These are covered by some remnant forests remaining from the once extensive and lush tropical moist forests. They are also typified by large areas of degraded forest, with small and open canopies, as well as scattered trees and brush and thickets. Lastly, there could be a cover of weeds and savannahs. Erosion in the hills is very high on steep slopes and particularly on land used for cultivation. Erosion on the hills and in floodplains is minimal during the winter season.

The principle factors in land degradation are (Hassan, 1991):

- sheet erosion in floodplains and terraces;
- gully erosion and landslides on sloping hills and erosion of banks by meandering rivers;
- loss of nutrients from the soil through removal of trees or agricultural crops;
- leaching of nutrients and improper management practices;

- improper application of agrochemicals and fertilizers;
- crusting, compaction, plough pan formation;
- salinization caused by tidal inundation, and waterlogging through poor groundwater irrigation management; etc.

Biological degradation results from changes in soil environment due to mineralization of humus caused by other degradation processes. Tertiary terraces occurring in central and northwest Bangladesh show three major landtypes (1) shallowly weathered, level compact clays (2) shallowly weathered closely dissected low chalas and (3) deeply weathered, level or broadly dissected strongly structured medium to fine textured chalas. Shallow terraces exhibit little erosion, while the chalas show little to moderate ersosion. The highly permeable dissected terraces with high fluctuations in water tables create conditions which easily leach nitrates and potash.

The tertiary hills, on the other hand, have very complex slope and drainage patterns. The hilly land is therefore subjected to sheet, rill and gully erosion. Under forest cover, or some other ground cover, the erosion hazard is less, but the hills are generally subject to tremendous erosion where the natural vegetation has been disturbed or removed. Heavy erosion is easily observed at government-managed rubber estates, clear-felled reserve forests, pine apple plantations, areas subjected to shifting cultivation, resettlement areas, numerous teak plantaions and road construction sites. In some locations the topsoil has been completely eliminated through sheet, rill and gully erosion.

Due to the complex geomorphology, it is difficult to precisely identify the areas with highest erosion, and few such studies have been done. The Soil Conservation and Management Centre of BARI at Ramgarh as well as BFRI have performed some limited studies. For example, on slopes less than 10% soil erosion was about 50 tons/ha/annum by BFRI. Slopes between 20% - 30% lost between 100-200 t/ha/an, whereas at 40%, the loss was as high as 300 tons. By contrast, cultivated land combining corn or rice together with mung bean lost sediments of about 70 tons/ha/an. For grassland, the difference is more dramatic, with sediment loss of about 2 tons/ha/an (Hassan, 1991). Jhum cultivation on 5% slopes lost 92 tons/ha/an, and 184 tons for 10% slopes. Pineapple cultivation in Sylhet District (noticed by the FMP in the field to be often planted down the slopes rather than contoured, as they should be) incurred soil loss of 247 tons/ha/an (Khan, L.R., 1991), and from a a recent study in 1990 it was found that in a newly clearfelled area in Cox's Bazar soil losses over a one year period occurred in the amounts of 256 and 102 tons/ha/an in the gully and replanted areas of teak, respectively.

Some guidelines were suggested by a Soil Conservation Task Force in 1982, but a more conservative estimate was made by BARI:

Percent of slope	Recommended landuses
2 - 12	Any winter (rabi) crop or soil covering wet (kharif) crop
13 - 20	Orchards, rubber or tea with or without terracing
21 - 30	Rubber with terracing/improved forestry
> 30	Natural or planted forests

These findings were more conservative than the task force recommendations, which implied slopes of 30-50 percent could be used for orchards, tea gardens, and plantations. For the purpose of the FMP, it is considered that a figure of 40 percent slope should be used for forestry purposes only.

Soil conservation measures taken to date have included: (1) embankments on the floodplains; (2) resettlement projects through the Hill Tracts Development Board (HTDB); (3) afforestation of unclassed state forests; (4) agroforestry; (5) strip and roadside plantations to a limited extent. None of these has had much impact to date, and the existing forest management system of clearfelling followed by burning and replanting exacerbates soil erosion tremendously.

The following factors are involved in determining a soil conservation strategy: (a) pressure on the land from increased number of people and livestock on marginal and steep lands; (b) government policies and political will and sufficient resource (institutional and financial) allocation; (c) landuse based on productivity and sustainability; (d) education and legislation (availability of extension services); (e) an imlementation or coordinating mechanism (there is some capacity at BFRI, SRDI, and IFCU, and BARD, but none of these has a national mandate).

Recommendations for soil conservation are that:

- research on the relationship between existing clearfelling/ artificial regeneration operations and soil erosion be initiated, as well as comparison to polycyclic management systems such as selection felling; research on underplanting, interplanting, fodder, legumes impact on soil erosion within different soil and forest types;

- rubber plantations, tea gardens and other horticultural enterprises should take appropriate measures to minimize erosion;

- the measures be biological rather than mechanical/ engineering approaches,;

- full participation and local community involvement in planning, implementation and design of soil conservation measures;

- soil conservation and watershed management together form one of the units and responsibilities of the proposed Environment Wing under Forestry III, and that sufficient personnel are staffed and trained within this unit;

- BFRI take the lead role in coordinating the research, designating appropriate management measures, and training activities for soil conservation in gazetted forest areas; the proposed Extension Wing of BFD will implement and replicate the techniques, with villager participation.

2. Watershed Management

As noted above, river erosion and watershed management issues extend much beyond the FMP, and are the subject of a national water master plan, and a Flood Action Plan. The issues are also of bilateral concern between Bangladesh and India. Lastly, they are of regional significance insofar as longterm macro management of integrated watershed basins is concerned. It is commonly accepted that 90% of the total water passing through Bangladesh originates outside the country. The existing emphasis nationally on the floodplains has been essential due to the scale of the problems, and also the potential of increasing winter rice yields through irrigation. However, watershed management outside the context of flood control or irrigation has been practically non-existent in the country.

In Bangladesh, the upland watersheds are almost insignificant compared with the scope of controlling, managing, and adapting to the awesome flow of the Ganges, Brahmaputra, and Meghna. However, even the schemes addressing such issues have impacts on the forest sector. For example, they affect reduced seasonal winter flows to the Sundarbans and increase salinity. The increased seasonal monsoon flows of the Ganges from Farakka leads to excessive flooding

(and loss of vegetation lining riverbanks). Waterlogging as a result of improper FCDI schemes is sometimes induced, thereby killing vegetation. Many projects have had an effect on reduction of wetlands, and the associated ecological, social, and economic impacts, etc.

It is well known that watersheds have an important value for soil and water conservation. The land value for conservation may be higher than for agriculture, industry, or timber extraction. A watershed value can be fluctuate from low , moderate, high, to critical. In order to weigh various factors, the following formula can be applied:

Table 7 - Calculation of preliminary watershed value indices.

Soil Condition	Weight	Water Value	Weight
1. erosion hazard		1. annual precipitation	
a. slope 60% +	10	a. 2,500 mm +	8
b. slope 45-60% and clayey texture	10	b. 2,000-2,499 mm	8
c. slope 45-60% and fine loamy texture, or shallow	3	2. downstream storage	
d. slope less than 45% but frequent soil movement	6	a. existing reservoir	10
2. unsuited to continuous non-forest cropping	5	b. planned reservoir	5
3. neither 1 or 2	1	c. important aquifer	4
	Sum = SC	3. neither 1 or 2	1
			Sum = WV

SX x WV = Watershed Value Index

Critical	= 100 +
High	= 70 - 90
Moderate	= 35 - 69
Low	= Less than 35

Unfortunately, the detailed level information and mapping is not available to make watershed value index calculations for the purpose of the FMP. The highly dissected nature of the hills would make this a difficult task. However, it is clear that with the high rainfall, steep slopes, and shallow soils, a number of areas within the Chittagong Hill Tracts would fall within the high and critical categories. In Bangladesh, upland or watershed erosion, occurs primarily in the south-eastern hill basins. A study in the early 1960s (Forestal 1961) concluded that 77% of the land in Kassalong and Rankhiang, for instance, would be suited to forestry as the only and best landuse. In the unclassed state forests of the CHT, there has been very little forest cover for many years. Such conditions constituted 85% of the CHT outside the Reserved Forests (Forestal, 1966b and Forestal , 1966c) and would actually not be as susceptible to erosion as jhum or land dedicated to other use. To a lesser extent watershed management is needed in the quaternary terraces as well.

Rivers in this region generally originate in the hill ranges of Tripura and Assam in India. The Karnafuli is the largest of these rivers. Other important rivers, whose headwaters lie within Bangladesh are the Sangu, Matamuhuri, Rainkhiang, and Maini. Activities that have caused upland erosion in Bangladesh are briefly outlined below:

torrential rains during the monsoon season, causing flash floods and erosion along the Muhuri River Feni (Noakhali), the Rainkhiang River near Rangamati and the Dalu river near Satkhania town (Chittagong) are among the most prominent;

- deforestation increases susceptibility to erosion processes; in the upper watershed areas of the Hill tract districts, drainage areas as small as 1 sq. km even produce surface runoff which increases erosion and sedimentation in rivers, even where bamboo was the dominant cover;

- shifting cultivation, a good landuse under conditions of long rotations, adequate land, reasonably decent soils, and small population, only about 10-15 percent of the land might have been cultivated at any given time; reduction of fallow periods in this bush fallow farming system has depleted organic matter, and contributed to soil erosion and long term productivity;

- agricultural practices such cultivation following slopes rather than contouring, contribute to accelerated erosion and soil loss;

- Roads, and other transportation (tracks and trails of logging sites, for example) constitute other sources of soil erosion in the Hill Tracts; as does quarrying of stones and sand;

- the construction of the Kaptai water reservoir in 1961 already displaced about 106,000 people from the Rangmati area, and forced them onto marginally cultivable land, and upper hilly areas, where their activities also contributed to silting up of the reservoir to some extent. It is not known to what extent siltation has occurred, as GOB authorities are inclined to keep such information difficult to access;

- reservoir sedimentation control through agronomic soil conservation techniques, vegetal cover, contouring, or mechanical structures have been largely absent;

The reservoir was formed by the damming of the Karnafuli river at Kaptai. The lake thus formed varies in depth by about 30 feet between seasons. The total drainage area of the reservoir approximates 110,000 ha which has been reported to supply an average annual erosion rate of about 2.54 mm (1/10 inch). Sediments deposit surveys at the mouth of 5 major tributaries flowing into the reservoir have been made annually. The approximate annual sediment yield of the reservoir may be about 7,700 ha/feet. Apart from frequent "load shedding" i.e., power shortages, the levels have an effect on navigation. The reservoir longevity and capacity is outlasting its designed performance standards, and does not appear to be critical at the present time. The surface area of the lake was 836 square km in 1977, and had by 1984 dropped to less than 700 square km.

Roads on forest lands present a considerable erosion problem when forest land is usually steep and the rainfall is heavy. The roads are not used much and so expensive roads with careful construction are not difficult to justify, in some viewpoints. Road use during harvesting operations can be very damaging. If they are constructed at the time of planting, there is a high start up cost. On the other hand to delay the construction until extraction starts, means inadequate access for purposes such as thinning and fire protection. Unsused roads will be a constant erosion problem if they are abandoned, with the near certainty of continuing deterioration until they become gullies. Simple and inexpensive control measures can prevent this, through regular placement of drains and cross bunds (slighly raised and terraced roads).

Management practices required to minimize erosion are: foundation of mechanical protection works followed by maintainance of a protective vegetative cover. Problems arise primarily during harvesting when both the cover and the harvest are removed, causing erosion. From the conservation point of view selective felling is much less damaging and so preferable where possible. Clear felling is a necessity with some species, or may be more economic, but tree cover will be entirely removed and the surface cover largely destroyed. It is debatable whether log hauling is better concentrated on a few routes known to be damaged badly or whether to spread the routes and incur lower soil disturbance over the whole area. Steep hillsides such as in the Hill

Tracts are likely to continue to erode for years subsequently, with snig tracks and roads turning to gullies, and irreparable damage.

Vegetation (particularly closed canopy forests) is a factor in watershed management. It acts as a barrier between rainfall and stream channels, and the leaves, branches, and trunks intercept and absorb water. Ground cover and undergrowth also perform this function. Forest litter accumulates fallen biomass materials also. Lastly, the soil itself is another buffer source between rainfall and erosion of forest soils. Generally speaking, a well-established , healthy, multi-layered forest has a beneficial effect on the hydrologic situation of watersheds. The role of forest management on the water-yield possibilities has been much debated, but conclusions have not been established with scientific precision. Various watershed models require streamflow simulations, and it cannot be conclusively established that forests automatically improve water yield. In some cases, the opposite effect has been achieved.

The protective and regulative function depends on forest types, structure, physiological conditions, and age. The function decreases with decreasing stocking density, and with decreased density through factors such as logging, thinning, and grazing. Pests and fires (often used deliberately by those who graze animals, and in the case of sungrass, to perpetuate certain economic crops) are also factors which reduce these protective functions. Watershed management is optimum through maintenance of healthy, well-stocked forests comprised of multi-layered and diverse species. These provide direct benefits in addition to biological diversity for animal habitats, maintaining a gene pool, and providing areas for scientific study and forest research under natural conditions. Lastly, the aesthetics of landscapes for recreation and ecotourism within protected areas are a positive function of good management of watersheds.

These benefits are altered with conversion of forests from tropical moist evergreen to deciduous hardwoods or conifers, and vice versa. Also replacing shallow-rooted with deep-rooted species changes the watershed benefits. Replacing species with well-defined characteristics related to coppicing, or nitrogen-fixing ability, or flood tolerance with species which cannot perform these functions, for example would be undesirable.

The undisturbed, closed forest is undeniably the optimal situation in watershed management. Felling systems can be planned to minimize damage to undergrowth, naturally regenerating young saplings, and unintended felling of so-called non-commercial species. Studies in Costa Rica have shown that non-commercial species sometimes have greater value left in situ than the commercial ones. Special care has to be taken in felling along stream courses and a protective strip of at least 50 metres should be left uncut. Such guidelines are provided later in the text.

Although there are no statistics on the impact of poor watershed management in the country, there is considerable implied economic loss from :

- increased costs for maintenance and repair of roads, water supply systems, irrigation canals, etc.;
- increased cost for dredging of ports and navigation waterways;
- loss of productivity through silting up of reservoirs;
- economic loss through imports of agricultural commodities or forest products which have decreased due to degraded land;
- reduction of groundwater, resulting in health problems;
- loss of life and physical infrastructure due to excess flooding, and consequent cost of preventive measures, etc.

Watershed management needs to be more integrative, not only within the responsibilities of foresters and soil conservationists. Social scientists, researchers, agriculturalists, and engineers all need to be brought together to understand the implication of planning and developing fully

integrated watershed basin schemes. The Master Plan Organization produced highly detailed (173 separate catchments) categories which resulted in 67 planning units. Unfortunately, but necessarily, for flood control purposes the concentration was in the floodplain areas and terraces. Relatively little data is available for planning watershed management projects in the tertiary hills. There is no specifically-defined organization or structure for watershed management within Bangladesh. Some action priorities for watershed management consist of:

- research into: (i) the relationship between shifting cultivation and sediment loads; (ii) the erosion resulting from existing clear felling management practices in various forest types; (iii) effects of resettlement schemes on watershed values; (iv) measuring erosion in the CHT for those areas characterized as "open scrub"; (v) quantification of watershed values through environmental accounting studies should be initiated;

- designation of major watershed basins within which an integrated watershed scheme can be undertaken; the most likely candidate for this would be the Sangu- Matamuhuri watershed basin; this area will also no doubt come under pressure for hydroelectric development at some future date; stringent EIA and benefit-cost studies would be necessary;

- designation of specific areas where pilot schemes for community-based watershed management can be undertaken on a priority basis;

- creation of a watershed conservation unit within the BFD's Environmental Wing; this unit would be combined with the soil conservation unit to form a functional cell, appropriately staffed, equipped, and funded;

- the participatory forestry and extension wing would work closely with this new unit, since all watershed projects should involve local communities in all stages of the design, planning, implementation, and evaluation of the projects;

- the projects would preferentially focus on biological techniques (forestry-oriented, with opportunities for villagers to benefit from NWFP, legumes and grasses, fodder, horticultural and multipurpose species) with structural and engineering techniques as supplementary mechanisms where needed (step and strip contour terraces would be more appropriate than full bench, or embanked, terraces).

- staffing arrangements within DOE should also have internal capacity to monitor soil conservation and watershed development projects; some capacity within MOEF would also be necessary;

- areas with degraded watersheds with priority for implementation of pilot projects would include (GOB, 1991b): The Madhupur Tract, the Garo Hills Piedmont, the West Barind Tract, Banshkhali to Harbang, and the Mirsarai-Sitakunda range in Cittagong District.

MAJOR FOREST ECOSYSTEMS

Forest Types of Bangladesh

No thorough or generally accepted description of the forested ecosystems of Bangladesh exists. A number of authors have described a variety of simple geographical or biophysical units (Champion et al, 1965; Das, 1990; Zabala, 1990). Most authors refer to three or four simple forest types in the country. None of these is suitable for an assessment of the extent to which natural ecosystems and habitats are protected in the existing network of protected areas.

Six broad forest types are described below. Within some of these broad forest types, a number of subtypes are described. Both the broad types and subtypes are an amalgamation of units described in the references cited above. Since there is no standard ecological classification system for Bangladesh, not all of the subtype units are directly comparable.

1. Tidal

The mangrove forest ecosystems originally covered a vast area of coastal Bangladesh. They extended from the Indian border in the west to the Chokoria Sundarbans, south of Chittagong and included the mangrove forests on the delta of the Naaf River at the extreme southeast corner of the country. Before the turn of the century most of the northern part of the Sundarbans were cleared. Recently virtually all of the mangrove forest in the vicinity of Chittagong, Chokoria and the Naaf River has been cleared for shrimp farming, salt production and agriculture.

This coastal forest type is now restricted to approximately 577,000 ha (of which 182,000 ha is water) in the Sundarbans on the Ganges River Delta. Although greatly reduced from their former extent, the present day Bangladesh Sundarbans are part of the largest remaining expanse of mangrove forest in the world. They account for at least half of the remaining area of natural forest in Bangladesh.

Three forest zones, or subtypes, are recognized in the Sundarbans tidal mangrove forests (Das and Siddiqui, 1985; Chaffey et al, 1985). Sundri (Heritera fomes) is the characteristic species of the freshwater tidal forest type; gewa (Excoecaria agallocha) of the moderately saline type; and goran (Ceriops decandra) of the saltwater zone. One early successional forest type along the newly accreted char lands is also recognized. These are described below and mapped in Figure 3.

a. Freshwater

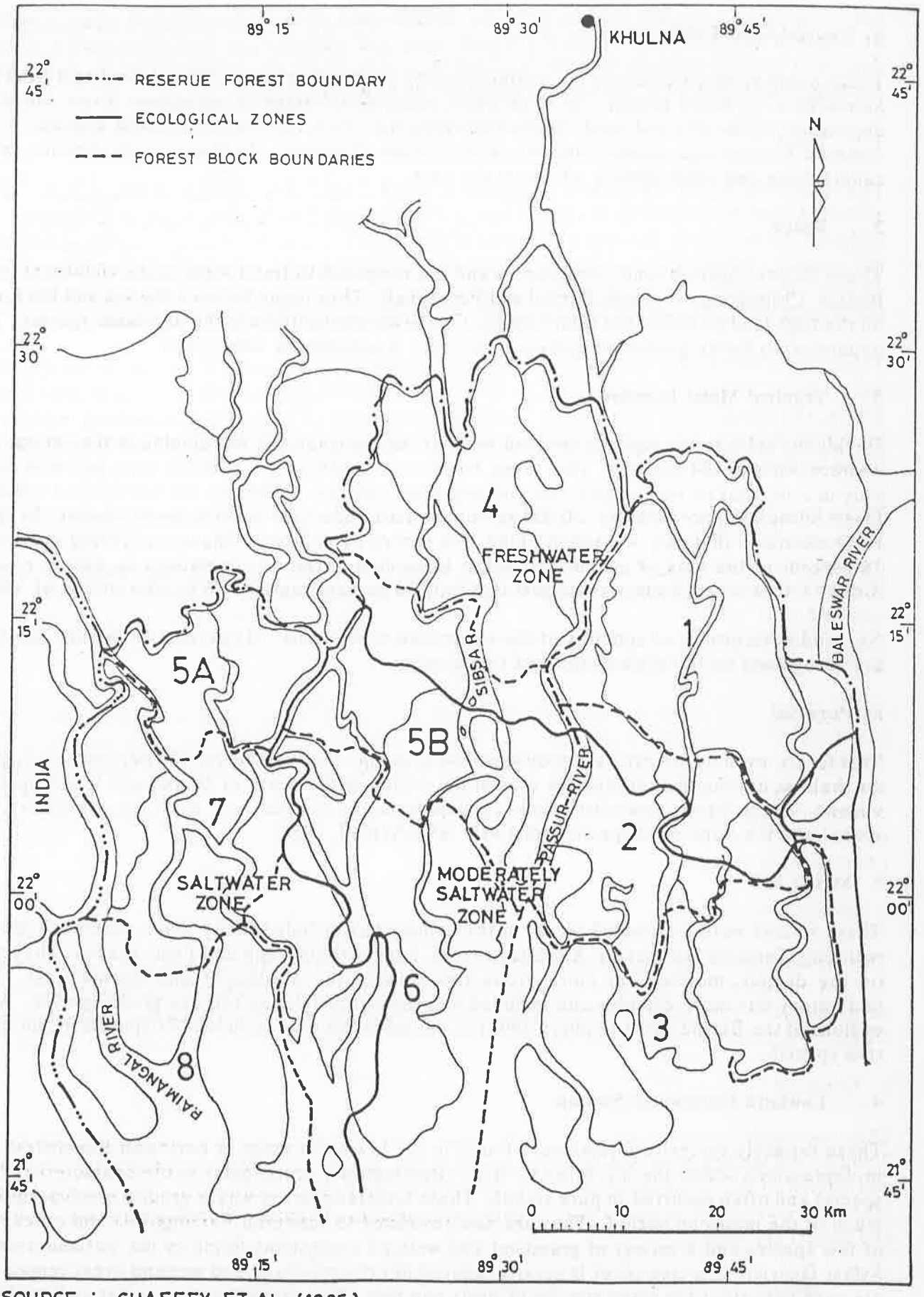
This type is found in the northeast corner of the Sundarbans and includes blocks 1 and 4. This area receives an inundation of from India and the soil gets a good coating of silt each year. The dominant species is sundri with a variable component of gewa. Golpatta (Nypa fruticans) is common on the banks of channels and creeks. This type includes a number of species not commonly found in the other zones. These include baen (Avicennia species), passur (Xylocarpus moluccensis), kakra (Brugiera conjugata), singra (Cymometra ramiflora), and tiger fern (Acrostichum aureum).

b. Moderately Saline

This type occurs in the central and southeastern portions of the Sundarbans and includes blocks 2, 3, 5A and part of 6. The forest canopy is predominantly gewa and sundri growing over a fairly dense jungle of goran and other species. The canopy is generally lower than the freshwater type. Golpatta is plentiful along river banks.

c. Saltwater

This type occurs in the southern and western portions of the Sundarbans and includes blocks 5B, 7 and 8. As salinity increases in this zone where the freshwater influence is the least, the height and quality of the forest decreases. The forest is a widely dispersed overstory of short gewa and other species over dense understory of goran with patches of hantal (Phoenix paludosa). Golpatta and sundri are scarce.



SOURCE : CHAFFEY ET. AL. (1985)

Figure 3 - Tidal Forest Subtypes

d. Coastal Char Lands

These newly accreted lands are not confined to any geographical area. They extend east from the Sundarbans to Cox's Bazaar. It is an early successional stage of mangrove forest following deposition of the silts and sands washed down by the rivers. Keora (Sonneratia apetala) is the common pioneer tree species following a succession of grasses. As these stands decline, gewa, sundri, baen and other species take over the sites.

2. Beach

These forests occur on sandy sea beaches and are restricted to small areas in the vicinity of Cox's Bazaar, Chittagong, Noakhali, Barisal and Patuakhali. They occur between the sea and the forest on the high land or adjoin the tidal forests. Casuarina equisetifolia is the dominant species. The understory is hardy grasses and plants sometimes in association with cactus.

3. Tropical Moist Deciduous

Deciduous sal forests originally covered most of the lowlands and floodplains in the central and western parts of the country. This forest has been dramatically reduced in area and now exists only in a number of widely scattered and degraded patches. Officially, the sal (Shorea robusta) forest occupies approximately 120,000 ha but the area under tree cover is much smaller. In 1985, FAO estimated that only 36 percent of the area remained as forest. Ghani et al (1990) shows that 18 percent of the area of notified sal forest is wooded, including plantations as well as natural forest. Other recent estimates suggest that only 10 percent remains (Winterbottom et al, 1989).

No good descriptions of subunits of the natural sal forest exist. However, two distinct subtypes are recognized on the basis of soil and tree canopy.

a. Pure Sal

This forest, even under natural conditions, had a canopy that was nearly 100 percent sal. It grew on shallow, dry and less productive soils in the region to the north of Dhaka and was frequently burned. These forests now exist only in coppice form and are pure sal. Even the understory, was sparse and the number of species, relatively few (Ahmad, 1938).

b. Mixed Sal

These forests were dominated by sal in the canopy but included many other associated species including Terminalia bellerica, Albizzia procera, Lagerstroemia spp and Ficus species They grew on the deeper, moister and more productive soils of the Madhupur and Barind tract. The understory was more complex and included a variety of deciduous and evergreen species. A list of flora of the Barind Tract (Zuberi, 1992) in the sal forest type includes 271 species including 41 tree species.

4. Lowland Freshwater Swamp

These formerly extensive forests were found in the low basin areas in northeast Bangladesh and in depressions within the hill forests. Hijal (Barringtonia acutangula) is the characteristic tree species and often occurred in pure stands. These forests occurred where ground is submerged for much of the monsoon period. They are now restricted to scattered Barringtonia and other trees of few species and a variety of grassland and wetland ecosystems found in the wetland areas of Sylhet District. The tree cover is greatly reduced but the grassland and wetland areas remain and are very important for many species of birds and fish. The characteristic grasses and reeds are nal (Phragmites karka) which predominates near water, ekhra (Erianthus revenea), and khagra (Saccharum spontaneum).

Alam et al (1990) report that a small patch of freshwater swamp forest remains in Sunamganj district. Scott and Rashid (in prep.) report a small patch of natural swamp forest remaining at Pasua Haor in Gurmar Beel.

5. Hill Forests

The hill forests consist of moist tropical evergreen and semievergreen forests which extended from the Teknaf Peninsula, north along the Myanmar border to the Chittagong Hills and Hill Tracts and the low hills in Sylhet District. Over 100 evergreen and deciduous species have been identified and there is no uniform or clearly defined forest type over a large area. Ecologically the hill forest is a transition between the Indian subcontinent Floristic Region and the Indo China Floristic Region. It possesses many of the characteristics of the Burmese forest (minus the indigenous teak of Myanmar) and the forest of the eastern Himalayas (minus the sal).

The forests are generally unevenaged and multistoried. Single species stands do not occur and the occurrence of a given species is often limited to a few trees per hectare. Pure stands of a single species do not occur naturally. The appearance is of an evergreen forest. The majority of the smaller understory trees are evergreen but most of the largest dominant and emergent trees are deciduous.

Six general subtypes have been defined (de Milde et al, 1985; Choudhury, 1990b). Only five are included here as one, the savanna subtype, occupies open areas following major disturbance. It is dominated by thick sungrass (Imperata species) covered with occasional widely scattered trees and is not considered a natural forest ecosystem.

a. Tropical Wet Evergreen

This subtype occurs in deep valleys with abundant moisture and favours shaded northerly slopes. Common dominant tree species reaching a height of 30 m are chapalish (Artocarpus chaplasha), chundal (Tetrameles nudiflora) and narikeli (Pterygota alata). The understory is a tangle of shrubs, creepers, climbers, ferns and orchids.

b. Tropical Mixed Evergreen

This tall multistoried forest occurs on hilly and undulating ground and on alluvial flats. The emergent trees are mainly deciduous and reach a height of 60-65 m. Principal species are garjan (Dipterocarpus species), civit (Swintonia floribunda), chundal and narikeli. There are also middle and lower story tree species and a diverse understory.

c. Tropical Moist Deciduous

This subtype occurs on the edge of rivers and in low lying areas. Trees interspersed with large open patches of grasses, reeds and bananas. The principal tree species are deciduous with the most important being kadam (Anthocephalus chinensis) pitali (Trewia nudiflora) and bandarhola (Duabanga grandiflora).

d. Tropical Open Deciduous

This subtype occurs on dry exposed slopes with a southern aspect. Large trees occur as scattered individuals. Principal species are koroi (Albizzia species) pitali, bandarhola and champa (Michelia champaca). The understory is a dense undergrowth of stunted evergreen tree species and Assam lota (Eupatorium odoratum) which forms an impenetrable tangle of stems.

e. Bamboo

Bamboo is found in abundance throughout several of the Forest Reserves in the Chittagong Hill Tracts and in Sylhet Division. It occurs in single or mixed species bamboo forests. Eight species are indigenous. Muli (Melocanna baccifera) is the predominant species and occurs as pure stands or in association with other species of bamboo over extensive areas. Muli prefers well drained sites while the other species prefer shaded moist sites. Bamboos also occur as an understory species in many of the other forest types.

6. Village Forests

These forests consist of mixed fruit, fuelwood, shade and other multipurpose trees and bamboos in homesteads and villages throughout Bangladesh. At least 149 species of native and introduced trees have been identified in the village forests. They now occupy approximately 270,000 ha and are likely to increase in area as population grows and natural forest continues to disappear. Although not a natural forest type in Bangladesh, village forests will become increasingly important habitat for flora and fauna in future.

SIGNIFICANT NONFOREST ECOSYSTEMS AND CRITICAL HABITATS

Freshwater Wetlands

Although the freshwater swamp forests described above have nearly disappeared from the country, a vast area of freshwater wetlands remains. The wetlands include lakes, the Ganges-Brahmaputra floodplain, river estuaries and at least 47 major haors and 6,300 beels. They occupy about half the land area of the country in the monsoon season.

These freshwater wetlands support a wide variety of species of fauna and flora, both terrestrial and aquatic. An excellent summary and comprehensive site information for 17 important freshwater wetland sites is provided by Akonda et al (1989) in the Directory of Asian Wetlands (Scott, 1989).

Of particular biological significance is the Haor Basin of Sylhet and eastern Mymensingh. This area is described as "a wetland ecosystem of outstanding international significance" on the basis of criteria established by the Convention on Wetlands of International Importance Especially as Waterfowl Habitats (known as the Ramsar Convention) (Akonda et al, 1989). These wetlands provide habitat for about 125 species of resident and migratory waterbirds as well as a diversity of aquatic and terrestrial plants, aquatic invertebrates, fish, mammals, amphibians and reptiles. In the winter they support 100,000-150,000 ducks and provide refuge for many species rare elsewhere in the country (Akonda et al, 1989; Scott and Rashid, in prep).

The wetlands have been greatly altered by conversion to agriculture, and flood control and are heavily utilized by fishermen. Although all forms of hunting is illegal in Bangladesh, hunting of birds on the wetlands for sport, subsistence and for sale is widespread. Fertilizer and pesticide use in surrounding agricultural lands and tea estates has an unknown impact.

The Haor Basin wetlands are of international significance and are presently subject to intense pressure from habitat change, resource exploitation and human disturbance. Entire ecosystems within them have disappeared and many of the original species of mammals and birds no longer occur in the country. But wetlands are also extremely resilient and regenerate quickly. They remain biologically productive and are amenable to management to reduce environmental impacts and disturbance and to restore original vegetation. At present, no freshwater wetlands are protected and there is no management for wildlife or waterfowl. Excellent opportunities still exist

and they are considered as among the highest priority wetlands for protection in Asia (Scott and Poole, 1989).

Bangladesh signed the Ramsar Convention in 1992 and is a party to the Action Plan for the Conservation of Wetlands in South and West Asia, known as the 1991 Karachi Declaration. This Declaration places a high priority on ensuring that wetland conservation issues are adequately covered in the Forestry Master Plan. Recommendations to establish Wildlife Sanctuaries for the protection of critically important habitats are provided in a later section.

Coastal Char Lands

The coastal area of Bangladesh west of the Sundarbans from the Haringhata River to Sandwip Island is characterized by rapidly accreting sand and mudflats and low lying offshore islands in the mouth of the Ganges River.

The significance of the rich intertidal mudflats as an extremely important wintering areas for migratory waterfowl, particularly shorebirds, has only recently been recognized. The area may constitute one of the most important such areas in South Asia (Asian Wetland Bureau et al, 1991).

Surveys in 1988 (Rashid, 1989) and 1991 (AWB et al, 1991) have counted over 100,000 birds of 61 species. The Ganges River dolphin and a variety of reptiles, amphibians and small land mammals are reported to be common (Akonda et al, 1989).

The area is of international significance because at least three globally threatened species use the area in significant numbers. Rashid (1989) discovered 300 Nordmann's Greenshank (Tringa gutiffer), on mudflats near Jiryiradwip. This number accounts for an estimated 30 percent of the world population of the species. Following that discovery, Bakwell and Howes (1989) found 257 of the very rare and globally threatened Spoonbilled Sandpipers (Eurynorhynchus pygmaeus) the largest concentration of that species ever found away from its breeding ground. The Asian Dowitcher (Limnodromus semipalmatus) was also found and large numbers of several species, including Indian Skimmer (Rynchops albicollis) considered threatened in Bangladesh were located.

There is a large human population settled on many of the char lands, particularly around Hatiya Island. Some disturbance to birds occurs from fishing, grazing and hunting but this is not felt to be significant (Akonda et al, 1989). Afforestation programs has been carried out on many of the coastal chars and have been highly successful. There is no evidence that they have had an adverse impact on birds and have probably benefitted many species of reptiles, fish and mammals.

Coastal Area from Chokoria to Teknaf

The coastline of Bangladesh south of Chittagong includes several estuaries and the offshore islands of Kutubdia, Sonadia and Moheshkhali.

The Chokoria Sundarbans are a complex of newly formed grassy islands, muddy banks and river channels in the estuary of the Matamuhuri River. An area of approximately 20,000 ha was covered with mangrove forest and provided habitat for a rich variety of invertebrates, resident and migratory waterfowl and shorebirds, gulls and terns. Prior to 1950, the estuarine crocodile (Crocodilus porosus) was present.

Virtually all of this forest has now been cleared and the area converted to shrimp farms and other aquaculture projects. Many of them have failed economically or were destroyed or badly damaged by the 1991 cyclone. (MOEF and IUCN, 1991).

Scott and Poole (1989) consider the area too degraded to merit any special effort but project proposals for rehabilitation of the area have been developed (MOEF and UNDP,1991). Assessment of the rehabilitation potential through reforestation with mangrove species is recommended later.

The Naaf River estuary also had extensive mangrove swamps and intertidal mudflats but virtually all of this has been cleared since 1982 for shrimp farms, salt production and rice paddies. Rashid and Khan (1987) reported 81 species of waterfowl using this estuary. Significantly, Lesser and Greater Adjutant Storks (Leptoptilos dubius and L. javanicus) both globally threatened birds, were recorded nesting in the mangroves. Both have probably now disappeared from the area. The crabeating macaque, found only on these islands in Bangladesh is now thought to be extinct in the country in the last five years as a result of habitat loss.

Between Teknaf Peninsula and the Chokoria Sundarbans, Kutubdia, Sonadia and Moheshkhali Islands all have sandy beaches used by four species of marine turtles for nesting. Eggs are removed and nests disturbed by fishermen and local people at numerous sites. All three islands are considered to have good tourism development potential (Parjatan 1991a; ESCAP, 1988). Moheshkhali is located only 45 minutes by launch from Cox's Bazaar and has sandy beaches, clean water, trees and offshore fishing. There are also historical and cultural site.

Lakes

There are only three natural lakes in Bangladesh. One of these, Bogakine Lake, is a small freshwater lake in remote forested hills near the Indian and Myanmar borders. A second lake, Rankhiang Lake is also in the Hill Tracts but little information is available.

Bogakine Lake is the only significant highland lake in the country. Although no research is known to have been conducted on the lake and no information is available on fauna or flora, it seems reasonable to conclude that, because of its isolation from other water bodies in Bangladesh, it could be of considerable limnological interest.

A large artificial lake, Kaptai Reservoir, was created in 1963 and extends into the Pablakhali Wildlife Sanctuary. This reservoir supports a variety of migratory waterfowl, herons and egrets. Significant numbers of the Openbilled Stork (Anastomus oscitans) have been recorded (Akonda et al, 1989). However, Kaptai Lake has a higher recreation value than a conservation value and is used by some recreationists. The Parjatan Tourist Corporation includes Kaptai Lake in its tour program for the Chittagong Hill Tracts.

Coral Islands and Reefs

There is only one coral island and reef in Bangladesh. St Martin's Island, locally known as Jinjiradwip, is located 10 km south of the tip of Teknaf Peninsula. The main island is about 800 ha and has extensive coral reefs off the western, southern and eastern shores. As the only coral reef in Bangladesh, it is of considerable conservation significance (Akonda et al, 1989).

The island supports at least 12 species of small mammals, over 20 reptiles, 4 amphibians and 85 species of birds. Of particular significance is the confirmed nesting of two species of marine turtles and the possible nesting of three other species. Most of the birds are migratory shorebirds or pelagic birds and there is a conspicuous absence of birds of prey which are common on the adjacent mainland (Khan, 1985).

The reefs and water support a rich growth of benthic algae and 165 species of algae have been identified (Islam, 1976 in MOEF and IUCN, 1991).

The human population on St Martins has grown from 500 in 1956 and 3000 in 1984 (Khan, 1985) to at least 5000 today. Cattle and goats range freely. Fattah (1979, in UNEP, 1986) describes heavy exploitation of the coral reefs, including bombing for fish and coral products and also the collections of shells. Khan (1985) reports heavy exploitation of the eggs of sea turtles and disturbance of the turtles.

As the only coral reef in the country, St Martin's has long been proposed for some form of protective status. Khan (1985) proposed that the whole island be declared as a National Marine Park. This has been supported by the National Environmental Management Action Plan (MOEF and UNDP, 1991) and the National Conservation Strategy (MOEF and IUCN, 1991). The Corbett Action Plan for Protected Areas of the Indo Malayan Realm (IUCN, 1985) puts St Martin's Island at the very top of a list of 44 urgent needs in the Indo Malayan Realm. Little has happened and the island continues to be threatened by increasing populations and destructive overexploitation. Recommendations are provided later in the report.

FOREST LANDS

Forest Categories

The forest land of Bangladesh can be classified under three broad categories. These are summarized in Table 8.

Table 8 - Categories of Forests in Bangladesh

Category	Area in ha	Tenure
Classified State Forest Land (+ Unclassified State Forest Land Under Control of the Forest Department)	1,461,538	Government Forest Land Managed by the Forest Department
Unclassified State Forest Land	663,968	Government Forest Land Controlled by Land Ministry
Private Forest, village woodlots and unused tea land	320,000	Privately owned
	2,445,506	

1. Forest Department Controlled Land

These are forest lands under the control and management of the Forest Department. Included here are 1,461,538 ha of land comprising reserved forests, protected forests, Unclassified State Forests, acquired forests, and newly accreted khas lands in the coastal belts. It is estimated that less than half of this area actually has tree cover.

2. Land Ministry Controlled Land

These are lands controlled by the Land Ministry. Included here are 663,968 ha of land. Much of this land occurs in the Khagrachari, Rangamati, and Bandarban Districts of the Chittagong Hill Tract. Most of these unclassified forest lands have been depleted as a result of unrestricted extraction of wood through grant of permits over a long period of time. This has opened the area for shifting cultivation as well. Some unclassified state forest lands have been transferred to the Forest Department for management, as noted above. The remaining land is administered by the District councils on behalf of the Land Ministry.

3. Private Lands

This includes about 270,000 ha of village woodlots (information from the Bangladesh Energy Planning Project indicates a somewhat higher area in villages under tree cover is 304,000 ha), 30.4% is under bamboo, 16.8% is under non fruit trees, 14.% is under mango, 12.1% under betelnut, 9.7% under coconut and 6.7% under jackfruit (see Mahtab et.al., 1991), and 50,000 ha of land comprising derelict and abandoned tea gardens, and areas in tea estates unsuitable for tea plantation.

Protecting and Managing the Forests of Bangladesh

At present, only 110,223 ha of forest land are protected under the national protection system. This represents only .7% of the total of Bangladesh. This is inadequate for the maintenance of biodiversity and ecological diversity. It is also inadequate to protect critical hill areas from environment degradation through soil erosion and the silting up of reservoirs and rivers. In order to conserve the remaining biodiversity and protect critical environments, it is necessary to bring at least 3.5 percent of the area of Bangladesh under a protection system. Within 5-years, all with functional management plans. The target by the end of the plan period is 5 percent.

Because of poverty and population pressures, it is not possible to bring such a large area into the protection system using a single use protection concept. A multiple use management system concept is required.

1. Opportunities for Multiple Use Management

Bangladesh's main opportunities for bringing land areas under a national protection system involves the existing classified forest lands. At present, these are classified under various categories, including reserved forest, protected forest, and acquired forest. However, under the present classification system and approach to management, the forest on the classified forest lands are being degraded and the area encroached. In order to slow down or reverse the present decline, it is recommended that all the classified forest lands of Bangladesh be included in the national protection system, and be managed under a number of multiple use management areas. A multiple use management plan would be prepared for each of these. This would introduce a systematic approach to forest land management, with landuse designated according to land evaluation, capability assessment, and suitability assessment. The management system would be developed with the full participation of the local people, and would reflect their aims and aspirations as well as the aims and aspirations of the government. This would have a dramatic impact on the approach to national land management in Bangladesh, and would bring a meaningful area under the national protection system.

Table 9 summarizes the area available for inclusion in multiple use management areas. Using the proposed "core-buffer-multiple use zone strategy" for the management of these Multiple Use Management Areas, the protection of biodiversity could be accomplished while still gaining more social and economic benefits from these areas.

Under this "core-buffer-multiple use zone strategy",

- protected core areas would be designated for the preservation of biodiversity through the preservation of natural forest ecosystems (267,578 ha). These could be protected areas under IUCN classification or protection forests under permanent forest estate.
- buffer zones would be designated to protect the core areas from outside interference, and provide wood and non wood products for the local people (258,377 ha). These buffer zones could also quality as potential protected areas under IUCN category VIII.

- multiple use zones would be designated for Forest Department Plantations and Participatory Forestry areas, which would be intensively managed for socioeconomic benefits (1,377,707 ha).

A case studies is given in Appendix 10 to illustrate the concept, as it could be applied to a range of forest and wetland areas in Bangladesh. Landuse priorities are best dealt with on a regional basis as discussed and presented in a following report section on ecologically sensitive areas.

Table 9 - Summary for Proposed Multiple Use Management Areas

Name of Area	Core Zone (ha)	Buffer Zone (ha)	Multiple Use Zone (ha)	Total
Sundarbans	70,000	133,000	377,000	580,000
Coastal Afforestation				100,000
Chittagong Division	26,987	14,000	42,378	83,365
Cox's Bazar Division	31,438	5,964	38,411	75,813
Chittagong Hill Tracts	93,657	62,413	168,029	324,099
South Sylhet Division	8,000	25,000	7,172	40,172
Sylhet Reed Lands	5,000	3,000	15,000	23,000
Wetlands of Sylhet and Mymensingh				32,442
Sal Forest in Central Region	32,496	15,000	56,320	103,816
Sal Forest in North Region .				15,000
Total	267,578+	258,377+	704,310+	1,377,707

Notes: + indicates that the area will increase once the land under wetlands and coastal afforestation have been allocated by zone.

ENVIRONMENTAL STABILITY

Global Climatic Change

1. General

Atmospheric pollution and ozone depletion are recognized globally as having increased significantly. The impacts of both have been widely documented by numerous sources. In the case of Bangladesh, they are growing, but relatively minor problems, compared to the possible impacts from global warming.

Sources of Greenhouse Gases (GHG) which contribute to global warming are as follows: (1) Carbon dioxide, primarily from fossil fuels; in Bangladesh, the anount has been estimated at 4% of the U.S.A. per capita emission; (2) Methane, at about double the pre-industrial levels, only has an atmospheric half-life of about 10 years; the sources are thought to be primarily wetlands, rice paddies, ruminants' enteric fermentation, landfills and biomass burning, coal mining and natural gas venting, etc.; the relative magnitude of each of these has not been precisely determined; (3) tropospheric ozone, to which the Bangladesh contribution would be insignificant; (4) Halocarbons, including CFCs, are primarily emitted from aerosols, refrigerants, foams, and solvents; they have a half-life of 50 years; Bangladesh emissions are negligible; (5) Nitrous oxides are produced mostly through natural processes and quantifying man-made sources has proved difficult; Bangladesh is a negligible source; (6) tropospheric aerosols are mainly confined to industrialized regions; (7) variations in the intensity of solar radiation are functions of cyclical changes in planetary motion and phenomena such as sunspots cycles.

Essentially, the theory (there are detractors and arguments against the theory) is that the gases would trap heat in the atmosphere and raise global temperatures. It has been postulated that global warming of temperatures between 1.5-4.5 degrees Celsius are a possibility between now and the middle of the next century. Through melting of polar ice caps and glaciers, and thermal warming of the ocean, sea level would correspondingly rise.

2. Potential Impact on Bangladesh

The far-reaching changes would be comprised of many elements, some of these affecting (Huq and Ali, 1990): population, infrastructure, agriculture, cities, islands, coastal aquaculture and salt pans, and forestry, etc. There would also be effects from increased flooding, salinity intrusion, storm surges, river sedimentation and morphology, and localized hydrometeorological impacts. The general locations of areas which would be affected are mapped in Figure 4.

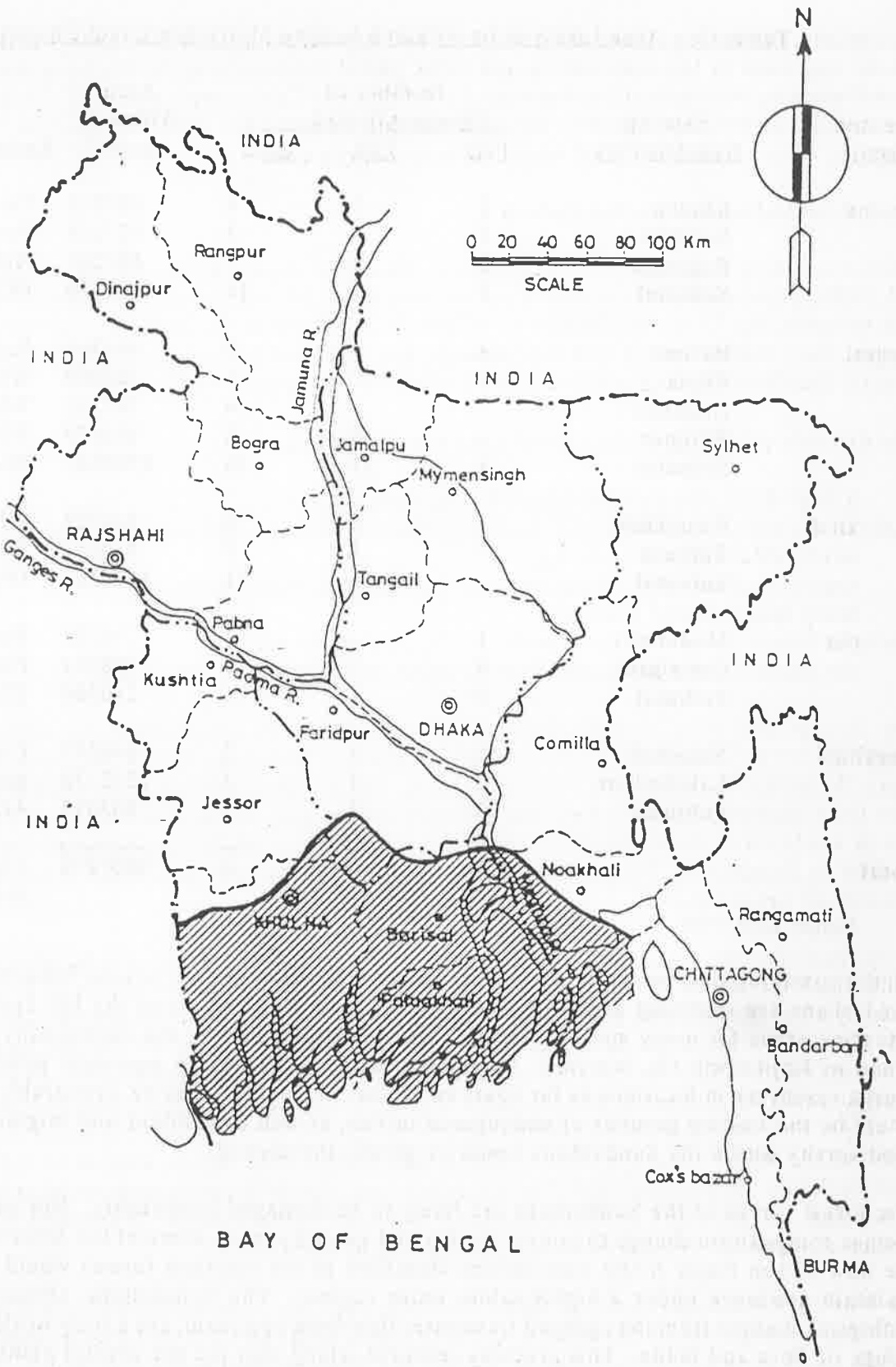
The dynamic processes of the coastal area are characterized by:

- a huge discharge and complicated river network;
- an enormous sediment load, both depositional and as suspended colloidal particles;
- strong tidal and wind activity;
- regular cyclones of devastating intensity and tidal storm surges;
- many island-dotted channels;
- the funnel shape and shallowness of the Bay of Bengal;
- the presence of a submarine canyon about 24 kilometres of the coast.

The Sundarbans being one of the areas of subsidence in Bangladesh, the effects might be magnified here. There have been tremendous changes in coastal morphology over the past 200 years. As an active delta these natural changes will continue, affecting the ecological procceses over time. However, in the event that global warming and sea level changes are imminent, the effects would no doubt be severe. So much so, that the potentially destabilizing effects cannot be ignored by Bangladesh. The whole of Patuakhali District, Barisal, and much of Khulna would be affected, as noted below.

A sea level change of one metre would inundate about 2.27 million ha of land of existing coastal lands which (about 15.8% of the total area of Bangladesh). About two-thirds of greater Khulna, virtually all of Barisal, and 100% of Patuakhali would be inundated. More than 40% of Noakhali and 12% of Faridpur would be affected as well. Thirteen out of 64 district in the country, consisting of 13.74% of net cropped area (1.18 million hectares) would be lost. There would also be unquantifiable changes in adjacent areas in soil fertility, cropping patterns, and land capability for crops. This would result in attendant poverty, mass migrations and the accompanying social strife which would naturally occur. The losses of the area would exceed $1.3 billion in its contribution to the national GDP. The losses to crops, industrial production, existing facilities such as housing, infrastructue and communications would easily exceed $10 billion (GOB, 1992). Predicted economic impacts have been quantified in Appendix 11.

The extensive coastal aquaculture farms currently exporting hundreds of millions of dollars worth of shrimp annually will be devastated by the changes. Quite apart from physical damage to farms (bunds could possibly be built higher around the ghers as mitigating measures), the estuarine breeding grounds would be severely affected. They are dependent upon a delicate balance of saline and fresh water, and the nutrients and detritus from leaf litter in the forests. A valuable source of foreign exchange would be jeopardized. Not only the loss of net present value, but the loss of foregone income from intensively and scientifically managed shrimp farms would be at least three times the income from present poorly managed farms. Intensive management in some countries in Southeast Asia has resulted in increased productivity by a factor of up to nine times the existing output for similar ventures.



Source: Adapted from Huq. S. and Rahman. A. 1991

Figure 4 - Likely Inundation Area with One Metre Sea Level Rise

Table 10 - Area Likely to be Affected by One Metre Sea Level Change

Greater District	Existing New Districts	Number of Thanas Affected Part	Full	Total	Area Affected (Acres)	Remarks
Khulna	Khulna	2	2	4	807072	Part
	Satkhira	3	-	3	527185	Part
	Bagerhat	2	5	7	567281	Almost Whole
	Subtotal	7	7	14	**1901538**	**64.7% of Dist.**
Barisal	Barisal	4	3	7	444366	Part
	Bhola	-	7	7	768969	Whole
	Jhalokati	-	4	4	187323	Whole
	Pirojpur	-	8	8	355179	Whole
	Subtotal	4	22	26	**1755837**	**99.1% of Dist**
Patuakhali	Patuakhali	-	6	6	741723	Whole
	Barguna	-	5	5	434657	Whole
	Subtotal	-	11	11	**1176380**	**Whole Dist.**
Faridpur	Madaripur	1	-	1	11332	Part
	Gopalganj	4	1	5	198974	Part
	Subtotal	5	1	6	210306	**12.4% of Dist**
Noakhali	Noakhali	1	1	2	340597	Part
	Lakshmipur	2	1	3	2232118	part
	Subtotal	3	2	5	563815	**44.2% of Dist**
Total		19	43	6	5607876	15.8% of the country.

Source: GOB, 1992.

All the coastal islands would be affected, as would the livelihooods of coastal fishermen, since the Sundarbans are spawning areas for some species, and at least part of the life cycle is spent in estuarine areas for many marine species. Also affected would be the ecologically unique coral island of Jinjiradwip (St. Martins). Miles of coastal beaches which represent pristine potential tourist resources in locations as far apart as Teknaf to Kuakata will be irreparably damaged, as would be the nesting grounds of endangered turtles, as well as resident and migratory wildfowl. Biodiversity within the Sundarbans would be greatly threatened.

The forest areas of the Sundarbans are likely to be damaged irreparably. Not only would the species composition change to poorer quality and quantity trees, some of the forests types (there are now eleven major forest associations identified in the reserved forest) would be unable to maintain existence under a highly saline water regime. The Sundarbans, already undergoing ecological changes from the reduced freshwater flow from upstream, are a truly world class unique refuge of flora and fauna. This precious resource, along with the the coastal plantations, would be threatened with oblivion. The total forest area, including plantations, would exceed 700,000 ha, more than half of the Reserved Forests in the country.

Response measures can take several strategies, in any number of combinations. The responses could be biological, technical or institutional. Biological strategies could involve (GOB, 1992):

- saline tolerant crop species;
- flood tolerant cereals, such as deepwater aman;
- gene banks;
- migration (both human and animal).

Technical strategies would include adoption of some structural and engineering protection such as:

- dikes and polders such as in existing coastal embankment projects;
- seawalls and crossdams, such as between Noakhali and Ramgati;
- artificial beaches, bulkheads, groynes.

Institutional strategies could use zoning limitations on habitation, or resource use, adaptability to changed conditions, changed landuses, etc. The strategies could range from nil protection, relocation of existing uses and functions, adapting to change within limited scope, to full protection and elimination of the threat. These would have to be carefully considered for their economic, social, and environmental cost. For example, it has been calculated by the BWDB (Huq and Ali, 1990) that the cost of new and renovated embankments for some 8,600 km of coastline would cost about $325 million at 1989 prices, i.e. $20,000 per kilometre. On the other hand, none of this would mitigate the impact on the forests to any degree. Political and social considerations would make relocation of millions of people unlikely, and the present high value of export products make the economics look reasonable in terms of benefit-cost for the shrimp sector alone.

The summary of the findings so far on climate change in Bangladesh are that: (i) there is a rising trend in minimum temperatures for the period 1961-1988 in ten urban stations studied show an increase of 0.6 degrees Centigrade (except for Khulna, interestingly); there was no discernible trend in maximum; (ii) there is no trend recognizable in mean seasonal changes over the past thirty years; (iii) annual rainfall has fluctuated within normal variations over the last 30 years; (iv) the mean monthly magnitude and frequency of heavy rainfalls has been normal. However, these findings do not cover a long time span. The one thing known with certainty is that not enough is known about the phenomenon to be very confident about any particular conclusions at this time. The following recommendations are made:

- clearly the burden of creating the problem lies with developed countries, and the principle of "the polluter pays" should be brought to bear; countries like Bangladesh, or Maldives, have not contributed to this global phenomenon, and should expect cooperation and compensation;

- raising the issue internationally must be done persuasively and persistently, because this is a slow process about which emergency meetings are not likely to be held; yet they threaten the very survival of many nation states with significant size of lowlying coastlines, heavy population pressures there, and a wide range of economic activities associated with coastal and estuarine ecology;

- there need to be serious studies of coastal processes and ecology, for which outside collaboration in terms of equipment and experience will be needed; some areas of research such as the interrelationships between climate change and poverty, population and natural disasters, have been relatively neglected and should be addressed through the Climate Action Networks, such as CANSA based in Dhaka;

- national legislation in itself would be relatively worthless, as the present situation shows people risk their lives to eke out an existence in marginal settings controlled by powerful mastans and jotedars; traditionally land erosion both in riverine and marine environments are something to which people have adapted; such adaptions should be harnessed;

- some level of cooperation regarding watershed management and deforestation in the region would provide a mitigating factor; regional cooperation on establishing baseline data, measuring change and coordination should be established through fora such as SAARC;

- a national level committee should be formed, headed by MOEF, to assess the status quo, and determine the scientific needs for monitoring; a task force co-opting members from relevant GOB, private sector, and NGO expertise should be formed;

- The Integrated Development of the Sundarbans Reserved Forest project should ensure that appropriate monitoring sites within the coastal belt are established and monitored.

Disaster Management

1. General

Environmental issues cover a number of major elements related to occurrence of any major cyclone. Cyclonic storms occur mostly during the months of April-May and October-November. Their impacts, noted above, range from moderate to devastating. Depressions in the Bay of Bengal also cause surges or high tidal waves, often inundating offshore coastal islands particularly. Almost the whole of the coastal belt of the country is fringed with the coastal embankment project, completed in the sixties, and designed for much smaller storm surges and tides. Lack of proper maintenance, these embankments have been weakened, eroded and breached in places. Coastal islands and newly formed charlands vary throughout the coastal belt. Some are mature, and have been inhabitated for many years. Many are compartmentalized by raised roads, or surrounded by polders. New chars are accreting around some islands, and agricultural activities are started, even though the areas are at high risk from natural hazards. The settlers are often proxies for jotedars, large landgrabbers who establish ownership over such lands through violence and intimidation. Yet another category of char consists of newly emerged land just above high water level, and below high tides. These are not well consolidated and may disappear in any given year to reappear elsewhere. While extremely high risk, land hunger drives people even to such lands. These are the kinds of areas the Forest Department has been trying to stabilize, in many instances succesfully, through afforestation. Wherever possible, lowlying coastal plains are used for agriculture, and in some areas, salt pans and shrimp farms. This has caused conflicts over land use.

Communications between islands, and between islands and the mainland are poor, in terms of transport and infrastructure. Cyclone shelters, constructed throughout the coastal belt and off-shore islands over the years have been far from adequate in numbers, design, and location, although they are these days designed as multipurpose community buildings. In many locations, the size and number cannot accomodate even 10% of the people, hence the high casualty rates from cyclones. Migrant labourers who go to coastal areas for employment are frequently the victims. Houses are of katcha (low) quality, which always results in much housing damage. Rice cultivation constitutes about 85% of the land use on the coastal islands and mainland.

Between 1960 and 1991 35 cyclones have struck Bangladesh. Figure 5 provides a an example of cyclone paths during various years. In 1991, a cyclone with wind speeds of up to 235 km. per hour, followed by 10 metre tidal surges struck a large area of the coast of Bangladesh ranging from Teknaf to Khulna. The storm track passed near Chittagong, with the worst affected areas including locations as widespread as Patuakhali and Cox's Bazar.

Subsequent to the cyclone, it was estimated that there had been severe losses in infrastructure, fisheries and livestock, possibly 138,000 deaths, and crop losses of $3 billion. Less well known was the significant environmental and ecological damage that was done to wildlife and vegetation in the coastal areas, in addition to village homestead forests and forest reserves in the cyclone path. More effective preventive measures, policies, and preparedness could have reduced the damage considerably.

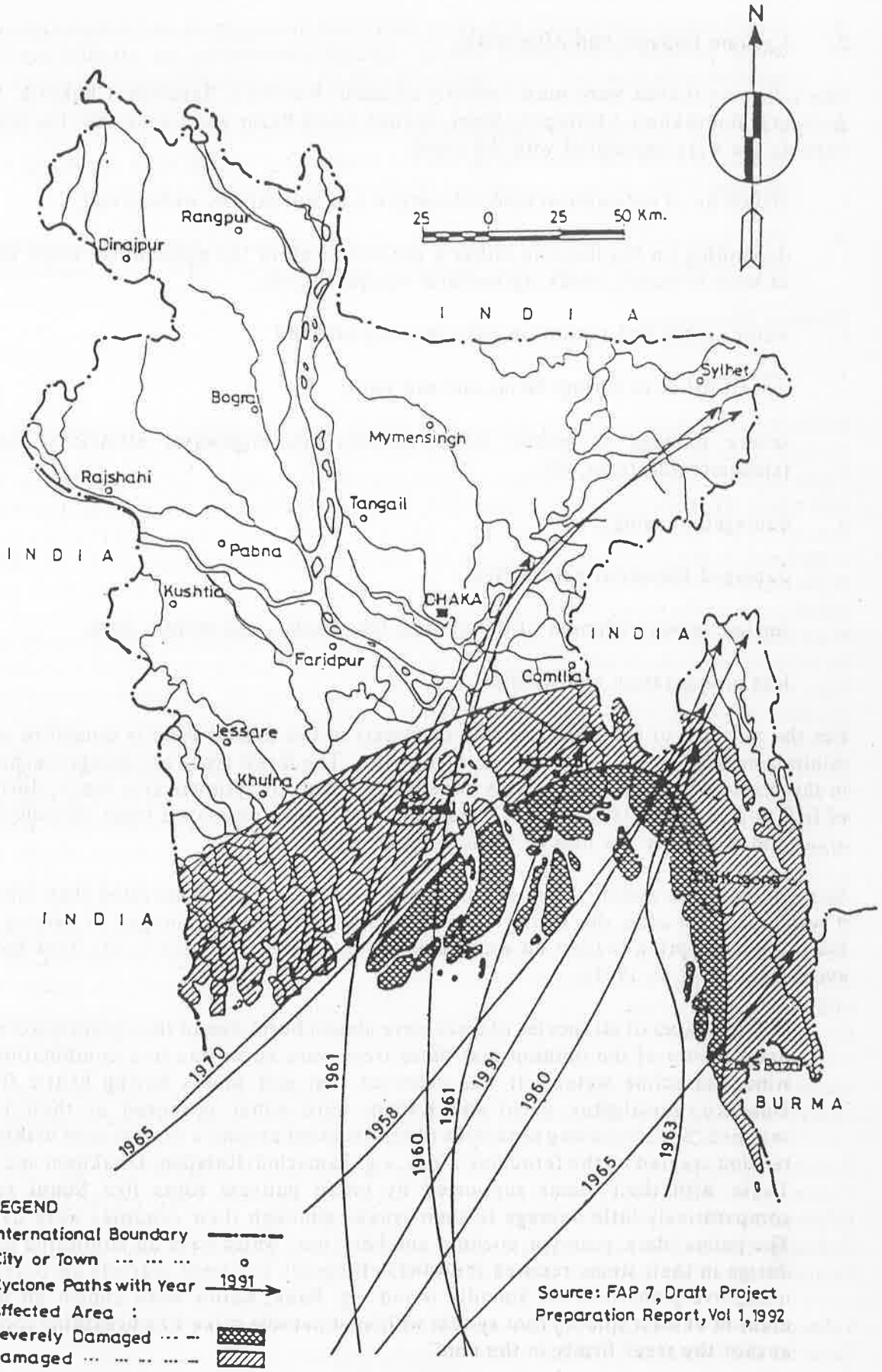


Figure 5 - Bangladesh Cyclone Paths and Locations

2. Cyclone Impacts and Aftermath

The following thanas were most severely affected: Kutubdia, Sandwip, Chokoria, Moheshkhali, Anowara, Banshkhali, Chittagong town, Teknaf, Cox's Bazar and Sitakunda. The following major impacts are were associated with the event:

- 50,000 ha of agricultural land submerged and soil salinity widespread;
- depending on the location either a portion or all of the agricultural crops were damaged, as were livestock, seeds, agricultural equipment, etc.;
- water supply and sanitation were severely affected;
- loss of fisheries shrimp farms and salt pans;
- severe damage to public infrastructure(roads, highways, electricity, water, sewage, telecommunications, etc.;
- damaged housing;
- damaged industrial enterprises;
- further impoverishment of the poorest households, and middle class;
- loss of vegetation and wildlife.

For the purpose of the FMP the role of forests in the coastal zone is crucial to mitigating and minimizing some of the impacts from such events. The forest types are mangrove, homestead, and in the mixed evergreens in the hills (where the effects of cyclones also reach; during the course of fieldwork early in 1992 the FMP team observed many destroyed trees throughout the coastal areas and miles into the hills of Chittagong District).

Some parts of the cyclone-affected area were more generously afforested than others. However, it was found just after the storm that almost all species were damaged to varying degrees. The following description is from an eyewitness reconnaissance mission to the area shortly after the event (Haider et al, 1991):

> "... The leaves of all species of trees were almost burnt due to the cyclonic storm. Local people were of the opinion that these trees were burnt due to a combination of hot wind and saline water... It was observed that soft woods having brittle fibre like Debdaru, Eucalyptus, Jarul and Kadam were either uprooted or their branches snapped. Species having tenacious fibres disposed around a central core withstood the tension created by the ferocious winds, e.g. Tamarind, Kalajam, Dhakijam and Garjan. Those with their stems supported by broad buttress roots like Simul sustained comparatively little damage to their trunks although their canopies were destroyed. The palms (date, palmyra, coconut and betel nut) which have an admirable structural design in their stems resisted the winds efficiently and were scarcely uprooted.... The mangrove planations on Sonadia island e.g. Baen, Keora were almost all intact on account of their spidery root system with innumerable spike-like breathing roots which anchor the trees firmly in the mud".

Branches of softwood or brittle species such as Casuarina, Sonalu, and Jarul snapped frequently, while Hijal and Gab were unaffected. There was great loss of leaf biomass from species like Mahogany, Sissoo, Jika and Sonalu. High velocity winds, saline moisture, and high heat turned

leaves brown and they defoliated. The leaves of common palms was less affected. The trees which exhibited least damage were Hijal (Barringtonia acutangula) and Gab (Diospyros peregrina) since these can sustain waterlogging and have hardy branches and stems. The following species also sustained lighter damage (Haider et al, 1991):

- Areca catechu (Supari)
- Avicennia spp. (Baen)
- Azadirachta indica (Neem)
- Borassus flabellifer (Tal)
- Cassia siamea (Minjuri)
- Cocos nucifera (Narikel)
- Dipterocarpus spp. (Garjan)
- Ficus spp. (Bot, Ashot, etc.)
- Melia azadirach (Gora neem)
- Michelia champaca (Champa)
- Phoenix sylvestris (Khejur)
- Syzygium cumini (Kalojam)
- Syzygium grande (Dhakijam)
- Tamarindus indica (Tetul)

Such species should receive prominence in coastal and homestead afforestation programmes. The palms also are hardy, and should be prevalent in cyclone-prone areas in the coastal belt. The "Coastal Green Belt" programme could benefit from such species, as would afforestation under FAP-7 exposed to periodic cyclones. Forests clearly reduced the effects of both wind and storm surges in well-forested areas such as the Sundarbans, whereas Chokoria (denuded of mangroves for shrimp ponds) suffered high casualties. Appendix 12 has a more complete list of species' survivability and tolerance to cyclones.

Some of the causes of damage can be directly related to the alienation of coastal mangroves from forest reserves for the purpose of shrimp farming, as in Chokoria. In Chittagong and Noakhali Districts, very limited amounts of land had natural mangrove cover. Thousands of hectares of land had been leased out to the Fisheries Department, Land Revenue and Land Administration, and there is illegal occupation also by known individuals. Through the acquiescence and connivance of government officers and ministers, most of the land in Chokoria was cleared, and then converted into either salt or shrimp ponds. This was against all established ecological principles, in spite of the Forest Department writing in earlier plans decades ago, that the area should be conserved, rather than exploited. No consideration was given to effects on ecological balance, food chains, or reproductive cycles of estuarine species.

A team from the National Forum of Environmental NGOs also covered more than two dozen locations, ranging from off-shore coastal islands to the interior hills. In addition to significant damage reported by the District Commissioner, there were heavy losses by the Bangladesh Air Force and Navy to planes and ships.

Significant damage to vegetation, and wildlife was also noticed. Turtles and tortoises were badly affected, the highest mortality among Kachuga tecta, Aspideretes hurum, and Lessimys punctata. Freshwater turtles in Kutubdia in particular were badly affected. Dead Green and Olive Ridley turtles (endangered marine species) were found. These nest in Sonadia, Kutubdia, Ghotibhanga, Inani, St. Martin's Island and Kuakata. Among avifauna, two species of cormorants and five species of herons were heavily affected, as were two species of egrets. The large scale destruction of trees would have directly imperiled their habitats. Coastal estuaries are spawning grounds of Ruhi, Catla, and Mrigal, and these were likely damaged as well (NFEN, 1991). Such species form important protein sources for people. Among the mammals, dolphins and porpoises, fishing cats and otters were found dead. Their role in the food chain would have affected predator-prey

relationships. Also lepidopterans, coleopterans, annelids, and other arthropods, in addition to numerous inveertebrates would have had their natural habitats destroyed. Ultimately this affects the delicate ecological relationships within estuarine areas, the rich fisheries, and people's livelihoods.

Not all mangroves survive such calamities. The keora trees (Sonneratia apetala) were heavily damaged in the Chittagong, Baradia, Kaladia, Charandweep, Ujandia, Puberchar, Laxmidia, Mukteria, Char Kamal, West coast Hatiya, and Char Osman (Nijhumdweep) islands. Many trees were uprooted, twisted and some defoliated. Tall trees were affected more severely than medium and saplings. Some amount of Baen trees were uprooted. All the casuarina trees at Cox's Bazar on the beach at the eastern sand dunes were totally damaged, and the trees along the south western coast were partially damaged.

In the mixed evergreen forests, the damages were also significant with older trees in the hill tops uprooted branches of softwoods were broken, massive defoliation , dessicated leaf phenomena as observed by the BCAS team, some leaves such as a few palms, coconut, datet palm, Betel, etc. managed to weather the storm better, etc.

A study team recently returned to the scene of the 1991 cyclone, to determine to what extent the area was still affected. In the Cox's Bazar District, apprehension that soil salinity would drastically reduce future rice crops was off the mark,but only through fortuitous circumstances. Heavy rains after the event removed salt residue from the top soil, and in 1992 there was a bumper crop. Other observations include (Haider, 1992):

- the fish catch this year was exceptionally low; this affected employment opportunities peripheral to direct fishing such as net vendors, fish dryers, and ice plant workers;

- a record salt production was achieved due to a long dry season in the winter of 1992, but salt cultivators were forced to take laons from money lenders and have not fully recovered;

- while shrimp farms were devastated, new ponds are being constructed and the industry continues to expand; however, it is mainly the rich with access to credit who are benefitting while small farmers' conditions are deteriorating;

- only some of the embankments have been repaired, leaving the poor vulnerable once again;

- marginal farmers who lost their crop are still unable to return loans from mahajans (moneylenders); either small plots of land, or in the worst cases, the homestead had to be relinquished in payment;

- only 20% of houses are rebuilt, and a huge amount of bamboo has been cut (estimated at 80%) for katcha huts; also, homestead forests are being cut due to the loss of cattle from which biomass fuel was formerly obtained;

- there has been frantic activity with regard to cyclone shelter planning (although construction is another matter);

- the middle class had no capital for agricultural inputs, and are being squeezed into marginal class category;

- some 80 % of children are malnourished in the coastal belt;

- major infrastructure such as the airport and public buildings in Chittagong have been reconstructed at great cost; military equipment (up to 40 Air Force planes damaged) will not be easily replaced;

On off-shore islands, the death rate originally reported now appears lower. There was also a bumper crop in Sandwip, and 75% of housing has been replaced. The embankment is still damaged in numerous locations, and the island remains under threat of erosion from the Meghna River. Of the betel leaf plantations destroyed in 1991 (100%) only 25% have been revived. The level of salinity in shallow tubewells is now at 1500 ppm, compared to 600 pre-cyclone. Lemon, jackfruit and other trees which surved last year are now losing their leaves. Migration has increased. In Kutubdia, mortality from the event has dropped to almost a quarter of original estimates. Only 50% of inhabitants have shelter, while others remain vulnerable. Embankment reconstruction will not be completed until June or July, 1994. From seven cylone shelters on the island during the event, nine have been built by BRAC and 62 more are proposed; even so, this will cover 80% of the population (leaving some 20,000 persons still completely vulnerable to a repeat disaster). Generally, the environmental health situation has deteriorated, with crises of drinking water common, increased skin diseases following the cyclone and persisting today, etc.

With regard to loss of wildlife and vegetation, there are mixed results. A cursory survey of wildlife populations and breeding status was carried out in both September 1991 and June 1992. This was suppplemented with interviews of locals. Amphibians were recovering. Some frogs and toads still were seen in limited numbers, although the Skipper Frog had recovered. Some of the tortoises and soft-shelled turtles, as well as lizards are seen to be recovering marginally. Snakes, both terrestrial and aquatic, were still relatively absent from their normal habitats. Aquatic birds have recovered relatively well. Some birds from adjacent areas and the hill forests seem to have migrated into the area. Mammals continue to be devasted except for some small mammals. Many of these animals have key roles in the web of life (foodchains and predator-prey relationships) and their longterm effect on the ecological relationships is unknown. The disappearance of rats and mice, shorterm, could reduce crop losses, for instance. But disappearance of frogs may increase insect populations, leading to increased pest infestations.

The impact on vegetation was severe in '91, as noted earlier, and especially on homestead vegetation, and the further depletion of trees to cope with losses from the cyclone (particularly bamboo for construction, and likely distress sales of timber and other multipurpose species for survival and loan repayments). Where the combination of species was tolerant to the event, there was a resilence. Some areas had recovered even by early 1992, as observed by the FMP field visits. In many areas, palms appeared to have healthy foliage, although this depended upon the severity and extent of exposure to the cyclone. In the hill forests of Chittagong District, softwood species such as Kadam (Anthocephalus chinensis), Simul (Bombax ceiba) and Jarul (Lagerstroemia speciosa) had not recovered. Many rubber gardens were seen to be heavily damaged, with trunks snapped like matchsticks. The species planted on the coastal range of hills such as Eucalyptus and Acacia would have contributed little to reducing cyclone effects in the hills. The leeward side of hills did comparatively better, it was observed. The mangrove trees remained relatively healthy. A visit to the inter-tidal zone in Teknaf was reported (Haider, 1992) to remark on robust and dense growth of Keora (Sonneratia apetala), Chaila (Sonneratia caseolaris) and Baen (Avicennia spp). However, given the protective buffer function of the Teknaf range of hills, this is hardly surprising. The FMP team noted that mangroves just north of Teknaf and Jailiardwip in this area were sporadic. The island itself appeared from a hill top on the main highway to be completely void of mangroves but it was not visited.

Flood Action Plan

Floods are regular phenomena in the country, and are usually not as devastating in impacts as cyclones and tidal surges. However, they cause regular damage annually, and collossal damage occasionally in years of exceptional severity, such as in 1987 and 1988. The regional elements of selected components of the Flood Action Plan (FAP) will be discussed within the context of environmental impacts only inasmuch as they relate to forestry issues. Full studies from the various consulting agencies are available with the Flood Plan Coordination Organization (FPCO).

Where FAP issues may impinge on forestry will also be covered later in the text, in the analysis of ecologically sensitive areas.

FAP was created following the unprecedented floods of 1987 and 1988. The plan was first undertaken as a series of flood policy studies prepared by the World Bank at the request of GOB. It was endorsed in 1989. Subsequent identification, planning and design of high priority projects were commissioned. The plan aims at measures to control flooding and improved drainage. Regional studies were initiated to provide inputs to the main components. The plan has 28 components, some of which merit brief examination in this report, these being:

- some of the earlier draft plans (Mott MacDonald, 1991) indicate that biological and ecological impacts would might lead to increased unquantifiable benefits include increased fruit and timber tree crops in the northwest; however, as wetlands decline within the area: "...longterm implications of changes to the system cannot be quantified or given a level of significance due to a lack of data. This evaluation concludes that insufficient priority is being put on these issues".

- in the southeast region, the importance of homesteads was noted as of particular environmental importance and that the homestead was a (MottMacDonald et al, 1992): " vital link in the social , economic and ecological systems which bind the whole landscape, ecology, economy and society together...that have been under-valued, under-rated, under-studied and ignored in most development planning to date. There are a number of key impacts which FAP projects could have on these systems which should be given careful consideration".

- in the Jamalpur priority project it is noted that the status of very many species of flora and fauna is already threatened whether there is a project or not, since natural vegetation has practically disappeared; existing pressures on flora and fauna will intensify with the project, because local brickmaking is significant, and the majority of the fuelwood for this comes from Madhupur; while the undesirability (strictly from an engineering viewpoint) of planting trees on embankments is evident(Sogreah et al, 1992b): "this has to be weighed against the potential benefits...(requiring) careful species selection in terms of rooting type and flood tolerance...(and) need to be considered for their shade and fruit value and planting programmes would best be carried out as part of an integrated programme of multi-purpose use for embankments".

- in the northcentral region, it is noted that (BCEOM, 1992a) whether any endangered species could be affected by any particular projects could not become clear "unless detailed field work is carried out. Provisions for this should be made in the feasibility stage". The same study notes that with regard to access to the common property resources of fisheries in terms if income and nutrition would be extremely difficult for FAP projects to mitigate. Such resources are dependent upon the maintenance of wetlands in particular.

- in the Brahmaputra Right Embankment Study (FAP 1), it was noticed that bricks used in floodproofing and as aggregates in road building would seriously deplete the wood resources. There were 32 brickfields within a portion of the project locality, all of whom had (Halcrow et al, 1992a): "piles of bamboo roots, as well as large stacks of timber". Annual requirements for these brickfields alone were estimated at the equivalent of about 6,000 tons of coal and almost 15,000 tons of timber. The project requirements for construction purposes are extensive, and if only bricks were used as a source of aggregate, it would necessitate 87,000 tons of timber.

- the FAP 7 Cyclone Protection Project (CPP) will improve 500 km of existing coastal embankments and its environmental impacts are said to be (Kampsax et al, 1992a: "limited

and mostly positive". It does suggest that the "need for government restrictions and control of the shrimp farmers with the aim of protecting the agricultural farmers and the coastal afforestation should be further looked into".

- the southwestern regional project notes the intricate ecological interrelationships and suggests that both homestead forestry (multipurpose and timber trees through participation of women and marginal farmers as well as larger landowners) and village bamboo need to be intensified, and that the raising of trees for commercial purposes should be further investigated.

- the northeastern regional project (FAP 6) has noted the longstanding tendencies to loss of fish production (possibly through industrial effluents as well as conversion of haors to agriculture, sedimentation, and overfishing; rapid deforestation has been noted in the area over the past 50 years. However, the values of formerly vast wetlands (and still the most significant in the country) have been recognized (Shawinigan Lavalin, 1992a) for hydrological and physical values, their role in economic production and employment, social and cultural values, as well as biodiversity conservation. The project has noted significant environmental values in the functions of the haor systems.

The overall impression of flood action projects is that: (i) more studies on environmental aspects, (particularly the likely irreversible impacts on fisheries and wetlands) are needed as projects move into the feasibility stage; (ii) with some few exceptions, little attention is being paid to the role of forestry in watershed management and the mitigation of possible impacts through afforestation; (iii) the projects have been criticized for not taking into account long traditions of coping mechanisms evolved by local people; (iv) that there has been little attention to public participation, including NGOs, throughout the process, and few references to the many instances of negative impacts of FCDI projects throughout the country.

The following observations and recommendations for disaster management are suggested:

- the environmental effects of cyclones are far-ranging, and in addition to damaging vegetation and wildlife, the major impact is on people's livelihoods, their ability to survive short-term and their ability to withstand the malnutrition, potable water crises, health consequences, damaged housing, loss of land and households, lack of access to institutional credit, etc. in the aftermath of such events;

- the impacts fell most heavily upon women and children;

- coastal afforestation schemes and embankment projects should seriously consider planting species with known resilience to cyclones, and preferably multi-purpose;

- trees must be planted on both sides of embankments, with the foreshore area devoted to mangroves;

- the number of mangrove species planted should be expanded; reliance on Keora and Baen (given susceptibility to stem-borer) should be minimized through the existing plantation trial units in the coastal divisions;

- the value of mangroves and coastal plantations is high enough in terms of mitigating cyclonic damage (together with the hoped-for cyclone shelters) to justify plantation for this reason alone; the policy to allow land to revert for agriculture after 20 years would be a serious mistake;

- afforestation schemes in vulnerable locations should be cognizant of the demonstrated resilience of some species over others; at the same time, they must be acceptable to local villagers; women should be major "targets" for such schemes;

- the off-shore islands and emerged chars will continue to be an ongoing human ecological disaster until the power of the jotedars is broken, and appropriate health, communications, infrastructure and credit facilities are provided to the poor; only GOB commitment can secure such an initiative;

- cross-dams, and other physical structures for reclaimimg land and reducing erosion in the coastal areas must have full EIAs, because in some cases their impact would have longterm implications on surrounding ecological processes.

- the FAP projects should give more attention to the potential role of forestry in the regional studies; construction of the infrastructure to limit flood impacts will have a negative effect on depleting homestead forests and forest reserves unless GOB moves strongly to operationalize the existing totally ineffective ban on firewood for brickmaking (even in Dhaka city, road construction under GOB projects uses wood everywhere, mocking the very legislators' inability to enforce the ban); gas is the preferred fuel (where available), with coal a distant second alternative, and developing potential quarries or importing aggregate is recommended as well.

ECOLOGICALLY SENSITIVE AREAS (ESAS)

General

In the linkages between social, economic, and environmental values, often the environmental factors have been given the least thought, sometimes resulting in long term negative impacts. It is possible -and indeed essential- to integrate conservation of resources for future generations into present development programs. Value systems and policy frameworks should promote: (i) environment/ economy integration; (ii) the principle of community economics (that people are at the centre of the development process); and (iii) conservation with equity. A very broad and strong consensus that environmentally sensitive areas must be given more attention by development planners has emerged over the past 20 years.

Sustainable development is a commonwealth of values which embrace these principles. The WCED (1987) has said:

> "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".

The Asian Development Bank's strategy for the forestry sector includes support for this as well, by (ADB, 1989):

> "...ensuring a broader concern for all humid tropical forests, giving priority to maintaining biological diversity, conserving tropical forest ecosystems-including mangroves and wetlands, and finding alternatives to encourage conservation of tropical forests..."

The World Bank echoes such aspirations, by stating that (World Bank, 1991b) it would encourage government adoption of:

> "...a precautionary policy toward utilization. This policy is motivated by uncertainties regarding the full valuation of environmental services, the inadequacy of knowledge concerning sustainable management systems, and the irreversibilities associated with loss of tropical moist forests. Specifically, the Bank Group will not under any circumstances finance commercial logging in primary tropical moist forests."

It has been pointed out earlier in the text that Agenda 21, IUCN, UNEP, WWF and UNCED have come out strongly with support for such positions, as has the GOB in its recent environment policy paper, position paper to UNCED, and its draft National Environment Management Plan. The National Conservation Strategy recognizes (GOB, 1991a):

> "All too often natural resources are taken for granted- as nature's free bounty awaiting unlimited exploitation by man. However, most are exhaustible. It is always wise to adopt a conservative attitude in the exploitation and use of any natural resources. Nothing should be supplied free of charge. A price tag, whatever nominal that may be, helps to prevent the misuse of any gift of nature.... the decline of tree cover in Bangladesh is a good example- a critical low of less than 10 percent of the land area presently. While the timber trade flourished, people economically and socially disadvantaged, dependent on minor forest produce, have been denied that benefit..."

Designation and Management

Today almost every country has some form of institutional mechanism and legislation to protect ecologically sensitive areas. Most often these are national parks, wildlife sanctuaries, protected landscapes, etc. A list of these categories, under the IUCN accepted international classification may be found in Appendix 13. Often their functions include, among a number of uses, the protection of wildlife. A list of threatened and endangered species in Bangladesh is attached as Apppendix 14. A comparative analysis of protected areas in the Asia-Pacific region is given in Table 11 below. With the exception of some very small island states Bangladesh has one of the lowest ratios of protected areas as a percentage of total land area. It is well below the average of 2.92 percent. The total protected areas of the world cover about 4.9 percent (UNEP, 1992).

In spite of specific policies set aside to protect unique and ecologically fragile areas, and of the existence of mechanisms to implement these policies, ESAs are still endangered. This is due not so much to biological factors, but more often to economic, social, and political pressures. In Bangladesh, the mechanism for implementation of the policy has been disfunctional for at least ten years. The protected areas are there in name only, and are subject to the same degradation as forest, wetland, and other landuse resources. Although legislation was passed in 1973, and authority was vested in the Forest Department, relatively little has been achieved. In fact in 1983, the Wildlife Circle within the Department was abolished, leaving the status quo as virtually the same as 20 years ago. There is only a Senior Research Officer, with whom almost all the responsibility rests, in actual fact. This underscores the fact that protection in legislation in itself is insufficient criteria to conserve an ESA. A number of the existing areas have been proposed years ago under various categories, but have not yet been gazetted. Many of those which have been gazetted are now so degraded that their inclusion may not be warranted for protected area status under IUCN classification.

It is painfully evident that a narrow sectoral approach to managing ESAs is unlikely to be successful. Even in the short run, an "island mentality", i.e., keeping people out of the ESAs, will not be successful. Particularly so in Bangladesh, where land scarcity and population pressures, poverty, and the huge dependence on wetlands and forests for food, fuel, construction material,

etc. mitigate against keeping an area undisturbed. It then becomes a matter of survival, and good intentions will not suffice in such a case. Even where there are relatively effective institutions and mechanisms for wildlife and protected areas, the support of other agencies and the general public is essential if a sustainable approach to conservation is to be achieved. People who have been traditionally dependent on the resource which the state has removed from them by legislation should be given a role in the management of ESAs. The concept of a buffer zone between these ESAs and more intensively used areas for public participation is a step in the right direction. However, these are very difficult to integrate and implement successfully.

Table 11 - Number and Total Area of Protected Areas in Selected Countries (Asia Pacific)

Country	Land surface (sq km)	No. of areas	Total area Protected (ha)	Percent protected
Afghanistan	650,088	4	142,438	0.22
Bangladesh	142,776	9	94,961	0.67
Bhutan	45,620	5	876,058	18.79
Burma	678,031	1	3,056	ns
Cambodia	181,035	0	0	0.00
China	9450,948	181	14,544,768	1.52
Cook Islands	241	1	13,468	55.88
Fiji	18,272	2	5,350	0.29
India	3287,593	426	10,965,200	3.30
Indonesia	1919,263	135	14,048,098	7.30
Kiribati	655	2	3,550	8.47
Korea	99,590	17	557,700	5.60
Lao PDR	236,885	0	0	00
Malaysia	338,885	41	1,713,721	5.06
Maldives	298	0	0	00
Nepal	141,414	11	958,500	6.77
Pakistan	803,941	56	7,283,657	9.06
Papua New Guinea	461,692	2	3,143	0.01
Philippines	299,765	0	0	00
Singapore	580	1	2,434	4.20
Solomon Islands	29,785	0	0	00
Sri Lanka	65,610	38	739,771	11.28
Taipei, China	35,980	3	149,577	4.16
Thailand	513,517	74	4,536,157	8.83
Tonga	699	0	0	00
Vanuatu	14,763	0	0	0.00
Vietnam, Soc. Rep	334,331	50	789,154	2.36
Western Samona	2,841	1	2,857	1.01
Total	**19,866,011**	**1,092**	**57,958,018**	**2.92**

Note: Includes only areas exceeding 1000 ha and within IUCN categories I-V
Source: Asian Development Bank, 1991b.

The experience with a number of integrated conservation-development programmes globally had the following lessons to be gleaned (Wells et al, 1992):

- projects are only a part of a larger framework which can undermine it, e.g.commodity price collapses, insurgencies, animals viewed as threats to agricultural crops, landlessness and access to land tenure, etc.; there must be commitment to institutional reorientation, clear

mandates and legislation, realistic institutional implementation and managment structures, and serious attention to land tenure and resource access to adjacent communities;

- while small scale initiatives are adequate in small ESAs, the experience must be replicable and eventually taken up on larger scale efforts, although with caution, since the experience with too rapid expansion has been all too apparent in many rural development schemes;

- participating organizations will need to link socioeconomic development with biodiversity conservation, viz., development NGOs will have to work with environmental NGOs, and governments will have to be able to work with NGOs;

- site selection is crucial to success: (i) it is helpful where there are low population densities (clearly not the case here); (ii) traditional technologies can be used for resource extraction; (iii) effective management already in place at protected areas (not the case in Bangladesh); (iv) there is willingness on the part of locals and central government agencies to cooperate; (v) participation of organizations with the necessary experience;

- local participation in a genuine sense, meaning not only as "target beneficiaries" or temporary wage earners during infrastructure and maintenance work;

- financial resources must be made available on a long term basis, and not just as one-shot "projects", since the need for a long gestation period in redressing decades of neglect is evident; rather the intention is to build a process;

- many of the projects suffered from flaws in the project design and implementation.

Criteria for Designating and Managing ESAs

Selection-criteria for ESAs cover a wide range of ecological, socioeconomic and managerial factors. Criteria which determine the site's significance to the overall society include (ADB, 1991b):

- economic benefit;
- diversity of species and ecosystems;
- critical habitat, international;
- critical habitat, national;
- cultural diversity;
- urgency.

Criteria which could enhance the site value also include:

- the site has demonstration value for conflict resolution or provision of benefits;
- the representativeness of its natural characteristics;
- it is compatible with a tourism value;
- an outstanding or unique landscape;
- recreation values;
- possesses research and monitoring values;
- has elements which could contribute to public education and awareness.

Lastly, the potential for management is a factor, inasmuch as the site might have:

- social acceptance of locals or official protection by Government;
- existing conditions or situation present an opportunity for future use;
- feasibility of aquisition;
- ease of access.

ESAs and Recommended Landuse Strategies

The protected area system in Bangladesh is unfortunately -as noted earlier- dysfunctional. Existing ESAs are neither being protected nor managed. In addition, there are a number of other sites which have been suggested as main areas of environmental concern in Bangladesh (see GOB, 1991a, and GOB, 1991b). It should be noted that ESAs not directly related to possible forestry concerns will not be considered here. The sites which correspond to the numbers below are described from the NCS (GOB, 1991a).

1. Mohananda Basin: Frequently flooded, and also subject to droughts.

2. West Central Barind: being dessicated through improper landuse. Low water-table and poor soils affect crop agriculture.

3. Middle Karatoa floodplain: affected by drying up of Karatoa river. Double-cropping of HYV Rice has led to severe sulphur & zinc deficiencies.

4. Brahmaputra-Jamuna floodplain: entire stretch affected by Brahmaputra Right Bank Embankment, which has breached 4 out of the last 5 years. The main river may be shifting westwards. Large floating population in the charlands. Sand deposits after floods often ruin cultivable land.

5. Chalan Beel: Once one of the largest permanent wetland areas of Bangladesh, now seriously degraded by FCDI projects.

6. Atrai-Hurasagar drainage basin: due to construction of ill-conceived embankments & regulators drainage has been impeded and water-logging has become a serious problem.

7. Southwest Jessore: this area is climatically subject to wide variations in rainfall and temperature. Due to reduced flow in the Ganges in the dry season salinity has increased and freshwater flow has decreased.

8. Northern Khulna: large-scale shrimp farming has increased salinity and farmer conflicts and reduced rice production. The landuse conflicts have been covered elsewhere in this report.

9. Khulna City and Mongla town: problem area due to industrial pollution, oil spills from ships and urban congestion. These are outside the scope of the FMP, although pollution from these sources gets into the Sundarbans.

10. Sundarbans: 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.

11. Patuakhali-Bhola-Noakhali char areas: affected by water-logging, salinity, and diluvion.

12. Garo Hills Piedmont: erosion, flash floods, and loss of tree cover has led to decreasing agricultural productivity.

13. Tangail: affected by silting of rivers, increase in sudden flooding.

14. Madhupur Tract: deforestation and improper use of sloping land has led to topsoil erosion. This in turn has silted rivers all around this important watershed area.

15. Sitalakhya River: industrial plants at Ghorashal, Palash and Demra discharge toxic chemicals into this river leading to suspected loss of fisheries and creation of hazard for public health.

16. Dhaka city: industrial and traffic pollution creates serious health hazard: urban expansion is destroying Class I agricultural land and some of the best horticultural land in the country.

17. Haor Basin: reduction in fish spawning areas, due to embankments, cutting off fish migration routes, and to increase in boro cultivation, with consequent increase in the use of pesticides.

18. South Sylhet: affected by deforestation, fish floods, and soil erosion.

19. Lalmai Range: deforestation, erosion and soil removal have reduced prodcutivity and may reduce future potential.

20. Lower Meghna: affected by floods, riverbank erosion, stagnant productivity, loss of fisheries and population pressure.

21. Central Noakhali: affected by water logging in the wet season due to impeded drainage and lack of irrigation supply in dry season due to saline groundwater. This has led to decreasing agricultural productivity.

22. Sandwip: thickly populated island being eroded rapidly. New land formations not consolidated. Frequently affected by cyclones and surges.

23. Sitakunda Range: affected by deforestation and sheet erosion with consequent loss of productivity. This area is a major source of thatching grass and therefore urgently requires landuse planning.

24. Chittagong city and port: industrial pollution, oil spills, and cutting down of hills leading to increasing erosion and consequent silting of rivers have degraded the environment.

25. Chandraghona: industrial units discharge large quantities of chemicals into Karnafuli river, destroying fisheries and posing health hazards.

26. Hill Tract: slash and burn cultivation (jhum) and improper use of hill slopes by immigrants has greatly increased erosion on the hill slopes and flooding of valleys, with serious decline in treecover.

27. Chokoria Sundarban: a forest area totally destroyed for use as shrimp forms. Now yields are declining and soils are becoming highly acid.

28. Chittagong coast-Kutubdia Island: severe bank erosion, loss of land and increase in salinity has led to environmental degradation.

29. Cox's Bazar: tropical moist forest with unique biodiversity is being destroyed through clear-felling and planting operations, unchecked encroachment and illicit felling of trees.

30. Jinjira (St. Martin's) island and reef: Coral reef being destroyed through over-exploitation of corals and molluscs.

31. Muhuri Basin: successful agricultural project utilizing surface water irrigation, has in turn led to excessive use of fertilizers and pesticides and likely pollution of important fishing areas in lower Big Feni River and Sandwip channel.

The following are areas which have been degraded mainly through loss of forest cover, which includes wetland vegetation. They merit special attention. They will not be described in any significant level of detail. In addition to the existing protected areas, they will require a rapid rural appraisal followed by more detailed surveys on a national level, on a systematic basis. At this time it is difficult, if not impossible, with some exceptions, to clearly specify what priority should be assigned to each. The areas will be described on a regional basis, and will add to the existing ESA list.

1. Northwest Region

The first 6 ESAs noted above are found here. All these projects are susceptible to impacts from FAP 2, particularly as regards to the status of wetlands. It is thought that some 2,000,000 ha of wetlands have been lost to FCDI schemes over the years. Chalan Beel itself was more than 100,000 ha in extent, and now is possibly as low as 5000 ha of year round water. There are about 185 beels in the northwest region, covering a toal of 33,000 ha, only half of which is still connected to some river system for several months during the monsoon season. Within the Purna Bhaba-Mohananda, the Eklaspur-Hazhagi beel occupies some 1400 ha. Dargapara-Fulban beel covers 4,600 ha. Most of the beels are less than 1000 ha. The process which naturally fills the beels over time through sedimentation has been accelerated by conversion to agriculture and numerous FCDI schemes. It may be seen from Figure 6 that fish migration pathways up the Mohananda basin, the Atrai and through breaches in the Brahmaputra Right Embankment scheme is an important element of the natural ecosystems of the region. Within the FAP 2 interim reports (Mott MacDonald 1991, Annexes 8 and 9) the lack of baseline data was acknowledged , and further studies were recommended with more than 100 person months of ecological and social impacts on common property resources, the decline in capture fisheries, loss of grazing land, and impact on wetlands in particular.

Little has been said about forests in any of these ESAs in the northwest, with the exception that one of the Chalan Beel polders seems to have benefited from tree plantation on some embankments. The loss of floodplain tree species is not mentioned. The Karatoya River was once renowned for the magnificent Sal trees completely lining its banks more than 100 years ago. Extensive grasslands throughout the Hurusagar, Mohananda and the upper northwest (Dal, Chailla, Nalkhagra) are now rarely seen. The study (Mott MacDonald, 1991) suggests that possibly a beneficial impact of the project will be increased fruit and timber tree cropping. The same study acknowledges that " ...The last sites of forested areas are small and...the current status of these areas is not clear". Rangpur, Dinajpur and Rajshahi have about 15,000 ha of reserved, acquired, protected and vested forests. Bogra has 7 ha. Of the total forest about 1500 ha remain of natural forest, most of it of poor density and quality. The FAP 2 report says:

> " a country totally dependent on a floodplain, estuarine and coastal system, cannot afford to be complacent or disregard the need for proper management fo its stock of natural aquatic resources or the pollution build up which increased population, urbanisation and industrialiisation entails. Field data, proper research and, above all, adequate monitoring is urgently required to put these issues in their proper perspective and to allow rational planning of so large a potential hydrological intervention as the FAP might imply".

A number of possible sites in the region have been suggested for further consideration. They are too numerous to mention here. They fall into the categories of:

- sites of natural beauty and recreational value;
- special scientific value;

- worthy of protection and conservation (migratory bird habitats, open water fish ecology, remaining sites of natuiral forest, and sites of cultural and historic value);

- sites for special environmental management and monitoring (notably sources of urban, industrial and agro-chemical pollution).

The far northwest and the Barind were not covered by the FAP project. Little has been systematically studied within the Barind Tract. Almost the entire land surface and vegetation of northwestern Bangladesh including the Barind Tract are in a degraded condition. Researchers and members of CER surveyed vascular plants, lower plants, aquatic and terrestrial invertebrates, fish, amphibians, reptiles, birds, and mammals. Six sites within three major formations of the Barind were surveyed, and it was generally noticed that for all categories under study, the inventory was less than 50% complete, including only some information about a few taxa, a local area or a few communities. However, a list of 16 endangered tree species was produced (Zuberi, 1992). A location close to Rajshahi (Char Khidirpur) is known to be one of the remaining places where gharials nest and breed. Also not far from Rajshahi (Godagari) is a known location of dolphin concentrations, and is also a spawning ground of pangas (a catfish).

2. Northcentral Region

Known as nesting and overwintering sites for migratory wildfowl, the entire stretch from Jagganathganj to Aricha is known to be used for such purposes. Between Nagarbari and Aricha are also important areas for waterfowl at Char Bumiheen and Komala. FAP 3.1, working within this specific area notes that the main issues in the area regarding ecology are the possible impact of induced environmental changes on the number and distribution of species. It is further noted that very many species of flora and fauna have already become extinct or are endangered regardless of any project development. Natural vegetation has all but disappeared. There are no gazetted parks or nature reserves within the northernmost part of the region. It is a region of high deficit in fuelwood, much of which is trucked in from Madhupur, for commercial, industrial and residential use. Dhaka, Tangail and Mymensingh have more than 100,000 ha of official forest lands, of which no more than one-quarter would consist of poor density natural forest scattered in small pockets throughout the districts. It is evident that forests here are dispersed and highly encroached. There are two National Parks in the area, both of them degraded and encroached. A more detailed discussion of these follows later in the text.

General - Sal Forests in the Central Region of Bangladesh, there are the remnants of a much more extensive forest, which formerly extended from southcentral Bangladesh westwards well into the Indian subcontinent. The remnants of the sal forest are an important component of the natural heritage of Bangladesh, and it is therefore important to preserve living examples of this forest type, and its associated flora and fauna. Most of the remaining sal forest are degraded both in terms of forest structure, and biodiversity, and an active programme is required to rehabilitate examples of this forest type to their former structure and biodiversity. Since these forests are located in a densely populated part of Bangladesh, the forests have been subject to encroachment and overexploitation. This makes the management of these forests using traditional forestry concepts impossible.

It is therefore widely recognized that a new approach to forest landuse is required. This new approach should be based on principles of sustainable development, and integrate conservation, production forestry, and participatory forestry with traditional farming practices. There are many outstanding landuse issues which are restricting the effective development of this important land resource. Most of these landuse issues are related to land tenure. The issue of land tenure is complicated by the traditional land rights of the tribal minorities, who have traditionally lived on these forest lands. Because of the human rights implications of tribal rights, it is important that the land tenure issues involving tribal minorities be solved through open and honest negotiations,

rather than through the forced implementation of top-down programmes and solutions. Table 12 summarizes the land controlled by the Forest Department in these districts.

Table 12 - Summary of Land Controlled by Forest Department For 6 Districts in the Central Region of Bangladesh

District	Reserved Forest	Protected Forest	Acquired Forest	Total Forest Land
Dhaka	-	603.6	214.7	818.3
Gazipur	274.1	17,030.9	8,187.1	25,492.1
Tangail	22,412.1	-	27,294.8	49,706.9
Mymensingh	1,345.5	1,438.7	12,936.0	15,720.2
Jamalpur	-	-	4,196.1	4,196.1
Sherpur	-	-	7,882.2	7,882.2
Total	24,031.7	19,073.2	60,710.9	103,815.8

Source: Mahtab et.al. 1991

Very little forest remains in the northwest of Bangladesh. Efforts are being directed to the central region, as noted in Table 13.

Table 13 - Summary of Landuse in Dhaka, Tangail, and Mymensingh

Division	Wooded Land (ha)	Plantations (ha)	Degraded & Blanks	Encroachment	Total Notified Area
Dhaka	6,734	917	15,414	3,157	26,222
Tangail	9,975	5,157	12,836	13,889	41,877
Mymensingh	5,787	3,844	5,401	12,640	27,673
Total in ha	22,496	9,918	33,651	29,706	95,772
% of Total	23.5%	10.4%	35.1	31.0%	100.0%

According to Ghani et.al. (1990), the forests are situated in 488 mouzas in 23 upazilas. In 1986, the three Forest Divisions prepared a statement of areas by mouzas showing areas notified as forest, area under tree cover, degraded land, plantation and encroachment. The statement contains the basic data on area of the mouzas, population, number of cattle and poultry, based on 1981 Population Census and 1983/84 Agricultural Census.

In the statement, wooded land refers to areas under tree cover crop of 10 years or older. The crop is generally composed of sal of coppice origin. However, in the Madhupur Forest and the forests along the border belt of Sherpur and Mymensingh districts, there are stands of sal of seed origin. In these two zones, there are other species seen growing as associates of sal. The common species are Dillenia pentagyna (ajuli), Adina cordifolia (haldu), Artocarpus chaplasha (chapalish), and Lagerstroemia parviflora (jarul).

Degraded land means young sal coppice, cut over repeatedly by local people, mostly of 1-2 years age.

The term encroachment is used here to mean areas under possession of people, and recorded as such. In most cases, either the Forest Department has instituted cases in courts or the encroachers have gone to court to establish their right over the lands.

Past Practices and Results - Until 1917, the forests were managed by the proprietors. Cutting areas were leased out to lessees for 5 years at a time. Shifting cultivation by the tribal population was allowed in some areas. Big blocks of land were cleared by settlers and squatters.

The first management plan was prepared for the Bhawal forests in 1917, and for the Atia forests in 1934. The prescription was simple coppice system with retention of 10-19 seed-bearer trees per ha. Planting of blank areas and climber cutting was prescribed. Yield regulation was attempted, but could not be implemented without accurate data regarding forest squatters.

After division of the country in 1947, the forest was divided into the Timber and Conservation Working Circles, where the aim was clearfelling followed by plantation establishment, and Coppice Working Circle. In the timber and conservation working circles, the rotation was 75 to 80 years. For the coppice working circle, the rotation was 25 years. Climber cutting, thinning, and fire protection measures were prescribed.

Ghani et.al. (1990) summarized the results of past management as follows: (1) The legal status of the forest land in major areas was not firmed up through a complete forest settlement operation as per provisions of the Forest Act, after the transfer of ownership to Government. The legal weakness of the Forest Act encouraged encroachment and irregular settlement; (2) No comprehensive survey was ever carried out to determine the exact location of encroachment areas; (3) Though all working schemes expressed the object of management as meeting local demand, the actual practice was to sell outputs in auction to traders for marketing outside. The local people met their requirements by illegal exploitation; (4) The coppice system prescribed with standard seed bearers could not be executed properly due to the loss of mother trees through illegal fellings. This resulted in inadequate seedling regeneration; (5) The failure of coppicing resulted in blanks and encouraged encroachment. This has also resulted in the reduction of annual sustained production. The short fall was met by illegal fellings in the areas adjoining the annual prescribed felling areas.

Recent Experience - In the early 50's and 60's, sal plantations were established over substantial areas. However, over time, most of these plantations were badly damaged leaving only a few patches of well-stocked sal plantations in Tangail and Mymensingh Forest Divisions. In the 70's, plantations of moderately fast growing indigenous species were raised on recovered encroached lands. However, most of the plantations could not survive due to the hostile actions of the affected people. The plantations of mulberry raised during this period had a similar fate.

In the 80's, plantations of fast growing species were established on some recovered areas, but these areas are also suffering the same fate. In spite of this, the plantation programme continues. Field visits to the Mymensingh and Tangail Divisions highlighted some of the problems associated with the plantation programme in this area.

In spite of funding under the Community Forestry Project, the Forest Department has a very poor image in the eyes of the people, including the farmers, local administrators, and non government organizations. Many people complained about harassment during the process for expropriation of land for plantations. In some cases, according to local sources, this involved the physical abuse of women and children. Women and children who gather twigs and small branches from forests

for local fuelwood also complained of ongoing abuse by Forest Department staff. Whether the charges are true or not, the result is a very poor image for the Forest Department.

Local people cannot understand why locally useful degraded sal forests are being cleared, and converted to plantations of exotic species, which are less useful for the local people. The beneficiaries of such plantations are the timber and fuelwood traders who buy the wood at auctions, and not the local people.

Local people often benefit more from natural brush which provides a range of products, including fuelwood, poles, twines from vines, fencing materials, traditional medicines, and edible roots, than from single purpose plantations. This natural brush is also rich in natural flora and fauna, which helps preserve the biodiversity of the area. Local people therefore openly question the rationale behind such plantations.

3. Landuse Strategy in Northern and Central Region

Table 14 presents a sustainable landuse scenario for the Classified Forest Lands of Central Bangladesh, based on the "Core-Buffer-Multiple Use Strategy" for the management of natural resources.

Table 14 - Sustainable Landuse Scenario for the Classified Forests of the Central Region of Bangladesh

Zone and Landuse Type	Area by Zone (ha)	% of Area	Area by Type	% of Area
Core Zones	32,496	31.3%		
Wooded land			22,496	21.7%
Degraded and Blanks			10,000	9.6%
Buffer Zones	15,000	14.4%		
Degraded and Blanks			10,000 5,000	9.6%
F.D. Plantations			5,000	4.8%
Multiple Use Zone	56,320	54.3%	51,320	
FD Plantations				4.8%
Participatory Forestry and Agriculture				49.5%
Total	103,816	100.0%	103,816	100.0%

Core areas would be maintained for the preservation of biodiversity through the preservation of ecological diversity. There would be no logging in the core area, and access would be restricted. About 31.3% of the classified forest land, or 32,496 ha, would be designated as core zone.

A large core area is needed to protect viable populations of the main components of the ecosystem, both flora and fauna. The areas designated as core area may be disturbed or degraded. This does not matter as long as the forest area contains viable mother trees of the main species. It is also envisaged that enrichment planting will be used to increase biodiversity, and introduce seed stock into existing coppice stands. The forest designated as core area also does not have to

be in one block, but can be in several blocks. It would however be highly desirable to have some of these scattered core areas linked, as much as possible, through corridors of vegetation in the buffer and multiple use zones. This would assist the movement of wildlife between core areas.

For this reason, it is highly desirable to use native species in any plantations which are established and maintained in the area, and to enrichment plant areas being managed under participatory forestry programmes.

The buffer zone would be managed in such a way as to protect the core areas, and extend the habitat available to wildlife. Timber could be extracted on a selection basis, if adequate regeneration and advanced growth of suitable species are established on the site. About 14.4% of the classified forest, or 15,000 ha, would be designated as buffer zone. The extraction of wood and non wood products would be controlled by leases or permits.

The multiple use zone would be intensively managed for the production of wood and non wood products, as well as suitable agricultural crops. The aim would be to develop each site with the most suitable crop. In some cases, this would mean agricultural crops such as pineapples, sugarcane, vegetable gardens, and/or fruit orchards. In other cases, this would involve appropriate agroforestry models. In still other cases, it would mean block plantations, or the intensive management of blocks of degraded sal forest. About 54.3% of the classified forest, or 56,320 ha, would be designed as multiple use zone.

Participatory forestry and environmentally appropriate agriculture in the multiple use zone would be encouraged by the granting of long term leases (30 years), which would be transferable to offspring and renewable on certain conditions at the end of the lease period (30 years). This system would be used for land which is not subject to disputed tenure. The courts should settle any outstanding cases of land tenure on other lands. Priority must be given to the people who presently occupy the land.

In the case of ethnic minorities (tribal peoples), land tenure issues should be settled through direct negotiations. There may be advantages in including tribal lands into a reserve system, which would integrate their lands with some of the lands designated as buffer and core areas. Some of the established block plantations which are adjacent to tribal lands could be included, and managed by local groups for wood production, and income generation. Thus, this whole land area would be managed in an integrated and participatory manner for conservation of biodiversity, production of wood and non wood products, and the preservation of the culture of the tribal peoples. This approach would probably be most appropriate in the Madhupur area. A special Garo Multiple Use Management area could be established, including Madhupur National Park as part of the protected core area

Retaining Forest Plantations and Sustainable Landuse - The sustainable landuse scenario for classified forest lands in the sal forest area of the Central Region of Bangladesh proposes that:

- It will be difficult for the Forest Department to protect this area. Thus, there is little point in establishing new plantations.

- Because of difficulties associated with the protection of existing plantations, it would be advisable to convert these Forest Department plantations into participatory forestry plantations, managed and protected by the local people. This could be done through long term leases. Preference should be given to poor people already living adjacent to these plantations.

- In areas dominated by tribal peoples, there would be advantages in integrating plantations into a reserve area for conservation, production of wood and non wood productions, and the preservation of tribal culture.

- It should be noted that 3,000 ha at Madhupur were handed over to BFIDC for the establishment of a rubber plantation. The alienation of this land for BFIDC required the removal of local families from the area. In some cases, harassment was used to remove these families, and local people complained of physical abuse. In order to rectify this unfortunate situation, an effort should be made to convert this public sector plantation into smallholders' rubber, involving the displaced people in the programme. This would be a good opportunity to involve tribal people who have been disadvantaged by the migration of people from outside the area into the area. This could be integrated with the Participatory Forestry programme, since smallholders' rubber cultivation is a form of participatory forestry.

- It is recommended that no new plantations be established on forest lands in the Region until integrated forest management plans have been prepared for each of the proposed Multiple Use Management Areas. To continue to establish plantations risks putting the limited land resources under a long term landuse before the most beneficial use of the land resource has been determined by a proper planning process.

- It is recommended that tribal rights be settled through direct negotiations. There may be advantages in including tribal lands into a reserve system, which would integrate their lands with some of the lands designated as buffer and core areas. Some of the established block plantations which are adjacent to tribal lands could be included, and managed by local groups for wood production, and income generation. Thus, this whole land area would be managed in an integrated and participatory manner for conservation of biodiversity, production of wood and non wood products, and the preservation of the culture of the tribal peoples.

- A special 'Garo' Multiple Use Management area could be established, including Madhupur National Park as part of the protected core area.

4. South Region

General - The area is highly deficit in fuel in locations remote from the Sundarbans. The area also has extensive haors, baors, and beels throughout the moribund delta. Ata Danga Baor is the only one mentioned in the Asian Wetlands Bureau directory as significant. However, recent surveys have confirmed that a number of coastal chars are of significance. The stocking of natural mangroves has been said to have dropped by 40% between 1961-1984 (Chaffey et al, 1985). Areas of the Sundarbans are undergoing top-dying (see Figure 6) among Sundri trees, for which a number of reasons have been advanced, but none conclusively. The Sundarbans has just over 577,000 ha of forest, most of it having been cut over previously over the past 100 years. The area as a whole is of international importance, and should be designated with an appropriate category which provides for protection and management of this unique resource.

The Sundarbans Mangrove Forest, which is situated in the combined deltas of the Ganges, Brahmaputra and Meghna Rivers, is reputed to be the largest contiguous mangrove forest in the world. Approximately two thirds of the remaining forest lies in the southwest corner of Bangladesh and the remainder in India.

The Bangladesh portion, which is the subject of this discussion, now includes some 410,000 ha of mangrove forest and 170,000 ha of open water areas in river channels, canals and tidal creeks. However, it must be kept in mind that the original forest extended much beyond its present

boundary, and that the present forest represents only a small remnants of a much larger forest. As recently as the last 100-200 years, the Sundarbans Mangrove Forest extended much farther inland and included much of the Khulna Region, and formed a continuous forest east along the coast of Bangladesh as far as the Chokoria Sundarbans and the Naf River.

In order to preserve a remnant of the more extensive Sundarbans Mangrove Forest, the present reserved area was declared a Reserved Forest under the Forest Act in 1879. Since then, the Sundarbans Reserved Forest has been managed by the Forest Department, and all harvesting of forest products and fish has been legally controlled by the Forest Department. There is no legal hunting in the Reserved Forest.

This has important implications for landuse planning, in as much as the planning and allocation of land for various landuses should be based on the whole of the former Sundarbans Mangrove Forest area and not be restricted to the area presently under Reserved Forest. That is, it must include the areas which have been cleared for permanent agriculture, shrimp and fish culture, homesteads and villages, and urban and industrial centres. This planning will be done under the coastal zone management plan, but will designate the existing reserved forest for managed as recommended here.

The fact that the mangrove forest within the Sundarbans Reserved Forest represents only a small part of the previous forest makes it even more precious for conservation of biodiversity, and as a breeding ground for species whose range extends much beyond the present boundaries of the reserve. This is true for animals such as fish, shrimps, crabs, birds, etc., and for vegetation such as colonizing species which help stabilize new accretions.

This has important economic benefits. For example, the head of the Bay of Bengal is the most important fishery in the subcontinent. The mangrove forests and mudflats of the Sundarbans Reserved Forest provide a vital breeding and nursery grounds for a large proportion of the finfish, crustaceans and molluscs that make up this fishery. In recent years, the recorded annual catch in the Sundarbans Forest Reserve has ranged from 6,000 to 10,000 metric tonnes, while the total annual catch in the Sundarbans Reserved Forest and adjacent waters of the Bay of Bengal has been estimated at 38,000 metric tonnes. This contributes hundreds of millions of Taka to the annual GDP. NWFP from the Sundarbans Reserved Forest have also contributed hundreds of millions of Taka to the GDP.

The total income derived from various products in the Sundarbans for 1988/89 (extracted from Project Preparation Report: Environmental Component Bangladesh Forestry III Project, p. 150) is listed in Table 15.

Table 15 - Sundarbans Forest Products

Forest Product	Tk million
Fish	300.0
Wood (excluding goran)	257.0
Firewood (sundri and goran)	237.0
Gewa pulpwood	80.0
Golpatta fronds	32.0
Zinok grass and hantal	7.8
Honey, beeswax	2.5
Total	916.7

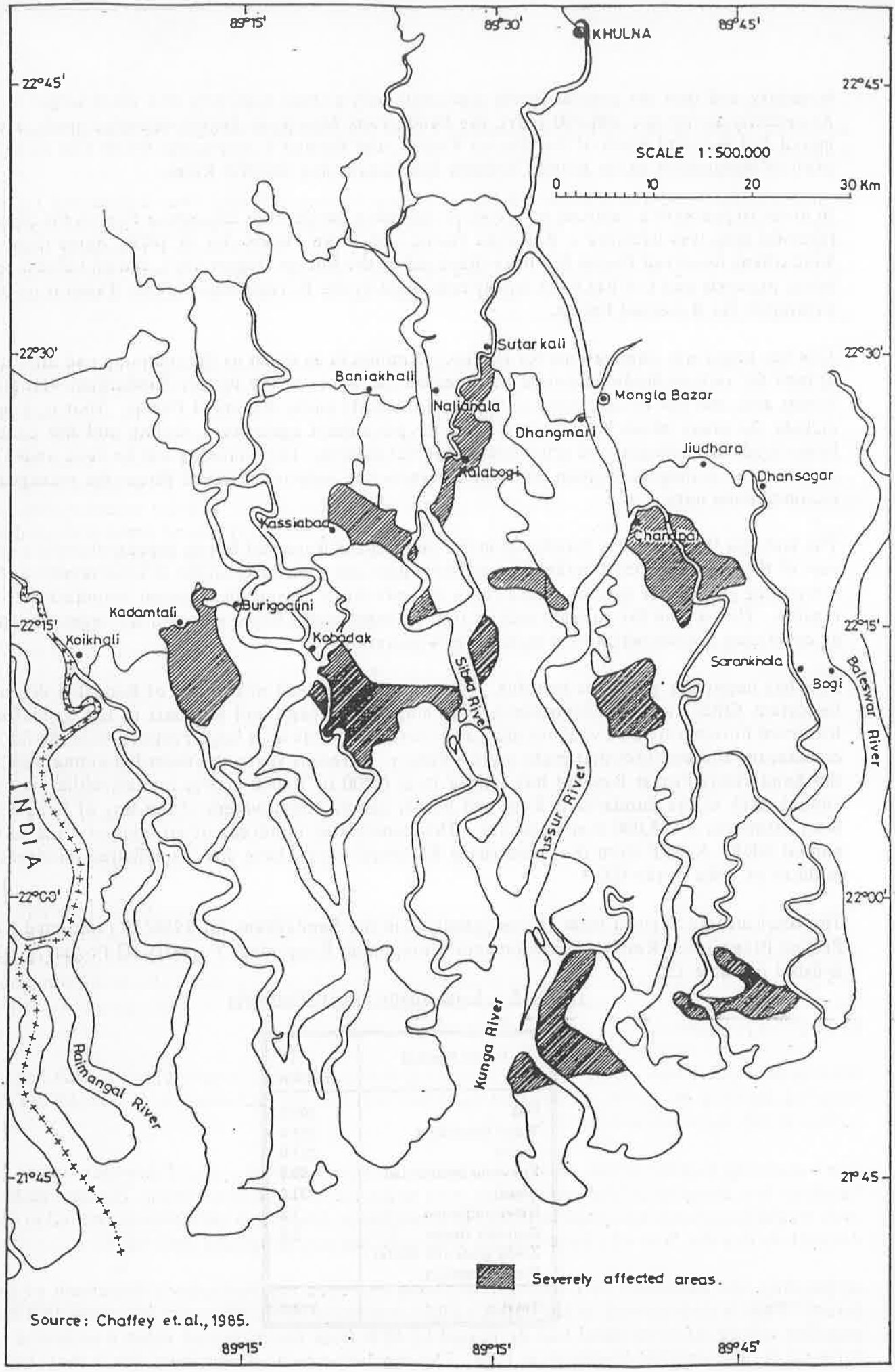


Figure 6 - Areas of Top-Dying of Sundri

According to the same report, this provided 11,040,000 man days of work for several hundred thousand people.

In addition, the Sundarbans Reserved Forest supports a very rich and diverse flora and fauna, including at least 330 species of plants, 42 species of mammals, 270 species of birds, 35 reptiles, 8 amphibians, and 120 species of commercially important fish. It is the largest remaining tract of habitat for the Royal Bengal Tiger, Panthera tigris, and the last refuge for a variety of mammals, birds and reptiles which are now rare or extinct elsewhere in Bangladesh. Thus, it is irreplaceable for wildlife conservation in Bangladesh.

The Sundarbans Reserved Forest also acts a natural barrier to cyclones and tidal bores, and protects densely populated agricultural areas to the north from many natural disasters. This was acknowledged in the Choudhury Working Plan of 1968, which had as one of its objectives the maintenance of forest structure thereby "ensuring possible protection of cultivated land in the interior from the devastation caused by periodic cyclones, storms and tidal waves". Some of the storms have resulted in considerable loss of life. For example, a 1970 storm killed between 300,000 and 500,000 people; a storm in May 1985 killed over 11,000; and the severe cyclone of April 1991 killed at least 138,000 people. The densely populated agricultural areas protected by the Sundarbans have been spared from many of the worse impacts of such storms.

5. Landuse Strategy in the South Region

Recent inventories and studies show that the Sundarbans are being overexploited. As a result, many species of mammals, birds, amphibians, reptiles, fish, and crustaceans are on the decline, while the stocking of major economic species are being drastically reduced. This led Chaffey et. al. (1985, A Forest Inventory of the Sundarbans, Bangladesh, p. 172) to conclude that:

> "...if the Sundarbans is to continue to be managed for sustained yield production, the level of exploitation will have to be substantially reduced. In the absence of such a reduction, the prospect for the Sundarbans is that within the foreseeable future the forest will be depleted to such an extent that it could become questionable as to whether the whole or even part of it should retain its status as reserved forest."

The biomass resources of the Sundarbans are declining because of overexploitation due to extraction by two competing groups (1) large wood-based industries needing large quantities of biomass raw materials on a sustained basis and (2) numerous small scale users providing materials and products for domestic use and cottage industries. The resources just can't meet the combined needs of these two groups, and therefore a decision has to be made as to which group of users is to be given preference.

Khulna Newsprint Mill - The Khulna Newsprint Mill which was commissioned in 1959 has an installed capacity of 40,000 ADMT per annum. This can be increased to 50,000 ADMT, if sufficient raw materials are made available.

The harvesting plan for Gewa wood was based on a 20-year cutting cycle. Extraction was to be based on four five-year felling plans, which were to outline detailed operations. The first cutting cycle was to have been completed in 1980. However, due to lower than anticipated production and disruptions due the War of Liberation, the first cycle was not completed until 1987.

Apparently, the extraction rate during this period exceeded the real growth increment of the forest. This is documented in the ODA (1985) inventory. This inventory indicated that the standing volume of gewa wood had decreased by 45% from the projected volume estimates by Forestal in their original inventory in 1959. The conclusion to be drawn from this is that the

Sundarbans Reserved Forest cannot provide the Khulna Newsprint Mill with a sustainable supply of raw materials at volumes which will meet the capacity needs of the mill.

The Khulna Newsprint Mill is facing serious economic problems. As noted in the Harvesting Report, the company is presently losing about 5000 Taka (US$130) per tonne of newsprint, mainly due to the high cost of furnace oil. The Forest Department has recently raised the royalty rate to 15 Taka per cft. This will increase the loss on newsprint by an additional 1350 Taka (US$35) per tonne. Under such circumstances it is very difficult, if not impossible, for the mill to continue to operate. As already noted above, the mill is also experiencing problems associated with supply of raw materials from the Sundarbans Reserved Forest. These problems are likely to increase in the future, especially in light of the growing recognition of the international importance of the Sundarbans for conservation purposes. A representative series of nature reserves or national parks designed to preserve the biodiversity of the numerous ecosystems and forest associations found in the Sundarbans would also reduce the area available for industrial extraction of the various species. If this happens, the amount of raw materials available for KNM on a sustainable basis would be even further reduced. The Ministry of Environment and Forest has recognized this possibility and has advised KNM to reduce its dependence on forest produce and to explore the possibilities of using alternative raw materials other than forest produce (see BCIC 1990). It is difficult to envisage sustainable sources of such raw materials in the Khulna area, other than from the homestead forests. If such materials were acquired from homestead forests, this would contribute in a major way to the depletion of the homestead forests, and this would have a negative impact on the rural people, especially the poor.

Thus, the shortfall should come either from imported pulp or from pulp from plantations established in the Chittagong area, where under utilized forest lands are more readily available. However, as an interim measure, various scenarios could be developed where a portion of the raw material requirements of KNM could come from the Sundarbans and part from outside. The proportions would depend on the outcome of the studies scheduled to be carried out in the Sundarbans under the Integrated Development of the Sundarbans Forest Project and the Forest Resource Management Project. In light of the recognized energy deficiency in the Khulna region, such scenarios should only be viewed as temporary measures, to provide the mill with wood until such time as the mill needs a major overhaul of machinery or when machines needs to be replaced. At such time, the mill should be closed and funds used to build capacity in under utilized areas of the Chittagong region.

Khulna Hardwood Mill - The Khulna Hardboard Mill has an annual production capacity of 30 million square feet of 4' x 8' x 1/8" hardboard. The mill is presently running at 60% of capacity or 18 million square feet due to a lack of raw materials. According to the Harvesting Report, the Forest Department has been supplying only 19,822 m3 (700,000 cft) of fuelwood and top-dying sundri wood, since the Moratorium imposed in 1989 on the cutting of trees in high forest,

Because of the Moratorium, the cutting of Sundri is restricted to trees which are at least 50% dead. The policy of only salvaging Sundri trees when they are 50% dead has resulted in much higher costs to KHBM and to BFIDC's treatment plant. Extraction and delivery costs are also high.

It is difficult to image any scenario which can guarantee a sustainable supply of raw materials for the Khulna Hard Board Mill based on resources within the Sundarbans Reserved Forest. As noted in the ODA (1985) inventory, the volume of sundri has decreased by 40% since 1959.

The management of the reserved forest based on principles of sustained yield management will require a reduction in the annual extraction rate. This will mean less raw materials for the Khulna Hard Board Mill and for sawmills in the Khulna, Barisal and Patuakhali districts.

In light of this situation, a strategy needs to be found to provide the mill with raw materials until such time that the mill needs a major overhaul, requiring a large capital investment. At such a time, consideration should be given to closing the mill in Khulna, and building another mill where raw materials will be more readily available from plantations established especially to provide for the needs of the mill;

An interim strategy could be based on supplementing reduced supplies from the Sundarbans with raw materials brought in from outside.

Local Sawmills - According to ESCAP (1987), round wood from the Sundarbans represented up to 80% of the consumption of the sawmills in the Khulna, Barisal and Patuakhali Districts. This level of consumption cannot be maintained by round wood from the Sundarbans. As noted above, the management of the Sundarbans Reserved Forest based on principles of sustained yield management will require a reduction in the annual extraction rate. This will mean less raw materials for the sawmills in the Khulna, Barisal and Patuakhali districts. Furthermore, poor recovery rates of only 38% from sawmilling would exacerbate wastage of resources. An interim strategy could be based on supplementing reduced supplies from the Sundarbans with raw materials brought in from outside.

Fuelwood - As noted by ESCAP (1987), fuelwood harvesting has increased faster than that of other woods. This is particular true of sundri fuelwood, the extraction of which has been rising at an annual rate of 18% or so. The extraction of goran, the other major fuelwood, has been rising at a rate of 5%, making the overall rate of increase for all fuelwood 13%. Fuelwood from the Sundarbans is marketed over much of western Bangladesh and also as far as Dhaka for both domestic and industrial use. According the Chaffey et. al. (1985), 317,700 tons of fuelwood were extracted in 1982/83, and this was down from a high of 499,700 tons in 1979/80.

The supply of fuelwood from the Sundarbans could be increased by silviculture activities, which would increase the stocks of fuelwood species. This might mean a reduction in the stocks of gewa, which is not a fuelwood species.

Government and non government agencies are presently expending considerable human and material resources on expensive programmes aimed at increasing the availability of fuelwood in the energy deficit west Bangladesh. It would probably be more cost effective to focus these resources on the sustained yield management of the Sundarbans for fuelwood and timber.

Non Wood Products - The leaves of the nipa palm (golpatta) are used for thatching, and those of the palm Phoenix paludosa (hantal) for making house walls. Grass cutters harvest mature stands of grasses on char islands and in the southeastern meadows during the winter months. These are important raw materials for the rural poor. It is therefore important that the Sundarbans Reserved Forest be managed for sustained supplies of these materials. This may mean developing active programmes for the management of these plants. Many thousands of people enter the forests between April 1st and mid-June to collect honey and beeswax from wild bees' nests, and in recent years the annual harvest has been estimated at about 230 metric tonnes. In order to increase the yield of honey and bees' wax, it may be necessary to encourage the growth of key fodder species, either through natural or artificial regeneration. This may reduce the area available for growing traditional industrial woods, such as gewa. The focus should be on the native bees, which are migratory and adapted to the food supplies of the area. Exotic bees should not be introduced. Mollusc shells are gathered and used to produce lime for consumption with betel nut. The stocks are being overexploited, and stocks may benefits from having some breeding areas set aside within core areas of nature reserves.

Fisheries - The fishery in the head of the Bay of Bengal is the most important fishery in the subcontinent. The mangrove forests and mudflats of the Sundarbans provide the vital breeding and nursery ground for a large proportion of finfish, crustaceans and molluscs that make up this

fishery. It is estimated that some 35% of the marine fish catch in the Bay of Bengal is of species dependent upon the Sundarbans for some period of their life. During the winter months, many thousands of fishermen and their families from as far away as Chittagong establish temporary camps along the outer coasts. The greatest concentration of these seasonal fishermen occurs on Dubla Island, where at the height of the fishing season there may be as many as 10,000 people. The recorded catches in the Sundarbans and adjacent waters have increased from around 60,000 metric tonnes in the early 1960s to about 150,000 metric tonnes in recent years.

However, despite a steady increase in fishing effort, fish catches are now declining. The fishery is also threatened by the increasing capture of post-larval and early juvenile prawns, mainly the Tiger Prawn (Penaeus monodon). It has been estimated that for every kilogram of the desired species caught, between 10 and 20 kilograms of fish fry and prawn larvae of other species are discarded with great mortality. Efforts by the Forest Department to control this harvest have met with strong opposition, and this extremely wasteful practice continues.

Thus, it is important for conservation of fishery resources to designate areas within the Sundarbans as protected areas with restricted access, which can be used as nursery areas for fishery species. The present system of wildlife sanctuaries is inadequate for this purpose, and more areas must be set aside and protected by managed buffer areas. Thus, in order to protect fishery resources, it will be necessary to protect more areas, thus, reducing the area available for wood extraction.

Wildlife - The Sundarbans Reserved Forest supports a rich fauna. A Directory of Asian Wetlands describes some of the more interesting aspects of this fauna. Some wildlife populations are under threat from disturbance and poaching, particularly along the Passur River where access is relatively unrestricted. Fishermen's camps are also a major source of disturbance to wildlife, and there is extensive illegal hunting and trapping, not only by fishermen and woodcutters, but also by high officials of civil and defense services stationed in the area. In order to protect these species and help increase their numbers, it will be necessary to set aside a number of core areas which have restricted access. These will serve as breeding areas for rare and endangered species, as well as some of the more common species. A series of core areas will be necessary. With time, the core areas may have to be modified and/or changed to conserve various components of the flora and fauna of the area.

Ecological Diversity - The Sundarbans Reserved Forest is not one large homogeneous ecological unit, but a heterogeneous mix of smaller ecological units spread over space and time along a number of dynamic environmental gradients. These can be defined in terms of ecological zones, forest/ vegetation types, and/or associations representing various stages of succession.

Curtis (1933) recognized three ecological zones within the Sundarbans, differentiated according to salinity and species composition. Chaffey et. al. (1985) used Curtis' terminology, but shifted the boundaries eastwards to better reflect present realities.

The present Wildlife Sanctuaries include some good examples of vegetation on new accretion. Care must however be taken in managing some of these areas so that they are not overgrazed by deer, and disturbed by man, in order to allow natural succession to take place. This is important for scientific research into natural processes, and for educational activities related to natural succession.

A total of 13 main floristic types of forest and four non forest types were recognized and mapped by Chaffey et.al. (1985). Each of these forest types provide different habitats for various species of flora and fauna, and therefore each has a role to play in the preservation and conservation of the Sundarbans. Thus, it is important that all these types are adequately protected in a Nature Reserve management system for the Sundarbans.

The fact that some areas which were formerly dominated by sundri are now above tidal influence and the sundri and other mangrove species have been replaced by dryland species strongly suggests that sundri is only an edaphic climax species, and the true climax vegetation would be dryland lowland forest. With uplifting, the succession would continue through various freshwater swamp formations/ associations to dryland lowland formations/associations. This has important implications for the management of the more inland areas, where land has risen above tidal influence. Such areas should also be included as core areas to allow for greater ecological diversity and biodiversity in the Sundarbans Reserved Forest.

Preferences and Priorities - As noted above, the biomass resources of the Sundarbans are declining because of overexploitation due to extraction by two competing groups (1) large wood-based industries needing large quantities of raw materials on a sustained basis and (2) numerous small scale users providing materials and products for domestic use and cottage industries. The resources cannot meet the combined needs of these two groups, and therefore a decision has to be made as to which group of users is to be given preference.

Since industrial users can make use of alternative supplies or can relocate in areas with sustainable supplies of raw materials, preference and priority must go to small scale users for domestic use and cottage industries. This preference is based on socioeconomic considerations related to social equity and poverty alleviation. Giving preference to small scale users does not automatically eliminate industrial use. For example, gewa can be used for matchwood. The matchwood industry uses less volume than the newsprint industry, but employs more people. For example, according to ESCAP (1987), the match factories in Khulna employed 4,000 people, while the Khulna Newsprint Mill employed 2,250 people and the Khulna Hardwood Mill only 269 people. Match making is also a good cottage industry. Overall recommendations include:

- The whole of the Sundarban Reserved Forest should be set aside as a World Heritage Site. This would add 580,000 ha to the protected area system, effectively increasing the present size to about 3.5 percent of total area of the country;

- The area would be managed on a multiple use basis, core areas of approximately 70,000 ha would be comprised of National Parks or Wildlife sanctuaries, approximately doubling the present area;

- Buffer zones would comprise about 133,000 ha. Some of this area may be necessary for inclusion in the core zone, pending surveys of flona and fauna;

- The largest portion - the multiple use zone of 377,000 ha - would be managed on a sustainable basis for fuelwood and NWFP, primarily directed towards meeting the needs of the rural poor.

6. Coastal Plantations

Char Kukri Mukri, Sonar Char, are among the charlands important for migratory wildfowl. In Bhola plantations, while encroachment is limited, a large percentage of forest plantations are being eroded. In Noakhali, there is very high erosion in this region. Companiganj has had 69% of plantations eroded, while Sagoria has had 50% disappear. These examples underscore the difficulty of raising and maintaining plantations in the coastal areas. There are important areas for migratory wildfowl here (Nijhumdwip and Ghasiar Char), but the importance of plantations here in mitigating disasters has been demonstrated earlier in the text. Illustrates the coastal area of Chittagong. Next to Noakhali, Chittagong has the second largest land area under plantation, consisting of 32,000 ha planted. It is unknown at the time of writing what amount of land has been encroached or eroded. Both are thought to be realtively low, although the number of failed plantations might be quite high. Other ESAs in the area include Urir Char and Baradia for migratory wildfowl. Kutubdia is a well known nesting site for internationally endangered sea

turtles. Figures 7 and 8 graphically illustrate what has happened to the Chokoria Sundarbans, as a result of landuse conflicts and misuse of resources. The former is the area of healthy mangrove circa 1975. The latter shows the area completely devastated, to an extent that it would be difficult to rehabilitate. It was also an area where the cyclone and tidal surge of 1991 did tremendous damage.

Newly Accreting Coastal Lands - The mangrove environment in Bangladesh covers the 730 km length of the coastline of the Bay of Bengal, which forms the southern boundary of the country. The depth of the area landward varies from less than 1 km to about 100 km. In the past, this whole zone was covered by a continuous mangrove forests which extended from West Bengal in India to the Chokoria Sundarbans in the Cox's Bazar District. Much of the mangrove environment, outside the Sundarbans, was converted to agricultural land for field crops, grazing, and fish/shrimp culture.

At present, the population in this belt is very dense, particularly in the Noakhali region. ESCAP (1987) estimated that the population dependent on the mangrove ecosystem was at least 7 million in 35 upazillas.

The series of disastrous cyclones and tidal surges in the period 1960-1965 prompted the Government to initiate cyclone protection measures. These measures included the construction of embankments, shelters, earthen "dhippi", and ponds. There was also a recognized need for coastal afforestation to establish a protective shelterbelt along the coast. The idea of shelterbelts came from the observation that the Sundarbans natural mangrove forest provided protection to the western coastal areas against cyclones.

A mangrove afforestation project was initiated by the Forest Department in 1965 in the Coastal Zone between the mouth of the Haringhata River and the tip of the Teknaf Peninsula. Some 36,032 ha were planted during the period 1965-66 and 1979-80. Under the Second Forestry Project, an additional 40,000 ha of mangrove plantations have been established, and maintenance was carried out on existing plantations.

It is proposed under the Forest Resources Management Project (Forestry III Project) that mangrove afforestation would be carried out on 23,800 ha of newly accreted land, and on 9,100 ha of existing plantations which were severely damaged by the April 1991 cyclone.

On 14 August 1985, in a meeting chaired by the Minister of Land Administration and Land Reform, it was agreed that 40,486 ha of newly accreted lands in the coastal areas would be transferred to the Forest Department for 20 years for afforestation under the Mangrove Coastal Afforestation Project supported by the World Bank.

As shown in the cyclone of April 29, 1991, the coastal communities from Feni to Sitakunda which are protected by a 1 to 2 km wide of shelter belt of plantations suffered the least casualties and property damages. This alone is enough justification for keeping the plantations as shelter belts. Obviously, they have to be declared as reserved forest, if they are to be permanently under forest cover.

Over the long term, accretions and uplift may result in some plantations rising above tidal influences; thus, making them no longer suitable for mangrove species. When this happens, it is advisable to replace mangrove plantations with plantations of high value dryland tree species. The Forest Department and the Forest Research Institute are presently carrying out trials to determine which dryland species are most suitable for this type of plantation. Some of the species which appear to have potential for this purpose are: Dalbergia sissoo, Albizzia procera, Acacia nilotica, Samanea saman, and Leucaena spp. (Ipil ipil).

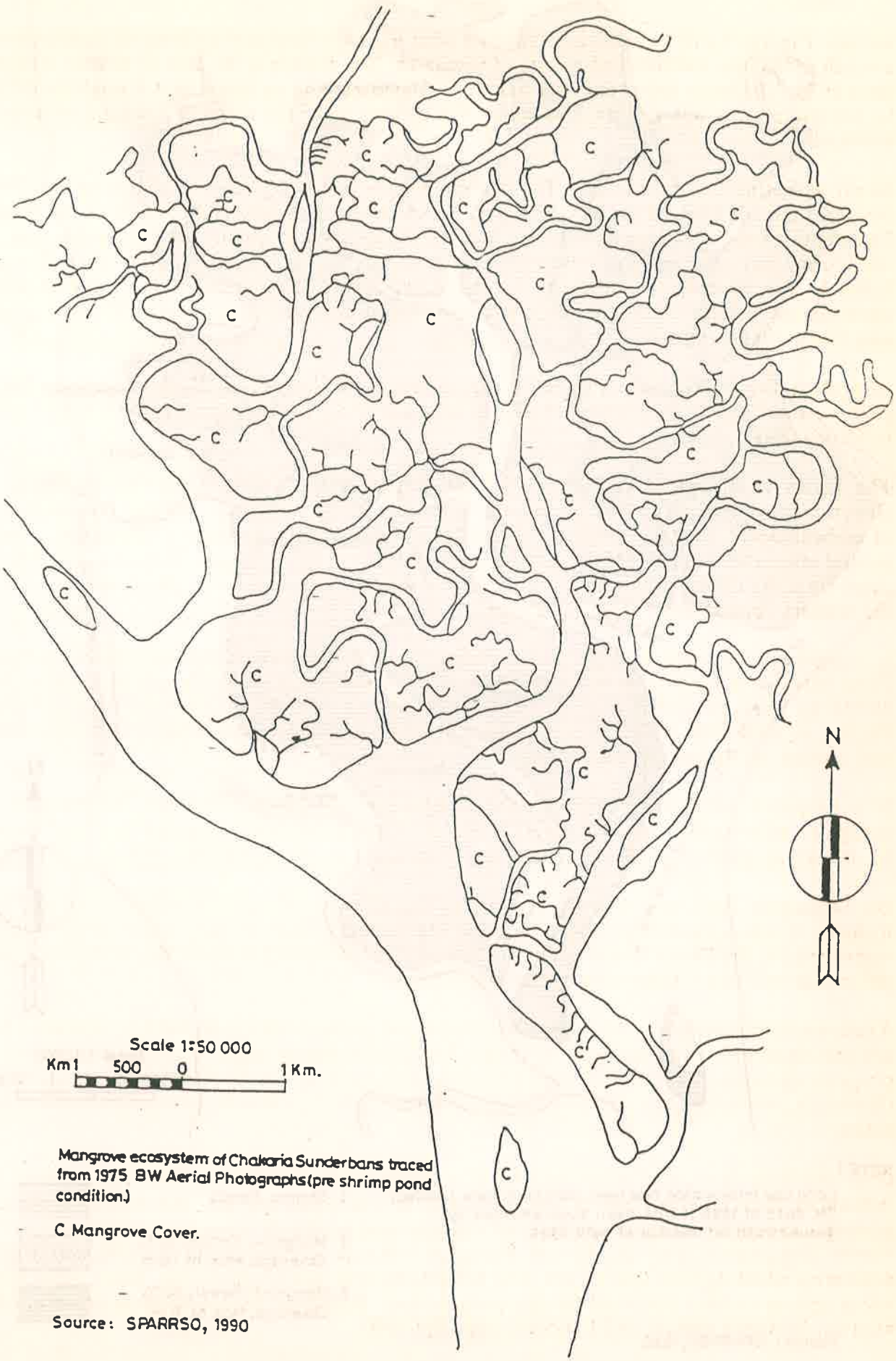
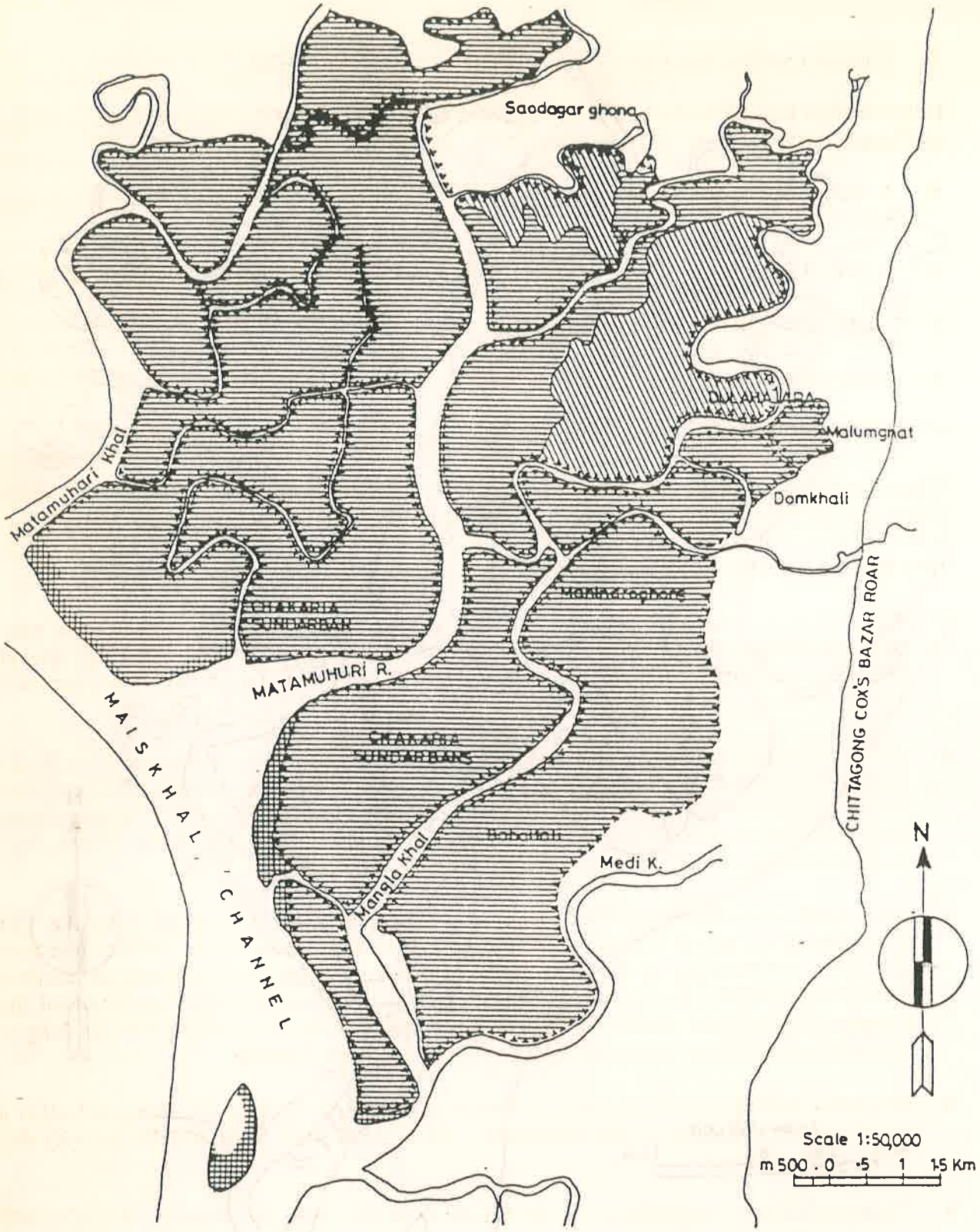


Figure 7 - Chakaria Sundarban Land Use, 1975



NOTE :

Land use information has been Obtained from Landsat TM data of 1988. It has been supplemented by groundtruth infomation of NOV. 1989.

1. Shrimp Ponds
2. Mangrove Scrubs, 60 %. Coverage, Max. ht. 1-5 m
3. Mangrove Forest, 80 % Coverage, Max. ht. 5 m.

Source : SPARRSO, 1990

Figure 8 - Chakaria Sundarban Land Use, 1988

7. Coastal Landuse Strategy

It is therefore feasible to declare newly accreted lands as reserved forests, and manage them over the long term for:

- A shelter belt to protect human life and property in low-lying coastal areas from cyclones and tidal surge.
- A cover to accelerate the process of siltation and the stabilization of newly accreted soils.
- Production of wood for fuel, timber, and other uses.
- Generation of employment in coastal areas.
- An environment for wildlife, fishes and other estuarine and marine fauna.

Wherever possible, people should be discouraged from living permanently in the open disaster-prone coastal island. Putting newly accreted lands in reserved forests would be one way of achieving this, and reducing future disasters and lost of life and property. In areas which have already been handed over for agriculture, other options should be explored:

- When new accretions are given over for agriculture, the land should go to the people who are actually going to live on the islands, and not to absentee landowners. An effort should be made to rationalize present land tenure to ensure that the farmers actually have tenure over the land which they are farming.
- An effort should be made to identify tree crops which can be profitably grown on these low lying islands and coastal areas. These tree crops could then be grown in a protective mosaic with field crops. This would help reduce the impact of cyclones and tidal surges. Some of the commonly occurring species are coconut, betelnut, date palm, guava, lemon, mango, Acacia nilotica, Albizia procera, Dalbergia sissoo, Samanea saman, etc.
- The wood and non wood products which come from areas controlled by the Forest Department are put up for public auction and sold to the highest bidder. This system favours the better-off business people over the local residents. The local residents generally only benefit by being hired as low paid labourers. It is therefore strongly recommended that a system be developed which would allow poor local people to participate in the long term management of these resources, and give them long term benefits.
- The same principle could be used for timber and fuelwood from plantations, and other non wood products associated with plantations. In the allocation of all permits, priority should go to the local poor.
- Such participatory management would benefit from the active involvement of NGOs. NGOs have considerable experience in working with the rural poor, and in group development for the management of a common resource;
- The important role of women in the gathering and processing of wood and non wood products should be recognized, and women should benefit equally from permits issued.

8. Southeast Region

Only two areas have been identified as ESAs in this area. The Lalmai hills are a remnant of the sal forest. It is also being mined for sand, and being put to other inappropriate uses. The Muhuri

Basin has been described also as an ESA in the NCS. It is not an area with relevance for forestry, and the issue is more related to FCDIs. However, other sites are wetlands and major bird areas, as well as spawning grounds for giant shrimp. Work under FAP 5 will have to consider mitigating impacts of embankments on fish migration pathways. The Meghna-Dhonagoda project has been severely criticized in many earlier studies for failing to pay attention to the kinds of impacts FAP 5 will likely incur.

9. Chittagong Hill Tracts

General - The reserved forests of the Chittagong Hill Tracts have considerable potential for multiple use forest management. At present, the forest lands in these reserved forests are being rapidly degraded by illegal logging and shifting cultivation. If the present trend continues, the forest lands in these reserved forests will be devastated, and converted into unproductive forest lands within 10 years. This will have a serious impact on the natural environment, and will result in increased soil erosion, and the silting up of rivers and reservoirs. There is therefore an urgent need to bring these areas under intensive multiple use forest management. This however will not be possible until the present ethnic problems are settled according to principles of human rights through direct negotiations. The average population density in the area is 73.9 per km^2, which is much less than for Bangladesh as a whole. This reflects the lower carrying capacity of the land in the Chittagong Hill Tracts.

The native people of the Chittagong Hill Tracts are divided into a number of different tribes, of varying size and origin. The main tribes are: Chakma, Marma, Tipra, Tanchangya, Mro, Lushai, Kuki, Khumi, Khyang, Riang, Bom, Pankho, Bonjogi, and Shendu. The most important tribes are the Chakmas, Marmas and Tipras, and they account for about 90% of the tribal population. In the past, many ethnic Bengalees from the plains have settled in the towns of the Chittagong Hill Tracts. During the past decade, a sizeable number of landless Bengalee people have settled in the area under various rehabilitation programmes undertaken by the Government. However, this has now been stopped.

In order to convert the natural forests to supposedly more productive plantation, the policy of the Forest Department has been to clearcut areas of natural forest and replant them through a system of artificial regeneration. Plantations were first started in 1871 when Tectona grandis (teak) seed was obtained from Burma. Since then, teak has been the species used for most of the plantations. It has been planted as pure stands and in varying mixtures with other exotics, mainly Honduras Mahogany (Swietenia macrophylla), and with some of the species indigenous to the Chittagong Hill Tracts, mainly Lagerstroemia speciosa (jarul), Gmelina arborea (gamar), Dipterocarpus spp. (garjan) and Artocarpus chaplasha (chapalish). Plantations have been established using various methods, including a strip method, a standard six by six planting in blocks, and by taungya cultivation by shifting cultivators (jhumias). The latter method has proved the most satisfactory. However, with the development of mechanized logging in the area, the shifting cultivators (jhumias) cannot cope with the extensive areas requiring taungya cultivation. As a result, a system combining artificial and natural regeneration has been prescribed.

In this system, taungya plantations are made in large 20 to 40 ha blocks that have been clearfelled. In these areas, the natural forest are left between the exploited blocks. These strips are supposed to function as a seed source and as a protective strip against fire and wind. The plantations have suffered severely from cyclones on several occasions and, in addition, large areas of plantations have been inundated by the artificial lake behind the Kaptai Dam.

Southeastern Hill Forests - This is an area of national importance in terms of the amount and quality of remaining tropical wet evergreen forests. Only pockets of good density high forest remain. Most of the area is degraded and consists of less than 25% cover under closed canopy high forest. The figures have been calculated on a range basis, based on RIMS data for individual

beats as of mid-1992. There are startlingly similar patterns throughout Cox's Bazar, with the notable exception of the Teknaf Peninsula, where some fine high forest remains. However, transects through the area by the FMP team (at Himchari in the north, as well as through the Teknaf Game reserve) revealed that areas marked on field maps as high forest were in fact in reality scattered trees and brush. The figures presented here are surely on the high side, and are a cause for alarm. The Sangu and Matamuhuri areas are also ESAs, in particular the former. It is one of the last undisturbed remaining forest areas in the country. In the event that the Pablakhali Wildlife Sanctuary has been significantly degraded as a habitat, only the Sangu has the sizeable area and necessary characteristics to serve as a large sanctuary.

Unclassed State Forests - Much of the Chittagong Hill Tracts was available to tribal peoples for meeting their domestic requirements before the 1870s. By 1875, an alarming decrease in forests was noted and a number of state government forests had been gazetted. The remainder was termed "Unclassed State Forest Land" (USF) or District Land". Tribals were allowed to continue to practice jhuming in these areas, and could utilize forest products to meet their domestic requirements . Export of specified commercially valuable species of logs was prohibited unless they were of a minimum merchantable size. While Reserved Forests were protected to a great degree, the USF lands have encountered disastrous removal. By the early 1960 there was virtually no forest outside the Reserved forests. Jhumed land had not reverted to timber or bamboo, but rather was degraded to grassland or scrub. A landuse and soil survey in the mid 1960s (Forestal, 1966b) revealed that only about 65,000 ha (less than 7%) in the entire USF could be categorized as forest.

Both the timber and the bamboo were only found in the more inaccessible and less populated areas of the Hill Tracts; mostly on the Burmese border, and the remoteness was likely the dominant factor in there being any forest at all remaining. The cost of extraction to commercial markets was prohibitive from 90 percent of the locations, since the total volumes and density per ha were insufficient to support any feasible timber extraction. It was recommended that these remnant pockets of forest be left to meet household consumption of the hill people. Whatever remains now serves as protection forests in the areas where they occur. The remainder of the USF is severely degraded. Only a long term integrated watershed development programme explicitly with the full participation of tribals could possibly rehabilitate the area.

10. Jinjiradwip (St. Martin's Island)

This ESA is unique for being the only coral reef in the country. There is no question that it should be preserved from the present exploitation for tourist souvenirs and its possible future use as a source of aggregate for road-building or other purposes.

11. Northeast Region

The Greater Sylhet District has a total area of about 13,674 km2 or 1,367,400 ha. Within this area, the Forest Department administers 748.2 km2, or about 5.5%. The status of the forests are as follows. The Proposed Reserved Forest was previously Unclassified State Forest which is now under the process of reservation.

Reserved Forest	46,965 ha
Proposed Reserved Forest	23,189 ha
Acquired Forest	4,669 ha
Total	74,823 ha

The Reserved and Acquired Forests cover a very small percentage of the Greater Sylhet District (0.4%), and are inadequate to meet local demands for wood and non wood products. Thus, priorities have to be set as to the allocation of the limited resources to various uses, including providing industrial raw materials, providing wood and non wood products for domestic use and

cottage industries, and conservation of ecological diversity and biodiversity. Some of the main landuse issues will be discussed below, after which a recommended landuse strategy will be outlined.

Sylhet Pulp and Paper Mill - In an agreement made between the Government of the Province of East Pakistan and the Forest Industries Development Corporation on the 1st of July 1965, the Government earmarked 23,026.8 ha in the forests of the Sylhet district for exploiting reeds and grasses for a period of 30 years, in order to help the FIDC in setting up industries for the manufacture of pulp and paper and such other materials as can be produced and manufactured from products out of reeds and grasses.

Thus, the Sylhet Pulp and Paper Mill Ltd. (SPPM) was originally conceived to utilize the reed lands as their major source of raw materials. However, the mill was eventually designed to utilize a combination of bamboo, reeds and jute. When the mill began production in 1975, it was using 100% bamboo, since the jute line was not yet working properly and reeds were not readily available.. It was not until 1987 that SPPM started to use a limited amount of reeds in their mill, and in 1992 less than 1% of the raw material for mill comes from reeds. The reasons given by various parties for this switch from reeds to bamboo and wood are varied and often conflicting. The Forest Department tends to blame SPPM for mismanagement of the resources, while SPPM tends to blame encroachment. It is however likely that a number of factors contributed to the change, including:

- From the beginning, usable reeds probably only occupied 8094 ha of the total area. Thus, the resource was limited from the very beginning, and probably insufficient to supply the mill on a sustainable basis. During the War of Liberation, the West Pakistan army destroyed the reeds and burnt the reed lands so that they could not be used as a hiding place for freedom-fighters.

- Ecological changes resulting from increased sedimentation have occurred in some areas, and this has made the sites less suitable for reeds.

- The area is used intensively for grazing cattle and buffalo during the dry season, and these animals cause considerable ecological damage to the site through compaction of soil and damage reed regeneration.

- There has been limited encroachment for the cultivation of paddy and other food crops; however, according to a report prepared by the Forest Department this amounts to only about 800 ha of the total, which is not very significant.

- Reeds are pilfered by local people to use as fuel for the making of lime, and this has helped to deplete reed stocks in some parts of the area.

Attempts to regenerate the reed lands through reed plantations has not been successful. Also, because of depth of the annual flooding in the area, it is highly unlikely that economic plantations of fast-growing tree species can be established in the area for providing an alternative source of raw materials for the mill. As a result, SPPM has requested that the Forest Department take back the reed lands and provide SPPM with 8094 ha of uplands for plantations to meet the long terms needs of the mill.

Due to fluctuations in availability of supplies from these various sources from year, it is impossible for the mill to carry out long term planning for the procurement of the raw material needs. They are at the mercy of the fluctuating supplies and markets. If the mill is to remain in operation, it is imperative that a long term strategy be developed, which would ensure the supply of raw materials for the mill. This will not be easy since at present only one third of the mill's

requirement of raw materials come from Forest Reserves and Acquired Forests. The rest come from private sources, mainly homestead forests.

Homestead forests may not maintain the present level of extraction, without depleting stocks if village needs increase. This would threaten the social and economic wellbeing of rural people, especially the rural poor, who depend on the homestead forests for fuel and building materials. Homestead forests should be managed on sustained yield principles. Under sustained yield management, the homesteads will not be able to supply fully both the local demands of the people and the demands of industries. Since industries have alternatives supplies of raw materials, priority should be given to supplying local needs.

Thus, public and private sector industries should look to developing alternate sources of fuel and raw materials. Regulations for use of non wood energy sources by brick fields and bakeries should be enforced, and facilities improved to provide industries access to the new energy sources. In the case of SPPM, the raw materials should come from existing forest reserves. SPPM and other industries should be discouraged from using raw materials from homestead forests.

It should be noted that SPPM cannot develop a reliable long term strategy based on the raw materials from tea estates, village homesteads, and imported bamboo from India. Only a lease agreement with the Forest Department for reserved land, either bamboo forests or pulpwood plantations, can provide the needed security of supply necessary for long term planning and effective mill management. However, under present management practices, it is not possible for SPPM to get a sustainable supply of raw materials from Forest Department reserve land.

This suggests that closing the mill may be the best option. Therefore, a study should be carried out to determine the feasibility of closing SPPM and moving pulp production to an area where land is more readily available for pulpwood plantations.

Recommended Reed Lands Strategies - As noted above, SPPM would like to return the reed lands to the Forest Department in exchange for 8000 ha of upland sites. At present, the reed lands are of little value to SPPM, and it does not make sense for the land to remain under their control. It is therefore important that a sustainable landuse strategy be developed for the reed lands which would maximize social, economic, and environmental benefits.

12. Northeast Region Landuse Strategy

It is recommended that a "Core-Buffer-Multiple Use Zone Strategy" be used when allocating landuse in this area, and that:

- At present, approximately 8000 ha of reed lands have been declared as Forest Reserve. The classification of the rest of the area is still pending. If feasible, the core and buffer should be confined to the existing Forest Reserve. However, the final designation of the core-buffer area will depend on a more detailed study of the area, aimed at determining the most appropriate areas for the above landuses;

- The core area would be totally protected with restricted access, and would be managed in a way which would encourage the regrowth of reeds in suitable areas and fresh water swamp forest in other areas. It is important for the protection of biodiversity to have protected areas which contain representatives of these important freshwater swamp species. Thus, ecological diversity must also be preserved;

- The buffer zone would contain reed plantations and plantations of long rotation trees, which would be managed with the participation of the local people, to meet their local needs. Hand cut fodder could also be extracted from the area, but free-roaming livestock would be banned;

- It is recommended that the multiple use area surrounding the core-buffer area be identified as a special area for ecodevelopment (SAED) to reduce the dependence on the reserve. This would require a balanced landuse with field crops, tree crops, livestock, and fisheries activities organized in such as way as the maximize socioeconomic benefits while sustaining the environment.

- Rather than focusing on the clearing of new areas for plantations, the focus should be on making existing plantations more productive, through better and more intensive management practices. If the estimates for the Forest Resource Management Project are realistic, then it should be possible to double the production of short rotation plantations and triple the production from long rotation plantations.

- There are land classified as denuded which should be given priority for the establishment of plantations. This would increase the area under plantations without destroying the areas under natural forests. Better management of the plantations may also help prevent soil erosion and environmental degradation.

- The remaining areas of natural forests should be protected for the preservation of ecological diversity and biodiversity (both flora and fauna). This represents only 5,378 ha or 13% of the Forest Reserves and Acquired Forests in the southwest part of the Sylhet Division. In terms of the total area of the Greater Sylhet District, this represents only 0.4% of the total area. The Conservation Consultant has identified some areas of old plantations, which have a diverse undergrowth of species from the natural forests and are the home for many species of wildlife. It is also recommended that some of these areas be protected as well.

South Sylhet High Forests - This area, as other high forests in the country is threatened with extinction unless appropriate steps are taken to preserve it. The entire area is less than 25% forest cover, with a few exceptions totalling no more than 2,500 ha of land. There are also large areas of natural bamboo that have been much depleted. Transects through Rema-Kalenga revealed mostly a secondary forest, which over time could be rehabilitated. One area of old plantations (Lawachara) resembled a natural forest in structure, but not yet in floristic composition. This fine forest illustrates that such areas, given sufficient time, can return to a semblance of their original condition. This would require significant institutional and policy changes from the present practices in the Forest Department.

Sylhet/ Eastern Mymensingh Haor Basin - The haor basin of Sylhet and Mymensingh is a wetland ecosystem of national and in some cases international importance. The wetlands are home to a very wide variety of resident and migratory waterfowl, including perhaps as many as 100,000 to 150,000 ducks, and provide a refuge for many other species of wildlife which are becoming increasingly rare elsewhere in Bangladesh. Wildlife (Bird) Sanctuaries for Tanguar Haor, Dekhar Haor, Hakaluki Haor, Kawadighi Haor, and Hail Haor have been proposed in recognition of their importance to conservation.

Generally, the lakes, beels and ponds support subsistence and commercial fisheries, the seasonally flooded lake margins support rice growing, and the marshes provide grazing for domestic livestock. Trees, shrubs and reeds provide fuel and building materials, while water plants may be used as fertilizer. Most of the wetlands are owned by the Government and managed under the Additional Deputy Commissioner, Revenue through a system of permits and leases. The wetlands vary considerably according to the size of the area, the duration of flooding, vegetation cover, and land tenure.

There is however growing concerns that these wetlands are being overexploited, and that this may ultimately lead to their destruction. For example, in recent years, fish yields from these wetland areas have been declining, while the number of birds and animals frequenting the wetlands are

also declining. Sedimentation is also increasing in many wetland areas, and this is affected by the landuse in the surrounding area.

The loss of these wetlands would have international as well as national impacts, and this should not be allowed to happen. It is also an unnecessary loss, since rational landuse planning and practices would allow the wetlands to continue to supply benefits for the people, while at the same time conserving the ecosystem for the conservation of fish and other wildlife.

Wetland Sustainable Landuse Strategy - In order stop the decline of these wetland areas, it is recommended that new policies and legislation be developed which will allow for multiple use of these wetlands according to principles of sustainable development. For this to be effective, each wetland area must be managed as an integrated whole. Each wetland area will require an integrated management plan which includes fisheries, agriculture (field crops and animal husbandry), wood and non wood products, and conservation of the ecosystem for biodiversity of flora and fauna.

It is only through sound management based on sustained yield principles that these wetlands can continue to provide meaningful yields of fish. The fish need to be protected so that they can reproduce and grow to optimal market size, before being harvested. This is not happening now. Immature fish are being harvested to maximum yield, rather than being managed.

There are also many areas around the fringe of these wetlands which could be converted into intensively managed fishponds with embankments planted to a range of valuable economic trees, such as mangoes, jackfruit, litchi, coconuts, etc. This may be better than the present landuse system where one dry season harvest of rice and/or wheat is obtained from surrounding areas.

Thus, rational landuse planning for the wetland areas is likely to increase the economic benefits coming from the area. If the poor are given priority in the development and utilization of these resources, then there are likely to be social benefits as well. The areas would be managed under the multiple landuse management described throughout this report.

The size of the core and buffer zones would vary according to the size of the wetland area being managed, and the nature of the protected core area.

The core zone would be totally protected with restricted access, and would be managed in a way which would encourage the regeneration of the ecosystem and the reproduction of important fish and wildlife stocks.

The buffer zone would be managed with the participation of the local people to meet their local needs. This would be done through a system of permits and leases. Since most wetland areas are relatively small, the buffer zone should include all the remaining government-owned wetlands outside the core area.

The multiple use area would be the privately-owned parts of the wetlands and the adjacent agricultural lands which border the wetlands. It is recommended that the multiple use area surrounding the core-buffer areas be identified as special areas for ecodevelopment (SAED) to reduce the dependence on the wetland areas protected in the core-buffer area. This would require a balanced landuse with field crops, tree crops, livestock, and fisheries activities organized in such a way as to maximize socioeconomic benefits while sustaining the environment. An integrated development programme for the multiple use area, based on sound environmental management practices could be taken on as a pilot project to be funded by some donor agency.

In the future, some of the protected core areas in the Multiple Use Management Areas may be re-designated as National Parks or Nature Reserves, in order to increase their status and facilitate their management and development.

It is recommended that the government owned land at Hakaluki Haor be designated as a National Park, and recommended as a World Heritage Site. The Multiple Use Management Areas must have an integrated management plan. The formulation and implementation of such a plan would require coordination between all the government departments and agencies concerned, including the institutions for Conservation, Agriculture Department, Fisheries Department, etc.

Table 16 gives the area for the ten main wetland areas located in the Haor Basin of Sylhet and Eastern Mymensingh.

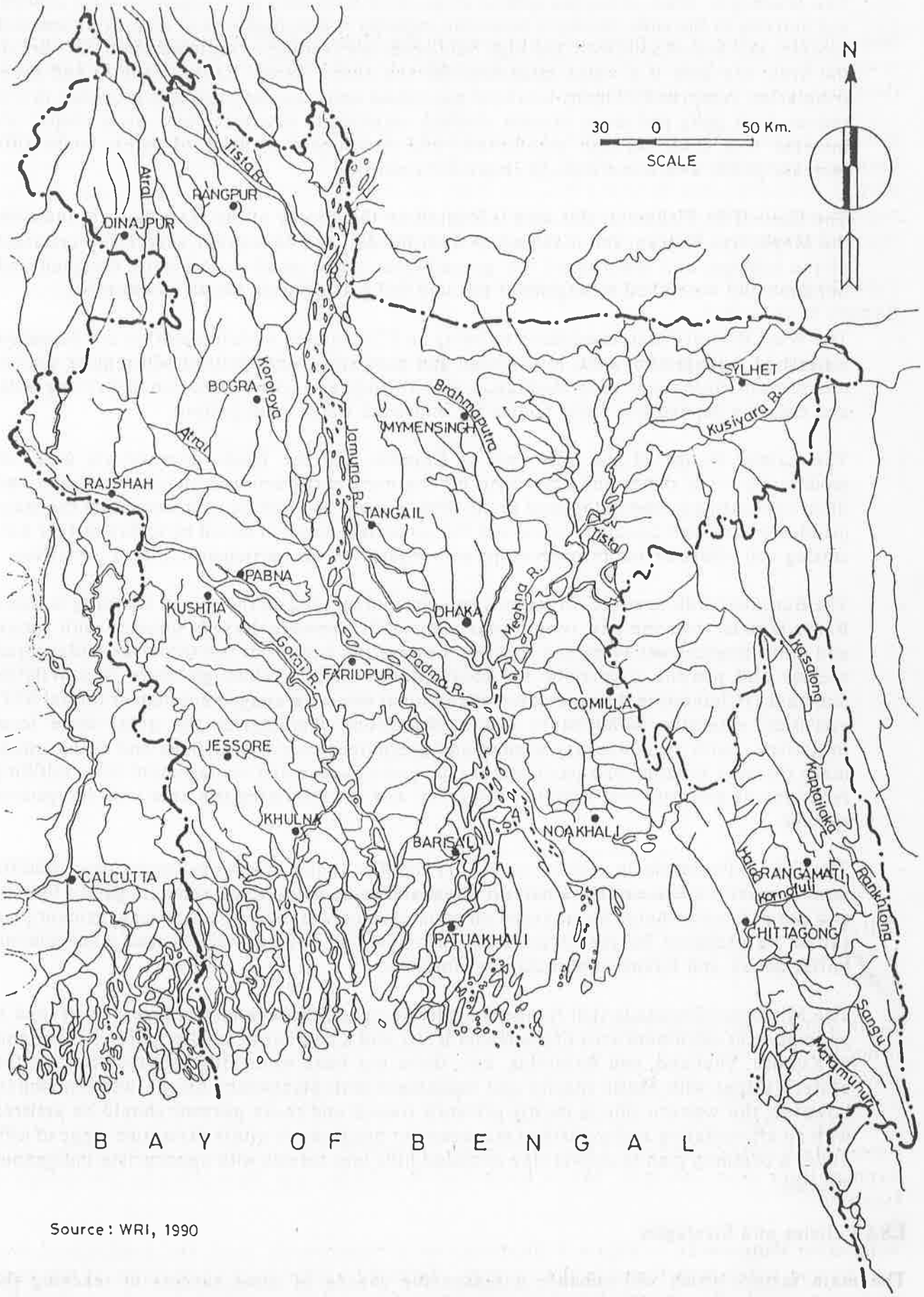
Table 16 - Major Wetlands in the Haor Basin of Sylhet and Eastern Mymensingh

Name of Area	Area
Meda Beel	122 ha
Tanguar Haor	1,566 ha
Gila Beel	160 ha
Dekhar Haor	325 ha
Kuri Beel	73 ha
Erali Beel	320 ha
Dubriar Haor	156 ha
Hakaluki Haor	20,400 ha including 4,440 ha of beels
Kawadighi Haor	414 ha
Hail Haor	8,906 ha in rainy season 3,643 ha in dry season
Total	32,442 ha

If Hakaluki Haor were designated as a National Park and the rest of the areas designed as Multiple Use Management Areas, 32,442 ha would be brought into a national protected area system. This 32,442 ha represents .22% of the area of Bangladesh.

North Sylhet Wetlands and Reedlands - As noted earlier there are a number of key wetland sites in northern Sylhet, these being :Hakaluki Haor, Hail Haor, Tanguar Haor, Balai Haor, Kawadighi Haor, and Gurmar Haor. Sites worthy of inclusion as ESAs (and not included in NCS or NEMAP include the reedlands of the north (not marked on the map, but located north of Chatak, Sunamganj, and Gowainghat in Figure 22); these are elaborated on elsewhere in the landuse and conservation parts of the FMP. Three other areas of possible outstanding national significance are: Karchar Haor near Taherpur, Muria Haor near Bianibazar, and Bara Haor in the vicinity of Jantiapur.

Vulnerable Watersheds - Figure 9 illustrates on a country-wide level, the complicated river systems and watersheds found in the country. As noted earlier in the text, most of the water originates outside the country. However, a number of degraded watersheds have been identified as ESAs requiring special attention (GOB, 1991b). These include:



Source : WRI, 1990

Figure 9 - River Systems

- The Madhupur Tract; dissected upland areas there have very poor organic matter content and fertility in the soils, moisture retention capacity is low, high loss of tree cover and soil erosion, and loss of soils from the high baid areas are leading to sedimentation of rivers in the area; the area is a water catchment for the rivers Turag, Banar, Bangshi and their tributaries, comprised of many localized watershed units; a pilot project is proposed to: (i) reduce both gully and sheet erosion through small-scale structures and cover crops; (ii) increase tree cover through agroforestry and enrichment planting of forest lands; (iii) increase public awareness through improved extension.

- The Garo Hills Piedmont; this area is located on the border of the Garo Hills in India on the Meghalaya Plateau, and is subject to flash floods, sand deposition, severe deforestation of the hilltops, and lowering of the groundwater table; small-scale locally designed and implemented watershed management through full participation would be desirable.

- The West Barisal Tract, in addition to being an ESA related to deforestation is a degraded watershed management area; low rainfall and poor soil characteristics will require similar measures to those required in Madhupur, with an emphasis on afforestation, improving soils, and creating dependable water bodies for improved water management.

- The Lalmai Range of low hills west of Comilla, and the Kasba Terrace are areas of moderately steep slopes and have been for the most part denuded; increased erosion and illicit hill-cutting (some of the land in the area is khas) by building contractors are the main problems; localized flooding occurs, and the remedial approach would be to ban further hill-cutting and afforestation through crops and vegetation via participatory, local initiatives.

- The Banskhali hills south of Chittagong have been degraded all the way to Harbang in Cox's Bazar District over the past twenty years especially; formerly heavily forested with garjan and other tropical wet evergreen species, they are the habitat of the serow, an endangered species and provide a corridor for elephant movements; although there is a Wildlife Sanctuary (Chunati) in the area, it is dysfunctional with no management plan or formal BFD activities; extensive monoculture exotic plantations characterize the area; some local initiatives (with an honourary warden and preliminary surveys of flora and fauna would make the area suitable for a participatory integrated watershed management area, fulfilling functions of afforestation, wildlife protection, and rehabilitating the area with indigenous species.

- The Teknaf Peninsula, in addition to its very significant qualities for preservation of wildlife (and in several areas, extensive natural forest and some mangroves) remnant garjan forests, and beach forests, should be managed on an integrated watershed basis; a management plan should be prepared for the entire area, encompassing both protected area management, buffer zones, and intensive participatory forestry.

- The Mirsharai-Sitakunda Hill Range is highly degraded through loss of forest cover, and is an important catchment area of the Halda River and a number of smaller perennial streams at Kumira, Sitakund, and Baratakia, etc.; there has been some BFD afforestation on the eastern slopes with exotic species and occasional teak plantations on the western slopes; however, the western side is mostly privately owned and these persons should be assisted with an afforestation and watershed management programme within the entire range of hills under a common plan to convert the denuded hills into forests with appropriate indigenous species.

ESA Policies and Strategies

The main factors which will enhance a reasonable chance of some success in reaching the conservation objectives for protected areas are that:

- effective management plans exist;
- buffer zones of compatible landuse on the periphery exist;
- an economic value can be placed on these natural resources and be demonstrably beneficial to surrounding communities;
- that adequate consideration is given to existing and likely future human use trends in the area;
- planning and management for these areas should be done in the context of cooperating where possible with existing regional and local plans.

Calculation of the economic contributions of ESAs to the economy is a new science, and has not yet been done in Bangladesh, or very few other places for that matter. Nevertheless, ESAs must be viewed as capital resources which should not be depleted. Conflicts with other programmes must be identified, and multiple use management is likely to have greater success. The ESAs identified thus far from this study and the others which have preceded it have barely been touched upon, and much more needs to be learned about them. The capacity to assess the status, trends, and relative priorities of the biological resources of the country is inadequate at the present time within the existing institutional structures.

This capacity can only be built be creating an organization whose mandate will include precisely such responsibilities. A new Department must be created to fulfil these responsibilities. The Department will: (a) compile national inventories of flora and fauna, the habitats and ecosystems which are fragile , and utilize rapid rural appraisal methods to initiate pilot projects; (b) the Department would rely on the private sector (NGOs, university departments, research and consulting organizations) to ensure national representation of all ecosystems, and to maximize the available trained personnel in the natural sciences and disciplines; (c) the Department would necessarily be field-oriented, and staff would have to be appropriately selected; (d) regular exchange of information and the production of quality materials on the natural history of the country would be an objective; (e) the national level programme would benefit from linkages with international organizations such as IUCN, WWF, UNEP, WCMC, etc.

The highest recommendation is that such a new department be formed under the MOEF. Since this will require some time, a mechanism will have to be established which initiates some of the required actions, in fact helping to establish the new department. General recommendations include:

- Rapid rural assessments of existing identified ESAs, and putting priorities on these.

- National inventories of flora and fauna to be established.

- All high forests in the country should continue to be under a moratorium on exploitation. All forests with slopes more than 40 degrees are to be declared protection forests, and all forests with more than 50% under high forest should be considered for protected area status pending the completion of the necessary surveys. The Kassalong Reserve could be available for limited extraction pending a full EIA, satisfactory logging plans subject to community reviews, and resolution of ethnic problems in the area, to offset the complete ban elsewhere in the hills.

- The Sundarbans should be declared a World Heritage site, the wildlife sanctuaries expanded, and buffer zones accordingly established. The nomenclature and categories may change, since the IUCN will be proposing new categories in the near future to replace the existing recognized categories of protected areas.

- The quaternary terraces should be under intensive participatory forestry, and a special commission should be set up to review land disputes.

- Community-based management must be given a serious impetus immediately, if ESAs are to survive in Bangladesh.

DEFORESTATION

General

The forests of Bangladesh have been disappearing at a rapid and accelerating pace, both quantitatively and qualitatively. While the forests in Bangladesh are relatively insignificant on a worldwide scale, global deforestation is a continuing serious concern. Forests cover 3.6 billion ha (27.7 % of the total ice-free land in the world. Of this total, boreal forests comprise 25.4 %, and temperate forests 21.2%. The remainder is (53.4%) in tropical forests (UNEP, 1992). Moreover, some 650 million ha are covered by "other wooded vegetation", including forest fallow (jhumed land), shrubs, thickets, scattered trees and brush. A recent forecast indicates that the supply of industrial roundwood will not meet world demand by the year 2010. Per capita consumption of fuelwood in developing countries is .45 m^3. Bangladesh has a consumption of .11 per capita.

Data on a global basis has been conflicting concerning the rate of deforestation. For example, two frequently quoted statistics for loss of tropical forests, have been elucidated. The FAO/UNEP estimate of disturbance in closed tropical forests in the early 1980s was 7.5 million hectare, while another prepared for the American National Academy of Science was placed at 22.0 million hectares. However, FAO/UNEP referred to deforestation, while the latter related to conversion, which incuded fallow areas within the closed broad-leaved tropical forest. With the exclusion of fallow areas, the area shrinks to about 7.5 million hectares. Deforestation rates of 6-7 million hectares annually is equivalent to rates of 0.5-0.6 per cent. Estimates of the amount of forest which has already disappeared vary significantly, ranging in one case from a low of 4% up to 40% cleared or degraded (Mather, 1990). The latter figure has been used by WRI and others, who have estimated that as much as 15 per cent of the extent disappeared between the early 1960s and early 1980s. Moreover,the consequences of depletion of the dry tropical forest resources for fuelwood may be even more serious, since it affects local popoulations directly and immediately. However, trends are:

- in the closed canopy moist forest, large areas of forest have been modified in structure and floristic composition by logging, in addition to deforestation;
- all virgin forests suitable for production will either be deforested or logged within a century, at present rates;
- where species diversity is often highest (more accessable lowland forest) the impact in terms of direct resource depletion and species loss is highest; this is the case for example in Bangladesh, in the Sal forest, and low hills of Chittagong and Cox's Bazar;
- the more remote areas where resource values for timber production are lower, meanwhile, result in accelerated soil erosion (again, in Bangladesh, examples would be the USF and CHT reserves);
- thus the most densely populated and accessible forests are the most endangered, as has been observed in Bangladesh as well;
- the loss in resource values, implicit at present rates, will result in as yet unquantified permanent damage to species and genetic resources, rather than timber.

For consistency throughout this report, the macro level statistics will rely on FAO/UNEP figures for global and regional deforestation, as well as within Bangladesh. The primary source, however, will be the latest completed inventories, various Forest Department sources such as working plans, published statistics by BFRI, and supplemented by recent RIMS data acquired in 1992, and compiled by the author from preliminary field estimates, as well as computerized landuse summaries by RIMS.

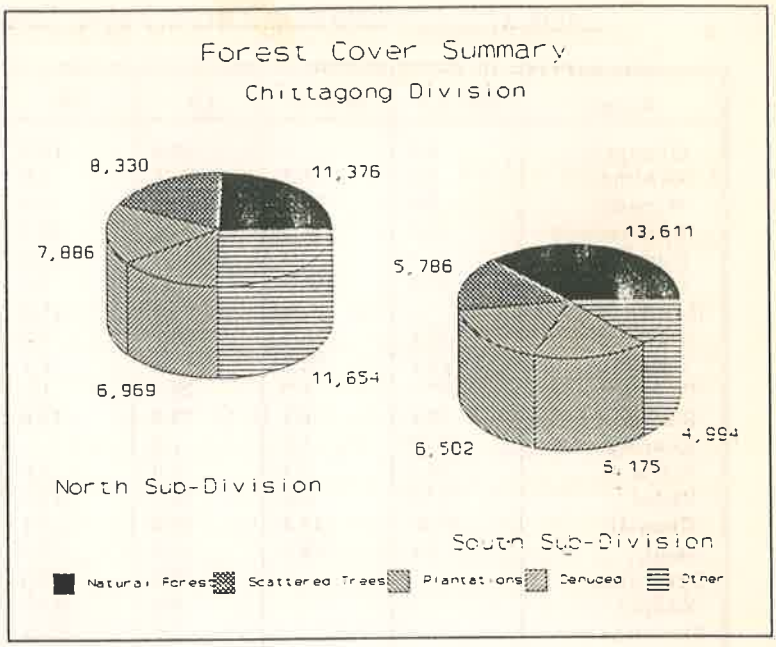


Figure 10 Forest Cover Summary

Source: Choudhury, 1991b

The forests of Bangladesh have been disappearing at a rapid and accelerating pace, both quantitatively and qualitatively. Appendix 15 illustrates area and volume summaries for selected forest areas.

1. Hill Forests

Areas of good to medium density of high forest in Chittagong Forest Division comprised approximately 30,000 ha in 1985 (based on aerial photography from 1983).

Figure 10 indicates that, as of the most recent management plan, the high forest (natural forest) in Chittagong had dropped to about 25,000 hectares. Detailed calculations of RIMS data in mid-1992 shows that only 20,000 ha of high forest remain. Only three ranges out of twenty -Dohazari, Khurusia and Patiya- had more than 50 % or more area of high forest within the range (note: individual beats or blocks in other ranges occasionally exceeded 50%, but not the average for the range as a whole). Table 17 illustrates how poorly stocked the majority of the ranges are.

Table 17 - Percentage of Forest Cover Type by Ranges, Chittagong Division

Range	HF. LF	St & B	LR	SR	AGRIC	FP/ Denued	Total Hectares
Olinagar	4.4	-	40.4	15.2	-	40.0	923
Karerhat	4.6	6.8	72.5	6.0	2.2	7.9	4,061
Mirsarai	0.6	30.4	20.3	13.4	-	35.3	6,437
Baraiyadhala	11.2	29.5	13.0	19.5	-	26.8	747
Kumira	-	-	2.3	22.6	-	75.1	4,632
Narayanhat	27.9	3.7	26.7	7.9	2.1	31.7	7,430
Hasnabad	-	-	13.3	13.3	-	73.4[d]	1,286
Hathazari	35.8	15.5	16.5	7.8	-	23.4	7,676
Ichamati	10.3	52.7	17.4	8.1	-	11.5	2,319
Dohazari	57.6	5.2	28.7	1.2	-	7.3	5,558
Rangunia	25.8	8.1	25.4	13.6	8.5	18.6	2,097
Khurusia	83.3[a]	1.5	1.5	-	-	13.7	3,123
Patiya	76.1	5.3	8.9	5.0	-	4.7	6,448
Padua	37.5	6.6	14.2	12.2	-	29.5	4,443
Chunati	17.6[b]	13.5	26.6	7.1	-	35.2	6,232
Jaldi	3.4	48.5	15.8	7.5	-	24.8	5,156
Barabakia	-[c]	-	10.9	22.0	-	63.7	2,533
Kalipur	-	-	0.6	11.0	-	88.4	2,005
Madarsha	-	-	2.2	21.8	-	76.0	934
Town	-	-	-	-	-	-	
Total (ha)	20,561	11,620	15,699	8,254		23,929	80,209

Notes: Bamboo areas not specified

a. Includes 49 ha of Garjan Forest
b. Includes 11 ha of Garjan Forest
c. Includes 86 ha of Garjan Forest
d. Includes 230 ha Sungrass

HF High Forest
LF Low Forest
LR Long Rotation Plantation
SR Short Rotation Plantation
FP Failed Plantation

Source: RIMS data, Forest Department, 1992.

In Cox's Bazar, natural forest cover has dropped from 31,300 ha in 1985 to about 24,300 (see Figure 11).

Current RIMS data places the high forest at a slightly lesser amount (see Table 18). As in the case of Chittagong, only three ranges average more than 50% of high forest. These are Idgaon, Inani, and Teknaf.

Table 18 - Percentage of Forest Cover Type by Ranges, Cox's Bazar Division

Range	HF or LF	St & B	LR	SR	Total Plantation	Denuded	Agric	Total
1	19.1[a]	2.6	56.6	14.9	3139	4.4	1.4	4394
2	18.9[b]	9.0	38.4	13.5	1685	9.2	2.5	3247
3	54.8	-	41.2	2.7	2012	1.3	-	4592
4	22.5	6.8	34.8	13.0	2342	19.8	3.1	4898
5	40.0	2.9	36.2	10.5	2680	8.8	1.6	5733
6	-	-	-	39.7	158	-	60.3	398
7	31.2	20.7	10.9	17.3	1113	19.5	.4	3965
8	18.5	.5	37.7	11.7	2163	27.8	3.8	4373
9	70.7	7.9	12.0	1.5	967	7.5	.4	7178
10	40.6	.5	38.5	9.3	3280	8.4	2.70	6853
11	39.5	2.3	43.0	3.2	2179	10.3	1.7	4714
12	57.8[c]	6.3	15.2	1.6	1352	18.5	-	8016
Total (ha)	23,758	2,965	18,230	4,838	23,068	7088	1,114	58,361

Notes: Excludes
a. includes 43 ha of Garjan; b. includes 276 ha of Garjan; c. includes 49 ha of Garjan
Source: RIMS data, Forest Department, 1992.

From Table 3 in Appendix 15 , it can be noted that natural forest in 1987 in Southern Sylhet consisted of just over 6,000 hectares out of 40,000, i.e., 15%. This accounts for only 7.6 % out of 70,000 ha, if North Sylhet and Sunamganj are included. Although the RIMS data for North Sylhet and Sunamganj was incomplete, it is nevertheless accurate in terms of natural forest. It is known that freshwater swamp forests have all but disappeared and that the once extensive reedlands have been virtually completely destroyed). It can be readily seen in that there is very little natural forest remaining. Outside of protected areas, there are less than 1,000 ha of natural high forest in the whole Forest Division. Figure 12 illustrates this paucity of natural forest.

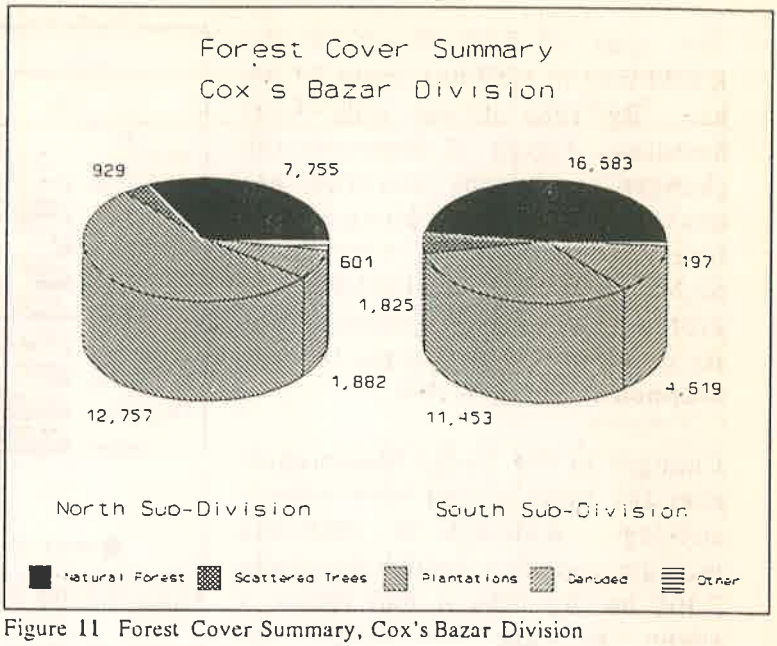


Figure 11 Forest Cover Summary, Cox's Bazar Division

Source: Choudhury, 1991a

Table 19 - Forest Cover Types, Sylhet Forest Division

Range	HF	ST & B	Bamboo	Plantation	Denuded	Agriculture	Total
Juri	-	20	7,408	2,427	16	0	9,871
Moulavi Bazar	5	-	-	2331	623	5	2964
Rajkandi	234	24	4554	2113	20	0	6945
Kulaura	-	-	2,762	243	8	1,495	4,508
Habiganj	1,796[a]	21	-	3,975	139	0	5,931
Raghunandan	1,575[b]	414	-	1559	22	0	3,580
Satchari	390	19	-	1,047	62	0	1,518
North Sylhet	121	-	-	950	1,163	520	2,774
Sunamganj	5,039[c]	850	-	-	1,153	-	7,042

Notes:

[a] Includes 121 ha of murta.

[b] Figure includes 1556 ha of sungrass. Actual natural forest only 19 ha.

[c] No breakdown provided for species, likely this represents reeds. The figures are at variance with working plans.

1. Remaining High Forest restricted to 200 ha in Kamarchara Beat in Rajkandi; 1600 ha in Rema-Kalenga Beats (in National Park) in Habiganj, and 80 ha in Satchari.
2. Bamboo forest significant in Juri, Rajkandi and Kulaura.
3. Lawachara Beat in West Bhanugach (Maulavi Bazar) has old plantations with structural characteristics resembling natural forest.

Source: RIMS data, Forest Department, 1992

The area of high forest in the Rankhiang in 1963 was about 20,300 ha. By 1983 it was only 7,100 hectares. Figure 13 illustrates the changes. Current statistics are unavailable. The Kassalong natural forest (timber -types) were about 52,700 ha in 1963. By 1983 this had dropped to 46,400 approximately. As of 1990, this is thought to have dropped to about 41,400.

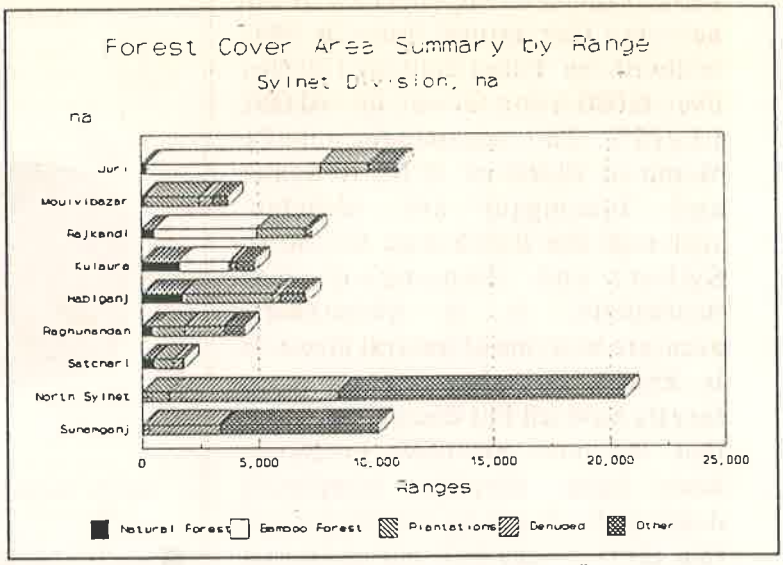


Figure 12 Forest Cover Area Summary by Range

Source: Choudhury, 1990b

Changes in the Sangu-Matamuhuri over the same period were equally striking. Although in 1961 the medium-good density high forest was 7,100 ha, by 1984 it had shown a slight increase to 8,700 ha. However, the poor density high forest and other less qualitative timber types which comprised 87.5% of the forest in 1961 had dropped to 64.2 % by 1984. Jhum cultivation, moreover, rose from virtually nil to 23%. Figure 14 graphically shows these changes.

2. Mangroves and Coastal Forests

In the Sundarbans, the canopy density has also decreased. Seventy-eight percent of the the forest had canopy closure of 75% or more in 1961, versus 65% with canopy closure of 70% or more in 1984. A controversial study and inventory (Chaffey et al, 1985) indicated that standing volume of Sundri had declined by 40%. In addition, about 17% of Sundri stems were affected with top-dying in those ecological zones where Sundri was a major species. Existing volume is shown in Appendix 15.

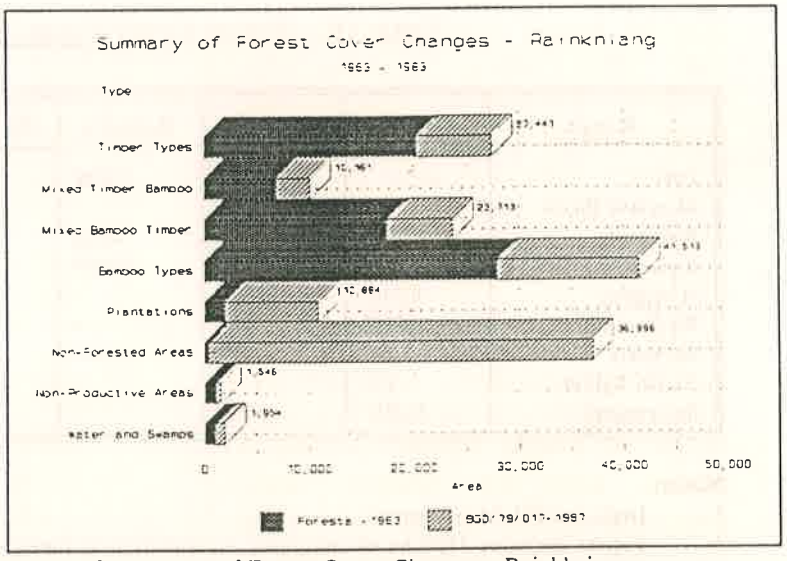


Figure 13 Summary of Forest Cover Changes - Rainkhaiang

Source: Choudhury, 1991c

Gewa is said to have decreased by 45%. The estimated removals exceeded annual allowable cuts (including goran and all other fuelwood) by over 100% between 1959-1984. These figures have been disputed by the Forest Department and the Khulna Newsprint Mill which conducted a joint survey with contrary findings in some cases, although they confirmed some of the findings as well.

Coastal afforestation has been dealt with directly earlier whereby coastal afforestation for all divisions except Chittagong have been quantified. Of the 110,000 ha reputedly planted, provisional estimates coming through RIMS data shows far less. The net area planted appears less than 60,000 ha. Encroachment is reasonably low (averaging five percent, for all coastal divisions, and highest in Chittagong at 11.2%). Average erosion of plantations was about 21%, with Bhola and Noakhali exceeding the average, and Patuakhali the lowest rate. The average percentage of failed

plantations was 17.7%. The highest was in Chittagong (at 26.7%), followed by Patuakhali at 23.8%. The statistics for failed plantations, eroded and encroached ones combined approach 40%. It would appear that plantations are clearly a high risk venture, but have a high pay off in terms of disaster mitigation. It is unknown how much damage was done to plantations during the 1991 cyclone. The figures vary from official estimates, but have come directly from the field up to late 1992.

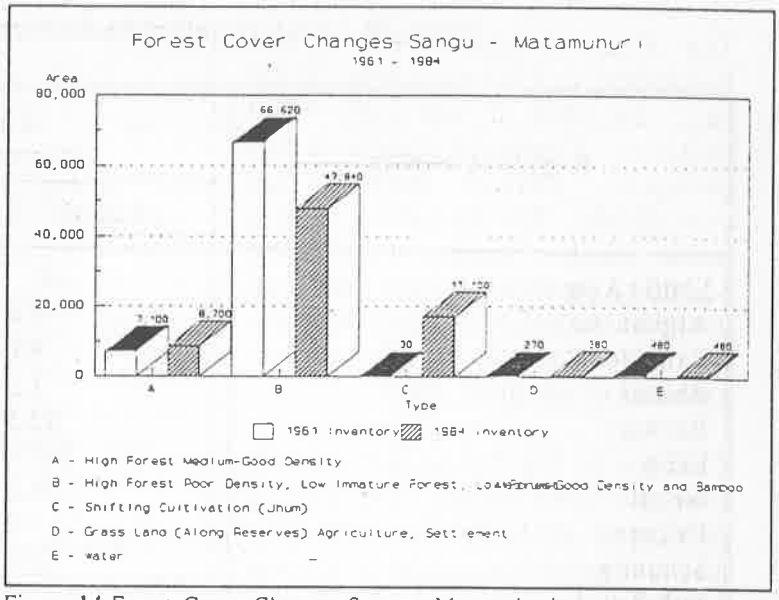


Figure 14 Forest Cover Changes Sangu - Matamuhuri

Source: Choudhury, 1990a

3. Sal Forests

The Sal forests once extended as a vast tract across central and northwest Bangladesh. Out of total legal forest gazetted of about 90,000 ha (seee Appendix 15), less than 17% consisted of natural forest as of 1989. Much of this is of poor quality. The widely acknowledged frantic pace of deforestation has no doubt reduced this figure by significant amounts. During FMP field visits, little more than roadside strips of woods existed in many places, with the interior badly degraded. The largest remaining tracts are in Tangail and Dhaka, and of these a portion are in national parks which are not being managed appropriately. Figure 15 illustrates the status as of 1989, based on a study done in 1990.

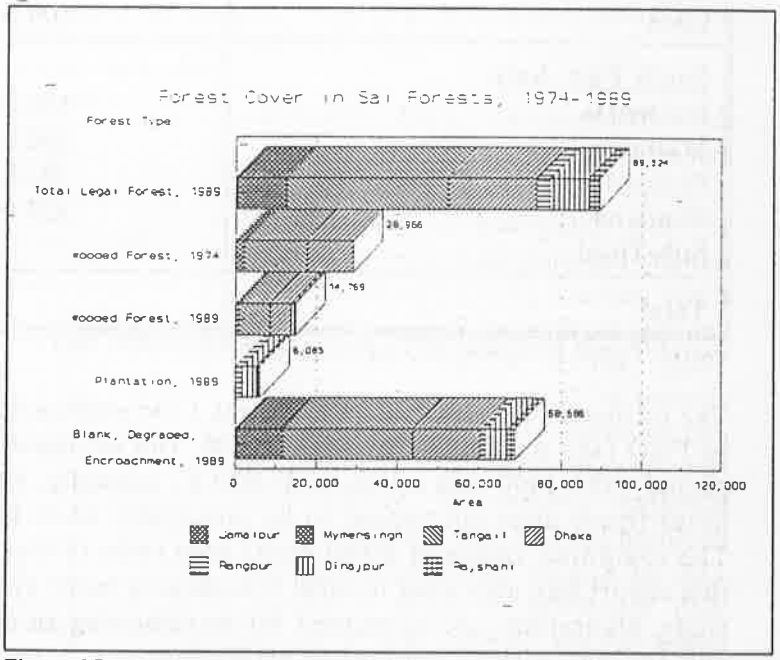


Figure 15 Forest Cover Changes in Sal Forest Plantation

Source: Ghani et al. 1990

Trends and Projections

Throughout the mid 1970s to the middle of the 1980s, it was thought that Bangladesh had a deforestation rate of 8,000 ha annually, and that the country had lost a projected 80,000 ha over that period. Table 20 below illustrates the comparison with other countries in the Asia-Pacific region. Only Bhutan and Pakistan had lower rates.

Table 20 - Deforestation in Asia and the Pacific (000 ha)

Region/Country	Annual Deforestation		Total Deforestation
	1976-80	1981-85	
South Asia			
Afghanistan	15.0	15.0	150.0
Bangladesh	8.0	8.0	80.0
Bhutan	1.5	1.5	15.0
Burma	95.5	105.0	1,002.5
India	147.0	147.0	1,470.0
Nepal	84.0	84.0	840.0
Pakistan	7.0	7.0	70.0
Srilanka	25.0	58.0	410.0
Sub-Total	-	-	4,037.5
East Asia			
China	NA	NA	NA
Indo-China			
Laos	100.0	100.0	1,000.0
South-East Asia			
Indonesia	550.0	660.0	5,050.0
Malaysia	230.0	255.0	2,400.0
Philippines	101.0	91.0	960.0
Thailand	333.0	252.0	2,952.0
Sub-Total	-	-	12,362.0
Total	-	-	16,399.5

Source: Forest Resources of Tropical Asia, FAO/UNEP, 1981

The estimated forest cover in 1980 was 1.145 million ha, whereras the most recent estimate made by FAO (see Appendix 16) was 769,000. The estimated annual forest cover area change over the period 1981-1990 was a loss of 37,600 ha annually, which is a reduction of 3.3% annually. This latter figure does not appear to be unrealistic when looking at the recent examples cited above. The computed values of forest cover area refer to forests of natural origin. The basis throughout this report has also used natural forests as a more appropriate indicator. As noted in the FAO study, plantations are accounted for by removing an equivalent amount from natural forest area and adding a similar amount to plantations.

The existing statistics from the Forest Department place the forest cover at a slightly higher amount than FAO (see FMPb). They are as follows:

Category	Hectares
Natural Forest (Medium-Good Density)	85,315
Natural Forest (Poor Density)	79,890
Scattered Trees & Brush	82,979
Mainly Bamboo	71,196
Sundarbans	374,899
Parks and Sanctuaries	110,073
Total	**804,353**

Remaining categories include: (i) Plantations- 331,766; (ii) jhum and encroachment- 99,013; (iii) unproductive and blanks (18,029; (iv) other, including khas and USF- 781,472. Thus it may be readily seen that some form of forest cover (800,000 ha approximately) compares to highly modified landscapes of about 1,230,000 ha. The total forest area by legal status (including reserved, acquired, protected, vested, unclassed, and khas, is about 2,240,000 ha. It should be noted that even under the optimistic statistical scenario of the Forest Department, that the trends are disturbing:

- forest cover as a percentage of legal status (though not necessarily under the control of the Department) is approximately 36%;

- of this amount -if the Sundarbans is removed from the calculation- the remaining tropical evergreen and moist deciduous forest (including protected areas and bamboo, but excluding scattered trees and brush) comprise only 19% of legal forest cover;

- some form of natural forest cover (excluding village homestead forests) comprises only 5.7% of the country's total area;

- in absolute terms, the USF has lost the largest amount of forest, but much of this has not been been recent, having been already heavily degraded in the 1960s;

- the most endangered forests are the Sal forests of central, northern, and northwestern Bangladesh (as well as the small pockets of remnant Sal in Comilla); this is due to the heavily degraded condition of the remainder as well as encroachment pressures ;

- the hill forests of Sylhet, by virtue of the small size of remaining natural forest are also in an endangered state;

- bamboo, noted as only some 70,000 ha within the production report (FMPb) has been reported at twice that level (about 140,000 ha) by the bamboo specialist, but the gregarious flowering of some bamboo species will cause a crisis over the plan period, as a result of large scale dying during their natural cycle, in addition to the overcutting in villages, and even selling of the remaining roots and rhizomes to brick fields;

- as noted in earlier examples of specific areas, the situation is worse than the average figures portray, due to : (i) a few relatively well-stocked areas skewing averages upward; (ii) the data is out of date, and even the most recent RIMS data was found to overstate the amount of high forests, as transects by this subteam through several areas confirmed; it must be stressed that new inventory data is now urgently required, which could change the existing figures significantly.

Applying the FAO-calculated rate of deforestation of 37, 600 ha annually, or 3.3% towards the remaining forest areas, it is evident that the projections are ominous. Under the status quo scenario, the forests of Bangladesh will have largely disappeared over the period of the FMP, likely with the exception of the Sundarbans, due to its remoteness and lack of immediate encroachment and population pressures.

Social Dimensions of Encroachment

1. Extent and Trends

The extent of encroachment into state-managed forests has been repeatedly put forward as one of the most important factors in deforestation. Yet the Forest Department has not substantiated this, in specifically quantifiable terms of area under encroachment. Reviewing the available data,

the latest statistical bulletin of BFRI (GOB, BFRI, 1992) has no figures for this aspect of forest management. It does (inexplicably) mention the former FAO deforestation estimate rate of 8000 ha annually within a table showing the extent of mangrove forest areas in some Asian countries. While there are scattered references throughout the text referring to specific forest areas, encroachment is not usually specified. Rather it is subsumed as non-forest, non-productive, or denuded.

Similarly, it is difficult to extrapolate from other official sources. For example in a table of land use summary for Chittagong Forest Division (Choudhury, 1991b), the categories are natural forest, scattered trees, plantations, denuded, and "other" of which there are some 16,000 ha. A recent RIMS figure puts less than 500 ha as under agriculture, and some 23,000 ha as denuded or failed plantations. For the Sylhet Forest Division, a similar land use summary using the same categories (Choudhury, 1990b) places some 24,000 ha under the "other" category, while 13,790 is denuded. Of the 24,000 "other", about 19,000 is in North Sylhet and Sunamganj. There is a notation that "part of the area" is encroached.

In the central Sal forests, the area encroached (see Table 5 in Appendix 15) is described as "blanks and encroached". In the CHT the description is often "jhum and encroached". The detailed questionnaire circulated to the various field offices of the Forest Department (see FMPb) revealed about 71,000 ha encroached and/or jhumed in the hill forests and 28,000 in the same category in the Sal forest areas. None is shown for the coastal plantations, which is contrary to recent field data. There are categories for "scattered trees and denuded" as well as for "unproductive including blanks".

It is undisputable that the USF of the Chittagong Hill Tracts have been encroached and jhumed throughout virtually the entire area of some 700,000 ha over the years. Other areas of the Hill Tracts, notably CHT (south) have been encroached well over 30,000 ha, most of this in the Matamuhuri, since the Sangu is less accessible. CHT (north) has been encroached/jhumed over about 17,000 ha. The following statistics (not including the USF) are indicative of the magnitude of encroachment.

Hill Tracts	Hectares
CHT (South)	31,783
CHT (North)	16,622
Chittagong	12,535
Cox's Bazar	3,913
Bandarban	3,430
Sylhet	2,510
Total	**70,793**

Sal Forests	
Mymensingh	11,336
Dinajpur	5,828
Dhaka	5,000
Tangail	3,593
Rajshahi	1,536
Rangpur	927
Total	**28,220**

It should be noted that these estimates have come from the field, and that they are at variance with other sources. For instance, in Tangail alone, this figure plus unproductive blanks totals some 6,600 ha, whereas an earlier study had suggested that blanks and encroachments here total some

30,000 ha. However, the trends, as described in an earlier section, are that increasing amounts of land are being subjected to encroachment, and that the Forest Department has not managed to reverse or even reduce the rate of incursions (see Table 21 below).

Table 21 - Achievements in Plantations in Different Areas (1973-90)

Plantation Type	FFYP(inc.TYP) (1973-80) Achievement	SFYP (1980-85) Achievement	TFYP (1985-90)		
			Target	Achievement	%
Replanting of Exploited Natural Hill Forests(ha)	21,723	26,883	30,360	18,173	60
Afforestation of Degraded and Denuded Reserve Forest Area (ha)	6,761	11,886	36,000	2,376	7
Afforestation of Unclassed State Forests of CHT(ha)	8,446	17,996	29,150	10,721	37
Afforestation of Newly Accreted Lands in Coastal Areas (ha)	30,982	40,415	40,485	32,553	80
Woodlot and Agroforestry Plantations(ha)	-	2,932	15,628	5,413	35
Strip Plantation(km)	-	3,410	4,980	4,241	85
Rubber Plantations(ha)	474	4569	9,140	4,596	50
Seedling Distribution (millions)	26.7	21	76	42	55

Source: Fourth Five Year Plan

Some attempts have been made at afforesting encroached land and "rehabilitating" jhum cultivators in cluster villages. The table above indicates that the results were less than satisfactory, to say the least. The achievement over the period of the Third Five Year Plan for afforestation of the USF was only 37%. The achievement for afforestation of degraded and denuded reserve forest was merely 7%.

2. Social Impact

A number of aspects of existing forestry practices, including encroachment, have been described in Appendix 9 in detail, via various case studies which highlight the social dimensions. In the first place, there is a clear adversarial relationship between the Department and people. The table below gives some indication that simply following up on cases requires enormous time and effort. A backlog of case has built up over the years which has increased from 13,000 in 1972 to almost 400% higher by 1991 (almost 50,000 cases pending).

Table 22 - Breaches of Forest Rules in Bangladesh (Selected Years)

Year	Pending Case	Current Year's Offences				
		Firing	Fellingg	Grazing	Others	Total
1972-73	13,304	17	9,956	112	1,253	11,338
1980-81	35,006	1	6,968	276	2,900	10,145
1981-82	39,730	2	8,474	239	3,469	12,184
1982-83	41,335	5	5,723	212	2,751	8,691
1983-84	44,582	12	7,210	827	2,711	10,760
1984-85	45,581	6	6,364	207	2,600	9,177
1986-87	38,489	2	10,595	114	2,038	12,749
1990-91	42,479	NA	NA	NA	NA	9,022

Source: GOB, BFRI, 1992 and Forest Department, 1992.

Note:
1. Total Department cases pending as the close of 1990-91 was 49,668.
2. Largest No. of cases pending: Sundarbans, Chittagong & Cox's Bazar.

The first case study revealed that:

- a major factor contributing to deforestation was the corruption within the Forest Department, as well as other Departments associated with the possible transit of forest products;

- there is a loss of employment opportunities on the part of the poor, who cannot afford to compete with middlemen who control forest product extraction in collusion with the Department;

- improper alienation of forest land for purposes such as agriculture, military installations, shrimp farming, etc. further marginalized those who depended to some extent on forest products for their livelihoods.

The second case study revealed the negative effects which have resulted from :

- the creation of the Kaptai dam in the CHT;

- that development in the CHT has not managed to reach rural dwellers beyond the main towns;

- that experience with the attempt to plant rubber in the Madhupur forest revealed the lack of trust in the Forest Department, who undoubtedly in some cases evicted persons from land to which they had even held title for years; the attempt was abandoned only when the donor agency involved concluded that it would be inappropriate to proceed with the project.

In almost all cases, there was clearly gender differentiation (also covered in one of the case studies) which did not enhance the participation of women in forestry projects, or in having access to land titles under agroforestry schemes. In the majority of case studies, the local people were not adequately consulted about pending projects. In some cases, they were not consulted at all.

The project itself led to encroachment in some cases, such as in the Kaptai dam. People who were practicing sedentary farming in the valleys were forcibly displaced, and either compensated poorly with lesser quality land elsewhere or no compensation. Those on marginal lands were forced

higher up the slopes, thereby farming land more prone to erosion and causing sedimentation in the lake. The system of land administration within Bangladesh is so archaic, that many of the cases in Madhupur were caused by disputes over land titles, between Departments and Ministries and between people and Departments. The administrative maze in getting permits and access to forest resources is mentioned throughout case studies as a cause of persons believing the system is stacked against them. The case of an independent forester not being given permission to cut his own trees for some years is indeed proof that the system is flawed, to say the least.

Attempts to involve encroachers in the protection of land have been few in Bangladesh. The resettlement schemes in the Hill tracts have been noted as having some deficiencies. The fact that the insurgency is still active is testimony to this fact. Other ventures such as the community participation in Betagi and Pomora have also been described to a limited extent in Appendix 9, as well as elsewhere within the master plan (see FMPe). The latter two were characterized by:

- charismatic and flexible leadership/ patronage, which is normally absent in BFD projects;
- there was a strong attempt at real community participation, and to allocate land for the purpose; unfortunately, the amount of land involved-two hectares- is not replicable throughout the lowlands;
- minimal interest by the BFD in following up on such initiatives elsewhere, until the World Bank-funded Forestry III suggested some small pilot schemes within different locations and physical conditions;

In the last of the case studies, the role of communities in forest management was examined in South Asia generally, and specifically in the case of West Bengal because of the project location in Sal forests there, and its possible relevance for Bangladesh. Lastly, the case of forest protection groups in Proshika Manobik Unnayan Kendra was studied. Although such activities were extended to roughly 1000 ha, the experiences were very positive in terms of future replicability. The sustainability of such experiences requires:

- official authorization in the form of benefit-sharing contracts between the groups and the BFD;
- intensified action research to improve interim benefits from forest protection prior to the trees maturing;
- recognizing the central and crucial role of the community organizations, rather than the BFD in carrying out such projects;
- facilitating full participation of the communitites in the planning, implementation and replication of the activities;
- ensuring that equity considerations receive priority, i.e. that such projects should be directed towards those most in need.

3. Enhanced Forest Protection

Throughout the FMP team visits to the field over a number of months, it become clear that much of the time of the field level officers is spent in dealing with encroachment and illicit cutting. Although it was frequently pointed out that the "illicitors" and "miscreants" were the rural poor, it became quickly apparent that this was not the case. Illegal logging is carried out by hiring these people on occasion, but the instigators are a coalition of middlemen, timber traders, sawmillers, carriers, etc. Illegal cutters also cause significant damage to forests by selecting only the finest

trees, doing ancillary damage to the remaining forest. This is definitely done in collusion with BFD personnel some of the time. Where the illicit cargo has to go through checkpoints, more stringent measures could easily be taken but are not. It is relatively easy in Bangladesh to set up good checkpoints due to the paucity of major highways and also transport by waterways which could be guarded at strategic locations also. Other Departments are sometimes involved in this activity (as noted in Appendix 9) such as BIWTA, police, and of course the Army. Nothing could get through the gateways at the hill tract entry and exit points without the tacit agreement of Army personnel. Such agreement is lubricated with apparently attractive financial incentives for the concerned personnel.

An immediate striking paradox is that if three-quarters of the time is spent chasing the miscreants, perhaps the rest of the time is spent in the courtrooms (with 50,000 cases pending). The actual cases prosecuted are only a portion of what is transpiring in the field. Yet virtually no attention has been paid to this issue in any project done over the years. The BFD repeatedly has requested a supply of arms and walkie-talkies. Apparently ,this permission or bugetary allocation is always denied. Nevertheless, it should be kept in mind that illicit loggers are well-armed themselves, and that in fact this often results in the forest officers allowing them access for fear of their lives, which is an understandable situation. However, forest officers also frequently harass small scale poachers and individuals. Responsible and diligent officers are placed in difficult situations, since they are often powerless to deal with a situation in which their superior officer has been a willing accomplice, if not an instigator. The FMP occasionally heard banter about how much money had to be "bid" for the better (more lucrative) field postings allowing for much undeclared extra income. Nevertheless, the situation can be addressed meaningfully in a number of ways. Some are disincentives for illegal behaviour, and some are positive incentives requiring cooperation and understanding.

The following observations are recommended for more detailed examination. The existing penalties for forest offenses are paltry and ineffective. Recently an employee of a national bank was sent to prison for five years for embezzling Tk 200,000. Last month a man received three years for demanding a dowry of Tk 10,000. Forest resources in lakhs of Taka have been regularly stolen on a daily basis, and the fine has never been enough to deter the persons involved. When queried about the number of Forest Department officials tried under the Forest Act, and their fine or punishment in case of conviction, no reply was forthcoming after more than four months. The "miscreants", however, are dutifully compiled on an annual-basis. There is the myth promulgated that the BFD has nothing to do with this illegal logging. The unrecorded difference in supply and demand in Bangladesh is enormous. The sawmills and furniture factories are full of raw materials, that by their size and species, obviously do not come from village homesteads. There is plunder involved here valued at hundreds of million of dollars, about which few concerns have been expressed.

The following recommendations are made to attempt to reverse the rate of deforestation:

- An independent commission on the forestry sector, led by a prominent and respected jurist, should investigate the situation, similar to the wildlife task force in 1986. They should be given the necessary powers and independence of MOEF and BFD commensurate with the task.

- Penalties should include mandatory jail sentences for the larger offences, and by tracing ownership, seizure and confiscation of all equipment as an accessory to the crime.

- Armed protection squads, properly equipped, could be tried out. However, this should be done in collaboration with army, police, BDR, etc. Their mandates will have to be clearly spelled out, and rigid selection made of participating members, since this could actually lead to more abuse in the wrong hands.

- Providing incentives to informants might have interesting returns on the investment.
- Definitely functional checkpoints should be set up at strategic locations, manned around the clock.
- Access roads to forest areas and plantations should be planned so that such checkpoints are built in.
- A special commission or task force should be set up to eliminate the backlog of court cases. It should be remembered that it is rarely the instigator that is charged, but rather the hired pawns.

These are the "hard" solutions, which in themselves would never stop deforestation and encroachment but would help to arrest the pace until the long term measures begin to work. These would consist of well-tested measures such as :

- Closing the gap between supply and demand, which would mean far-reaching institutional changes and policy mechanisms, as suggested elsewhere in the master plan (FMPa).
- Fully utilizing the new participatory and extension wings to be created within the Department.
- Forest lands occupied by staff on a full-time basis, such as would be the case with the new recommended Department of Conservation.
- Developing awareness and public support through media and fora such as the environmental coalitions and the Bangladesh Forum of Environmental Journalists.
- Putting full financial and logistical support behind the community-based resource management concept.
- Expanding the existing 1000 ha under forest protection committees to a target of 40,000 within a five year period, using the Proshika model with modifications as necessary throughout different ecological zones.
- Large scale participatory social forestry programmes through which people will benefit from forest establishment and protection.

CONSERVATION OF ECOLOGICAL PROCESSES

Fauna

Bangladesh is located at the confluence of three major biotic regions and includes elements of the fauna and flora of all three. MacKinnon and MacKinnon (1986) describe the country as situated in an important transition zone between Peninsular India, the Himalayas and Indo China. It is part of a large unit, including the Indian states of West Bengal, Assam, Meghalaya and others and a small part of Myanmar. It is referred to as the Bengal Assam Bio-Unit of the Indo-Malayan Realm. As a transition, this Unit is extremely rich in species but moderately low in endemism. The forests of the unit were the richest on the Indian subcontinent. They supported the greatest diversity of mammals and a high diversity of birdlife. The Unit is one of the three biologically most important units in the whole Indian subcontinent.

Unfortunately, in Bangladesh the forests which formerly covered most of the land area have been greatly reduced. At least 94 percent of the original natural habitat and vegetation has been lost to human settlement and agriculture and what remains today is a remnant of the forest types that once existed (MacKinnon and MacKinnon, 1986). Over the past 20 years the forest cover has declined from an estimated 15 percent of the land to only 5 percent. The annual estimated deforestation is 8,000 ha (ADAB, 1992).

Because of deforestation and other factors, species richness of fauna and flora is greatly diminished. Many species are now extinct in the country and many more species are listed as threatened or endangered.

1. Mammals, Reptiles, Amphibians and Birds

There is not complete agreement about the number of species of mammals, reptiles, amphibians and birds in Bangladesh.

Sarker and Sarker (1988) undertook the preparation of a comprehensive list of the wildlife of Bangladesh and provide a general assessment of their status and distribution. They list 932 species of wildlife in the country, including 123 species of mammals; 154 reptiles; 23 amphibians; and 632 birds. Various other sources provide slightly different numbers. Khan (1982), for example, lists 840 species of wildlife including 119 species of mammals, 124 reptiles, 19 amphibians and 578 birds. Akonda et al, 1989 refers to 120 species of mammals and 19 species of amphibians. Khan (1985) increased his list of mammals to 125.

Harvey (1989, updated by Johnson, Thompson and Woolner, 1992) provides the most complete list of bird species. He lists 668 species of birds recorded in the country. One hundred and eightyeight species are known to breed and a further 59 are likely to do so. The rest, nearly 400 species, are migratory and found in Bangladesh only in certain seasons. Many of these are waders and waterfowl from the northern latitudes of Siberia and China. Others are mountain and high latitude forest species which utilize the lowland forests of Bangladesh in winter.

The lists, particularly of birds, are also in a steady state of change. The updated Harvey (1992) list includes 37 species, all migrants that have been added to the list in the past 6 years. Recent work in the freshwater wetlands has identified an additional four new species for the country (Scott and Rashid, in prep.).

Only one species of wildlife is endemic to Bangladesh. The Bostami or Dark Softshell Turtle (Trionyx nigricans) is restricted to a pond at the shrine of Hazrat Sultan Bayazid Bostami, near Chittagong. The pond was excavated many centuries ago and the origin of the semicaptive turtles is uncertain. There are an estimated 150-200 individuals in the population which depends almost entirely on food provided by visitors to the shrine (Akonda et al, 1989). Some research on the Bostami turtle has been undertaken by students and faculty of Chittagong University. The population appears to be secure.

A second turtle, the Yellow Turtle (Morenia petersi) was identified by Khan (1985) as endemic to Bangladesh but has recently been reported from Assam, India and is no longer considered endemic to Bangladesh. This species in common and has a widespread distribution. It also appears to be secure.

Despite the minor disagreements about numbers of species, all sources agree on three major facts about the wildlife in Bangladesh.

First, the diversity of wildlife fauna, probably between 850 and 900 species, is remarkable for a country with an area of only 14 million ha. The 668 known bird species, for example, represent

about half of the total number recorded on the entire Indian subcontinent and 7 percent of the known species in the world (Harvey, 1989). The number of bird species in Bangladesh compares very favourably to the 800 species found in the much larger land masses of Europe and the United States. The number of mammals is about 20 percent of those on the entire Indian subcontinent.

Second, this considerable array of species is significantly less than existed less than a century ago. Eighteen species no longer occur in the country and many of the remaining species are greatly reduced in numbers and in range. At least 12 species of mammals, including all three species of rhinoceros, wild buffalo, wolf and swamp deer have disappeared from Bangladesh in the 100 years, most of them in the last 40 (Rahman and Akonda, 1987). At least one reptile, the marsh crocodile has disappeared from the wild.

In Harvey's (1992) list of 668 species of birds, fully 20 percent (nearly 140 species) have not been reported in the last 10 years. Extinct birds include the Pinkheaded duck (Rhodanese caryophyllacea), Bengal Florican (Eupodotis bengalensis), and two species of peafowl (Pavo cristatus and P. muticus) (Rahman and Akonda, 1987).

Third, the extinction of species seen over the last 50 years continues today at an alarming rate. The large number of endangered species are discussed below.

2. Endangered Species

The situation for a number of animals is critical.

There is no comprehensive and authoritative list of the endangered wildlife species in Bangladesh although a number of lists from various sources do exist. These include IUCN (1990), Sarker and Sarker (1988), and Rahman and Akonda (1987). The most complete description of threatened and endangered species is provided by Rahman and Akonda (1987).

Sarker and Sarker (1988) list 133 species that are threatened or endangered - 33 mammals (27 percent of all present); 22 reptiles (14 percent) 2 amphibians (10 percent); and 83 birds (14 percent).

The IUCN Red Data Book (Green, 1990) and Rahman and Akonda (1987) list 129 species of wildlife as threatened or endangered, including 37 mammals, 21 reptiles, 2 amphibians and 69 birds. In addition, the Red Data Book includes a further 308 species as rare or doubtful. Thus about 45 percent of the species of wildlife in the country are in the rare, threatened or endangered category.

Gharial - The gharial (Gavialis gangeticus) is a large fisheating crocodile. It is the only species in its family and is disappearing throughout its range in Bangladesh, India, Nepal and Pakistan. In Bangladesh, it was widely distributed in the country before 1950, occurring in all the large rivers and many smaller ones. Now it is confined to a few localities on the Jamuna, Padma and Brahmaputra (Khan, 1982).

Khan (1982) estimated a total population in the country at 20 animals. Rashid and Khan (1985, in Akonda et al, 1989) could find only five individuals in the Padma River and reported only a few individuals in the Jamuna during a 1984/85 survey. They estimated the total population of gharial at less than 15. Faizuddin (1985) observed a total of 28 animals - 4 in the Jamuna, 6 along the Brahmaputra and 18 along the Padma.

All observers agree the population has been declining alarmingly as a result of egg collection, hunting for skins and meat as well as habitat loss through river siltation. If this animal is not already extinct, prompt action to save it in a captive breeding program, as recommended by Rahman (1989), should be undertaken.

Serow - The status of the serow (Capricornis sumatraensis), the only antelope in the country, is also very precarious. Khan (1985) describes it as on the brink of extinction with an estimated population of 50. Its presence in Sylhet district and the Chittagong Hill Tracts is uncertain and there are certainly less than 50 individuals left in questionable habitat in the Chunati Wildlife Sanctuary.

Crab Eating Macaque - The crab eating macaque (Macaca fasicularis), which was restricted to coastal mangrove habitats near the Naaf River, may already be extinct. Its habitat has been almost completely destroyed in the last 10 years for shrimp farms, salt production and agriculture. Recent surveys by biologists of the Nature Conservation Movement (NACOM) failed to find any of these monkeys.

Birds - Many of the endangered birds may also no longer occur in the country. For example, in the survey by Asian Wetland Bureau and NACOM in the spring of 1992 (Scott and Rashid, in prep) only 3 of 18 Red List species known to formerly occur in the region were observed.

The Whitewinged Wood Duck (Cairina scutulata) was last reliably reported in the country in 1978 (Husain and Haque, 1981) and seems unlikely to have survived continued deforestation and unrest in the Chittagong Hill Tracts. It may now be extinct in the country.

Harvey (1989) puts further emphasis on the serious state of the bird fauna. About 33 percent of the species of birds (220) in the country are dependent on forested habitats. These have been under continual pressure as the forests are cleared for agriculture, tea plantations, timber extraction and short rotation plantations of exotic species. Numbers are greatly reduced from the forest habitat loss of the past and some, if not all, of these species must now be in danger.

All species in the Crane family and the Owl family are threatened and nearly all species of the Parakeet, Falcon and Accipiter families are threatened. Only about 60 species (less than 10 percent) that are highly adaptable in their habitat use are felt to be secure in their status (Harvey 1989). Migrant birds are less obviously threatened since they can alter migration patterns. But all records seem to indicate that the numbers of migratory birds are a fraction of the past. Hunting, overfishing, habitat loss in the wetlands and disturbance are all implicated.

3. Invertebrates

There has never been any inventory or systematic list of the terrestrial invertebrates of Bangladesh (Mahtab, 1991). Many play an important role in soil fertility, while others are major pests on forests and agricultural crops or vectors of disease. Several, including the lac insect and silkworms are utilized commercially. There is no systematic list of the large numbers of butterflies that are found in the forest.

There are also a vast array of marine and freshwater invertebrates, many of which are of commercial importance. Although a major part of the biodiversity of the country, invertebrates are not discussed further in this report.

4. Fish

Bangladesh is rich in fish species with more than 260 known freshwater species and at least another 475 species in the marine waters of the Bay of Bengal (Mahtab, 1991). Although another

important part of the biological diversity of Bangladesh, fish are also not further discussed here as, with minor exceptions, all responsibility for fish lies outside the Ministry of Environment and Forests.

However, fish and aquatic invertebrates do play a major role in the productivity of several natural ecosystems and their management has important implications for the protection and management of many wildlife species. The wetlands of Sylhet and Eastern Mymensingh, for example, support the richest inland fisheries in the country. The numbers of fisherman, their nets and the alteration of habitat for fisheries management have major impacts on the internationally significant migratory and resident birds using the same waters.

In the Sundarbans, and also in the freshwater wetlands, fish and prawn numbers are in decline because of overfishing (ESCAP, 1987; Mahtab, 1991). This will eventually effect the many bird and mammal species that rely on them as food. Donor-funded programs to clear mangrove forest for shrimp ponds and poison freshwater beels to enhance commercial fish production have far reaching effects on the environment and biodiversity.

A sustainable management strategy for fish and aquatic invertebrates and the habitats they utilize is necessary in order to protect all species including mammals, amphibians, reptiles and birds.

Mahtab (1991) proposes that "Fish Parks" should be established in several river systems in order to provide a refuge from exploitation and to protect the diversity of fish and invertebrate species. Where possible, these protected areas should be integrated with National Parks and Wildlife Sanctuaries which protect terrestrial ecosystems and wildlife.

Flora and Endangered Plants

Bangladesh is situated at the interface of three major biotic regions but the rich flora has been much less studied and documented than the fauna.

Approximately 5,000 species of flowering plants (angiosperms) are estimated to occur in the country. This includes more than 500 species of medicinal plants and 29 species of indigenous orchids. Documentation of the flora of Bangladesh is proceeding under the direction of the National Herbarium but to date only 56 families with 206 species have been documented. There is no estimate of the number of tree species in the country.

There are at least nine endemic plant species in the country, including four endemic trees and woody climbers. Most endemics are from the Chittagong Hill Tracts.

Bangladesh has rich plant genetic resources of such crops as amaranths, bananas, cotton, jute and tea. Centres of rich biodiversity of the main food and fibre crops of the world are called Vavilov centres. Bangladesh is located in one of these. There are estimated to be over 8,000 varieties of rice and nearly 3,000 varieties of miscellaneous other crops (Mahtab, 1991).

It is assumed that many of the species of flora have disappeared from the country or are greatly reduced because of factors such as deforestation, conversion of wetlands to agricultural land and overharvest. For example, a 1990 survey of flora in Chunati Wildlife Sanctuary failed to find 30 species that were recorded in 1925. That survey also identified at least 16 species that have commercial, horticultural or medicinal significance that are now very rare in Chunati and threatened by the pace of deforestation and encroachment. These include palms, rattans, yams, orchids and wild relatives of cultivars, and are important for gene pool conservation.

Indicative of the absence of information is the comprehensive descriptions for 23 of the wetlands on Bangladesh (Akonda et al, 1989). While good descriptions can be provided for "fauna", there

is generally either "no information or "none known" for ""special floral values" in the wetlands. Very useful information on flora in the wetlands is being collected as part of the AWB and NACOM studies for the Northeast Regional Project of the Flood Action Plan.

A tentative list of threatened plants has been prepared by the National Herbarium. This list includes 27 species of vascular plants, including nine endemics (MOEF, 1991; Mahtab, 1991). Eight trees and woody climbers are on the list. Little information is available as many of the species on the list are from the Chittagong Hill Tracts.

At least one threatened tree species, Sonneratia griffithii, may no longer be present in the country. It has been found only in the Chokoria Sundarbans, which have been badly degraded.

Wildlife Management and Research

All authority and responsibility for wildlife management and research in Bangladesh is vested in the Forest Department. Since 1983, when the Government abolished the Wildlife Circle and moved all 112 staff of that organization to other duties, there has been one Senior Research Officer in Headquarters devoted to the interests of wildlife in the country. He is occasionally assisted by short term staff.

Theoretically, staff in each of the Forest Divisions have a responsibility for wildlife. In practice, although staff are interested, there are no programs, no budgets and no time allotted to wildlife. Effectively there is no wildlife management in Bangladesh at the field level. Even if there was, it would probably be confined to reserve forest land although much of the wildlife occurs in wetlands, villages, and the coastal areas outside the forest.

Occasionally there are responses to crises. For example, after capturing and exporting over one million kg of frogs legs annually between 1977 and 1986, a survey was mounted to determine frog populations. Based on that survey, the legal capture and export of frogs was stopped and two formerly abundant species, the Indian Bullfrog and the Green Frog are now on the IUCN Red List of endangered species.

All hunting was banned in the country by executive order in 1989. However, there are no staff to enforce this law and hunting continues in a number of areas both for sport and for subsistence. There is a major trade in waterfowl which are caught in set nights at night in the wetlands and transported for sale in the markets in Dhaka. Hunting of tigers and netting of deer is alleged to continue in the Sundarbans. Poaching of elephants is alleged to occur near Chunati. The Department appears to do no enforcement of these wildlife related laws.

Although many reports have documented the rapidly declining habitat for wildlife in the country and the number of species sliding towards extinction, there are no programs or activities underway or planned within the Department for any of these endangered species.

Prior to 1986, there was a significant amount of wildlife research underway in the country. This included projects studying tigers and crocodiles in the Sundarbans and studies of primates in the sal forests and elsewhere.

Today some research programs and wildlife surveys continue but they are entirely undertaken by local nongovernment organizations like NACOM and MARC or by graduate students and faculty at several universities. International NGOs like the Asian Wetland Bureau are also involved. Forest Department does not participate officially or directly in any of this work.

A government appointed Wildlife Task Force in 1986 made a number of wildlife related recommendations including the reestablishment of the Wildlife Circle within the Forest

Department (Wildlife Task Force, 1986). No action has been taken on any of these recommendations and they have been overtaken by time and changing circumstances.

Wildlife Management and Research Recommendations

Principal requirements include:

- An institution with a mandate to manage wildlife throughout the country is essential. It's functions should include the coordination of inventory surveys, the determination of priorities for action on threatened and endangered species and enforcement of the legislation. The protection of wildlife and its habitat must be made a national priority;

- An institution for wildlife management should not be housed in Forest Department. Many important wildlife species utilize habitats in rivers (gharial and Gangetic dolphins), coastal mudflats and beaches (marine turtles and migratory birds), freshwater ponds and wetlands (frogs and wetland birds), and village forests (common langur). None of these habitats are within the traditional purview of the Forest Department and they are unlikely to receive much attention from a Department which has had very virtually no role in wildlife management, even in forests, since 1983.

- Attention must be devoted to the threatened and endangered species in Bangladesh. This should include (i) Preparation of a priorized list of the species most imminently threatened with extinction in the country; (ii) Identification of the species for which captive breeding programs are required and feasible; (iii) Identification of the species on which action to protect critical habitats is required; (iv) Preparation of species recovery plans for the list of species identified in 1. above; (v) A research program to look at the habitat requirements of such endangered species as serow and elephant.

- Existing legislation regarding illegal hunting and the illegal export of animal products must be enforced.

- A program should be initiated to promote the conservation of wildlife in village forests.

Protected Area Management

1. Existing Areas

There are four legally gazetted National Parks, seven Wildlife Sanctuaries and one Game Reserve in Bangladesh. All have been created under the provisions of the Bangladesh Wildlife (Preservation) (Amendment) Act of 1974. The existing protected areas, their size and the forest types or habitats they represent are shown in Table 16. Their locations are shown on the map in Figure 16.

The 12 formally protected areas occupy an area of 110,223 ha, or about .75 percent of the land area of Bangladesh. This is well below the target of 5 percent established by the Wildlife Task Force in 1986 and the target of 12 percent recommended by the World Commission on Environment and Development.

Two sanctuaries account for 54 percent of the total protected area and one of these, Pablakhali, the largest in the country, is of very questionable value. One of the National Parks was established for historical and recreation values and has little conservation value. Three protected areas are less than 1000 ha in size.

Excellent summary descriptions of each of the protected areas is provided in the IUCN Directory of South Asian Protected Areas (Green, 1990). Much of the information in that report was compiled from earlier reports of Olivier (1979), Sarker and Fazlul Huq (1985) and others. There has been no systematic field evaluation of any of the protected areas in over 10 years. Consequently there is little current information on the state of forest cover, wildlife populations or human activity. In some important ways parts of the IUCN Directory are out of date.

A review of the current status and condition of each protected area is provided in Appendix 3. This review updates or provides more detailed information on the existing protected areas based on fieldwork undertaken in this consultancy or review of reports completed after 1990. It does not repeat information provided in the IUCN Directory which should be consulted for basic details on all of the protected areas. Specific recommendations are provided for each protected area and form the basis for the general recommendations, presented later in the report.

2. Legislation

The legislation providing for the establishment and management of protected areas in Bangladesh is the Bangladesh Wildlife (Preservation) (Amendment) Act of 1974. It amended legislation passed in 1927. Section 23(3) of the 1974 Act allows the government to declare any area a National Park, Wildlife Sanctuary or Game Reserve. A National Park is defined in the Act as:

> "a comparatively large area of outstanding scenic and natural beauty with the primary objective of protection and preservation of scenery, flora and fauna in the natural state to which access for public recreation and education and research is allowed".

Hunting, capturing or disturbing of wild animals, firing of guns, burning, cutting or damaging plants or trees, clearing land for any purpose or polluting water is prohibited. Public entry, settlement, residence and the introduction of exotic animals or domestic animals for grazing are not prohibited.

Construction of roads, rest houses, hotels and amenities for the public in National Parks is provided for in the Act which states that these facilities must be planned so as not to impair the primary objective of establishing the park.

A Wildlife Sanctuary is defined in the Act as:

> "an area closed to hunting, shooting or trapping of wild animals and declared as such under Article 23 by the Government as undisturbed breeding ground primarily for the protection of wildlife inclusive of all natural resources, such as vegetation, soil and water".

Wildlife Sanctuaries have generally the same prohibitions as National Parks but in addition, persons are also specifically prohibited from entering or residing within Wildlife Sanctuaries or from introducing any domestic or exotic animals. There are no prohibitions on the discharge of firearms or disturbance of wildlife.

Game Reserves are defined as:

> "an area declared by the government as such for the protection of wildlife and increase in the population of important species wherein capturing of wild animals shall be unlawful".

They are simply areas within Forest Reserves where hunting and shooting of wild animals requires a special permit and capture is prohibited. They provide no other protection for fauna or flora than is provided in a Reserve Forest.

The government may for scientific, scenic or aesthetic reasons, or for the betterment of any of these areas, or for any other "exceptional" reasons, relax any or all of the prohibitions. Section 23(6) of the Act provides that the government may approve whatever changes to boundaries of any of the protected areas as it may decide.

The Act also provides for the establishment of private Game Reserves. These are areas of private land set aside by the owner for the same purpose as a Game Reserve and declared as such. The owner then has the same powers of prohibition and enforcement as a government official in a Game Reserve. No private Game Reserves have been established in Bangladesh.

3. Administration

Administration of the existing protected areas in Bangladesh is nominally under the administrative jurisdiction of the Forest Department. However, no staff have ever been identified as responsible for protected areas although this was generally considered to be a role of the Wildlife Circle. Since that Circle was abolished in 1983, there has been no department or agency with the mandate or capability to properly manage or protect any of these protected areas. No Headquarters or Divisional staff are assigned to this task.

At the field level, protected areas are administered as part of the normal duties of range and beat officers and forest guards. They generally consider the protected area as simply a part of the Reserve Forest. In the three Sundarbans Wildlife Sanctuaries and in Bhawal National Park there is some sense that forest guards in the beat offices are providing protection for a protected area. In other protected areas, there is no sense that staff are administering a protected area that requires a different approach than adjacent reserve forests.

The administration of protected areas is made difficult because the boundaries often do not coincide with the Forest Department boundaries of ranges, beats, compartments and blocks. The protected areas often include parts of several beats and ranges and protected area boundaries do not coincide with compartment boundaries. Thus different range and beat officers can take different approaches within the same protected areas. The overlapping of boundaries perpetuates the situation where the protected area is considered exactly the same as the adjacent reserved forest.

In virtually all of the protected areas there are no signs or boundaries markers, not even on main roads, to identify them in the field. In the case of Sundarbans East (Katka) where signs do exist, they are misleading because they incorrectly identify the location of the Sanctuary. Local villagers cannot be expected to know of the existence of a park or sanctuary if no signs exist and forest guards cannot be expected to enforce any of the provisions of the legislation.

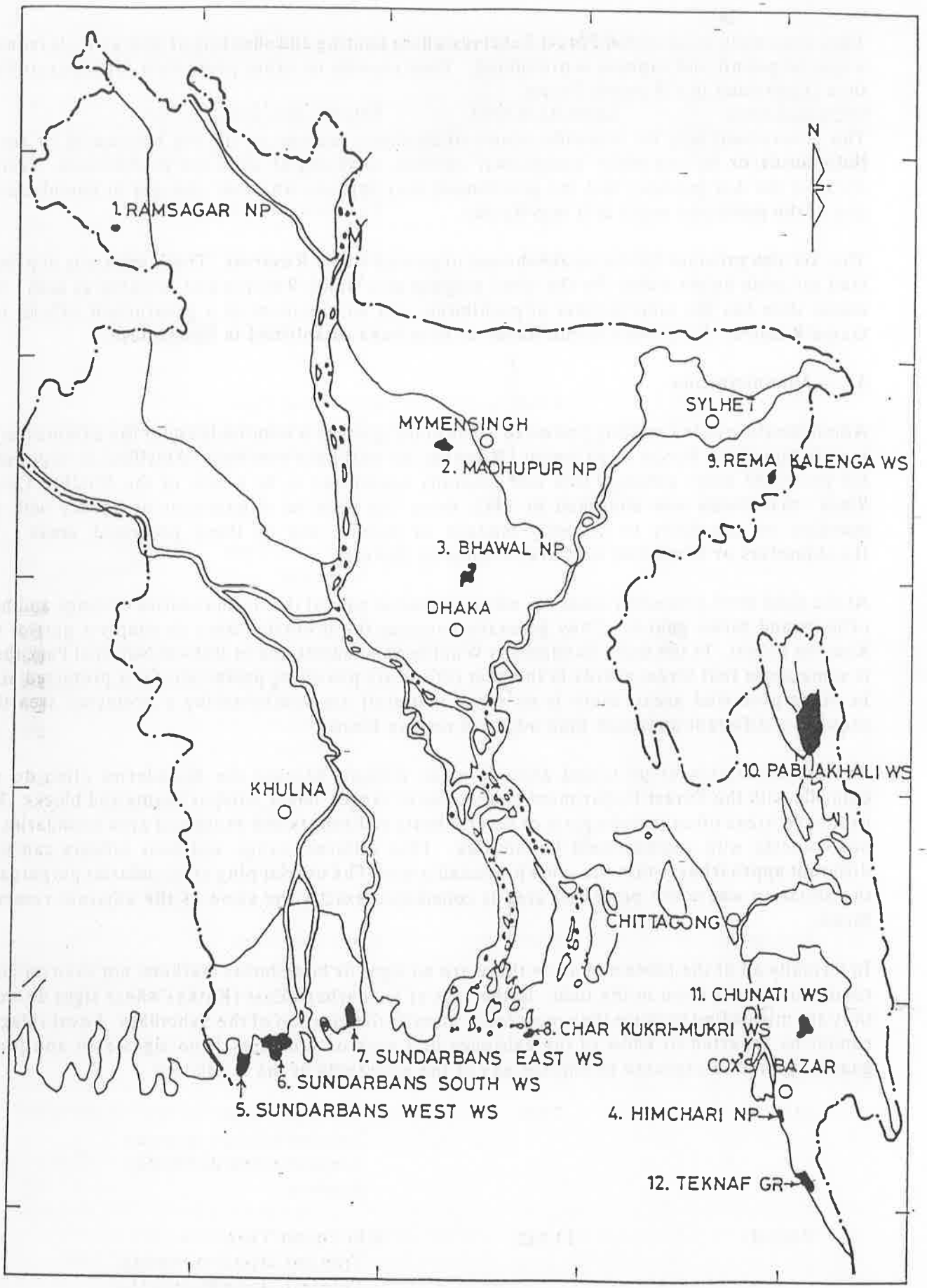


Figure 16 - Existing Protected Areas in Bangladesh

Table 23 - Protected Areas of Bangladesh

Protected Area	Land Area (ha)	Forest Type/Subtype
National Parks		
Ramsagar	50	Recreational. No forest
Madhupur	8,436	Moist Deciduous Forest Type Mixed sal
Bhawal	5,022	Moist Deciduous Forest Type Pure sal
Himchari	1,769	Hill Forest Type Tropical mixed evergreen Tropical moist deciduous
Wildlife Sanctuaries and Game Reserve		
Sundarbans West	9,069	Tidal forest Type Saltwater
Sundarbans South	17,878	Tidal Forest Type Saltwater Moderate saline
Sundarbans East	5,439	Tidal Forest Type Moderate saline
Char Kukri-Mukri	40	Tidal Forest Type New accretion
Rema-Kalenga	1,095	Hill Forest Type Tropical open deciduous
Pablakhali	42,047	Hill Forest Type Tropical wet evergreen Tropical mixed evergreen Tropical moist deciduous Tropical open deciduous Bamboo
Chunati	7,761	Hill Forest Type Tropical mixed evergreen Tropical moist deciduous Bamboo
Teknaf	11,615	Hill Forest Type Tropical Mixed evergreen Tropical Moist Deciduous Bamboo
Total Protected Area	110,223	

4. Present Management and Protection

Four of the protected areas in Bangladesh are to some degree protected, and serving the purposes for which they were created. These are the three Sundarbans Wildlife Sanctuaries and Bhawal National Park all of which have a number of forest guards stationed within them and who serve to protect them to some extent.

The Sundarbans are also protected by their isolation and the Royal Bengal Tiger and are not included in the gewa cutting plans of Khulna Newsprint Mills. However, golpatta is cut, honey is collected, and fish are caught with permits sold by the Department for those activities as in all adjacent areas. Quantities of fuelwood, poles and other wood products are removed from the sanctuaries with or without the approval of the Department as in all other parts of the Sundarbans.

In Bhawal National Park, there is a strong recreational focus and a master plan has been prepared by the Forest Department. Removal of fuelwood has been minimized by making a decision to allow the removal of very large quantities of leaves for fuel.

In the other National Parks and Wildlife Sanctuaries, there is no semblance of protected area management. In many cases Forest Department staff are unaware of the boundaries, or even the existence of the protected area. The protected area is simply a part of the surrounding Reserve Forest land.

Forest Department officers sell permits to allow collection of firewood, sungrass and poles. Fires are allowed to encourage the growth of bamboo. Grazing of livestock in the Wildlife Sanctuaries is tolerated by Forest Department staff in the same way that it is tolerated in the adjacent forest. In at least three Parks and Sanctuaries, the Department has recently had major forestry programs to clear natural vegetation and plant short rotation exotic tree species. All of these activities are prohibited in the legislation establishing Parks and Sanctuaries.

Forest guards are employed fulltime in "protecting" the forest from encroachment and illicit cutting. Little or no distinction appears to be made between protected areas and reserved forests. The guards have been successful in protecting trees around beat and range offices but, because of the small number of guards, their lack of communication equipment and transportation, have been largely ineffective in "protecting" protected areas or reserved forests.

In many cases, the focus on protection of one area has simply pushed encroachers and tree cutters further into the heart of protected areas. In some areas the narrow focus on "protection", not management, has incurred the animosity of local people and will make the job of real protection much more difficult in future.

As noted by MacKinnon and MacKinnon (1986) the highest conservation priority in Bangladesh, as in all other countries of the Indo Malayan Realm, is to greatly improve the level of management in the existing parks and protected areas.

5. Protected Area Network Gaps

There are two main approaches to identifying areas for protection and conservation. One involves the conservation of representative samples of all ecosystems that exist in the country. This approach requires the description and mapping of the range of ecosystems in the country but has the benefit of conserving whole groups of related species.

At least two, and preferably three, replicates of each ecosystem should be included in the protected area network. Unfortunately, this is not possible for some ecosystems in Bangladesh.

The second approach is to protect sites that are identified to be of particular importance to individual species. Historically, this approach reflected a bias for big game species. In Bangladesh, it has been reflected in the Elephant reserve at Teknaf, Tiger Sanctuary in Sundarbans and Deer Breeding Centres. The current approach used internationally is to identify and protect sites of importance for plants, birds, reptiles butterflies and other nongame species as well as the traditional large mammals. These can be referred to as critical habitats.

Both approaches need to be used together to develop a network of protected areas.

In Bangladesh, the existing system of protected areas was established with little regard for ecological or any other criteria and does not represent the forest ecosystem units or critical habitats. Table 24 shows the representation of the forest types and subtypes described in an earlier section in the existing network of protected areas. The gaps are clearly shown.

The major gaps for which there is no representation at all are:

a. Freshwater subtype of the tidal forest.
b. Beach forest type.
c. Lowland freshwater swamp type.

Several forest types have only one protected area to protect a representative sample of the type. These are:

a. Newly accreted subtype of the tidal forest.
b. Pure sal subtype of the tropical moist deciduous forest.
c. Mixed sal subtype of the tropical moist deciduous forest.
d. Tropical wet evergreen subtype of the hill forest.

Very poor representation of the important hill forest types is provided by Pablakhali Wildlife Sanctuary. It has been entirely cut in one form or another and is of very uncertain status at the present. The newly accreted forest subtype of the tidal forest is poorly represented by Char Kukri-Mukri because it is so small.

Significant nonforest ecosystems and critical habitats are also very poorly represented. Table ... shows the representation of the significant nonforest ecosystems and critical habitats described in an earlier section. The only critical habitat with representation in the existing network is the coastal char lands. That habitat is poorly represented by Char Kukri-Mukri Wildlife Sanctuary.

Other important habitats including the only coral reef in the country, nesting areas for marine turtles or crocodiles and the important freshwater wetlands are not represented at all.

Specific proposals to fill these gaps by extending the boundaries of existing protected areas and creating new protected areas are provided later in the report.

Table 24 - Representation of Forest Types in Existing Protected Areas

Forest Types/Subtypes	Representation
Tidal Forest	
Freshwater	None
Moderately saline	Sundarbans East WS
	Sundarbans South WS
Saltwater	Sundarbans South WS
	Sundarbans West WS
Newly accreted	Char Kukri-Mukri
Beach Forest	None
Tropical Moist Deciduous Forest	
Pure sal	Bhawal NP
Mixed sal	Madhupur NP
Lowland Freshwater Swamp Forest	None
Hill Forest	
Tropical wet evergreen	Pablakhali WS
Tropical mixed evergreen	Pablakhali WS
	Himchari NP
	Chunati WS
	Teknaf GR
Tropical moist deciduous	Pablakhali WS
	Himchari NP
	Chunati WS
	Teknaf GR
Tropical open deciduous	Pablakhali WS
	Rema-Kalenga WS
Bamboo	Pablakhali WS
	Chunati WS
Village (Urban) Forest	City parks (Dhaka)

Note: Representation of the Hill Forest types is assumed based on limited field observation in Chunati, Himchari, Teknaf and Rema Kalenga and written descriptions of Pablakhali. All forest types in Pablakhali have been greatly altered and may no longer exist.

Table 25 - Extent of Nonforested Ecosystems and Critical Habitats

Ecosystem or Critical Habitat	Existing Protected Areas Representation
Freshwater Wetlands	None
Coastal char lands	Char Kukri-Mukri
Coastal estuaries and islands	None
Lakes	None
Coral Islands and Reefs	None

6. Zoos, Herbaria and Botanical Gardens

Zoos, herbaria, botanical gardens and captive breeding centre have an important role in conserving the biological diversity of a country. This is particularly true of Bangladesh where so many species of fauna and flora are threatened and endangered and where natural habitats are greatly reduced and deteriorating.

The role of zoos and captive breeding centres is exemplified by the situation with marsh crocodiles (Crocodylus palustris). This species is extinct in the wild in Bangladesh but a few are in captivity in a pond beside a mazar (religious shrine) at Bagerhat. From there, some young animals were taken to the National Zoo in Dhaka. The same approach could be taken to conserve some of the

few remaining gharials, serow and other species. Fenced enclosures exist in the former Deer Breeding Centres at Duluhazra and Madhupur National Park.

The integration of the National Herbarium, the National Botanical Garden at Mirpur and the Baldah Historical Garden in Dhaka is underway. A 1992 project initiated by the Government of Bangladesh provides for development of the Gardens and construction of a facility to house the National Herbarium at the Botanical Gardens. The principal objective of this project are to strengthen the ability to collect and store plant specimens from different parts of the country in order to safeguard the threatened and endangered flora. Although approved, the project is awaiting funds from the British Overseas Development Agency (ODA).

In addition, it is clearly recognized that there is a need to develop a clear mission statement for the Botanical Garden (Heywood, 1990). The Garden has an important role in conserving native plants of the country and facilitating research into many aspects of the flora. It also provides a very pleasant and aesthetic venue for helping to educate the general public about the rich diversity of plant life in Bangladesh. The IUCN Botanic Gardens Conservation Secretariat has offered to assist in the further development of the Garden.

Recognition of the important conservation and education roles of these facilities and their location in one functional unit with other conservation specialists will be important for the future conservation of biodiversity.

7. Recommendations

- It is essential that an institution with responsibility for the management of protected areas be created in Bangladesh. This institution should be separate from the Department with responsibility for Reserve Forest land. Each protected area should be under one administrative unit with a consistent set of management objectives and procedures;

- Boundaries of each protected area should be clearly marked with signs.

- Improved management of protected areas should involve a new approach. A simple focus on "protection" will not serve to protect natural areas. Management must involve meeting the needs of local people in a constructive way and seeking their cooperation in protecting designated areas.

- Legislative changes are necessary to revise the activities allowed and prohibited in protected areas. For example, in Wildlife Sanctuaries there must be protection for the habitat of fauna and flora. Those human uses and resource extractions which do not impair habitats can be permitted. In National Parks, settlement and grazing should not be permitted. The Game Reserve category should be eliminated and upgraded to Wildlife Sanctuary.

- Gaps in the existing network of protected areas need to be filled by establishing new protected areas or enlarging existing ones.

- There is a need for a new class of National Park to protect areas of national cultural, historical and recreational importance.

- The facilities with a role in exsitu conservation should be located in one Department with other specialists involved in conservation. These facilities should be strengthened in recognition of the important role they have to play in Bangladesh.

Tourist Development Potential

1. General

Tourism in protected areas in Bangladesh is very undeveloped at the present time. Recent assessments have been provided by ESCAP (1988), UNDP and WTO (1988) and Pannell, Kerr and Forster (1990).

Domestic tourism in protected areas is focused on Bhawal, Madhupur and Ramsagar National Parks. Bhawal is heavily used, receiving up to 60,000 visitors on some holidays and an estimated 600,000-700,000 visitors per year. Ramsagar and Madhupur also receive many visitors but less but Bhawal. These local visitors come by bus for picnics and to walk in the parks. Their activities are entirely recreational and in a number of ways are actually a detriment to the flora and wildlife in Bhawal and Madhupur. Visitors have little awareness of the natural features or wildlife of the Parks. No information is provided and there are no regulations on their activities. Recommendations to make the activities of these visitors more compatible with National Park protection are made in the Conservation Specialist Report.

The only area that is presently visited by international tourists or expatriates living in Dhaka is the Sundarbans. Parjatan Corporation runs tours from Dhaka to the Sundarbans East and South Sanctuaries in association with a tour operator in Khulna. One private tour operator based in Dhaka also runs Sundarbans trips. Other accessible National Parks and Sanctuaries including Chunati, Teknaf and Himchari receive virtually no visitors.

In the 1991/92 season, Parjatan ran 25 tours. Other tourists made private arrangements independent of Parjatan. Forest Department statistics indicate that 165 foreign tourists visited the Sundarbans in 1989 and 345 in 1991. The total number of real tourists per year has probably never exceeded 500. A number of government, military, harbour authority and other personnel and a large number of local people also visit the Sundarbans every year but these are not considered as tourists.

All tours to the Sundarbans are conducted by boat. The only overnight facilities are the Forest Department rest houses at Katka and Hiron Point and the Harbour Authority rest house at Hiron Point. These can be used by tourists with prior notice but are not readily available. The boat trip from Khulna or Mongla Port to these rest houses takes between 8 and 12 hours.

It is generally agreed that at present the Sundarbans has little potential for mass tourism due to the cost, lack of suitable boats and shore facilities, and the distance and travel time (Green, 1990; Phillipson, 1988).

2. Development Prospects

There is potential for expansion of the limited special interest trips for foreign tourists and resident expatriates that Parjatan and private operators now conduct. Blower (1985) has suggested that this should be based around selfcontained launches, called "floatels". Facilities including jetties, nature trails and viewing towers could be constructed at strategic locations. There is also potential for seaplane access to international standard lodges in remote corners of the Sundarbans. A proposal seeking international assistance to do a feasibility study on the tourism development potential of the Sundarbans has been prepared by Parjatan and awaits approval (Parjatan, 1991b).

This kind of tourism development aimed at foreign visitors requires a very careful and well planned approach and cannot be undertaken in the current circumstances of wildlife and protected area management in Bangladesh. The Forest Department authority over the protected areas at present means that tourism has a very low priority. There have been a number of conflicts

between the Department and Parjatan Corporation in the Sundarbans and some rather inappropriate facilities have been constructed. Tourism development in the Sundarbans will require professional management, careful planning and a lot of investment.

There are more realistic and less costly opportunities for domestic tourism elsewhere in Bangladesh. Tourism development in several protected areas would have the important added advantages of providing employment and income for local people and serving as sites for environment education and awareness programs. Development of tourism at these sites would foster much needed local pride and interest in natural history. Four locations are suggested for this type of tourism development.

First is the Cox's Bazaar area where hotel and other facilities for tourists already exist and which is already a tourist destination (ESCAP, 1987). Himchari National Park is situated only 5 km from Cox's Bazaar. Although being rapidly degraded, it does have some beautiful forest, waterfalls, a forested stream and a variety of wildlife. There are good opportunities to involve local people in developing trails, providing guiding services to visitors and selling crafts. This Park with its forest, birds and scenery could be promoted in association with the beach at Cox's Bazaar from which it is readily accessible.

Teknaf, although farther from Cox's Bazaar, is also a reasonable and very interesting day trip. It offers a much larger area for walking and wildlife viewing and a greater range of species. There is road access to the centre of the Reserve and to some beautiful forest and caves from Whykeong. Here also, local people could be involved in the construction and maintenance of trail and viewing facilities and could act as guides and porters.

Chunati and the Duluhazra Deer Breeding Centre on the main Chittagong-Cox's Bazaar road are farther from Cox's Bazaar but also offer opportunities. Road side nature centres could be developed and captive animals could be seen at Duluhazra.

The second area offering tourist potential is in the Srimangal area. The Lawachara forest, Hail Haor and Hakaluki Haor provide some excellent viewing of birds and a rich forest with wildlife. Wildlife or ecotourism development here could be promoted in association with the scenic and interesting tea gardens. Development will require hotel or lodge facilities but offers the advantages of providing employment and income for local people and involving them in protecting the areas.

Third, Madhupur National Park could be a development focus for ecotourism. This Park has a beautiful, open forest that is ideal for walking and watching capped langurs and birds. It is less than 4 hours from Dhaka and would be an ideal weekend destination for expatriates or Bangladeshis living in Dhaka. Attractive lodges or rest houses on the perimeter of the Park would be required. Tourism development here could involve roads, trails and fences and would provide employment.

Finally, a protected area in the northern part of the freshwater zone of the Sundarbans will soon be accessible by road for Mongla. A sanctuary in Compartments 27 and 28 would be much more readily accessible to domestic tourists than the existing protected areas and would provide the only realistic opportunity for Bangladeshis to see some of the Sundarbans forest with all its wildlife and birds. A protected area at this location, designated as part of a larger National Park in the Sundarbans, could be developed to offer safe viewing of tigers. It would involve and benefit local people directly. A major reason for establishing a protected area in the north part of the Sundarbans is to provide those important local economic and social benefits.

Phillipson (1988) provides an excellent and realistic assessment of the potential for developing tourism around the wildlife and protected areas of Bangladesh. He points out that a prerequisite

for any tourism development will have to be much improved protection for wildlife and protected areas, and enforcement of existing laws. The establishment of an agency that can manage these resources with an understanding of the link between protecting wildlife and their habitats and the development of ecotourism is essential.

3. Recommendations

Major development recommendations are:

- Wildlife and protected areas must be under proper and effective management prior to the development of ecotourism. This is necessary to integrate the protection of the areas with tourism development;

- A wildlife and protected area institution must recognize the role of ecotourism can play in assisting the protection of wildlife and protected areas and must be dedicated to that objective. At the moment this is not compatible with the role of the Forest Department where wildlife, protected areas and tourism have very low priority.

- Ecotourism development in Bangladesh should be focused on the areas of Cox's Bazaar, Srimangal, Madhupur and the northern part of the Sundarbans in order to combine the benefits of economic development with the social benefits of involving local people and increasing the awareness in Bangladesh of the rich diversity of fauna and flora. This type of tourism development should primarily focus on Bangladeshis and resident expatriates. It should be a labour intensive development.

- Tourism development in the Sundarbans has potential but will require considerable expenditure. Development should be slowly and carefully planned. The feasibility study proposed by Parjatan (1991) should be supported. Foreign tourists expect a high standard of physical facilities and park management. They will also expect to see tigers and crocodiles and ways to do this have to be developed.

NON GOVERNMENTAL ORGANIZATIONS

General

Non governmental organizations (NGOs) in Bangladesh have been operating for more than twenty years. They are comprised of more than 10,000 organizations at village level, although only perhaps between 600-700 are registered with the NGO Bureau, and are authorized to receive funds from abroad. Over a hundred are foreign-based and the remainder are national organizations.

These organizations vary in size from thousands of employees (BRAC and Grameen Bank) to a handful. Their operations cover all sectors. They can be classified as (a) relief and welfare organizations; (b) those concerned with local self-reliance; and (c) sustainable, integrated development agencies. It is estimated that more than $250 million is received on an annual basis by these agencies. Perhaps three-quarters of such funding is directed towards the largest organizations, which would be about several dozen agencies. Besides the formal NGOs, there are academic entities, research and consulting firms, and private sector agencies. Those participating in environmental activities per se are far fewer in number. However, there are many agencies which have at least some activities related to environment such as social forestry, fisheries, environmental awareness-building, research and advocacy organizations, etc. The following consists of a brief profile of the more prominent environmentally-focused agencies, and in particular, those with some expertise and interest in forestry, biodiversity, and resource management.

Profile of Selected Environmental Agencies

1. Bangladesh Centre for Advanced Studies

BCAS is an independent research organization working on resource management, environment and developmental (RMED) issues, particularly in multi-disciplinary and inter-disciplinary areas. The agency has worked with local experts and local groups in the forestry sector. The main focus has been on: (i) Trees and tenure (several on-going research projects); (ii) Trees and women; (iii) Homestead forestry; (iv) Trees and conflicts; (v) National capability and training in social forestry; and (vi) Forestry policy issues. BCAS is the coordinator and the implementing agency of the State of the Environment Report (SOER): A Citizens Report. This report is funded by a consortium of more than 20 national NGOs and attempts to address people's own perceptions and definitions of their environment, needs and priorities, as well as indigenous technology and knowledge.

BCAS raises RMED issues of national importance, engages in consensus building, identifies research agendas, and directly undertakes interdisciplinary and multidisciplinary research projects. It relies on a large number of BCAS Fellows, both nationals and expatriates, from a wide range of disciplines including natural, engineering, health and social sciences.

2. Institute for Environment and Development Studies (IEDS)

The agency deals with a broad spectrum of environmental issues, focusing on (i) Research activities such as natural substitutes for poisonous chemicals; (ii) training environmental volunteers; and (iii) environmental publications. Projects have included: banning of frog legs export, intensive organic farming, literacy to marginal people, and environmental awareness. Forestry sector projects have included social forestry , and plantation studies using natural substitutes for pesticides, and the importance of wetlands. It is the Bangladesh representative of Friends of the Earth International.

3. Climate Action Network South Asia

CANSA was formed in 1991, and a secretariat has been established at the Bangladesh Centre for Advanced Studies. The progress to date includes: (i) A CANSA Resource Centre has been established with over 1,000 items of publications; (ii) the first regional meeting was held in Dhaka in November 1991; (iii) consensus on a research agenda has been developed; (iv) linkages have been created with other Climate Action Network (CAN) members and networks in North America, Europe, and Africa. Research has been undertaken on methane emissions, existing estimates for GHG emissions, mitigation strategies, and potential impact studies of sea-level rises. CANSA will provide inputs to the INC, governments and interested parties in the form of technical and background papers. The agency will also perform an advocacy role with South Asian Governments and NGOs.

4. Multidisciplinary Action Research Centre (MARC)

MARC is the combination of a research institute, consulting firm, and NGO. It attempts to bridge the gap between theory and practice. It undertakes research and information studies and action programmes as well. Areas of current emphasis are human resources, institutions, technology, and natural resources, particularly in agriculture, water resources, and forestry sectors.

A survey on perceptions of environmental data was carried out under an IUCN-supported project on Natural Resource Information Centres. The main goal of this survey was to assess the need for centres of natural resource information in the process of natural resources management at thana, union and village levels. Twelve thanas were selected to ensure an adequate representation of

various important ecological regions of Bangladesh, i.e., forests, flood plains, Barind Tract, haors and off-shore islands.

Of particular relevance are papers on the flora and fauna of Chunati Wildlife Sanctuary, and a pilot project model for management of Chunati.

5. Nature Conservation Movement (NACOM)

The organization consists of a number of multi disciplinary individuals comprising wildlife biologists, naturalists, sociologists, historians and journalists, etc. Its aims and objectives are to: (a) stimulate public awareness of environmental issues; (b) to promote creation of a data bank, library, information centre and a natural history museum; and (c) conduct species inventories, breeding atlases, and create captive breeding centres, etc. The following are some of the activities of this field-oriented agency:

- research and surveys of wetlands in Bangladesh, both in coastal areas and inland; this has involved collaboration with the Asian Wetland Bureau, and surveys for the World Bank Forest Resources Management Project as well as the Northeast Regional Water Management Project (FAP-6);

- migratory waterfowl censuses, which have identified some of the world's highly endangered species in the coastal wetlands of Bangladesh, and helped to establish the importance of Bangladesh as an internationally important wetland under several of the Ramsar Convention criteria;

- establishment of people's participatory conservation programs at Mashok, Kapassia, under Gazipur District, Gulotia in Manikganj District and Whykeong in Cox's Bazar District.

An achievement in Kapassia has been the creation of a local organization, which has initiated and maintained a conservation centre and library with NACOM guidance and support. Gulotia in Manikganj and Whykeong in Cox's Bazar are being developed as conservation centres also.

nature education programmes have been conducted since 1986 in different degraded ecosystems. The organization organizes conducted nature walks in various ecosystems, and provides consultancy and technical services.

6. Wildlife and Nature Conservation Society of Bangladesh

The agency has collaborated in some research activities with POUSH, NACOM, and SCONE. A public awareness campaign on nature conservation, wildlife management, and development of National parks and protected areas is being promoted among the public, local communities and NGOs. Via nature magazines, lectures, and other media, presentations have been given on "recreation forestry- wildlife tourism".

Project proposals and profiles have been prepared for the conservation of wildlife and biodiversity in a captive breeding centre at Dulahazara, the Chunati Wildlife Sanctuary, and an elephant sanctuary in Himchari and Teknaf. Proposals have also been developed for nature conservation in protected forest areas in the forests of Chittagong, and for the "Tiger Project" in the Sundarban Wildlife Sanctuaries.

7. Wildlife Preservation and Nature Conservation Association

The agency fundamentally aims for public motivation for environmental protection, with specific interests in forestry, flora and fauna. It is based in Chittagong.

8. Palli Unnayan Sangstha (POUSH)

Poush has a number of programmes which include:

- experiment with an "eco-village" concept in four villages in 1991, in Cox's Bazar, Chakaria, and Kaliakoir. The programme is in a nascent stage only, but intends to include tribal villages in Jhenaigati and Lama thanas;
- there is an afforestation programme, begun in 1986, which has been expanded in 1991 through the support of the World Food Programme. Existing programmes were expanded to new areas in Netrokona and Bandarban districts;
- POUSH has initiated afforestation programmes in Lama, Naikhongchhari and Bandarban thanas, and local response to its model for participatory forestry has been encouraging.
- Some preliminary surveys were carried out on the status of the ecological status of the Teknaf Game Reserve and Chunati Wildlife Sanctuary, and the agency has planned to set up observation centres around the Chunati Wildlife Sanctuary and do some tree planting in Harbang, Banshkhali and Chunati.

9. Centre For Environmental Research

The centre, at Rajshahi University, is involved in the collection of field data on land use, degraded ecosystems, forest ecology and conservation. The centre has been compiling data and descriptions of various species of plants and animals of the region, including the remnant patches of Sal forests of Northwestern Bangladesh, vegetation of the Barind Tracts, and chars, river banks, and sand-dunes of the Padma and the Sundarbans. The plants have been described and conserved in a herbarium, and threatened and endangered species lists are under preparation.

The Centre has published research papers, and given presentations on vegetation, forestry, environment and other related issues. Three videos have been made. Symposia and workshops have been organized by the Centre in the University, local colleges and other institutions on environment, forests and biodiversity.

10. IUCN Bangladesh

This agency is the Bangladesh representative of the World Conservation Union. It participated in the formulation of the National Conservation Strategy (NCS) initiated in 1987. A liaison office was set up in 1989 at the invitation of MOEF, and a country representative was appointed late in 1991. Its programme priorities are: (a) policy formulation; (b) promotion of biodiversity; (c) environmental education and awareness; and (d) provision of technical and advisory services to donors, NGOs, and GOB. The agency has provided support for and done evaluations of the National Herbarium, National Botanical Gardens, and the NEMAP.

The agency has access to strong international technical support services through its linkages to IUCN headquarters. Locally, it has initiated recruitment of some member agencies. Its immediate goals are to undertake a number of projects for which it is seeking funding.

11. Proshika Manobik Unnayan Kendra

The organization has been active in forestry and environmental activities for many years. The programme has four primary components:

- roadside and strip plantations, in which the agency encourages groups to take long term lease of roadsides/embankment sides from the relevant government authorities; approximately 50% of the group members are women; in 1991 year over 650 km of roadsides were planted with nearly two hundred thousand trees;

- forest protection in some large tracts of reserved government forest land, such as Kaliakoir, Mirzapur, Shakhipur and Sreepur thanas; groups in this area took up a forest protection programme beginning in 1986, whereby areas of degraded Sal forest are targeted for protection and regeneration; groups have attempted to receive formal benefit sharing agreements form the Forest Department in about 900 ha of forest;

- homestead gardening, through organized training and credit is promoted, from which about 7,500 families are practicing improved homestead gardening;

- nursery development, whereby seedlings and saplings are supplied to organized groups to develop nurseries, both through credit from a revolving loan fund (RLF) and with groups' internally mobilized savings as well; in total, 3,000,000 seedlings and saplings were distributed in 1990-91 from nurseries developed by such groups.

12. Bangladesh Rural Advancement Committee (BRAC)

The programme started in 1985, and stresses two functions: nurseries and plantations. The nursery programme consists of village nurseries and area nurseries. The former ensures supply of seedlings locally, and focuses especially on women, thereby increasing employment for disadvantaged women in the rural labour force. The area nursery programme has been implementing a sericulture & tree plantation programme since 1978 for increasing silk production & improving afforestation and also income generation for rural landless poor women.

BRAC's tree plantation programmes in homestead & roadside plantations aim to improve nutritional status, income generation and supply of fuel. The roadside plantation were begun in Jamalpur in 1989. It has distributed over four million seedlings among the group members, marginal farmers and among the poor people at nominal prices. One hundred twenty-five workers are employed under this programme. A total of 416 groups are involved under this programme, the majority of which are female groups. Lands are leased from the Forest Department on a longterm basis. To date, 4736 group members and 121 BRAC staff have received training.

13. Caritas Bangladesh

The programme started in 1986, and includes sapling distribution, motivation, and training. It has set-up 99 nurseries, arranged 2,554 meetings, and 49 workshops to date. It has 36 workers including 2 specially trained workers at present. There is a significant annual budget for these activities.

14. Centre for Mass Education in Science (CMES)

The social forestry programme has included nursery establishment, homestead plantations, sale of saplings and training. There are 28 staff in the programme. The syllabus in their non-formal education programmes include tree plantation and maintenance, and schools have their own

nurseries. The Centre also promotes organic fertilizer for homestead forestry, as well as introduction of improved stoves.

The above agencies illustrate the range of NGO involvement in forestry and environmental issues. Appendix 7 describes these activities in more detail, and supplements the list of agencies by a considerable number.

NGO Weaknesses and Strengths

A number of potential areas which could be construed as weaknesses have been pointed out. These include (Cort, 1989): (i) there is a low level of awareness of the environmental impacts of development programmes generally; (ii) more coordination and information-sharing is needed; (iii) their technical capacity is limited; (iv) they have little ability to influence policy. Other limitations are that:

- the scale of their operations in most cases has not had much impact either on a thana or even a union parishad level, for the small organizations;
- the time frame for funding from donors does not often take into consideration the longer term necessary for projects in forestry, which require years for results sometimes;
- there has frequently been a lack of cooperation from the local level officials, in allocating khas land or roadside strips;
- local village elites and vested interest groups still strongly oppose programmes which target and organize the poor and their attempts to control benefits persist;
- the NGOs frequently allocate only a small part of their budget from revolving loans for specific forestry activities;
- there has often been a lack of cooperation from the Forest Department, both in terms of availability of seeds, seedlings, and -more importantly- in terms of tenure agreements, which mitigate against project success;
- it is difficult for small organizations to have access to needed training, technical assistance and funding, since donors prefer the larger NGOs with a track record and accountability; yet it these small village-level organizations which are meant to facilitate self-reliance;
- the potential for learning through workshops and exchange of experience is high, but rarely available to smaller groups working at village level, even though apex organizations have been formed to deal with such problems; such apex organizations require more effective coordination;
- there is much competitiveness between NGOs.

At the same time, doubtless, there are more positive impacts overall. Factors which lead to more successful achievement of programmes include:

- NGOs play a catalytic and facilitating role, which is less top down than GOB programmes;
- flexibility and responsiveness to local needs enable them to make the necessary changes more quickly than government agencies;

- they are less bureaucratic (though not necessarily always);

- they are becoming more sensitive to gender issues, and their programming accordingly reflects a better understanding of the differential environmental impacts on women;

There has been varying success in the specific field of social forestry which has been covered elsewhere within the master plan (see FMPe). There has not been a long tradition in social forestry in Bangladesh. Neither has there been much experience in the environmental aspects of development activities. These observations apply to donor agencies, GOB and NGOs as well.

While a number of NGOs have included social forestry and environmental activities as part of their overall development programmes, there has been no significant funding provided for the organizational development and capacity-building of the NGO community in these sectors. Nevertheless, there have been significant contributions from many NGOs, often under difficult conditions, as noted above.

The Forestry Master Plan now under preparation has sought the views of NGOs for their participation and involvement. There is clearly a tremendous need for greater GOB-NGO cooperation. Much depends upon very significant changes to existing attitudinal and policy constraints within the Department. However, mechanisms can be explored for potential participation for institutional capacity -building of the NGO community.

To date, the feedback from NGOs during the planning process, in addition to the above, includes:

- the need for a new department to be responsible for parks, protected areas, and wildlife management and to preserve ecologically sensitive areas such as wetlands and the remaining high forests in the hills;

- the necessity for innovation in protected area management;

- to ensure sustainable livelihoods for the poor who depend on increasingly dwindling common property resources;

- the need for decentralizing environmental management and for much awareness-building at community level;

- replication of successful pilot projects in community-based forest resource management.

A mechanism to strengthen NGO capacity in various aspects of the forestry sector would need to consider the following factors. Strengthening of "environmental" NGOs, i.e. wildlife and nature societies can best be done in collaboration with kindred organizations in the region and elsewhere. Examples would be WWF, IUCN, WRI, APPEN, etc. These can get very focused technical and financial assistance through setting up conservation trusts and boards. The danger is that the resource itself (trees, wildlife) tends to get more attention than the importance of the resource for people's livelihoods. There needs to be some collaboration between mainstream development NGOs and such agencies.

The focus needs to be on forestry, but forestry should not be isolated from intersectoral linkages. A new mechanism might duplicate existing setups, i.e., Forum of Environmental Journalists, Coalition of Environmental NGOs,etc.

Strengthening NGO Linkage

The non government organization movement offers several advantages to forests developments, amongst which the major supporting recommendations are that:

- Two national trust funds be set up for NGOs, to be managed by independent Boards of Directors selected from amongst themselves, with representation from MOEF, DOE, the new proposed Department, and acknowledged authorities/ experts in the field of nature conservation;

- The first would be based on a national heritage or conservation trust, modeled on such trusts elsewhere in the region by agencies such as IUCN and WWF. It would be directed towards agencies whose main objectives are concerned with environmental conservation, biodiversity, protected area surveys and management, etc. The fund would consist of pledges from various donor sources. It would be conservatively invested and the annual proceeds would be directed towards appropriate activities, which would be clearly spelled out in the charter of the fund. Mechanisms for discussing potential functions, structure and management would be done through a short term consultancy. GOB would have a role in the fund through MOEF, primarily via the new Department for conservation and resource management;

- The second fund would be for the purpose of community-based natural resource management. It would be created on the basis of perceived needs of the rural poor, to promote and support activities such as:

  - natural resource information centres, located in existing field offices of NGOs and in selected microenvironments and ecosystems; the conceptual basis for this has been framed by MARC;

  - eco-villages, i.e., integrated resource management at community level in selected locations; a conceptual basis has been suggested by POUSH;

  - special emphasis on a resource centre for the linkages between women and environment;

  - applied/action research, in the fields such as: (i)tree/land tenure systems (ii) common property management methodologies and experiences throughout the country; (iii) community watershed management; (iv) exploring microenvironments and traditional techniques and technologies for village forest management;

  - formation and extension of forest protection committees; the feasibility and practicability for this has been demonstrated by Proshika Manobik Unnayan Kendra;

  - training of NGO workers, school teachers, villagers, local government officials, industrial managers;

  - a source of follow-up financial support to SOER;

  - employment and income generation through small-scale forest-based industries;

  - information and public awareness campaigns at primary and functional literacy level; production of films, videos and books about forest conservation, wildlife, and the importance of village forests;

- a centre of excellence in social forestry, promoting NGO linkages within the country, linkages with similar centres in the region, inviting lecturers from within the country and the region, and providing fellowships to local innovators.

- Attempts would be made to use existing NGO facilities where possible. The fund would be managed via a mechanism of a small secretariat and an independent board of directors. In order for the fund to be participatory, and to truly reflect the versatility yet clarity needed, the mechanism should be created by the NGOs themselves. Given that the proposed activities represent the realities of necessitating innovative management for the optimum utilization and sustainability of resources, this will necessitate in depth dialogue within the NGO community. Potential donor consortia should be considered.

- It is a given that both funds will be on grant terms. The first will be a self-sustaining fund from which the capital will not be depleted. GOB would be expected to make a nominal financial commitment (perhaps 10%) to the annual expenditures of the first fund. The second fund would be a pilot project for a period of five years, for which expenditures would be fully covered, and a five-year commitment would be expected from donors. Subsequently, a permanent fund could be established, or merged with the other fund under expanded contributions. The period of five years will have allowed for the environmental and development NGOs to build the rapport and working relationship necessary for joint efforts towards sustainable development initiatives.

FOREST BIODIVERSITY

General

Conservation of ecological processes is essential for preserving individual species and habitats, relying on natural processes as a regulatory mechanism (rather than human-induced interventions where possible), and for maintaining biodiversity. Ecological processes include all plant and animal processes and activities which have an impact on the state of ecosystems. The processes which comprise the dynamics of an individual ecosystem are not easily characterized and need to be individually described, in their unique aquatic and terrestrial environments. A number of concerns relate to ecological processes, these being: (a) the integrity of the water system; (b) the impact on soils can alter conditions on microbes with specific effects,such as plant pathogens, mycorrhizal fungi, and symbiotic nitrogen-fixing bacteria, particularly when burning is part of the forest management regime; (c) predator/ prey relationships and population dynamics can have serious effects; (d) cycles of disturbance and recovery (fire, grazing, jhum on vegetation); (e) localized forest treefalls, landslides, diseases and pests; (f) river erosion is a natural ecological process with many repercussions on Bangladesh; (g) flooding, cyclones, on a macro scale also can be considered as natural, although these can be mitigated to some extent.

Threats to ecological processes include (IUCN, 1984): (1) alternation of major mineral or organic components (such as through jhuming), fertilizers, pesticides; (2) physical disturbances to landforms, (e.g. dams, depletion of aquifers, FCDI projects); (3) removal of vegetation, the effects of clear cutting on soil fertility, erosion, and habitats; (4) hazardous or toxic chemicals such as herbicides, pesticides, heavy metals (found increasingly in the Sundarbans, downstream from industrial sites), etc.; (5) destruction of key species, via the introduction of pests, exotic plants, removal of predators, and the consequent effects on regulatory systems;

Conservation of ecological processes can be significantly promoted by maintenance of biodiversity and management of a system of protected areas for natural habitants and ecosystems.

Biodiversity is measured in terms of the numbers, variations, and population in a given area. The first is "species diversity" and consists of the numbers of species in the total population. The second includes the different varieties and races within a species and thus constitutes the "genetic diversity" within the gene pool. Gene pool means the collection of all the different genes in the various individuals of a population. Since individuals live in particular habitats with their characteristic microenvironment, the existence of variation in habitats, i.e., "ecosystem diversity" offers the possibility of the existence of more diverse life forms.

Status and Trends

The table below gives a comparative indication of biodiversity in Bangladesh compared with other countries, both in the region and globally.

Table 26 - Comparative Biodiversity in Bangladesh Versus Other Countries

Country	Area (sq.Km)	Plant Species	Plant Species per 100 sq.km	Mammal Species	Mammal Species per 10,000 sq.km	Bird Species	Bird Speciesper 10,000 sq. km
Asia							
Bangladesh	144,000	5,000	3.5	120	8.3	668	47.7
China	9,597,000	30,000	0.3	394	0.4	1,195	1.2
India	3,166,828	15,000	0.5	350	1.1	1,200	3.8
Philippines	300,000	8,000	2.7	165	5.5	750	25.0
Japan	369,698	4,200	1.1	186	5.0	632	17.1
Indonesia	1,919,443	40,000	2.1	479	2.5	1,500	7.8
Australia	7,682,300	18,000	0.2	299	0.4	700	0.9
Africa							
South Africa	1,184,827	23,000	1.9	279	2.3	795	6.7
Zaire	2,345,410	11,000	0.5	409	1.7	1,086	4.6
Uganda	236,578	5,000	2.1	311	13.1	989	41.0
South America							
Paraguay	406,840	7,500	1.8	157	3.9	630	15.5
Brazil	8,511,965	55,000	0.6	405	0.5	1,567	1.8
Colombia	1,138,914	45,000	3.9	356	3.1	1,665	14.6
Venezuela	912,047	20,000	2.2	305	3.3	1,295	14.0
Europe							
Great Britain	244,443	1,800	0.7	77	3.1	233	9.5
France	549,619	4,400	0.8	113	2.0	342	6.2
Finland	337,032	1100	0.3	62	1.9	232	6.9

Note:
1. Some of the relatively small countries with high figures for the number of species per unit area, such as in the case of Bangladesh, share many of those species with neighbouring countries.
2. Bird species for Bangladesh include migratory species, in addition to resident, breeding birds, because of the importance of wetlands here for migratory species. If only resident breeding birds are included (247) the number per 10,000 sq. km. becomes 17.1.
3. Due to the rapid destruction of natural habitats, this species diversity is confined to very small areas dispersed throughout the much altered ecosystems.

Source: Adapted from: Government of Indonesia VTF/ INS/ 065/ INS Forestry Studies Technical Report No.1, Vol. 4., p.68)

Within Bangladesh, the diversity of wildlife fauna, probably between 850 and 900 species, is remarkable for a country with an area of only 14 million ha. Eighteen animal species no longer occur in the country. The remaining species are greatly reduced in numbers and in range.The flora is no less remarkable, but is significantly less than existed less than a century ago. It is estimated (MacKinnon and MacKinnon, 1986) that Bangladesh has lost 94% of its original natural habitat. Before human habitation and the introduction of sedentary agriculture, the floodplains and lowlands were likely nearly all forested. Similarly, in the case of forests, a number of species are becoming rare and endangered.

Some of the mechanisms for biodiversity loss are: (i) habitat loss and fragmentation (large forests now dwindling into small, isolated remnant forests); (ii) introduced species; (iii) over-harvesting and exploitation of species; (iv) contamination of soils and watersheds through pollution; (v) global climate change; and (vi) industrial forestry and agriculture.

The situation can be summarized by the following:

- the remaining sal forests have been reduced to a much degraded state;
- the remainder of natural forest habitats are pretty much restricted to the Sundarbans, and the Chittagong Hill Tracts as well as the Teknaf Peninsula;
- freshwater swamp forests are endangered in northern Sylhet, as are swamp forest species (such as Barringtonia acutangulata, Pongamia pinnata, Phyllanthus spp, Vetiveria zizanoides, Crataeva nurvula, etc. Aquatic plants in the haors and beels as well as reedlands are also endangered. More than 90 macrophytic plant species were identified in a survey of vegetation of the region (Shawinigan Lavalin et al, 1992b);
- the Forest Department management practices (clearfelling followed by burning and often replanting with short rotation, exotic species contribute to poor habitats;
- coastal and marine biodiversity is largely unknown;
- the existing institutions (National Botanical Gardens and National Herbarium) are poorly equipped and inadequately staffed;
- while the flora of Bangladesh includes some 5000 Angiosperms in 188 families, very little has been done to document these;
- BFRI has limited ex-situ endangered species in several sites, as well as an arboretum and medicinal plants garden; limited work has been done in germplasm conservation there, as well as at BARC facilities;
- there are no plans to manage the remainder of the natural forest at the present time, as the forest is scheduled to be converted to plantations entirely;
- there has been limited experimentation with restoration ecology for rehabilitation of degraded lands, particularly in the case of indigenous species, as exotics have been favoured by the Department to date;
- there have been few incentives for private foresters and tea estate owners to manage their lands for improved animal habitats and tree biodiversity;
- little attention has been paid within the Forest Department to biomass potential, fodder crops, legumes, grasses as soil stabilizers, rattans and other NWFPs,etc.

Appendix 17 illustrates the wide range of available options for the Department in considering species to sites combinations which would enhance tree diversity considerably:

- In terms of biomass production, the results of field trials indicate that three out of twelve Eucalyptus spp were found suitable for roundwood and biomass. Leucaena leucocephala and Cassia siamea were found to have less potential, particularly in acidic soils;

- Selection of better provenances is a key factor in performance, and high biomass also requires a relatively lower packing density.

- Trials in Charkai and Charaljani by BARC have demonstrated that the genetic differences between seed sources in performance are critical. However, expanding the trials to include more indigenous plants would be a positive step.

- Lists of potential fodder species can be found in Appendix 17. There is also a summary of important attributes of ground cover legumes and grasses, as well as estimated biomass yields from ground cover legumes.

- In underplanting, interplanting and buffer planting, attention should be given to such species. In the case of soil preparation, planting under shelter is far cheaper and ecologically preferable to planting on cleared land.

- Often heard criticisms of planting under natural conditions are that growth and yields are low and slow, but this is balanced by better quality.

- The Appendix also includes an extensive list of species suitable for low-lying land, given that this is an important ecological habitat in the country.

Endangered Species

As noted above, few species have been identified as endangered. None of the species noted in the wetlands are on an endangered list. Although the country does not have a large list of endemic plants, its diversity is unique for its size. Among the 5000 Angiosperms, 192 were previously reported as of medicinal importance, but the National Herbarium has a new list exceeding 500. About 1560 angiosperms are said to occur in the Chittagong Hill tracts alone, to which the herbarium will add another 700 species. About 130 species of fibre resources (68 of them woody species) both wild and cultivated have been reported as quite common in the forests, but these are now diminishing rapidly due to habitat destruction and overexploitation. There are 29 indigenous orchids, of which eight are of medicinal value, but their status is unknown.

The table below illustrates the rattan resources, of which there have been 11 species recorded. Three of them are so rare as to no longer be included in the list. Only C. tenuis is cultivated in the homesteads and therefore being conserved. C. erectus is found primarily in the Sitakunda Hills, and is decreasing in numbers very quickly. C. Logisetus is known only from some areas in Cox's Bazar. Both Daemonrops and C. Latifolius have shown alarming declines, and require immediate conservation measures. Given the importance of rattans in homestead use and as a raw material in cottage industries, an active conservation program of plantations and protection of species is required. This has also been recommended by the NWFP specialist (see FMPc).

Table 27 - Rattan Resources of Bangladesh

Species	Local name	Distribution
1. Calamus erectus Roxb.	Kadam Bet	Sylhet, Chittagong
2. C. gracilis Roxb.	Mapuri Bet	Chittagong
3. C. guruba Ham.	Jali Bet	Sylhet, Chittagong, Dhaka
4. C. latifolius Roxb.	Korak Bet	Chittagong
5. C. longisetus Griff.	Sanchi Bet, Bandori Bet	Cox's Bazar
6. C.tenuis Roxb.	Bara Bet	Almost all districts
7. C.viminalis Wild. var,fasciculata Becc.	Golla Bet, Golak Bet	Chittagong
8. Daemonorops jenkinsianus Mart		Sylhet, Chittagong

Source: IUCN, 1990b

A tentative list of twenty-seven vascular plants threatened in Bangladesh has been prepared but neither their use or distribution is known. Priorities for surveys of wild ancestors of fruit and oil crops, industrial and commodity crops, timber species, and plants used as forage and fibre are listed below.

Table 28 - Priorities for Ecogeographical Surveying in Bangladesh

Coconut	Entire gene pool
Banana	Wild species
Mango	Wild species
Rice	Wild species
Forage resources (legumes)	Forage grasses
Crotalaria, Desmodium, Medicago,	Axonopus, Panicum
Phaseolus	Bothriochloa, Paspalum
Pueraria, Vicia,	Brachiaria, Setaria
Vigna	Chloris, Urochloa, Hemarthria

Source: IUCN, 1990b.

The conservation of wild gene pool resources is a matter of urgency. It should be both ex situ (seed stores, clonal orchards, and botanic gardens) and in situ, ie. in natural protected communites. Surveys of natural sites (especially within the protected areas system) to determine which species are present and to what degree they are protected would be cost-effective. Identification of variability within gene pools and contributing factors is a necessity for in situ conservation. Conservation ex situ is less effective, but a necessary alternative. The needs are basic yet extensive (IUCN, 1990b): "Systematic, ecological and geographical data is stressed as a background to germ plasm collection and conservation. Ecogeographical surveying can indicate priorities for action...". Guidelines for conservation of biodiversity are attached as Appendix 18.

BFRI has also taken initial steps in conserving endangered forest plants. There was a project whose objectives were to : (1) conserve the genetic resources of endangered species; (2) create a living museum from a germplasm plot; and (3) study the biology of endangered species. In the fiscal year 1988-89, four hectares plantation of thirteen endangered species, was initiated at Hyanko. In Keochia, 25 endangered and 5 multipurpose trees were planted on 8 ha. In 1990-91seed collection and germination and growth was done on nine endangered species. Some of the species included: raktan (Lophopetalum fimbriatum); bakul (Mimusops elengii); civit (Swintonia floribunda); dakroom (Mitragyna parvifolia); kanjal (Bischofia javanica); pitraj (Aphanomixis polystachya) and boilam (Anisoptera glabra). Also included were tetua koroi (Albizia odoratissima); deshi gab (Diospyros embryopteris); tali (Palaquium polyanthus); belati gab (Diospyros discolor); moss (Pterospermum aurifolium); motor koroi (Albizia lucida); bohera (Terminalia belerica); kuchela (Strychnos nuxvomica); nagalingom (Courpotia guianensis). Even trees such as garjan, chalmugra, and jarul (all formerly very extensive) are now regarded as endangered species.

Seed collection and morphology, germination and seedlings growth were conducted in the Keochia Research Station on species such as pitali (Trewia nudiflora); nageshwar (Mesua ferra); sindur (Mollotus philippinensis); debdaru (Polyathia longifolia); kumbi (Carega arborea); and jigra (Pithecelobium spp).

To date, 31 endangered species and five multipurpose species have been conserved at Keochia and Hyanko. In Keochia, 10 of these same endangered species were planted under different site conditions. As noted earlier sixteen species considered rare in the Barind Tract have been collected by CER. Three species of bamboo are now considerd rare and endangered also (FMPb). Thus, a start has thus been made towards documenting the endangered species.

Forest Management Options

Management prescriptions for increasing tree diversity would benefit from using the broad macro policy guidelines provided in Appendix 5. Also the more detailed guidelines in Appendix 18 provide guidelines at the individual landscape level, and at the level of management units. It is assumed that the highest and best quality protection would come from setting aside totally protected areas in sufficient number and quality. It naturally follows that these areas must have workable management plans.

The following recommendations for enhancing forest diversity are suggested:

- The establishment of a new Department for the conservation of protected areas is the most significant initial step which could be taken by MOEF.

- Identify and classify the permanent forest estate into production forests and protection forests, in addition to the totally protected areas. Such core protection forests should have a surrounding buffer zone for limited use to be developed in close consultation with people living on the perimeter of such areas.

- Identify the role of women in maintaining forest biodiversity, and use women researchers and extension agents.

- Through resource accounting, determine the economic value of biodiversity conservation or setting aside areas of protection forest for soil conservation, watershed management and as potential extractive reserves by indigenous peoples.

- Experiment with management systems for natural forest, including alternatives to clear-felling.

- Stop the practice of burning after clearfelling, and leave some amount of dead and hollow trees as habitats for animal species.

- Map and prescribe management for areas of high biodiversity within management plans and working plans.

- Reduce the number and size of canopy gaps as much as possible, in felling operations.

- Use rapid rural analysis for biodiversity as part of both monitoring and inventories.

- Attempt where possible to provide corridors between islands of remnant forests, since such practice assures a higher chance of survival rather than in isolated clusters.

- Long rotation indigenous species are generally better habitats than short rotation exotics.

- Use a wide range of species in plantations, rather than monocultures; attempts to rehabilitate lands will have better chance for success when the species used are naturally found in the area in question.

- Remnant forests like the areas of dominant emergent garjans in limited locations of Chittagong and Cox's Bazar should be preserved where spontaneous natural regeneration is happening.

- Restoration ecology needs a significant impetus, since much of the future natural forest will have to be rehabilitated and regenerated from existing bush fallow and scrub land;

- Undertake surveys with the objective of determining which species are endangered, and which ones are actually protected within existing protected areas.

- Merge the National Herbarium and National Botanical Gardens with the new Department for conservation and natural resource management, for greater synergy and collaboration.

- Ethnobotanical and ethnopharmacological studies should be done at community level. Persons with traditional skills and knowledge in these areas should be identified and intimately involved in such surveys.

- Database exchanges with like-minded institutions in the region should be encouraged, as well as exchange of personnel for in-service training. Databases within the country should be done on a regional basis, and shared at national level.

- Adeqately trained taxonomists are rare in Bangladesh, and such skills will have to be developed through a commitment to a human resource development programme.

- Provide incentives for private foresters and tea garden owners to diversify their species, since secondary forests also can be good habitats for some species.

- Keystone species important in food chains or with an important role of in forest ecology should be preserved.

- Taking care in silvicultural treatment that pesticides and insecticides are not harmful. Manuals in Bangladesh refer frequently to the use of chemicals such as dieldrin which are not only hazardous (especially when personnel are not adequately trained in precautions in handling and storage), but banned in the country.

- Management of biodiversity in village forests will need attention also. Some villages are unique for an assemblage of rare plants and/or animals.

- Regular monitoring through remote sensing of changes in forest cover and status of protection forests.

- Enhancing national capabilities in germplasm conservation and tissue culture will improve gene banks.

STRENGTHENING ENVIRONMENTAL INSTITUTIONS

General

Sustainable development is both a goal and a process. The critical institutional elements and objectives which contribute towards the goal of sustainable development have been identified by WCED as (WCED, 1987):

- a flexible administration with built-in learning and adaptation;

- a technological system which is constantly innovating solutions;

- production systems which preserve the ecological base for development;

- social systems which provide for conflict resolution;

- self-reliant economic systems;

- political systems which ensure citizen participation.

It is a fact that such elements are not easily fostered in an international system which itself has unsustainable patterns of trade and finance. As noted in the introductory section of this report, changes to the global system would have far more impact if imbalances and injustices were addressed through global institutions. These include debt reduction and loan writeoffs, fairer terms of trade for commodity-producing nations, reduction of profligate consumption in the northern developed economies, etc.

However, the process of sustainable development is no less challenging. In the case of EIA, it implies that a knowledgeable, concerned and affected public should be:

- notified (in advance) of possible decisions which might affect them;

- given substantial encouragement and assistance to comment;

- provided with media coverage, as appropriate to the magnitude of the impending event/decision;

- assured the opportunity to interact fully with all possibly affected parties;

- respected for their opinions and ackowledged through actions which take such opinions into account.

Neither for the goal nor the process, are the conditions optimum in Bangladesh. To begin with, the low literacy rates and communications problems are an enormous impediment. Nor are the hitherto sanctimonious attitudes of public servants conducive to dialogue and mutual respect. There is a vertical and centralized authority, rather than diffused responsibility and authority. The approach is technocratic and bureaucratic, rather than holistic and responsive. The system does not reward innovation and creativity. Rather it encourages mediocrity and obedience to authority. Such characteristics of the government mechanism in general and of the forestry sector in particular have been covered in detail elsewhere (see FMPa). Nevertheless, there have been some actions initiated which give cause for some cautious optimism.

Ministry of Environment and Forests

1. Policy

The GOB FFYP (1990-1995) describes its environmental objectives as follows:

a. preserve, protect and develop the natural resource base;

b. to control and prevent pollution of soil, water and air;

c. promote environment-friendly activities within the process of development;

d. strengthen the capabilities for environmental management for both the private and public sectors to promote sustainable development;

e. create public awareness and active participation in environmental initiatives.

There are a number of actions yet to be taken which can further enhance initial steps towards creating a national framework for integrating development and conservation. Adoption of an integrated approach to environmental policy is one of the first actions which can have results. The existing policy for the forest sector is outdated, and no longer serves the pressing needs of the day. The draft national environmental policy is a start in the right direction, but is too broad to be of much value when used to assess trade-offs between sectors.

Appendix 19 describes in more specific terms the needs for sustainable environmental management in the forestry sector. Sustainability at the national level should desirably consider (ITTO, 1991): (a) the characteristics of the forest resource base; (b) the continuity of flow of resources; (c) the level of environmental control; (d) the socio-economic effects; and (e) the institutional frameworks. The existing policy does not address these factors fully. Furthermore, the policy approach at the level of forest management unit needs clarification as well. The criteria suggested are accompanied by examples of indicators. These criteria are : (i) resource security and continuity; (ii) the conservation of flora and fauna; (iii) an acceptable level of environmental impact; (iv) socio-economic benefits; and (v) planning and adjustment to experience. Appendix 20 goes into considerably more detail as an example of more holistic and sectorally integrated ecological guidelines for forest management. Both documents provide specific actions and examples of indicators which move beyond the draft policy to date. EIA then becomes a means of identifying and preventing problems, rather than a rigid method of applying restrictions on proposed activities. A full EIA should only be done when projects clearly show through a preliminary screening that there are significant environmental, social, or economic impacts. An IEE is sufficient for the screening methodology.

2. Legal Framework

The laws in respect of environmental concerns are much outdated. As noted previously, there is a torturous labyrinth of conflicting jurisdictions and responsibilities. This aspect has been covered in some detail elsewhere, and will not be repeated. However, Bangladesh is a signatory to a number of international conventions. Some have been brazenly ignored nationally, such as the CITES convention regarding trade in protected animals. Legislation regarding marine and inland pollution at ports such as Mongla, Chittagong, and Dhaka are ignored with impunity. Laws such as the 1973 Wildlife (Preservation) (Amendment) Act need to be rewritten to fit the exigencies of the current dismal situation. Much existing legislation involves dozens of agencies, whereas the law should be applicable to all. Only the goverment may take action against a company or individual who is breaking a law. The important elements of the legal framework should ensure:

- Control over landuse planning and development.
- Penalties for non-compliance of sufficient severity to act as a deterrance.
- Ensuring citizen's groups or individuals can both contribute to enforcement and be entitled to compensation for economic and ecological losses resulting from not adhering to laws.
- There should be transparency and accountability in the agencies responsible for implementation and enforcement of environmental laws. Public access to data should be guaranteed.
- That the laws be implementable, i.e., that sufficient resources are made available to implement and monitor such legislation.
- Legal aid should be made available for those without the financial means to pursue legal actions against transgressors.

- International conventions which have been signed by Bangladesh should be ratified in the immediate future.

3. Structure and Functions

UNDP is currently engaged in a project to strengthen MOEF, as well as under preparatory assistance projects to both NEMAP and the coastal area resource management plan. The Ministry provides overall direction to DOE, BFD, BFIDC, BFRI, and IFCU. Its primary focus for direct liaison with other ministries in environmental matters would likely be through their planning cell. For national level matters, they would liaise with the Planning Commission, where environmental responsibility rests with a division for agriculture, water, and rural institutions. The following constitute the primary weaknesses of MOEF:

- the Ministry only has 16 persons at functional levels, only two of whom have had any training in environmental management; the remainder of staff are clerical and administrative;

- the planning cell is not yet functional;

- there is virtually no baseline data on environmental concerns in the country;

- facilities, equipment, and logistical support are lacking;

- the Ministry acts as a clearing house for new development projects of other Ministries but lacks the technical and analytical capability to do so.

The UNDP project will have completed a needs assessment after about two years, and hopes to clarify and define a five-year programme of institutional development. In spite of the considerable lack of institutional capacity, the Ministry has prepared a draft proposal for submission to the GEF amounting to more than $3 billion. This illustrates how detached from reality the MOEF can be. As a complementary part of the UNDP-supported institutional development, it is recommended that:

- A new Department for conservation of natural resources and protected areas and wildlife be established; that the Director General and at least 50 staff be hired within six months of tabling the FMP.

- That a temporary Forestry and Conservation Monitoring Cell be created as a technical assitance project under the FMP. Its primary role would be to coordinate and implement the recommendations made within the landuse conservation and environment investment portfolios of the FMP.

- The Unit would be attached to MOEF, and would ensure that conservation, biodiversity, and environmental management issues are addressed within the planning, management and monitoring of all forestry activities within the agencies falling under the aegis of the Ministry. This unit would function for a period of three years. Its first priorities would be to advise on the creation of the new Department, and to restructure the Wildlife Advisory Board into a functional body with specific goals and objectives. In addition to coordination of implemention of recommendations from the FMP, it will provide technical advisoty services to the planning cell of MOEF, the proposed Environment Wing in BFD, as well as necessary changes within DOE.

- The unit would have the following basic functions:

  - to advise the MOEF, BFD, DOE, and other agencies within the Ministry on forest conservation issues;

  - after preliminary environmental guidelines for the forestry sector are prepared under the Forest Resources Management project, the unit would produce detailed guidelines for the various forest types and dendroecological regions;

  - to prepare a comprehensive database of local expertise in forestry, protected area management, wildlife management and conservation issues, and to identify likely agencies and individuals who could be contracted to perform some of the recommendations of the FMP;

  - to advise, initiate and train BFD, DOE, staff in creating and managing an environmental data base from the inventories and surveys to be performed within the FMP;

  - to advise on the creation of protection forests within the BFD, their demarcation, management, and monitoring;

  - to assist in the formulation of guidelines for forest management plans for development of buffer zones, delineation of critical watershed areas, and appropriate measures for soil conservation;

  - to assist in defining training needs in environment-related functions within MOEF and its Departments;

  - to assist the BFD, BFRI, and BFIDC, with application of appropriate management principles to natural forest management under the different forest types and dendroecological zones;

  - to act as a resource for the NGO community, the Extension Wing of BFD, regarding participatory forestry.

Department of Environment

1. Policy, Legislation, Structure and Functions

The DOE faces similar deficiencies in terms of present institutional capacity for EIA and environmental monitoring. There are 70 existing posts within DOE, half which are posted to four regional field offices. Three-quarters of these are non-professional. The agency's organogram has for some time provided for the creation of 98 new posts. None had been recruited as of late 1992. Several administrative posts have been filled by deputation on a temporary basis. There is a branch at headquarters for enforcement, research and EIA, meant to be staffed with 25 persons in total. Of these the Eco-Regeneration and EIA wing will have nine employees. Of these nine, two are senior administrators, there are two research officers, two investigators and three clerical and support staff. The enforcement wing will only be staffed by five persons in total, these being two senior administrators, two inspectors and a typist. The research wing is similarly inadequately staffed. The other main branch will be for planning, administration and coordination, staffed with 37 persons. There is agreement in principle that there will be a total of 388 staff overall eventually.

EIA procedures consist of:

- the initiators of the project proposal prepare the TOR for the EIA and submit it to DOE for review and approval;

- the initiators actually conduct the EIA, usually through local private consulting firms;

- an IEE is submitted to DOE for approval; DOE comments, and if necessary the draft final report is amended; a final report is then submitted.

The eco-regeneration wing proposes to undertake: (i) environmental monitoring and surviellance of the coastal area of the country, via procurement of a laboratory cum research vessel; (ii) environmental monitoring of inland fish resources, and stabilization of chars and river bank ecosystems; (iii) environmental monitoring of village forest resources; (iv) management of wetlands and conservation of biodiversity throughout Bangladesh.

DOE has proposed national environmental quality standards and is awaiting approval for these. The forest industries sector is also included. Pulp and paper mills have initiated partial effluent treatment and/waste recovery, but only through neutralization by lime or lagooning effluent.

A total of 905 polluting industries have been identified, but little follow-up action has been taken. The divisional offices of DOE are supposed to monitor the activities of commercial brick fields, but brick fields ignore this completely. Throughout field visits by the FMP it was noted that virtually all brick fields were using wood, blatantly defying the law, with no visible action taken whatsoever. A total of 14 pesticides have been banned in the country. The Forest Department prescribes the use of one of them -endrin- for routine silvicultural treatments.

To date, only three GOB officials have been trained on EIA, these being one person from DOE and two from MOEF. Initial environmental examinations (IEE) for very few industrial units have been conducted, including some related to the forest sector: (i) Magura Paper Mill at Sonargaon, Narayanganj; (ii) Cement Factory at Sitakunda, Chittagong; (iii) Elias Brothers Cement Grinding Factory at Rangadia, Chittagong; (iv) Apex Textile Mills, Gazipur; (v) Dhaka Paper Mills at Katchupur, Narayanganj; (vi) Impress Tannery, Mankingonj; (vii) Urea Pertilizer Factory, Ghorashal; (viii) coal mining project at Barapukuria Project; and (ix) KAFCO.

Bangladesh has signed about twenty international conventions, including CITES, and the recent UNCED agreements on biodiversity and climate change. The proposed Bangladesh Environment Preservation Ordinance has been under "active consideration" by GOB for several years. The Environment Policy 1992 has already been passed, apparently. The list of projects submitted for consideration under the FFYP consist primarily of water and air quality proposals, as well as industrial pollution control, much along the lines of the old Department of Environmental Pollution Control.

2. National Environmental Monitoring and Pollution Control Project

The NEMPC is a good illustration of DOE strengths and weaknesses to date. The project was an ADB-funded technical assistance programme. The following were characteristic of the project :

- the NEMPC team did not have access to policy discussions outside the DOE, limiting the potential contributions to the cross-sectoral nature ofthe field;

- there have been limited opportunities to contribute to policy formulation;

- the relationships between MOEF, DOE, and BFD were indistinct, and clear working relationships were not formulated;

- MOEF did not support DOE in environmental management; the expectation was that DOE should support the MOEF;

General conclusions were that: (a) policy strengthening, especially in enforcement, was unsuccessful without the necessary technical capacity within DOE; (b) the NEMPC products such as environmental quality standards (EQS), management plans and guidelines would not be useful unless staff had gone through the process of their application; (c) training was reduced to classroom lectures which did not readily translate into practical knowledge; (d) there was a need for more quantification of issues through more field and laboratory results. It was suggested that (SEATEC, 1992a):

- problem-solving should be carried out through practical areas of activity;

- MOEF and its affiliated agencies should be prepared for internal reorganization through the formation of environmental planning cells;

- the present state of DOE capacity was of very low quality from scientific and engineering viewpoints;

- all technical work by individual staff should be reviewed by at least two other staff at peer level;

- existing ADB guidelines be the basis for DOE manuals;

- the agency is oriented to a bureaucratic approach, rather than encouraging decisions by technical level staff.

It is clear that DOE is in its initial stages only, of formulating strategic plans for the sector. The agency relies heavily on staff with a chemical and engineering background. There were virtually no references to natural resource management by the NEMPC in the final report except for some brief notations on the importance of wetlands, as well as one field trip into northwest Bangladesh where inconclusive discussions were held with Forest Department officials on one occasion.

The industrial side of EIA seems to be an area of concentration for the ADB. The IDA of the World Bank has also offered to support DOE with an Industrial Investment Credit for pollution control targeted at specific industries. It is recommended that:

- DOE, in future staffing, strongly reorient its human resource needs with applicants from the natural sciences, i.e., aquatic and terrestrial biologists, ecologists, foresters, botanists, limnologists, zoologists, sociologists, anthropologists, etc. Such staff should form at least one-third of all professional staff;

- The agency has virtually no database, nor any means for monitoring one. A GIS system, cartographers, and adequate access to aerial photography and satellite imagery is needed within the agency if it is to properly monitor the environment. Where such expertise can be acquired from other departments or the private sector, initiatives should be taken to do so.

- Very few people have been trained in EIA. In fact, during one recent course in late 1992, the majority of participants in a training course boycotted it as being of little practical use.

- The agency will be ultimately responsible for ensuring future forestry activities are within proper guidelines. DOE should address the need for staff development and training in specific functional areas, forestry, wildlife management, and wetlands management being some examples. To date, there is virtually no capacity;

- The DOE must get away from the test tube/chemistry/engineering focus if it is to meaningfully address the EIA requirements of projects affecting these natural resources.

- Training in remote sensing, coastal area management, GIS applications, wetland and forest ecology will be some of the areas requiring attention.

- The agency will remain the premier institution for EIA, even though it is a goal to build up this capacity within the BFD Environment wing; all private and public sector industries should have their internal capacity or seek external assistance, but DOE should be the final arbiter;

- The library is inadequate. An on-line computerized database, shared with other agencies would be useful. The necessary equipment should be acquired only as trained staff are available to operate it. Such staff will probably be available from various FAP studies which are nearing completion, and whose projects have been extremely well equipped with both advanced technology and well-trained staff.

Forest Department

The new Forest Resources Management Project will introduce a number of positive changes which depart from traditional BFD approaches. A new Directorate for Social Forestry will be beneficial, as will the proposed Environment Wing. The inadequacies of existing policy, legislation, and management have been covered earlier in this document. Under Scenario 1, the Department has additional staff coverage, particularly for soil and watershed conservation, as well as delineating, demarcating boundaries, and managing these areas as protection forests, along with the necessary buffer zones.

Under the FMP it is recommended that existing protected areas be excised from the permanent forest estate and placed under the jurisdiction and management of the new conservation Department.

The BFD will manage the permanent forest estate on the basis of the guidelines proposed in Appendix 18 and Appendix 19. This will be on a multiple use basis with core protection zones, a buffer zone with limited use, and an intensive use zone for participatory forestry. This report agrees with the recommendations made elsewhere (FMPc) that land for industrial forestry (specifically pulp and paper mills) should be made available for the companies to produce their own fibrous raw materials.

The Forest Department at the present time does not have any formal environmental guidelines or standards for the forest sector in its operations. There is provision for creation of such guidelines under the World Bank-supported Forestry III. However, this consists of only three person-months of consultancies. In the meantime, it is recommended that the guidelines provided in Appendix 21 be used in the interim. Since DOE is utilizing basic guidelines adapted from ADB manuals, it would be preferable to use the same source in the interim, for consistency. The following recommendations would enhance the internal capacity of the BFD to carry out IEEs and EIAs within its operating areas:

- The RIMS system is being upgraded to include Geographical Information Systems (GIS) for enhancing forest management. Some accessory equipment is missing and needed (e.g. there

should be provision for an image processor, both hardware and sofware) and will be supported under the FMP.

- There is provision for new aerial photography and satellite imagery under Forestry III, but this does not include the northwest and northcentral sal remnants, the USF, or the CHT. Such provision will be made under the FMP.

- One of the early products which should be produced is comparative forest cover maps (based on the aerial photography and satellite imagery available) for the years 1973, 1983, nd 1993. Such a product would be invaulable in monitoring expected changes over the FMP period;

- The soil conservation and watershed management unit within the environment wing will require detailed contour mapping of areas of pilot projects in community-oriented small scale watershed management.

- Each individual management plan must have a strategy for multiple use management of the forest reserves, with each zone mapped and management principles for the zones specified; such plans should spell out clearly the location of ecologically sensitive areas, unique and fragile habitats, and plans for wildlife management within the relevant zones.

- All management plans should specify potential sociological and economic impacts on the surrounding communities, especially in the case of tribal peoples.

- Training in soil conservation and watershed management, coastal area management, wildlife management, natural forest management, and rapid rural assessment techniques, should be provided in addition to EIA. Such elements are further elaborated in the institutional report (see FMPa).

Other MOEF Agencies

1. BFRI

BFRI will not be expected to conduct much research in the fields of wildlife management, since the new department will take over such functions. Areas where BFRI can expand research include:

- Soil loss under different conditions and cover crops will be a vital contribution. The rather large areas which will be planted and felled will be very vulnerable to erosion, and comparative studies need to be done.

- Ecological studies will need to be set up in the permanent sample plots recently designated by RIMS.

- Community-managed watersheds.

- Forest protection groups.

- Natural resource accounting.

- Physiobiotic and ecological linkages of human exploitation systems on the periphery of forest reserves.

- More research on NWFP, especially canes, rattans, and medicinal plants; much basic taxonomy remains to be done also.

- Documenting the values of so-called "uncommercial species" from ecological viewpoints.

2. BCIC and BFIDC

It will be essential for BCIC and BFIDC to respond positively to the need to adopt, where practicable and feasible, improved environmental quality standards regarding their treatment of effluents, wastage in the sector, improving yields from plantations, and less destructive extraction methods for logging, where applicable. Areas recommended for these institutions include:

- Training of in-house personnel in EIA and improved environmental standards; the agencies will have to comply with national EQS, as will the private sector.

- A short-term consultancy to assess the source and magnitude of pollution emanating from existing BCIC and BFIDC operations.

- Retrofits with pollution abatement equipment and techniques, where feasible. Retrofits should be on a grant, rather than loan, basis. This should occur when upgrading or expansion might be anticipated. In the case of new mills, such equipment will be mandatory.

- Conversion of wastes into useful byproducts should be explored.

- Switching to energy sources other than wood products where possible (note: mining of peat has been suggested in some quarters as a commercial fuel; this is highly destructive ecologically as the local deposits are of low density and can result in subsequent saline water intrusion).

- Reducing the amount of freshwater required in operations, output of condensates and particulate matter.

- Exploring alternative fibrous raw material sources for pulp and paper, and reducing wastage in the sawmilling industry. Growing fibrous raw materials through cooperatives of the rural poor could have positive socioeconomic benefits, if properly designed with community involvement.

3. IFCU and Other Training Institutions

IFCU is the only university-level institution in the country offerring a four year degree programme in forestry. Khulna University is establishing a forestry and wood technology curriculum. Two year diploma courses are offerred at forest schools in Sylhet and Rajshahi. In-service training is provided at BFDTC, Kaptai, plus the other institutions, as required. There has been minimal attention to environment in any of the forestry-related institutions. A single course in environmental forestry is being conducted. Approaches to EIA for the forestry sector have not been taught, nor are there any guidelines extant. There has not been any field-level, hands-on training in this discipline. Current plans are to upgrade the two year diploma course into three year training, at an institute to be established in Chittagong. Facilities in Chittagong will be expanded and refurbished.

There are very few alternatives for environmental training. BUET has an engineering degree in water resources management with an environmental focus, and the mainstream universities all have standard science courses such as botany, geography, zoology, etc., through which students can get occasional field exposure to environmental issues. A private university (Independent University of Bangladesh) which has not yet received a charter plans to offer, inter alia, a B.Sc. in Environmental Management, with the possibility of specializations within the discipline.

Provisions have been made within the FMP for training at higher levels (Masters and PhD) for existing forest staff in environmental disciplines (see FMPa for details). The Forest resources Management Project will train one PhD in environmental science.

The forest ranger designation is to be phased out. Forest guards hitherto have received vey little training. More than three-quarters of forest guards and other non-professional staff in BFD have received no training. The following recommendations are made with regard to improving capacity for EIA training needs:

- IFCU should expand the number of courses it teaches in the environmental sciences, and particular attention needs to be given to soil conservation, watershed management, and EIA.

- There is a major need for training in restoration ecology, and rehabilitation of degraded areas.

- Given the plans under FMP to stop logging in the hill forests, it becomes a matter of necessity to ensure a strong component of natural forest management is introduced in the curriculum.

- Training in rural sociology, and social impact of EIA are an essential ingredient of forest management in a Bangladesh context. Training restricted to the technical aspects of forestry can only further alienate foresters from people.

- In-service training needs have been entirely inadequate. The FTDC at Kaptai has been dysfunctional. In-service training for environmental aspects of forestry, with emphasis on creating capacity for having functional EIA capacity within each forest division would be one of the major goals of the proposed environment wing.

- The new three year curriculum in Chittagong should provide for a specialty in environmental aspects of forestry, therby providing an enhanced professional source of staffing for the environment wing.

- Forest guards should have an option of specializing as environmental technicians, for eventual posting within the environment wing.

- In-service refresher courses in EIA and environmental sciences at middle and senior management level should be encouraged within the region, at centres of excellence in neighbouring countries.

Community-Based EIA

As noted in the earlier section on NGOs, decentralization of authority and responsibility within the BFD should result in field level capacity for EIA, as well as within the planning, development, and environmental wing. Similarly, the community-based resource management programmes proposed will train large numbers of villagers in functional forest resource management. Such villagers will be actively involved in the design of buffer zones and intensive use zones within the permanent forest estate. In addition, they will be extensively consulted wherever protected areas exist or are proposed, with a view to a role in participating in management of such areas. Some of the strategies should include:

- Techniques for water quality monitoring, in the vicinity of forest-based industries.

- Undertaking of surveys to demarcate boundaries of forest reserves, and provide for people to share in the management and proceeds.

- The exchange of information and skills between communities in resource management and EIA.

- Enforce landuse or pollution legislation at local level, through citizen participation in development activities at union or thana level.

MASTER PLAN ENVIRONMENTAL IMPACTS

The FMP will generally improve the environmental impact of the forestry sector. Impacts to date have been analyzed throughout all specialist and subteam reports. It is clear that from all perspectives related to environmental values, the status quo has negative ecological, social, and economic impacts.

It has been demonstrably concluded from other specialist components of the FMP that the low-input, low-output scenario (Scenario 1) yields only temporary benefits. At best, it extends the time required before the forest resources are irreparably destroyed in terms of biodiversity, wildlife, soil and water conservation benefits, and employment generation potential. The forest industries sector, the opportunity for participatory forestry, and foregone values mentioned above would all decline. Irreversible declines would also be registered in the use of forest resources as sources of medicinal and herbal plants, as gene pools of commercial timber species and wild ancestors of domesticated foods. As sources of research and recreation, the forests would inexorably deteriorate. Lastly, there are cultural and religious values which are still maintained in certain rites and rituals, particularly in tribal communities. The latter would be particularly threatened by the disappearance of the forest base. Given that deforestation continues (abated even significantly from the 36,000 ha annual rate) in the long term, all that would remain is either degraded forests, or plantations at the end of the plan period under the Status Quo.

No impact assessment of the Status Quo, or "without project" is presented here for the reasons outlined above. Major adverse impacts can be expected from virtually all aspects of the forest sector, given continuing trends.

Appendix 22 indicates the likely impact of the FMP on the forest resources under Scenario 1, whereby half the remaining natural forest is cut over, and the rest would be reserved after cutting stops in 20 years. It should be noted that due to the macro nature of the plan, it is not possible to do detailed site commentary, as this has not been specified in the plan. The likely impacts have been scoped under the three most important factors, these being logging, reforestation, and community forestry. The detailed guidelines for these have been presented in Appendix 21. The results indicate some modest improvements in a few scattered areas, but a continuing adverse impact on ecological, economic, and social aspects of the sector. Without the necessary revitalized administrative structure under an autonomous body, and the creation of a new Department for conservation, the sector has few prospects for rehabilitation. The new Department for conservation, once adequately staffed with appropriate qualified personnel, would also fit into an autonomous structure. It should be understood that the autonomous board would not consist of the private sector taking over functions of national legislation and ordinances, but that it would be a public sector enterprise administered under true autonomy. It can be noted from Appendix 22 that a number of areas would continue to be of sources of ongoing concern, even though there is no doubt an improvement over the existing situation.

Appendix 23 is a preliminary screening of impacts under the Scenario 2 of FMP. These have been done under extant formats in use elsewhere in the sector. When compared with Scenario 1, it may be seen that under Scenario 2, there are obvious advantages and environmental benefits which accrue. In those areas noted as significant impacts, attention will have to be paid in the pre-

feasibility studies towards generating sufficient data to investigate the extent of the impact, whether adverse, or beneficial. In the case where, for example, major new industrial enterprises are to be established they will be required to undergo the formal scoping and screening process through DOE, and a full EIA if deemed necessary. The following section outline the impact of the major master plan components.

Economics and Marketing

This subteam (see FMPd) has evaluated the existing economic information and analyzed the economic costs and benefits of recommended management, strategies, and programmes. While having little direct impact on environmental aspects, its indirect impact is positive. The following constitute some of the characteristics which contribute to environmental values:

- The sector creates value added of $537 million in 1992; this is expected to increase to $2.6 billion by the year 2013.
- Total employment could increase from 800,000 to 2.15 million by the end of the plan period.
- It will create import substitution, which at the present rates are : paper-53%, pulp-30%, and wood products-17%.
- Pricing existing and future wood products at market prices will enable substantial revenue increases for the GOB.
- Improved forest management will eliminate industrial extraction in the Hill Forests under the recommended Scenario 2.

Forest Industries

This subteam will make a number of positive contributions, and at the same time will require careful siting, and good environmental practice. Many of the sawmills, pulp and paper, hardboard mills and other industries were established years ago. They were designed under standards which would not be acceptable today. For example the mill at Chattak has been analyzed in 1992, and found to exceed GOB quality standards of BOD (biochemical oxygen demand), COD (chemical oxygen demand), and suspended solids. These likely have an impact on fisheries down stream, particularly in the dry season. Wet season readings from monitoring stations are within limits. Many of these units share equally unacceptable levels of effluents and emissions, and are located on rivers and other water bodies. Some require simple technologies to reduce such emissions. Specialist person months have been set aside to determine the possible interventions. Some of the benefits of the industries sector are:

- Industries with high wastage and very uneconomic returns are scheduled for liquidation.
- Industries capable of being a going concern in the private sector will be privatized.
- Industries will be allocated their own land for growing raw materials, and it can be done under participatory forestry as well. Higher productivity is positive environmentally.
- Substantial benefits will come from rationalizing the sawmilling industry and making it more efficient, thereby conserving scarce natural resources.
- Industries will operate under more autonomy which will make for improved productivity also.

- An important increase in the non-wood forest products sector will take place, which will benefit the poor, and allow for important local cottage and construction industry to continue, as well as to expand employment.

Forest Production and Management

This sector proposes an autonomous board also. Under Scenario 1, there will be negative environmental impact, as half the hill forests are expected to be cut over, representing a permanent loss in biodiversity and ecological values. Under Scenario 2, 10,000 ha are slated for cutting, and only from the Kassalong Reserve. Provided that proper environmental standards are observed in the logging practices, and that social problems related to the security situation are resolved through dialogue with the affected persons, it is possible that this trade off will do much to preserve biodiversity in other areas of hill forest throughout the country. The planting and felling of a substantial number of hectares annually will create conditions which will lead to significant erosion, unless mitigating efforts are undertaken at the planning stage (road standards, numbers, location and number of skidding trails, steepness of slope, seasonal rainfall, etc. Suggestions have been made by the subteam to minimize these through cessation of burning after clearfelling and planting of ground cover with legumes and grasses. Some of the positive benefits include:

- Minimizing dependence on Hill Forests for future forest production.
- Setting aside the entire Sangu as a resource reserve for future conservation.
- More attention to the role of tribal communities in the CHT under recommended programmes would be desirable; any programme there would have to go through a full EIA.
- Increasing MAIs (mean annual incremental growth of trees) through improved silvicultural treatments, thus reducing pressure on existing forest land.
- A significant bamboo production programme will be undertaken. This will contribute to the importance of both preservative treatments and propagation of bamboo to offset the expected gregarious flowering and dying out of muli bamboo throughout the plan period.
- Encroachment will be lessened in the northern and central districts by benefit-sharing agreements for agroforestry, thereby improving degraded land.

Participatory Forestry

This subteam makes a number of very positive environmental benefits through recommendations directed towards genuine participation and benefit-sharing agreements. At the same time, it leaves open the question of whether monocultures of exotic species should continue. In some cases, such species fill a need, on badly degraded land, but the trend is towards indigenous species. A number of agroforestry models have been suggested. Some of the environmental benefits can be noted directly from Appendix 22, under the reforestation section. The major ones are:

- Increased use of substitutes for wood energy are recommended, such as gas, solar cookers, and improved stoves and biogas. However, the recommendation for atomic energy should be viewed with great caution.
- Use of multipurpose trees is recommended.

- Villagers and participating farmers will have more say over selection of species and agroforestry modules; this is positive, since villagers have evolved very unique models on their own which are environmentally positive.

- The role of women is given prominence in all efforts to diffuse agroforestry techniques as well as to ensure that women are a target group who acquire tenure and benefit-sharing.

- Private forestry is recommended, and has been shown in a number of cases to be more efficient than BFD, particularly in the homestead forests.

Forest Institutions

This subteam makes perhaps the most fundamental difference within the master plan strategies. It has noted the deficiencies within the present organizational and administrative set up, including the lack of importance given to environmental values by the BFD to date. It suggests a complete sectoral restructuring, a concerted effort towards human resource development, and increased research. This will support a more flexible and autonomous structure which will be more productive. Institutional changes and recommendation will:

- Replace the national forest policy and enact new legislation with new ones, including appropriate changes in the environmental and conservation aspects.

- Restructure the sector under an autonomous board, with the possibility of greater independence in carrying out mandates for conservation.

- Increase the size and quality of the protected areas system.

- Suggest policy measures and strategies which support the environment and land use subteam.

- Introducing environmental accounting and the principle that "the polluter pays".

- Encourage excellence in staff capabilities and morale, as they will not be constrained from carrying out necessary duties by antiquated and centralized functions and regulations.

Land Use, Conservation and Environment

This report will contribute to enhanced environmental awareness within the MOEF, the BFD, and other agencies within MOEF, as well as the private sector. The report basically concentrates on environmental stability, sustainability, the conservation of ecological processes, productivity, and improved environmental management. It also makes a commitment to participatory, social and community forestry, equity, community-based management, the expanded role and importance of women in the sector, as well as promoting a dialogue between NGOs, GOB, and donor agencies. The report recommends:

- That such considerations receive more attention than in the past.

- A commitment to the creation of a new Department for conservation of natural resources and protected areas management.

- Increased soil and watershed protection.

- Training opportunities for all levels of staff in environmental concerns.

- Increasing public awareness of environmental issues in the forestry sector.

- The establishment of experimental nature centres.

- Involving communities directly in resource management.

- Expanding the protected areas system, and designating the existing forest estate into protection and production forests, with the use of buffer zones.

- Multiple use and very much more productive management of the permanent forest estate.

INVESTMENT NEEDS AND OPPORTUNITIES

In a macro planning exercise it is not possible to quantify with precision and detail the costs of each programme component. The programme components should therefore be considered as indicative. More detailed costing procedures would require an appraisal or pre-feasibility mission.

Investment programmes and costs are described in Appendix 2. First, the programmes are presented on the basis of two Scenarios for costing. Scenario 1 is a low-input module which assumes minimal change from the existing policy, management and institutional frameworks within the MOEF, BFD and other concerned Departments and parastatal corporate entities. Scenario 2 assumes major changes in the policy, management and institutions.

Strategy

The Scenario 1 programme includes institutional strengthening by enhancing the proposed Environmental Wing within BFD, and strengthening technical capacity in DOE. Projects which would take place under this programme component are:

- Creating and staffing a soil conservation and watershed management unit within the wing;

- Enhancing, through additional staff the EIA capacity of BFD;

- Enhancing capacity for wildlife management within the permanent forest estate;

- Increasing EIA capacity and monitoring in DOE;

- Conducting inventories of the Chittagong Hill Tracts, including USF and the Sal Forest in norther and central forest division;

- Upgrading technical equipment to include GIS not currently available.

At the same time, it is essential to create a new Department for the conservation and management of natural resources. This form the base for Scenario 2 and this new department would manage all protected areas (under IUCN international classifications) currently under the jurisdiction of the BFD. Major programmes carried out by this new institution include:

- Improved management of existing protected areas;

- Establishment of new protected areas;

- A new approach to forest management;

- Concerted effort to conserve endangered fauna and flora;

- Innovative approaches to working with and meeting the needs of local people in these areas

Additional benefits which will accrue from the programmes include:

- Enhanced capacity for EIA and environment management in the forestry sector;
- A sustainable managed-permanent forest estate, consisting of higher yielding production forests, as well as protection forests contributing to soil conservation, watershed management and maintenance of biodiversity;
- A genuine partnership between GOB agencies and people's organizations;
- Innovative local mechanisms to restore and enhance community management of common property resources, etc.

Detailed descriptions of the specific tasks required have been given in the report of the Conservation Specialist (Project 372001/7).

Under Scenario 1, the wing is staffed with 300 persons, assuming a minimal commitment is made by MOEF and GOB. This would include a headquarters office and staffing of four regional offices and protected areas. Under Scenario 2 the new department would have 720 staff, and would be combined with upgraded and staffed National Botanical Gardens, Zoo, and National Herbarium.

It should be mentioned here that under Scenario 1, without the uncompromised changes needed in policy, management and institutions, the natural resources will continue to decline. A comparison between Appendix 22 and Appendix 23 clearly shows that the potential for continued negative environmental impact on the scarce forest resources is high under Scenario 1. Under Scenario 2, introducing adequate environmental mitigation measures considerably enhances the prospects for sustainable resource management. Table 29 graphically portrays the differences between the two Scenarios. It is likely that by the time the major institutional changes are made (in 5-8 years) the new department would find its mandate and responsiveness strengthened under an autonomous body.

In Appendix 2, the programmes presented are for the recommended Scenario 2. However, costs have been shown for both Scenarios. Under Scenario 1, the proposed financing would be for GOB 36.6 percent and donors 63.4 percent for a total investment of $ 40.6 million. Under Scenario 2, the GOB component of total costs would be 14.3 percent and the total investment is $122.2 million.

Table 29 - Land Use, Environment and Conservation - Development Alternatives

Status Quo	Scenaroi 1	Scenario 2
Characteristics		
No commitment/ priority to conservation issues; no institutional setup	Wildlife Circle within Department has been unsuccessful. Attempts to set up a wing within the Dept. again will not work	A new institution created for wildlife & conservation
Protected area system of .75% of land area	Environment Wing suggested under Forestry-III will be relegated to the same fate; Wing would become dumping ground for FD officers in disfavour with senior management	Protected areas are high quality
No management plans for protected areas	Temporary attention diverted to minor projects in biodiversity, with assistance from international NGOs; floods, disasters and crop production continue to receive top priority in the country.	Management plans for protected areas
Threatened and endangered species in large numbers	Improvements in forest management and dwinding supply still unable to meet demand; continuing attrition of forests	Greater distributional effects (social equity)
No social equity		No. species threatened/ endangered stabilized
Forests managed for production only; no soil conservation, watershed protection		Forest management for multipurpose use, i.e., protection forests, production, biodiversity conservation
Over-reliance on village homesteads		Country's entire forest resources are managed; not only in reserves
Low productivity in FD reserves		Forest Department extension services apply to homesteads and degraded land in particular
No peoples participation in planning, management, or protection of forests		Improved environmental stability/ resilience to floods, cyclones, etc.
Highly unstable environment (global climate change, cyclones, floods, etc.)		Depletion of forests reserves halted; greater use of local species, multipurpose trees
Quantitative & qualitative depletion of forest reserves		Encroachment stabilized; some land excised from existing reserves; people involved in large-scale afforestation & private enterprises;
Within existing reserves, high degree of encroachment		
Land Use conflicts		
Stressed and degraded ecological zones		
No buffer zones		
Little cooperation with NGOs		
Inadequate data base, monitoring		
AACs unsustainable		

Table 29 - Land Use, Environment and Conservation - Development Alternatives (Cont'd)

Status Quo	Scenario 1	Scenario 2
Characteristics		
Biodiversity low under existing plantations, management, and felling systems		Reduced land use conflicts in coastal areas (shrimp vs. agaric vs. saltpans vs. forestry) and charlands
Reserves/ boundaries not marked for protected areas		Management of buffer zones around forest reserves to reduce pressures on exploitation
Environmental and social instability in CHT		Innovation, better cooperation with NGOs, cooperatives, private sector
Capacity for EIA & monitoring rudimentary		Monitoring of forest resource status through standardized systems/ data
Overlapping jurisdiction between FD and DOE		Annual allowable cuts to be based on sustainability criteria, not demand; environmental guidelines observed
No consultation with people in planning/ implementation/ monitoring		Broad-based consultations at local/ and to involve villagers
No training opportunities; no staff		Functional capacity for EIA within FD, DOE; a professional, multidisciplinary staffing structure
No full environmental accounting of the value of goods and services accrued from forest resources; future development/ land use opportunities foregone		Clear roles/ responsibilities within MOEF for management of forest reserves
		Longterm human resource development, utilizing local capacity/ expertise to the fullest extent

Table 29 - Land Use, Environment and Conservation - Development Alternatives (Cont'd)

Status Quo	Scenario 1	Scenario 2
Socio economic Impacts		
Increased pressures on remaining degraded forests, destruction of natural forests, increased supply demand gap	Under this scenario (25% - 50%) natural forest felled), meets short-term demand; shorterm & longterm reduction in biodiversity; number of endangered/ threatened species increased	Increase in tree cover; elimination of monocultures of exotics on large scale; longterm qualitative forest structure and floristic composition
Increased dredging costs at ports from increasing giltation due to deforestation	Forest industries sector partially rationalized; continued subsidies for failing industries	Improved watershed protection
Increased forest land transfers for other purposes	Increased system loss due to large scale teak felling, clearing of so-called "failed plantations".	Integrated area planning and land use
Future options for forest land diminished; fall in NWFP, bamboo, timber production		More efficient and productive forest product sector
Deterioration of national power grid		Intensified public participation in forest industries sector; employment generation
No investments in forest sector		Increased biomass production, maintenance of genetic resources
Loss of wild genetic resources (mango, banana, rice, forage legumes, rattans)		
Technical Impacts		
Obsolete, top-down management systems (beat, block)	Planning at range level; reorganization of ranges	Trained wildlife biologists, resource managers, ecologists, ex-situ conservationists monitoring environmental change
Inability to monitor environmental change	Establishment of plans for TPAs; continuing disinterest in implementation	Appropriate technology; pollution mitigation measures
Wastage and inefficiency in forest industries sector		
Obsolete technology/ environmental pollution		
Little technical capacity at field level related to TPAs		
Environmental Impacts		
Widespread disruption of ecological processes, extinction of species, social unrest/ inequity, ecological instability		Halt deterioration in medium term; reverse the situation in longterm
		Forests managed on ecosystem/ land capability/ suitability basis

APPENDIX 1
ABBREVIATIONS, TERMS AND CONVERSION FACTORS

ENVIRONMENT AND LANDUSE

APPENDIX 1
ABBREVIATIONS, TERMS AND CONVERSION FACTORS

ABBREVIATIONS

ACCF	- Assistant Chief Conservator
ADAB	- Association of Development Agencies Bangladesh
ADB	- Asian Development Bank
ADT	- Airdry Metric Tonne and Flora
AWB	- Asian Wetland Bureau
BARC	- Bangladesh Agricultural of Research Council
BCIC	- Bangladesh Chemical Industries Corporation
BFD	- Bangladesh Forest Department
BFIDC	- Bangladesh Forest Industries Development Corporation
BFRI	- Bangladesh Forest Research Institute
CAI	- Current annual increment
CCF	- Chief Conservator Forests
CF	- Conservator Forests
cft (T)	- Cubic foot true volume (1.27 x Hoppus cubic foot)
cft (H)	- Cubic feet hoppus (.785 x true cubic foot)
CHT	- Chittagong Hill Tracts
CIDA	- Canadian International Development Agency
CITES	- Convention on International Trade in Endangered Species of Wild Fauna cm- Centimetre
crore	- Ten million
DAE	- Department of Agriculture Extension
DCCF	- Deputy Chief Conservator
DCF	- Deputy Conservator Forests
DFO	- Divisional Forest Officer
DOE	- Department of Environment
ESCAP	- Economic and Social Commission for Asia and the Pacific
FAO	- Food and Agriculture Organization
FAO	- Food and Agriculture Organization of the United Nations
FCDI	- Flood Control, Drainage and Irrigation
FD	- Forest Department
FDTC	- Forest Development and Training Centre
FFYP	- Fourth Five Year Plan
FPCO	- Flood Plan Coordination Organization
GEF	- Global Environmental Facility
gm	- Gram
GOB	- Government of Bangladesh
GR	- Game Reserve
GS	- Game Sanctuary
ha	- Hectare
ha	- Hectare
hp	- Flywheel horse power
hr	- Hour
HTDB	- Hill Tracts Development Board
IFCU	- Institute of Forestry, Chittagong University
IUCN	- World Conservation Union: Formerly called International Union for Conservation of Nature and Natural Resources
kg	- Kilogram
KHM	- Khulna Hardboard Mill
km	- Kilometre
km^2	- Square kilometre
KNM	- Khulna Newsprint Mill
KPM	- Karnafuli Paper Mill
kw	- Kilowatt
lakh	- One hundred thousand
LPC	- Lumber Production Complex (Kaptai)
m	- Metre
m^3/ha/A	- Cubic metre per hectare per annum
m^3/ha	- Cubic metre per hectare
m^3	- Cubic metre
MAI	- Mean annual increment
max	- Maximum
md	- Man day
min	- Minimum
mm	- Millimetre

MM	- Million
MOA	- Ministry of Agriculture
MOE	- Ministry of Education
MOEF	- Ministry of Environment and Forest
MOFL	- Ministry of Fisheries & Livestock
MOIWDFC	- Ministry of Irrigation, Water Development and Food Control
MOLGRDC	- Ministry of Local Government, Rural Development and Cooperative
NACOM	- Nature Conservation Movement
NCS	- National Conservation Strategy
NEMAP	- National Environmental Management Action Plan
NGO	- Nongovernment organization
No.	- Number
NORAD	- Norwegian Agency for International Development
NRS	- Natural Regeneration Strip
ODA	- Overseas Development Agency
POTHIKRIT	- Nongovernment Organization
POUSH	- Nongovernment Organization
RF	- Reserved Forest
RF	- Reserve Forest
RIMS	- Resource Information Management System
SAARC	- South Asian Association for Regional Cooperation
SIDA	- Swedish International Development Authority
SIDA	- Swedish International Development Agency
SPARRSO	- Space Research and Remote Sensing Organization
SPPM	- Sylhet Pulp and Paper Mill
St	- Saint
T	- Metric tonne
TEX	- Timber Extraction (Kaptai)
Tk	- Taka
UNCED	- UN Conference on Environment and Development
UNDP	- United Nations Development Programme
UNEP	- United Nations Environment Programme
WB	- World Bank
WCS	- World Conservation Strategy
WFP	- World Food Programme
WID	- Women in Development
WRI	- World Resources Institute
WWF	- World Wildlife Fund

TERMS

Afforestation - Act of establishing tree crops on areas that have not previously, or in recent history, grown trees.

Agroforestry - A set of landuse systems that combine trees with pasture, arable crops, and/or animal production on the same land unit, either simultaneously or in short sequence. This agroforestry is a set of technologies or practices, as distinct from a program or policy. Certain agroforestry technologies find valuable application in programs of social forestry or community forestry.

Biological diversity or Biodiversity - The variety of life in all its forms, levels and combinations. Includes ecosystem diversity, species diversity and genetic diversity.

Biosphere - The thin covering of the planet that contains and sustains life. Some writers distinguish the biosphere (life), hydrosphere (rock, the crust of the earth). As used here, the biosphere includes the atmosphere and hydrosphere and that part of the lithosphere that contains and sustains living organisms.

Carbon fixation; Carbon sequestration - The conversion by plants, through photosynthesis, of atmospheric carbon dioxide into organic compounds.

Carrying capacity - Capacity of an ecosystem to support healthy organisms while maintaining its productivity, adaptability, and capability of renewal.

Closed forest - Natural forests where the tree crowns almost touch each other, leaving little space for sunlight to reach the forest floor. In Bangladesh, it is termed high forest, which is comprised of two types of natural, undisturbed forest. The first consists of small-crowned closed canopy high volume types. The second consists of large-crowned closed canopy, low-volume species.

Commercial logging - Extraction of timber in large quantities for industrial or export markets.

Common property - Tenure system whereby resources are collectively owned and managed and nonowners are excluded from access to the resources.

Conservation - The management of human use of organisms or ecosystems to ensure such use is sustainable. Besides sustainable use, conservation includes protection, maintenance, rehabilitation, restoration, and enhancement of populations and ecosystems.

Conversion forest - Forest assigned for conversion to agriculture or other nonforest use.

Cultivated ecosystem - Ecosystem where human impact is greater than that of any other species, and most of whose structural components are cultivated.

Cutover forests - Forests from which the original growing stock of timber has been removed.

Deforestation - The clearing of forests and the conversion of land to nonforest uses.

Degraded ecosystem - Ecosystem whose diversity and productivity have been so reduced that they are unlikely to recover without rehabilitation or restoration measures.

Depletion - Reduction in forest area or volume as a result of deforestation.

Desertification - Degradation of the land that ultimately leads to desert-like conditions.

Designated forests - Forest legally set aside for preservation or production.

Development - Increasing the capacity to meet human needs and improve the quality of human life.

Ecological process - A continuous action or series or actions that is governed or strongly influenced by one or more ecosystems.

Ecosystem diversity - The variety and frequency of different ecosystems.

Ecosystem - A system of plants, animals and other organisms together with the non-living components of their environment.

Ecotourism - Nature tourism.

Environment - The surrounding zone (the specific zone to be affected by the project), all natural resources (physical and biological and human resources), people, economic development and quality-of-life values.

Environmental services - Beneficial functions performed by natural forest ecosystems, including the maintenance or biodiversity, protection of soil and water resources, moderation of climate, influence on rainfall, sequestering of carbon dioxide, provision of habitat for wildlife, and maintenance of the earth's natural balance.

Environmental Planning - Planning activities with the objective of preserving or enhancing environmental values or resources.

Environmental Effect or Impact - An effect on an environmental resource or value resulting from natural or man-made actions, including project development (measured by physical, chemical and biological parameters).

Environmental Impact Assessment - Assessment of the changes in environmental resources or values resulting from a proposed project.

Environmental Monitoring - Observation effects of development projects on environmental resources and values, including sampling, analysis, temporary monitoring during the project construction stage and continuing periodic monitoring following commencement of project operations.

Exotic species - Species introduced from another ecological zone; usually opposite of indigenous.

Externality - A cost (or a benefit) of an economic activity by one party that is unintentionally imposed on (or received by) another party without compensation (or payment) and that leads to inefficiencies in competitive markets.

Forest fallow; bush fallow - Area dominated by woody vegetation after having been cleared and used for shifting cultivation.

Genetic diversity - The variety and frequency of different genes and/or genetic stocks.

Initial Environmental Examination - An initial examination for estimating probable environmental impacts in order to ascertain whether follow-up detailed studies are needed (whether an EIA is needed and if so, preparation of the EIA/TOR).

Mangrove forests - Forests that are normally found in the coastal zones and tidal areas.

Modified ecosystem - Ecosystem where human impact is greater than that of any other species, but whose structural components are not cultivated.

Natural ecosystem - Ecosystem where since the industrial revolution (say 1750) human impact (a) has been no greater than that of any other native species, and (b) has not affected the ecosystem's structure. Human impact excludes changes of global extent, such as climate change due to global warming.

Natural capital, natural wealth, natural assets - The stock of life-support systems, biodiversity, renewable resources, and nonrenewable resources.

Non-governmental organisation (NGO) - Any organisation that is not a part of federal, provincial, territorial, or municipal government. Unless otherwise indicated, includes private voluntary organisations, corporations, educational institutions, and labour unions.

Non-Wood forest products - Output from forests, such as gums, resins, honey, silk, hides, and skins, that are non-timber in nature; also known as minor forest products.

Participatory forestry - The voluntary involvement of people in self-determined change, through the planning, decision-making, and implementation of forestry programmes with well-defined benefit-sharing schemes.

Preservation - Keeping something in its present state.

Preservation forest - Forest designated for total protection of representative forest ecosystems in which all forms of extraction are prohibited.

Primary forest - Relatively intact forest that has been essentially unmodified by human activity for the past sixty to eighty years.

Reforestation - To restock a once-forested area with a tree crop.

Production forest - Forest designated for sustainable production of forest products.

Protected area - An area dedicated primarily to protection and enjoyment of natural or cultural heritage, to maintenance of biodiversity, and/or to maintenance of life-support systems.

Protection forest - Forest designated for stabilization of mountain slopes, upland watersheds, fragile lands, reservoirs and catchment areas. Controlled sustainable extraction of nonwood products could be allowed.

Rehabilitation - To return a degraded ecosystem or population to an undegraded condition, which may be different from its original condition. See also restoration.

Reserve forests - Forests that are legally constituted by Governments.

Restoration - To return a degraded ecosystem or population to its original condition. See also rehabilitation.

Secondary forest - Forest that is subject to a light cycle of shifting cultivation or to various intensities of logging but that still contains indigenous trees and shrubs. In Bangladesh this is essentially non-economic forest type, called scattered trees and brush. On better sites, it can be eventually reforested.

Selective felling; selective cutting - Harvesting of only a small proportion of the standing crop; the opposite of clearfelling.

Shelterwood system - A silvicultural system in which an existing stand of trees is removed in two or more fellings to encourage regeneration in the shelter of the remaining trees.

Shifting cultivation - Farming system in which land is periodically cleared, farmed, and then returned to fallow; synonymous with slash-and-burn or swidden agriculture. In Bangladesh, it is referred to as "jhum".

Silviculture - The science of growing and managing forests.

Social forestry - The use of trees, and/or tree planting, to pursue social objectives (usually betterment of the poor). Social forestry is a program that may include many elements of agroforestry. It often includes, but is not interchangeable with, community forestry, which has a narrower meaning.

Species diversity - The variety and frequency of different species.

Stumpage - A tax based on the quantity (and ideally the full worth) of timber from publicity owned lands.

Sustainability - A characteristic of a process or state that can be maintained indefinitely.

Sustainable management - Utilization of forests without undermining their use by present and future generations. Different systems of management are required for each category of forest, depending on the intended output.

Sustainable development - Improving the quality of human life while living within the carrying capacity of supporting ecosystems.

Sustainable use - USE of an organism, ecosystem or other renewable resource at a rate within its capacity for renewal.

Sustained yield - Production of forest products with an approximate annual balance between net growth and harvest.

Wasteland - Land that is currently producing useful biomass grossly below its potential. The reasons for underproduction may be many and varied, from technical (salinity, acidity or alkalinity, waterlogging) to social (disputed ownership or rights) or political (forest department or community ownership).

Adopted from: IUCN, 1991: Caring for the Earth; The World Bank, 1991. A World Bank Policy Paper The Forest Sector; Asian Development Bank. 1989 (Revised). Sector paper on Forestry.

APPENDIX 2
PROGRAMMES AND INVESTMENT COSTS

(Proj. 372001/30, App. 2)

PROJECT 372001/30
FORESTRY MASTER PLAN,
BANGLADESH (TA NO.1355-BAN)

ASIAN DEVELOPMENT BANK
MANILA PHILIPPINES
DATE: JANUARY 1993

ENVIRONMENT AND LANDUSE

APPENDIX 2
PROGRAMMES AND INVESTMENT COSTS

PROGRAMME: Institutional and Legislative Reform - Conservation

PROJECT TITLE/ DESCRIPTION:

Project 1A: Creation of a Department of Conservation

A Department of Conservation is to be established within the Ministry of Environment and Forests. This Department will have responsibility in all parts of the country for:

a. Management and planning of all existing and proposed protected areas;
b. Inventory of fauna, flora and endangered species;
c. Wildlife management;
d. Captive breeding programs for wildlife;
e. Ex-situ conservation of flora;
f. Co-ordination of ecotourism in protected areas;
g. Public education and information about conservation;
h. Enforcement of protected area, wildlife, and conservation legislation.
i. Establishing a natural history museum
j. Incorporate all zoos, national botanic gardens, and national herbarium under its aegis.

A separate Department is essential to co-ordinate and direct these activities and to establish priorities. The new Department, via enactment of new legislation, must be vested with the responsibility and authority to control and administer land, plants, and animals in the existing and future national parks, wildlife sanctuaries, game reserves and other protected areas. It will be provided with legal power to acquire additional forest land, wetlands, and other terrestrial and aquatic natural areas deemed of special ecological sensitivity or importance. It will have authority to implement relevant national legislation as well as international conventions to which Bangladesh is a signatory.

DEVELOPMENT OBJECTIVES:

To provide improved management of protected areas, all fauna and flora including endangered species in Bangladesh.

To create greater public awareness of the rich biological diversity of Bangladesh and foster programs for conservation.

To provide leadership in involving local people and non-government organizations (NGO's) in the protection and conservation of fauna and flora.

PROBLEM ADDRESSED:

At present there is no effective management of protected areas or fauna and flora in Bangladesh. Under the existing administrative structure, conservation and the protection of biodiversity have been neglected for more than 10 years. Existing protected areas are heavily encroached and are deteriorating. Many species of fauna and flora are threatened or endangered. A Department of Conservation is necessary to address these urgent problems.

ACTIONS AND IMMEDIATE OBJECTIVES:

1. Creation of a Department of Conservation
2. Recruitment/ appointment of senior staff
3. Establishment of priorities for action.

DESIRED RESULTS:

Improved management of protected areas, wildlife management and conservation.

A higher public profile and greater public support for conservation.

Participatory programs involving local people and bodies in the management of protected areas and protection of fauna and flora.

IMPLEMENTING BODY:

Ministry of Environment and Forests.

BENEFICIARIES:

Rural people in Bangladesh through participatory programs near protected areas, increased employment in protected areas. Less confrontation with government.

Urban people through better conservation is country's biodiversity and improved opportunities to visit protected areas.

International community through better protection of Bangladesh forests and wildlife.

POSSIBLE LOSERS AND NEGATIVE IMPACTS:

No negative impacts. Possible perceived losers may be the staff of Forest Department who will consider that some traditional, but neglected responsibilities have been transferred to another Department.

CONDITIONS NECESSARY FOR SUCCESS:

Support of Cabinet and other Departments in the Ministry of Environment and Forests.

Commitment of funds to support recruitment of competent high profile staff and to initiate long-term programs.

LINKS WITH OTHER PROJECTS:

National Conservation Strategy recommends new Department of Conservation

World Bank Forest Resources Management Project provides funding for strengthening Forest Department by creating an Environment Wing.

SEQUENCE OF ACTIVITIES:

1. Cabinet Support
2. Creation of Department of Conservation, administrative structure and budget, and amendment of legislation
3. Appointment of Director General
4. Recruitment/appointment of staff
5. Initiation of programs in areas of responsibility identified above

PROJECT LENGTH:

Three years

FOREIGN TECHNICAL ASSISTANCE:

Team of five people

PROGRAMME: Institutional and Legislative Reform - Conservation

PROJECT TITLE/DESCRIPTION:

Project 1B Amendment of Existing Forestry, Wildlife and Protected Area Legislation.

Amendments to existing legislation are necessary to:

a. create a Department of Conservation and identify its responsibility for the management and conservation of fauna, flora and protected areas in all parts of the country

b. amend the definitions of National Parks and Wildlife Sanctuaries, prescribe the objectives and types of activities permitted in each, create a new class of National Recreational and Historical Parks, and redesignate the existing Game Reserves.

c. provide for the designation of fully protected core areas within National Parks and Wildlife Sanctuaries and for buffer areas on the perimeter of National Parks and Wildlife Sanctuaries where critical habitats are protected and intensive management programs increase the production of products for local use.

d. provide for local boards to participate in the management of protected areas.

e. provide for the transfer of settled and encroached forest land in and adjacent to existing protected areas to private ownership and to provide for the transfer of forest land outside of protected areas to NGOs and local community groups for production of forest products for local use.

DEVELOPMENT OBJECTIVES:

To create manageable protected areas and provide for the production of products for local consumption in perimeter buffer areas.

To provide for local involvement and participation in management of protected areas.

To promote local support for protected areas and conservation programs.

PROBLEMS ADDRESSED:

Lack of an effective legislative basis for the management of protected areas

Lack of protection for wildlife habitats in National Parks and Game Reserves.

Settlement within existing protected areas.

Opposition of local people to protected areas which prohibit use of forest and other products.

Failure of past enforcement efforts aimed at prohibition of activities, rather than management.

ACTIONS AND IMMEDIATE OBJECTIVES:

Amended legislation.

DESIRED RESULTS:

Establishment of protected core areas of National Parks and Wildlife Sanctuaries and managed buffer areas on the perimeter.

Better protection of wildlife habitat

Recognition of important wildlife habitats outside of forested land.

Participation of local people in management decisions and greater support for conservation programs.

IMPLEMENTING BODY:

Ministry of Environment and Forests

BENEFICIARIES:

Rural people in Bangladesh through participatory programs near protected areas, increased employment in protected areas

Urban people through better conservation of the full range of the country's biodiversity.

International community through better protection of Bangladesh protected areas and wildlife.

POSSIBLE LOSERS AND NEGATIVE IMPACTS:

None

CONDITIONS NECESSARY FOR SUCCESS:

Cabinet support

LINKS WITH OTHER PROJECTS:

None

SEQUENCE OF ACTIVITIES:

1. Legislation to create Department of Conservation and define responsibilities
2. Amend Wildlife (Preservation)(Amendment) Act of 1974
3. Amend forest legislation

PROJECT LENGTH:

One year

FOREIGN TECHNICAL ASSISTANCE:

One person

PROGRAMME: Management of Existing Protected Areas

PROJECT TITLE/ DESCRIPTION:

Project 2A Revision of Existing National Park and Wildlife Sanctuary Boundaries.

Many of the 12 existing National Parks and Wildlife Sanctuaries require boundary revisions to make them more manageable and provide for better conservation of important species and ecosystems.

Aerial photo surveys are necessary to map existing land use and identify the most appropriate boundaries.

DEVELOPMENT OBJECTIVES:

To refine the boundaries of existing National Parks and Wildlife Sanctuaries to create more manageable areas.

To include important unprotected areas in the protected area and to remove settled or denuded areas that no longer serve their intended function from protected areas.

To establish core and buffer areas.

PROBLEMS ADDRESSED:

Existing boundaries of National Parks, Wildlife Sanctuaries and Game Reserves include areas that are heavily settled and degraded and no longer serve any protected area objective. These areas are an obstacle to proper management. In many cases boundaries do not include adjacent areas that do have high conservation value.

Refinement of boundaries based on aerial surveys would lead to much improved management and better conservation of wildlife and important ecosystems.

ACTIONS AND IMMEDIATE OBJECTIVES:

Preparation of land use maps for each of the 12 existing protected areas

Relocation of boundaries and identification of fully protected core areas to be included in National Parks and Wildlife Sanctuaries and of surrounding buffer areas.

DESIRED RESULTS:

Revised core protected areas, identified buffer areas and improved protected areas management.

IMPLEMENTING BODY:

Department of Conservation

BENEFICIARIES:

Local people through more appropriate protected area boundaries, and the identification of buffer areas for intensive management. Initiation of programs for local people in buffer areas.

Urban people through improved management of realistic protected areas.

International community through better protection of Bangladesh protected areas.

POSSIBLE LOSERS AND NEGATIVE IMPACTS:

None

CONDITIONS NECESSARY FOR SUCCESS:

Suitable technology and knowledge to conduct aerial survey for mapping at 1:10,000.

Appropriate legislation for the establishment of protected core areas and managed buffer areas

LINKS WITH OTHER PROJECTS:
The refinement of boundaries of existing protected areas should be a necessary prelude to a program for development of a management plan for each of the protected areas.

The aerial survey component of the project could be expanded to include all proposed protected areas.

SEQUENCE OF ACTIVITIES:

1. Aerial photographic surveys of each of the existing 12 protected areas
2. Preparation of land use maps at 1:10,000
3. Amendment of protected area boundaries based on maps.

PROJECT LENGTH

Three years

FOREIGN TECHNICAL ASSISTANCE

Five people

Aerial photography and mapping

PROGRAMME: Management of Existing Protected Areas

PROJECT TITLE/ DESCRIPTION:

Project 2B Surveys of Fauna and Flora

DEVELOPMENT OBJECTIVES:

In order to prepare appropriate management plans for each of the protected areas it is necessary to have basic inventory information.

PROBLEM ADDRESSED:

Lack of information about species of fauna and flora in protected areas and their current populations.

ACTIONS AND IMMEDIATE OBJECTIVES:

To conduct baseline surveys in each of the existing protected areas.

DESIRED RESULTS:

Basic inventory on which to develop management plans for each protected area.

IMPLEMENTING BODY:

Universities and NGO's operating with procedures and priorities established in co-operation with the Department of Conservation. Surveys of fauna and flora undertaken in Chunati Wildlife Sanctuary in 1990 provide a prototype for these surveys.

BENEFICIARIES:

Department of Conservation through improved information.

NGOs through field survey programs which provide employment and training for local people.

POSSIBLE LOSERS AND NEGATIVE IMPACTS:

None

CONDITIONS NECESSARY FOR SUCCESS:

A Department of Conservation to fund, set priorities and coordinate the surveys.

Co-operation of universities, and NGOs in undertaking the surveys.

Participation of field-oriented research organizations in the private sector and NGOs, with capacity to undertake such surveys on contract basis.

LINKS WITH OTHER PROJECTS:

Surveys should be a necessary prerequisite to the preparation of management plans as planned and to be funded under the Forestry III project

SEQUENCE OF ACTIVITIES:

1. Determine order of priority of existing protected areas for fauna and flora surveys.
2. Identify NGOs or other organization to be responsible for surveys.
3. Fund and implement surveys.

PROJECT LENGTH:

Five years

FOREIGN TECHNICAL ASSISTANCE:

None, support funding required.

PROGRAMME: Management of Existing Protected Areas

PROJECT TITLE/DESCRIPTION:

Project 2C Preparation of Management Plans

DEVELOPMENT OBJECTIVES:

To develop short and long term management plans for each of the existing protected areas.

PROBLEM ADDRESSED:

Lack of any plans, programs or protected area management activities in existing protected areas.

ACTIONS AND IMMEDIATE OBJECTIVES:

Based on revised boundaries and improved inventories, develop management plans for core protected area and adjacent buffer areas.

DESIRED RESULTS:

Improved protection of core protected area.

Development of co-operative participatory programs for the production of necessary forest products for local consumption on in the buffer areas surrounding protected areas.

Improved protection of wildlife, forests and ecosystems in buffer areas.

IMPLEMENTING BODY:

Department of Conservation

BENEFICIARIES:

Local people through programs to reduce dependence on products from within protected areas.

Conservation community and nation through improved protection of National Parks and Wildlife Sanctuaries.

POSSIBLE LOSERS AND NEGATIVE IMPACTS:

None

CONDITIONS NECESSARY FOR SUCCESS:

1. Boundary revisions and inventory information.
2. Amended legislation.
3. Participation of local people and bodies in preparation of management plan.

LINKS WITH OTHER PROJECTS:

World Bank Forestry Project will fund preparation of management plans

IUCN program to improve management of protected areas.

SEQUENCE OF ACTIVITIES:

1. Determine order of priority of existing protected areas for management plans.
2. Fund and begin preparation of plans.

PROJECT LENGTH:;

Five years

FOREIGN TECHNICAL ASSISTANCE:

Three persons

PROGRAMME: Community-Based Natural Resource Management

PROJECT TITLE/DESCRIPTION:

6A. National Conservation Trust

DEVELOPMENT OBJECTIVES:

A perpetual fund directed towards assisting NGOs with undertaking projects relevant to natural resources conservation.

PROBLEM ADDRESSED:

Difficulty for NGOs to access funding agencies with small projects, or multi-year ones. NGOs unknown to potential donors.

ACTIONS AND IMMEDIATE OBJECTIVES:

1. Team from IUCN, WWF, for two month T.A. to determine the necessary and desirable legal and administrative mechanisms of the fund. The fund to be modeled after Bhutan example.

2. Team to liaise with MOEF, environmental NGOs, Wildlife Advisory Board.

3. Objective to set up a fund $20 million in perpetuity, from which environmental NGOs can undertake projects.

DESIRED RESULTS:

Detailed trust fund with clear mechanisms for implementation, roles and responsibilities of various agencies.

IMPLEMENTING BODY:

National environmental foundation, with governing board of directors selected from prominent Bangladeshi conservationists.

BENEFICIARIES:

Country as a whole, from enhanced biodiversity and enhanced NGO capacity to carry out field programmes.

POSSIBLE LOSERS AND NEGATIVE IMPACTS:

None

CONDITIONS NECESSARY FOR SUCCESS:

1. Agreement among NGOs for conditions regarding fund use.
2. Support from MOEF for concept.
3. Competent and available local conservationists.
4. Interest by IUCN and WWF to undertake consultancy.

LINKS WITH OTHER PROJECTS:

Links with other community-based project.
SEQUENCE OF ACTIVITIES:

The first would be based on a national heritage or conservation trust, modeled on such trusts elsewhere in the region by agencies such as IUCN and WWF. It would be directed towards agencies whose main objectives are concerned with environmental conservation, biodiversity, protected area surveys and management, etc. The fund would consist of pledges from various donor sources. It would be conservatively invested and the annual proceeds would be directed towards appropriate activities, which would be clearly spelled out in the charter of the fund. Mechanisms for discussing potential functions, structure and management would be done through a short term consultancy. GOB would have a role in the fund through MOEF, primarily via the new Department for conservation and resource management.

LENGTH OF PROJECT:

Two months for establishment.

FOREIGN TECHNICAL ASSISTANCE:

Three people.

PROJECT TITLE/DESCRIPTION:

6B. Community-Based NGO Environmental Development

DEVELOPMENT OBJECTIVES:

This fund would be for the purpose of community-based natural resource management. It would be created on the basis of perceived needs of the rural poor, to promote and support activities noted below. Target $20 million over five years for variety of activities listed below.

Build institutional capacity for local NGOs.

Build partnerships with regional and international NGOs.

Implement projects with full community participation in resource management, particularly projects in forestry, common property resource management, and innovative conservation projects.

PROBLEM ADDRESSED:

Need for enhancement of existing environmental capacity of NGOs.
Need for community-based environmental management.
Need for alternative and innovative techniques for conflict resolution over resource use between people and needs for conservation.

ACTIONS AND IMMEDIATE OBJECTIVES:

NGOs to create fund.
Donors to support financially.
Working group within ADAB Coalition of Environmental NGOs.

DESIRED RESULTS:

- natural resource information centres, located in existing field offices of NGOs and in selected micro environments and ecosystems; the conceptual basis for this has been framed by MARC;

- eco-villages, i.e., integrated resource management at community level in selected locations; a conceptual basis has been suggested by POUSH;

- special emphasis on a resource centre for the linkages between women and environment;

- applied/action research, in the fields such as: (i)tree/land tenure systems (ii) common property management methodologies and experiences throughout the country; (iii) community watershed management; (iv) exploring micro environments and traditional techniques and technologies for village forest management;

- formation and extension of forest protection committees; the feasibility and practicability for this has been demonstrated by Proshika Manobik Unnayan Kendra;

- training of NGO workers, school teachers, villagers, local government officials, industrial managers;

- a source of follow-up financial support to SOER;

- employment and income generation through small-scale forest-based industries;

- information and public awareness campaigns at primary and functional literacy level; production of films, videos and books about forest conservation, wildlife, and the importance of village forests;

- a centre of excellence in social forestry, promoting NGO linkages within the country, linkages with similar centres in the region, inviting lecturers from within the country and the region, and providing fellowships to local innovators.

IMPLEMENTING BODY:

A committee within ADAB CEN. The committee will be comprised of 5-7 persons, including members of the coalition, MOEF representative as ex-officio member, and local experts on social forestry and environment. The committee will create standards for selection of NGOs for support. The centre will fund the NGOs directly, on the recommendation of the supporting committee. The committee membership will rotate. At the end of the fourth year, it will be explored whether a permanent trust fund is warranted, along the lines of the National Conservation trust, or some other mechanism.

BENEFICIARIES:

Communities in project locations.
GOB from innovative resource management experiments.

POSSIBLE LOSERS AND NEGATIVE IMPACTS:

None. Emergence of new Department of Conservation during period of implementation will require additional linkages.

CONDITIONS NECESSARY FOR SUCCESS:

Grass roots local support.

Development of an effective Department and a demonstrated ability to manage projects in areas suggested.

Implementing structure has wide support from NGOs.

LINKS WITH OTHER PROJECTS:

National Conservation Trust working towards same objectives, targeting resources more than people.

IUCN programs.

SEQUENCE OF ACTIVITIES:

Two month consultancy. Local experts plus liaison with IUCN, WWF group during their consultancy for conservation trust.

LENGTH OF PROJECT:

Five years.

FOREIGN TECHNICAL ASSISTANCE:

None.
PROGRAMME:

PROJECT TITLE/DESCRIPTION:

7. Forest Conservation and Monitoring Cell ✓

DEVELOPMENT OBJECTIVES:

1. Assist BFD with advisory services for operation of Environmental Wing to be established within Forestry III project.

2. Assist DOE in institutional development, technical; assistance, training, and EIA for forestry projects.

3. Assist MOEF, in advisory capacity for sustainable use of forests and monitoring implementation of FMP

PROBLEM ADDRESSED:

The Unit would be attached to MOEF, and would ensure that conservation, biodiversity, and environmental management issues are addressed within the planning, management and monitoring of all forestry activities within the agencies falling under the aegis of the Ministry.

ACTIONS AND IMMEDIATE OBJECTIVES:

This unit would function for a period of three years. Its first priorities would be to advise on the creation of the new Department, and to restructure the Wildlife Advisory Board into a functional body with specific goals and objectives.

DESIRED RESULTS:

The unit would have the following basic functions:

- to advise the MOEF, FD, DOE, and other agencies within the Ministry on forest conservation issues;
- after preliminary environmental guidelines for the forestry sector are prepared under the Forest Resources Management project, the unit would produce detailed guidelines for the various forest types and dendroecological regions;

- to prepare a comprehensive database of local expertise in forestry, protected area management, wildlife management and conservation issues, and to identify likely agencies and individuals who could be contracted to perform some of the recommendations of the FMP;

- to advise, initiate and train FD, DOE, staff in creating and managing an environmental data base from the inventories and surveys to be performed within the FMP;

- to advise on the creation of protection forests within the FD, their demarcation, management, and monitoring;

- to assist in the formulation of guidelines for forest management plans for development of buffer zones, delineation of critical watershed areas, and appropriate measures for soil conservation;

- to assist in defining training needs in environment-related functions within MOEF and its Departments;

- to assist the FD, BFRI, and BFIDC, with application of appropriate management principles to natural forest management under the different forest types and dendroecological zones;

- to act as a resource for the NGO community, the Extension Wing of FD, regarding participatory forestry.

IMPLEMENTING BODY: MOEF

BENEFICIARIES: MOEF, its associated departments and overall environment.

POSSIBLE LOSERS AND NEGATIVE IMPACTS:

None

CONDITIONS NECESSARY FOR SUCCESS:

1. Commitment from GOB
2. Adequately stapped unit

LINKS WITH OTHER PROJECTS:

Forest Resources management Project

SEQUENCE OF ACTIVITIES:

1. Pre-feasibility by IUCN, WWF one month consultancy.
2. Appraisal mission (donors)
3. Implement

PROJECT LENGTH: 3 years.

FOREIGN TECHNICAL ASSISTANCE:

7 Persons - Chief Technical advisor.

- Land Use Planner (with specialty in multiple-use management)
- Restoration Ecologist
- Forest Management Specialist
- Wildlife Management Specialist
- Watershed Management Specialist
- Protected Areas Systems Planner.

1. LANDUSE, CONSERVATION AND ENVIRONMENTAL MANAGEMENT, SCENARIO 1

Table 1 - Summary of Programme Costs

Programme Components	Million Taka			Million U $			% of Base Costs	% of FEC
	Foreign	Local	Total	Foreign	Local	Total		
A. PHYSICAL INFRASTRUCTURE								
1. Land Acquisition		5.0	5.0		0.1	0.1	0.3	
2. Detail Engineering and Supervision		18.1	18.1		0.5	0.5	1.2	
3. Civil Works	30.2	271.8	302.0	0.8	7.0	7.8	20.4	11.3
Subtotal	30.2	294.9	325.1	0.8	7.6	8.4	21.9	11.3
B. FURNITURE, EQUIPMENT AND VEHICLES								
1. Furniture		16.3	16.3		0.4	0.4	1.1	
2. Equipments	12.6	3.2	15.8	0.3	0.1	0.4	1.1	4.7
3. Vehicles	38.4	9.6	48.0	1.0	0.2	1.2	3.2	14.4
Subtotal	51.0	29.1	80.1	1.3	0.7	2.1	5.4	19.1
C. HUMAN RESOURCES DEVELOPMENT								
1. Overseas Training	16.2	1.8	18.0	0.4	0.0	0.5	1.2	6.1
2. Short Courses (Overseas)	20.3	2.3	22.5	0.5	0.1	0.6	1.5	7.6
3. Training of Trainers		3.0	3.0		0.1	0.1	0.2	
4. Training of Local Government Officials		2.0	2.0		0.1	0.1	0.1	
5. Training of Villagers		80.0	80.0		2.1	2.1	5.4	
6. Workshop and Seminars		6.0	6.0		0.2	0.2	0.4	
Subtotal	36.5	95.1	131.5	0.9	2.4	3.4	8.9	13.6
D. RESEARCH, DEVELOPMENT AND STUDIES								
1. Inventory and Surveys		8.8	8.8		0.2	0.2		
2. Research and Development Studies		28.0	28.0		0.7	0.7	1.9	
3. Monitoring and Evaluation		32.5	32.5		0.8	0.8	2.2	
Subtotal		69.3	69.3		1.8	1.8	4.7	
E. CONSULTING SERVICES								
1. International	119.4	13.3	132.6	3.1	0.3	3.4	8.9	44.7
2. Local		225.6	225.6		5.8	5.8	15.2	
Subtotal	119.4	238.9	358.3	3.1	6.1	9.2	24.1	44.7
F. RECURRENT COSTS								
1. Existing Staff Salaries		137.6	137.6		3.5	3.5	9.3	
2. Incremental Staff Salaries		325.8	325.8		8.4	8.4	22.0	
3. Operation and Maintenance of Facilities	1.2	4.8	6.0	0.0	0.1	0.2	0.4	0.4
4. Vehicle/ Equipment Operation/ Maintenance	15.0	15.0	30.0	0.4	0.4	0.8	2.0	5.6
5. Office Supplies and Consumables	14.0	6.0	20.0	0.4	0.2	0.5	1.3	5.2
Subtotal	30.2	489.2	519.4	0.8	12.6	13.4	35.0	11.3
BASE COSTS	267.3	1,216.4	1,483.7	6.9	31.3	38.1	100.0	100.0
Physical Contingencies	14.9	75.6	90.4	0.4	1.9	2.3		
TOTAL PROGRAMME COST	282.1	1,291.9	1,574.1	7.3	33.2	40.5		

Table 2 - Proposed Financing Plan, Million U $

Project Components	Total Programme Cost			GOB Financing			Donors Financing			Beneficiaries Financing		
	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total
A. PHYSICAL INFRASTRUCTURE												
1. Land Acquisition		0.1	0.1		0.1	0.1						
2. Detail Engineering and Supervision		0.5	0.5					0.5	0.5			
3. Civil Works	0.8	7.0	7.8		0.8	0.8	0.8	6.2	7.0			
Subtotal	0.8	7.6	8.4		0.9	0.9	0.8	6.7	7.5			
B. FURNITURE, EQUIPMENT AND VEHICLES												
1. Furniture		0.4	0.4					0.4	0.4			
2. Equipments	0.3	0.1	0.4		0.1	0.1	0.3		0.3			
3. Vehicles	1.0	0.2	1.2		0.2	0.2	1.0		1.0			
Subtotal	1.3	0.7	2.1		0.3	0.3	1.3	0.4	1.7			
C. HUMAN RESOURCES DEVELOPMENT												
1. Overseas Training	0.4	0.0	0.5				0.4	0.0	0.5			
2. Short Courses (Overseas)	0.5	0.1	0.6				0.5	0.1	0.6			
3. Training of Trainers		0.1	0.1					0.1	0.1			
4. Training of Local Government Officials		0.1	0.1					0.1	0.1			
5. Training of Villagers		2.1	2.1					2.1	2.1			
6. Workshop and Seminars		0.2	0.2					0.2	0.2			
Subtotal	0.9	2.4	3.4				0.9	2.4	3.4			
D. RESEARCH, DEVELOPMENT AND STUDIES												
1. Inventory and Surveys		0.2	0.2					0.2	0.2			
2. Research and Development Studies		0.7	0.7					0.7	0.7			
3. Monitoring and Evaluation		0.8	0.8					0.8	0.8			
Subtotal		1.8	1.8					1.8	1.8			
E. CONSULTING SERVICES												
1. International	3.1	0.3	3.4				3.1	0.3	3.4			
2. Local		5.8	5.8					5.8	5.8			
Subtotal	3.1	6.1	9.2				3.1	6.1	9.2			
F. RECURRENT COSTS												
1. Existing Staff Salaries		3.5	3.5		3.5	3.5						
2. Incremental Staff Salaries		8.4	8.4		8.4	8.4						
3. Operation and Maintenance of Facilities	0.0	0.1	0.2		0.1	0.1	0.0		0.0			
4. Vehicle/ Equipment Operation/ Maintenance	0.4	0.4	0.8		0.4	0.4	0.4		0.4			
5. Office Supplies and Consumables	0.4	0.2	0.5		0.2	0.2	0.4		0.4			
Subtotal	0.8	12.6	13.4		12.6	12.6	0.8		0.8			
BASE COSTS	6.9	31.3	38.1		13.8	13.8	6.9	17.5	24.3			
Physical Contingencies	0.4	1.9	2.3		1.0	1.0	0.4	1.0	1.3			
TOTAL PROGRAMME COSTS	7.3	33.2	40.5		14.8	14.8	7.3	18.4	25.7			
PERCENTAGE	17.9	82.1	100.0		44.6	36.6	100.0	55.4	63.4			

Table 3 - Phasing of Programme Costs, Million Taka

Programme Components	PY Year 1 - 5 FY 1993/97	6 - 10 1998/02	11 - 15 2003/07	16 - 20 2008/12	Total Costs Local	Foreign	Total
A. PHYSICAL INFRASTRUCTURE							
1. Land Acquisition	5.0				5.0		5.0
2. Detail Engineering and Supervision	14.7	3.4			18.1		18.1
3. Civil Works	245.3	56.7			271.8	30.2	302.0
Subtotal	265.0	60.1			294.9	30.2	325.1
B. FURNITURE, EQUIPMENT AND VEHICLES							
1. Furniture	8.4	5.2	1.2	1.5	16.3		16.3
2. Equipments	10.4			5.4	3.2	12.6	15.8
3. Vehicles	20.1	0.6	12.0	15.3	9.6	38.4	48.0
Subtotal	38.9	5.8	13.2	22.2	29.1	51.0	80.1
C. HUMAN RESOURCES DEVELOPMENT							
1. Overseas Training	12.0	6.0			1.8	16.2	18.0
2. Short Courses (Overseas)	13.5	4.5	4.5		2.3	20.3	22.5
3. Training of Trainers	1.0	1.0	1.0		3.0		3.0
4. Training of Local Government Officials	0.5	0.5	0.5	0.5	2.0		2.0
5. Training of Villagers	20.0	20.0	20.0	20.0	80.0		80.0
6. Workshop and Seminars	3.0	1.5	1.5		6.0		6.0
Subtotal	50.0	33.5	27.5	20.5	95.1	36.5	131.5
D. RESEARCH, DEVELOPMENT AND STUDIES							
1. Inventory and Surveys	8.8				8.8		8.8
2. Research and Development Studies	12.0	8.0	8.0		28.0		28.0
3. Monitoring and Evaluation	10.0	10.0	7.5	5.0	32.5		32.5
Subtotal	30.8	18.0	15.5	5.0	69.3		69.3
E. CONSULTING SERVICES							
1. International	90.4	42.2			13.3	119.4	132.6
2. Local	155.6	70.0			225.6		225.6
Subtotal	246.0	112.2			238.9	119.4	358.3
F. RECURRENT COSTS							
1. Existing Staff Salaries	27.6	31.7	36.4	41.9	137.6		137.6
2. Incremental Staff Salaries	39.9	79.9	95.8	110.2	325.8		325.8
3. Operation and Maintenance of Facilities	1.5	1.5	1.5	1.5	4.8	1.2	6.0
4. Vehicle/ Equipment Operation/ Maintenance	7.5	7.5	7.5	7.5	15.0	15.0	30.0
5. Office Supplies and Consumables	5.0	5.0	5.0	5.0	6.0	14.0	20.0
Subtotal	81.5	125.6	146.2	166.1	489.2	30.2	519.4
BASE COSTS	712.2	355.2	202.4	213.8	1,216.4	267.3	1,483.7
Physical Contingencies	48.9	20.8	10.1	10.7	75.6	14.9	90.4
TOTAL PROGRAMME COST	761.1	376.0	212.5	224.5	1,291.9	282.1	1,574.1

Table 4 - Cost Estimates - Civil Works, Furniture, Equipments and Vehicles

Items	Unit	Unit Cost (Taka '000)	Number of Units						Total Costs (Million Taka)							
			Year 1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	Total	Year 1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	Total	FEC	T and D
A. PHYSICAL FACILITIES																
1. Land Acquisition	Ha	5,000.0	1					1	5.0					5.0		
2. Detail Engineering and Supervision 1_/	Percent	6.0							14.7	3.4				18.1		
Subtotal									19.7	3.4				23.1		
3. Civil Works																
- Department	m2	10.1	500					500	5.1					5.1	0.5	0.5
- Regional Offices	m2	8.6	2,500					2,500	21.5					21.5	2.2	2.2
- Existing National Parks(Protected Areas)	m2	5.4	8,000					8,000	43.2					43.2	4.3	4.3
- New Protected Areas	m2	5.4	30,000	10,000				40,000	162.0	54.0				216.0	21.6	21.6
- Field Rest House	m2	5.4	2,000					2,000	10.8					10.8	1.1	1.1
- Herbarium and Botanical Gardens	m2	5.4														
- Regional Nature Conservation Center	m2	5.4	500	500				1,000	2.7	2.7				5.4	0.5	0.5
- National and Regional Zoo	m2	5.4														
- Natural History Museum	m2	8.6														
Subtotal								54,000	245.3	56.7				302.0	30.2	30.2
B. FURNITURE																
- Department of Natural Resource Conservation	Lumpsum	300.0	1		1			2	0.3		0.3			0.6		
- Regional Offices	Lumpsum	150.0	6		6			12	0.9		0.9			1.8		
- Existing National Parks(Protected Areas)	Lumpsum	1,000.0	1					1	1.0					1.0		
- New Protected Areas	Lumpsum	1,000.0	5	5				10	5.0	5.0				10.0		
- Field Rest House	Lumpsum	50.0	10	4		30		44	0.5	0.2		1.5		2.2		
- Herbarium	Lumpsum															
- Regional Nature Conservation Center	Lumpsum	50.0	14					14	0.7					0.7		
- National Zoo	Lumpsum															
- Natural History Museum	Lumpsum															
Subtotal									8.4	5.2	1.2	1.5		16.3		
C. EQUIPMENTS																
- Division	Lumpsum	3,000.0	1			1		2	3.0			3.0		6.0	4.8	1.2
- Department of Environment	Lumpsum	10,000.0														
- Forest Department	Lumpsum		1			1		2								
- Regional Offices	Lumpsum	200.0	1			1		2	0.2			0.2		0.4	0.3	0.1
- Existing National Parks(Protected Areas)	Lumpsum	1,000.0	1			1		2	1.0			1.0		2.0	1.6	0.4
- New Protected Areas	Lumpsum	1,000.0	1			1		2	1.0			1.0		2.0	1.6	0.4
- Field Rest House	Lumpsum	20.0	10			10		20	0.2			0.2		0.4	0.3	0.1
- Herbarium	Lumpsum															
- Regional Nature Conservation Center	Lumpsum															
- National Zoo	Lumpsum															
- Natural History Museum	Lumpsum	5,000.0	1					1	5.0					5.0	4.0	1.0
Subtotal									10.4			5.4		15.8	12.6	3.2
D. VEHICLES																
- 4 WHD Jeep	No.	1,500.0	8		8			16	12.0		12.0			24.0	19.2	4.8
- Motor Cycle	No.	60.0	15	10		15		40	0.9	0.6		0.9		2.4	1.9	0.5
- Speed Boat	No.	1,200.0	6			12		18	7.2			14.4		21.6	17.3	4.3
- Coastal Research Vessel	No.															
- River Patrol Boat	No.	1,000.0	3			6		9	3.0			6.0		9.0	7.2	1.8
- Amphibious Aircraft	No.	2,000.0														
Subtotal									20.1	0.6	12.0	15.3		48.0	38.4	9.6

Table 5 - Cost Estimates - Human Resource Development, Research, Studies and Operation/Maintenance

Items	Unit	Unit Cost (Taka '000)	Number of Units						Total Costs (Million Taka)							
			Year 1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	Total	Year 1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	Total	FEC	T and D
A. TRAINING AND SEMINAR																
1. Overseas Training	No	1,200.0	10	5				15	12.0	6.0				18.0	16.2	
2. Short Courses(Overseas)	No	450.0	30	10	10			50	13.5	4.5	4.5			22.5	20.3	
3. Training of Trainers	No	20.0	50	50	50			150	1.0	1.0	1.0			3.0		
4. Training of Local Government Officials	No	10.0	50	50	50	50		200	0.5	0.5	0.5	0.5		2.0		
5. Training of Villagers	No	2.0	10,000	10,000	10,000	10,000		40,000	20.0	20.0	20.0	20.0		80.0		
6. Workshop and Seminars	No	150.0	20	10	10			40	3.0	1.5	1.5			6.0		
Subtotal									50.0	33.5	27.5	20.5		131.5	36.5	
B. RESEARCH, DEVELOPMENT AND STUDIES																
1. Inventory and Surveys	Sum	800.0	11					11	8.8					8.8		
2. Research and Development Studies	Sum	800.0	15	10	10			35	12.0	8.0	8.0			28.0		
3. Monitoring and Evaluation	Sum	500.0	20	20	15	10		65	10.0	10.0	7.5	5.0		32.5		
Subtotal									30.8	18.0	15.5	5.0		69.3		
C. COMMUNITY BASED RESOURCE MANAGEMENT	Sum	1,167,000.0	0.4	0.2	0.2	0.2		1.0	466.8	233.4	233.4	233.4		1,167.0		
D. CONSULTING SERVICES																
1. International	mm	603.0	150	70				220	90.4	42.2				132.6	119.4	
2. Local	mm	155.6	1,000	450				1,450	155.6	70.0				225.6		
Subtotal									246.0	112.2				358.3	119.4	
E. RECURRENT COSTS														9.2		
1. Existing Staff Salaries	Sum	27,575.0	1	1.2	1.3	1.5		5	27.6	31.7	36.4	41.9		137.6		
2. Incremental Staff Salaries	Sum	39,928.7	1	2	2.4	2.8		8.2	39.9	79.9	95.8	110.2		325.8		
3. Operation and Maintenance of Facilities	Sum	1,500.0	1	1	1	1		4	1.5	1.5	1.5	1.5		6.0	1.2	0.6
4. Vehicle/Equipment Operation/Maintenance	Sum	7,500.0	1	1	1	1		4	7.5	7.5	7.5	7.5		30.0	15.0	3.0
5. Office Supplies and Consumables	Sum	5,000.0	1	1	1	1		4	5.0	5.0	5.0	5.0		20.0	14.0	2.0
Subtotal									81.5	125.6	146.2	166.1		519.4	30.2	5.6

2. LANDUSE, CONSERVATION AND ENVIRONMENTAL MANAGEMENT (SCENARIO 2)

Table 1 - Summary of Programme Costs

Programme Components	Million Taka			Million U $			% of	% of
	Foreign	Local	Total	Foreign	Local	Total	Base Costs	FEC
A. PHYSICAL INFRASTRUCTURE								
1. Land Acquisition		165.0	165.0		4.2	4.2	3.7	
2. Detail Engineering and Supervision		61.8	61.8		1.6	1.6	1.4	
3. Civil Works	103.0	926.7	1,029.7	2.6	23.8	26.5	23.1	12.7
Subtotal	**103.0**	**1,153.5**	**1,256.5**	**2.6**	**29.7**	**32.3**	**28.1**	**12.7**
B. FURNITURE, EQUIPMENT AND VEHICLES								
1. Furniture		36.3	36.3		0.9	0.9	0.8	
2. Equipments	203.6	50.9	254.4	5.2	1.3	6.5	5.7	25.1
3. Vehicles	94.1	23.5	117.6	2.4	0.6	3.0	2.6	11.6
Subtotal	**297.6**	**110.7**	**408.3**	**7.7**	**2.8**	**10.5**	**9.1**	**36.7**
C. HUMAN RESOURCES DEVELOPMENT								
1. Overseas Training	16.2	1.8	18.0	0.4	0.0	0.5	0.4	2.0
2. Short Courses (Overseas)	64.8	7.2	72.0	1.7	0.2	1.9	1.6	8.0
3. Training of Trainers		3.0	3.0		0.1	0.1	0.1	
4. Training of Local Government Officials		2.0	2.0		0.1	0.1	0.0	
5. Training of Villagers		720.0	720.0		18.5	18.5	16.1	
6. Workshop and Seminars		16.5	16.5		0.4	0.4	0.4	
Subtotal	**81.0**	**750.5**	**831.5**	**2.1**	**19.3**	**21.4**	**18.6**	
D. RESEARCH, DEVELOPMENT AND STUDIES								
1. Inventory		2.4	2.4		0.1	0.1		
2. Surveys		90.0	90.0		2.3	2.3	2.0	
3. Research and Development Studies		48.0	48.0		1.2	1.2	1.1	
4. Monitoring and Evaluation		100.0	100.0		2.6	2.6	2.2	
Subtotal		**240.4**	**240.4**		**6.2**	**6.2**	**5.4**	
E. CONSULTING SERVICES								
1. International	244.2	27.1	271.3	6.3	0.7	7.0	6.1	
2. Local		225.6	225.6		5.8	5.8	5.1	
Subtotal	**244.2**	**252.8**	**496.9**	**6.3**	**6.5**	**12.8**	**11.1**	**30.1**
F. RECURRENT COSTS								
1. Existing Staff Salaries		274.8	274.8		7.1	7.1	6.2	
2. Incremental Staff Salaries		798.3	798.3		20.5	20.5	17.9	
3. Operation and Maintenance of Facilities	4.0	16.0	20.0	0.1	0.4	0.5	0.4	0.5
4. Vehicle/ Equipment Operation/ Maintenance	40.0	40.0	80.0	1.0	1.0	2.1	1.8	4.9
5. Office Supplies and Consumables	42.0	18.0	60.0	1.1	0.5	1.5	1.3	5.2
Subtotal	**86.0**	**1,147.1**	**1,233.1**	**2.2**	**29.5**	**31.7**	**27.6**	**10.6**
BASE COSTS	**811.8**	**3,654.9**	**4,466.7**	**20.9**	**94.0**	**114.8**	**100.0**	**100.0**
Physical Contingencies	45.7	240.4	286.2	1.2	6.2	7.4		
TOTAL PROJECT COST	**857.5**	**3,895.3**	**4,752.9**	**22.0**	**100.1**	**122.2**		

Table 2 - Proposed Financing Plan, Million U $

Project Components	Total Programme Cost			GOB Financing			Donors Financing			Beneficiaries Financing		
	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total
A. PHYSICAL INFRASTRUCTURE												
1. Land Acquisition		4.2	4.2		4.2	4.2						
2. Detail Engineering and Supervision		1.6	1.6					1.6	1.6			
3. Civil Works	2.6	23.8	26.5		2.6	2.6	2.6	21.2	23.8			
Subtotal	**2.6**	**29.7**	**32.3**		**6.9**	**6.9**	**2.6**	**22.8**	**25.4**			
B. FURNITURE, EQUIPMENT AND VEHICLES												
1. Furniture		0.9	0.9					0.9	0.9			
2. Equipments	5.2	1.3	6.5		1.3	1.3	5.2		5.2			
3. Vehicles	2.4	0.6	3.0		0.6	0.6	2.4		2.4			
Subtotal	**7.7**	**2.8**	**10.5**		**1.9**	**1.9**	**7.7**	**0.9**	**8.6**			
C. HUMAN RESOURCES DEVELOPMENT												
1. Overseas Training	0.4	0.0	0.5				0.4	0.0	0.5			
2. Short Courses (Overseas)	1.7	0.2	1.9				1.7	0.2	1.9			
3. Training of Trainers		0.1	0.1					0.1	0.1			
4. Training of Local Government Officials		0.1	0.1					0.1	0.1			
5. Training of Villagers		18.5	18.5					18.5	18.5			
6. Workshop and Seminars		0.4	0.4					0.4	0.4			
Subtotal	**2.1**	**19.3**	**21.4**				**2.1**	**19.3**	**21.4**			
D. RESEARCH, DEVELOPMENT AND STUDIES												
1. Inventory		0.1	0.1					0.1	0.1			
2. Surveys		2.3	2.3					2.3	2.3			
3. Research and Development Studies		1.2	1.2					1.2	1.2			
4. Monitoring and Evaluation		2.6	2.6					2.6	2.6			
Subtotal		**6.2**	**6.2**					**6.2**	**6.2**			
E. CONSULTING SERVICES												
1. International	6.3	0.7	7.0				6.3	0.7	7.0			
2. Local		5.8	5.8					5.8	5.8			
Subtotal	**6.3**	**6.5**	**12.8**				**6.3**	**6.5**	**12.8**			
F. RECURRENT COSTS												
1. Existing Staff Salaries		7.1	7.1		7.1	7.1						
2. Incremental Staff Salaries		20.5	20.5								20.5	20.5
3. Operation and Maintenance of Facilities	0.1	0.4	0.5		0.1	0.1	0.1		0.1		0.3	0.3
4. Vehicle/ Equipment Operation/ Maintenance	1.0	1.0	2.1		0.2	0.2	1.0		1.0		0.8	0.8
5. Office Supplies and Consumables	1.1	0.5	1.5		0.1	0.1	1.1		1.1		0.4	0.4
Subtotal	**2.2**	**29.5**	**31.7**		**7.4**	**7.4**	**2.2**		**2.2**		**22.0**	**22.0**
BASE COSTS	**20.9**	**94.0**	**114.8**		**16.2**	**16.2**	**20.9**	**55.7**	**76.5**		**22.0**	**22.0**
Physical Contingencies	1.2	6.2	7.4		1.1	1.2	1.2	3.7	1.2		1.4	4.9
TOTAL PROJECT COST	**22.0**	**100.1**	**122.2**		**17.3**	**17.5**	**22.0**	**59.4**	**77.7**		**23.5**	**27.0**
PERCENTAGE	18.0	82.0	100.0		17.3	14.3	100.0	59.3	63.6		23.4	22.1

Table 3 - Phasing of Programme Costs, Million Taka

Programme Components	PY Year 1 - 5 FY 1993/97	6 - 10 1998/02	11 - 15 2003/07	16 - 20 2008/12	Total Costs Local	Foreign	Total
A. PHYSICAL INFRASTRUCTURE							
1. Land Acquisition	15.0	50.0	50.0	50.0	165.0		165.0
2. Detail Engineering and Supervision	36.0	11.8	3.9	10.1	61.8		61.8
3. Civil Works	599.8	197.1	64.8	168.0	926.7	103.0	1,029.7
Subtotal	650.8	258.9	118.7	228.1	1,153.5	103.0	1,256.5
B. FURNITURE, EQUIPMENT AND VEHICLES							
1. Furniture	19.7	9.7	4.0	3.0	36.3		36.3
2. Equipments	195.3	12.0	7.0	40.1	50.9	203.6	254.4
3. Vehicles	58.2	16.2		43.2	23.5	94.1	117.6
Subtotal	273.2	37.9	11.0	86.3	110.7	297.6	408.3
C. HUMAN RESOURCES DEVELOPMENT							
1. Overseas Training	12.0	6.0			1.8	16.2	18.0
2. Short Courses (Overseas)	18.0	18.0	18.0	18.0	7.2	64.8	72.0
3. Training of Trainers	1.0	1.0	1.0		3.0		3.0
4. Training of Local Government Officials	0.5	0.5	0.5	0.5	2.0		2.0
5. Training of Villagers	120.0	160.0	200.0	240.0	720.0		720.0
6. Workshop and Seminars	7.5	4.5	3.0	1.5	16.5		16.5
Subtotal	159.0	190.0	222.5	260.0	750.5	81.0	831.5
D. RESEARCH, DEVELOPMENT AND STUDIES							
1. Inventory	2.4				2.4		2.4
2. Surveys	90.0				90.0		90.0
3. Research and Development Studies	16.0	16.0	8.0	8.0	48.0		48.0
4. Monitoring and Evaluation	25.0	25.0	25.0	25.0	100.0		100.0
Subtotal	133.4	41.0	33.0	33.0	240.4		240.4
E. CONSULTING SERVICES							
1. International	180.9	90.4			27.1	244.2	271.3
2. Local	155.6	70.0			225.6		225.6
Subtotal	336.5	160.5			252.8	244.2	496.9
F. RECURRENT COSTS							
1. Existing Staff Salaries	55.1	63.3	72.7	83.7	274.8		274.8
2. Incremental Staff Salaries	97.8	195.7	234.8	270.0	798.3		798.3
3. Operation and Maintenance of Facilities	5.0	5.0	5.0	5.0	16.0	4.0	20.0
4. Vehicle/ Equipment Operation/ Maintenance	20.0	20.0	20.0	20.0	40.0	40.0	80.0
5. Office Supplies and Consumables	15.0	15.0	15.0	15.0	18.0	42.0	60.0
Subtotal	192.9	299.0	347.5	393.7	1,147.1	86.0	1,233.1
BASE COSTS	1,745.7	987.3	732.6	1,001.1	3,654.9	811.8	4,466.7
Physical Contingencies	119.8	62.3	42.6	61.5	240.4	45.7	286.2
TOTAL PROJECT COST	1,865.5	1,049.6	775.2	1,062.6	3,895.3	857.5	4,752.9

Table 4 - Cost Estimates - Civil Works, Furniture, Equipments and Vehicles

Items	Unit	Unit Cost (Taka '000)	Number of Units						Total Costs (Million Taka)							
			Year 1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	Total	Year 1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	Total	FEC	T and D
A. PHYSICAL FACILITIES																
1. Land Acquisition	Ha	5,000.0	3	10	10	10		33	15	50	50	50		165		
2. Detail Engineering and Supervision 1_/	Percent	6.0							36	11.8	3.9	10.1		61.8		
Subtotal									**51.0**	**61.8**	**53.9**	**60.1**		**226.8**		
3. Civil Works																
- Department	m^2	10.1	1,000					1,000	10.1					10.1	1.0	1.0
- Regional Offices	m^2	8.6	3,000					3,000	25.8					25.8	2.6	2.6
- Existing National Parks(Protected Areas)	m^2	5.4	10,000					10,000	54.0					54.0	5.4	5.4
- New Protected Areas	m^2	5.4	60,000	20,000				80,000	324.0	108.0				432.0	43.2	43.2
- Field Rest House	m^2	5.4	4,700					4,700	25.4					25.4	2.5	2.5
- Herbarium and Botanical Gardens	m^2	5.4	1,600					1,600	8.6					8.6	0.9	0.9
- Regional Nature Conservation Center	m^2	5.4	1,500	4,500				6,000	8.1	24.3				32.4	3.2	3.2
- National and Regional Zoo	m^2	5.4	10,700	12,000	12,000	12,000		46,700	57.8	64.8	64.8	64.8		252.2	25.2	25.2
- Natural History Museum	m^2	8.6	10,000			12,000		22,000	86.0			103.2		189.2	18.9	18.9
Subtotal								175,000.0	**599.8**	**197.1**	**64.8**	**168.0**		**1,029.7**	**103.0**	**103.0**
B. FURNITURE																
- Department of Natural Resource Conservation	Lumpsum	500.0	1		1			2	0.5		0.5			1.0		
- Regional Offices	Lumpsum	200.0	6		6			12	1.2		1.2			2.4		
- Existing National Parks(Protected Areas)	Lumpsum	5,000.0	1					1	5.0					5.0		
- New Protected Areas	Lumpsum	1,000.0	5	5				10	5.0	5.0				10.0		
- Field Rest House	Lumpsum	50.0	30	12		30		72	1.5	0.6		1.5		3.6		
- Herbarium	Lumpsum	300.0	10					10	3.0					3.0		
- Regional Nature Conservation Center	Lumpsum	150.0	13	17	5			35	2.0	2.6	0.8			5.3		
- National Zoo	Lumpsum	1,500.0	1	1	1	1		4	1.5	1.5	1.5	1.5		6.0		
- Natural History Museum	Lumpsum	1,500.0	1					1	1.5					1.5		
Subtotal									**19.7**	**9.7**	**4.0**	**3.0**		**36.3**		
C. EQUIPMENTS																
- Department of Natural Resource Conservation	Lumpsum	10,000.0	1			1		2	10.0			10.0		20.0	16.0	4.0
- Department of Environment	Lumpsum	10,000.0	1			1		2	10.0			10.0		20.0	16.0	4.0
- Forest Department	Lumpsum	2,000.0	1			1		2	2.0			2.0		4.0	3.2	0.8
- Regional Offices	Lumpsum	500.0	1			1		2	0.5			0.5		1.0	0.8	0.2
- Existing National Parks(Protected Areas)	Lumpsum	5,000.0	1			1		2	5.0			5.0		10.0	8.0	2.0
- New Protected Areas	Lumpsum	7,000.0	1			1		2	7.0			7.0		14.0	11.2	2.8
- Field Rest House	Lumpsum	20.0	30	12		30		72	0.6	0.2		0.6		1.4	1.2	0.3
- Herbarium	Lumpsum	14,500.0	10					10	145.0					145.0	116.0	29.0
- Regional Nature Conservation Center	Lumpsum	400.0	13	17	5			35	5.2	6.8	2.0			14.0	11.2	2.8
- National Zoo	Lumpsum	5,000.0	1	1	1	1		4	5.0	5.0	5.0	5.0		20.0	16.0	4.0
- Natural History Museum	Lumpsum	5,000.0	1					1	5.0					5.0	4.0	1.0
Subtotal									**195.3**	**12.0**	**7.0**	**40.1**		**254.4**	**203.6**	**50.9**
D. VEHICLES																
- 4 WHD Jeep	No.	1,500.0	18	10		18		46	27.0	15.0		27.0		69.0	55.2	13.8
- Motor Cycle	No.	60.0	30	20		30		80	1.8	1.2		1.8		4.8	3.8	1.0
- Speed Boat	No.	1,200.0	12			12		24	14.4			14.4		28.8	23.0	5.8
- Coastal Research Vessel	No.	15,000.0	1					1	15.0					15.0	12.0	3.0
- River Patrol Boat	No.	1,000.0	6			6		12	6.0			6.0		12.0	9.6	2.4
- Amphibious Aircraft	No.	2,000.0	2					2	4.0					4.0	3.2	0.8
Subtotal									**58.2**	**16.2**		**43.2**		**117.6**	**94.1**	**23.5**

Table 5 - Cost Estimates - Human Resource Development, Research Studies, Monitoring and Operation/Maintenance

Items	Unit	Unit Cost (Taka '000)	Number of Units						Total Costs (Million Taka)							
			Year 1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	Total	Year 1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	Total	FEC	T and D
A. TRAINING AND SEMINAR																
1. Overseas Training	No	1,200.0	10	5				15	12.0	6.0				18.0	16.2	
2. Short Courses (Overseas)	No	450.0	40	40	40	40		160	18.0	18.0	18.0	18.0		72.0	64.8	
3. Training of Trainers	No	20.0	50	50	50			150	1.0	1.0	1.0			3.0		
4. Training of Local Government Officials	No	10.0	50	50	50	50		200	0.5	0.5	0.5	0.5		2.0		
5. Training of Villagers	No	2.0	60,000	80,000	100,000	120,000		360,000	120.0	160.0	200.0	240.0		720.0		
6. Workshop and Seminars	No	150.0	50	30	20	10		110	7.5	4.5	3.0	1.5		16.5		
Subtotal									**159.0**	**190.0**	**222.5**	**260.0**		**831.5**	**81.0**	
B. RESEARCH, DEVELOPMENT AND STUDIES																
1. Inventory	Sum	400.0	6					6	2.4					2.4		
2. Surveys	Sum	30,000.0	3					3	90.0					90.0		
3. Research and Development Studies	Sum	800.0	20	20	10	10		60	16.0	16.0	8.0	8.0		48.0		
4. Monitoring and Evaluation	Sum	500.0	50	50	50	50		200	25.0	25.0	25.0	25.0		100.0		
Subtotal									**133.4**	**41.0**	**33.0**	**33.0**		**240.4**		
C. COMMUNITY BASED RESOURCE MANAGEMENT	Sum	1,167,000.0	0.4	0.2	0.2	0.2		1	466.8	233.4	233.4	233.4		1,167.0		
D. CONSULTING SERVICES																
1. International	mm	603.0	300	150				450	180.9	90.4				271.3	244.2	
2. Local	mm	155.6	1,000	450				1,450	155.6	70.0				225.6		
Subtotal									**336.5**	**160.5**				**496.9**	**244.2**	
E. RECURRENT COSTS														12.8		
1. Existing Staff Salaries	Sum	55,075.0	1	1.2	1.3	1.5		5	55.1	63.3	72.7	83.7		274.8		
2. Incremental Staff Salaries	Sum	97,825.2	1	2	2.4	2.8		8.2	97.8	195.7	234.8	270.0		798.3		
3. Operation and Maintenance of Facilities	Sum	5,000.0	1	1	1	1		4	5.0	5.0	5.0	5.0		20.0	4.0	2.0
4. Vehicle/ Equipment Operation/ Maintenance	Sum	20,000.0	1	1	1	1		4	20.0	20.0	20.0	20.0		80.0	40.0	8.0
5. Office Supplies and Consumables	Sum	15,000.0	1	1	1	1		4	15.0	15.0	15.0	15.0		60.0	42.0	6.0
Subtotal									**192.9**	**299.0**	**347.5**	**393.7**		**1,233.1**	**86.0**	**16.0**

APPENDIX 3
FORESTRY SECTOR RECOMMENDATIONS FROM NATIONAL CONSERVATION STRATEGY

PROJECT 372001/30
FORESTRY MASTER PLAN,
BANGLADESH (TA NO.1355-BAN)

ASIAN DEVELOPMENT BANK
MANILA PHILIPPINES
DATE: JANUARY 1993

ENVIRONMENT AND LANDUSE

APPENDIX 3
FORESTRY SECTOR RECOMMENDATIONS FROM NATIONAL CONSERVATION STRATEGY

Issue	Action	Implementing Agency
1. Policy	A committee headed by Secretary, Ministry of Environment and Forest with Chief Conservator of forests as Member secretary, the Director General, Department of Environment as member and representative from Planning Commission, the Ministries of Land, Agriculture, Livestock and Fishery, Local Government and Rural Development and experts from the departments of Botany and Zoology in Dhaka, Rajshahi and Chittagong Universities, major environmental NGOs and private sector to formulate draft forest policy to be adopted by Government. Assistance of professionals through subcommittees.	MOEF
2. Legislation	Complete Forest Settlement operation by appointing full time settlement officers, in districts concerned with supporting staff.	MOEF in collaboration with MOL, M.O. Establishment Cabinet Division and FD
3. Institution	A committee composed of representatives from Establishment Division, M.O. Environment and Forest, M. O. finance to review past proposals on staffing pattern of FD to formulate proposals for short and medium term implementation	MOEF in collaboration with M.O. Establishment and Finance Division
4. Increasing tree wealth in rural area	a. Implementation of Upazila Banayan Project Proposal by allocation of funds for achieving physical targets as per project proposals.	MOEF & FD
	b. Greater role for NGOs through allocation of WFP and other resources, and possibility of collaboration with FD for planting on forest Department Land and USF Land	MOEF & FD in collaboration with M.O. Relief, WFP and FD
5. Plantation of blanks in forests	Identify blanks in natural forests and older plantations including Sundarban forest and coastal plantation and replant under a crash program	MOEF and FD
6. Brick burning	a. Use of wood biomass in brick fields to be stopped by strict enforcement of the law.	M.O. Home Affairs in collaboration with MOEF, LG Division, MOW, R&RT Division, PD DCE and Local Government bodies
	b. Timely supply of coal to brick fields	M.O. Commerce
	c. Giving gas connections to brick fields	M.O. Energy and Minerals
7. Preservation treatment of bamboo, thatch grass and golpatta	Facilities to be established in large number of places in the country for preservative treatment by Government and encouragement of private investment on this item, if necessary, by giving subsidy at the initial stage	MOEF in collaboration with BFRI and BFIDC
8. Extraction of left overs in BFIDC working areas	Private parties to be allowed to extract left over timber and firewood at concessional rate of royalty if necessary	MOEF in collaboration with BFIDC and FD

Issue	Action	Implementing Agency
9. Transfer of forest Land for non-forest use	a. Transfer to be strictly prohibited. In unavoidable cases, order of the need of the State to be required.	MOEF
	b. A task force to be set to review transfer after 1972 and recover lands which are not absolutely necessary for the purpose for which they were transferred.	MOL with initiation from MOEF and FD.
	c. Allotment of all khas land in all hill areas, Barind, Madhupur Tracts for agroforestry or Forestry through private sector and NGOs	MOL in collaboration with MOEF, MOA, MDFL, RDC Division and FD
10. Shifting cultivation in Hill Tracts districts	Rehabilitate shifting cultivator families in settled villages under a programme which will incorporate gradual increase of tree and bamboo resources in their surrounding area.	MOSA (with initiation from MO LGRDC, MOEF, MOA, HTDB FD and Zila Parishads of Khagrachari, Rangamati and Bandarban)
11. Plantations		
a. Review	Review clear felling method in order to reduce damage to biodiversity.	MOEF in collaboration with BFRI, FD and DOE
b. Technique	Experimental plantations to be commenced without burning debris.	MOEF, BFRI and FD
c. Natural Regeneration strips	Plots with natural vegetation to be left at regular intervals within plantations.	MOEF and FD
d. Choice of species	Large scale plantation of exotics to be avoided and several indigenous species are to be used in plantation according to suitability of sites	MOEF and FD
12. Ban on exploitation in forest	a. Environmentally sensitive and biologically rich areas to be identified and protected for preservation. Management plans to be prepared for protected areas	MOEF (in collaboration with, FD and DOE)
	b. Replanting of failed plantations with local species to be given high priority under management plans	MOEF and FD
	c. Thinning to be done in all older plantations to meet market demand and improving health of plantations.	MOEF and FD
13. Sundarbans	a. Plan to formulated and implement for integrated development of all development including fishery, other aquatic resources and honey	MOEF, FD and DOE
	b. Enrichment planting of blank areas within the forest	MOEF and FD
14. EIA	Environmental impact Assessment (EIA) of all ongoing and proposed projects to be carried out.	MOEF (in collaboration with FD, DOE and Planning Commission)

APPENDIX 4
ENVIRONMENT POLICY AND MANAGEMENT

PROJECT 372001/30
FORESTRY MASTER PLAN,
BANGLADESH (TA NO.1355-BAN)

ASIAN DEVELOPMENT BANK
MANILA PHILIPPINES
DATE: JANUARY 1993

ENVIRONMENT AND LANDUSE

APPENDIX 4
ENVIRONMENT POLICY AND MANAGEMENT

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1. DRAFT ENVIRONMENT POLICY 1992

The existence and progress of life on earth depends on nature and environment. Gradual degradation of the natural environment in recent times has been identified as a serious threat to all species and progress of human civilization.

The Government of Bangladesh in view of the various adverse impacts on the environment, has attached special importance to the conservation and improvement of the environment. Various environmental problems are prevailing in the country, including natural calamities like recurrent floods, drought, cyclone, tidal surges etc., primary signs of decertification in the northern districts, increased salinity in the rivers, land erosion, fast depletion of forest resources, weather and climatic instability etc. The Ministry of Environment and Forest and the Department of Environment have been established to coordinate and supervise the activities related to environmental conservation and development. Moreover, the major problems of environmental pollution and degradation have been specifically identified.

Since, various socio-economic malaises like population explosion, poverty, illiteracy, inadequate health facilities, a lack of public awareness, etc have emerged as a serious hindrance to preservation of the environment, it has become imperative to solve these simultaneously and in coordination with the programme of activities related to environmental development. Through a well defined national policy, it is possible to solve the relevant problems and implement the government's commitments.

In the context of environment, the Government recognises that:

a. Since, environmental pollution and degradation beyond the national jurisdiction have profound and direct impacts on the nature, environment and resource base of Bangladesh, it necessitates alertness and a coordinated action programme.

b. The geographical location and setting of Bangladesh, its environmental degradation and gradual deterioration, along with the lack of appropriate technology and sustainable management techniques for the exploitation of resources have warranted adoption of an environment policy indicating priority areas for action.

c. People's participation is essential for sustainable utilization of the national resources towards achieving of environmental conservation and improvement. It can be ensured through the creation of widespread public awareness.

d. The issue of immediate and long-term solution of problems related to natural disasters must be and integral part of environmental protection and improvement, resource management, and conservation.

e. It is possible and necessary to ensure the development of the environment and the sustainable use of the resources of the country and also help the cause of global environment through adoption of appropriate measures at local and national levels through regional and international cooperation.

Objectives

The objectives of the Environmental Policy are as follows:

a. Ensuring the country's overall development and maintenance of the ecological balance through environmental conservation and improvement.

b. Protection of the country against natural disasters.

c. Identification and regulation of all types of activities related to pollution and degradation of the environment.

d. Ensuring environmentally sound development in all sectors.

e. Ensuring sustainable, longterm environmentally friendly use of natural resources.

f. Active association with all environment related international initiatives to the extent possible.

Policies

Environmental activities concern all regions and development sectors of the country. To achieve the overall objectives of the environment policy, the relevant guidelines for 15 different sectors are as follows:

1. Agriculture

Ensure that all steps taken and technologies adopted for agricultural development and attainment of self-sufficiency in food are environmentally sound.

Sustain the bases of all agricultural resources in the process of development and ensure their environmental compatibility and long term use.

Regulate the use of those agro-chemicals, artificial elements and inputs which diminish the natural fertility and organic properties of the soil and also cause harmful effects on man and other animals and arrange for adoption of protective measures for agricultural labourers. At the same time encourage the application of different natural fertilizers and insecticides.

Help environmentally congenial development in agriculture through proper changes in production relations targeted to help the cause of conservation and improvement of the environment and sustainable use of resources.

Increase use of environment friendly fibres like jute and jute products.

2. **Industry**

Undertake phasewise corrective measures in industries in relation to pollution control.

Conduct Environmental Impact Assessment (EIA) for all new government and non-government industries.

Ban setting up of industries producing goods which cause environmental pollution, close down such existing industries in phase and discourage use gross produced by such industries through of developing/introducing environment friendly alternatives to those products.

Assist in the development of environmentally sound and appropriate technology, encourage related research and extension activities and coordinate these activities with the best use of labour and providing justifiable price.

Ensure sustainable use and prevent wastage of industrial raw materials.

3. **Health & Sanitation**

Prevent activities harmful to public health in all spheres and development activities of the country.

Integrate environmental thinking into National Health Policy.

Include environment-related curricula in the health education system.

Develop healthy environment in the rural and urban areas.

Ensure healthy work places for labourers.

4. **Energy and Fuel**

Reduce and discourage the use of environment polluting fuels and encourage the use of environmentally sound and less harmful fuels and energy sources.

Reduce the use of fuel wood, agricultural residue etc. and increase the use of alternative fuel and energy.

Adopt appropriate precautionary measures regarding negative environmental impacts of the use of atomic energy and preventive measures against all kinds of atomic and radiation pollution.

Invent, use and expand improved technology for saving energy and fuel.

Conserve fuel reserves and renewable sources of fuel and energy.

Conduct Environmental Impact Assessment before undertaking projects related to extraction of fuel and mineral resources.

5. **Water Development, Flood Control and Irrigation**

Ensure environmentally sound utilisation of all water resources.

Ensure that water resource development and irrigation systems do not cause negative environmental impacts.

Ensure that all measures for flood control, including construction of embankments, dredging of rivers, digging of canals etc. be environmentally sound at the local, zonal and national levels.

Remove adverse environmental impacts of already undertaken measures in flood control and water resources management.

Keep rivers, canals, ponds, lakes, haors, boars and all other water bodies and water resources free from pollution. Ensure sustainable, long term and environmentally appropriate scientific exploitation and management of the underground and surface water resources.

Conduct Environmental Impact Assessment before undertaking projects related to water resources development and management.

6. **Land**

Prepare a balanced and environment compatible National land use policy and plan.

Prevent land erosion, preserve and increase soil fertility, and expand activities related to conservation and management of newly formed land.

Encourage land use systems commensurate with the different eco-systems in the country.

Prevent land from impacts of soil salinity and alkalinity.

7. **Forest, Wildlife and Bio-diversity**

Conserve, expand and develop forests and trees to maintain the ecological balance and meet the socio economic needs and realities in the country.

Include tree plantation programmes in all relevant development efforts.

Put a halt to the shrinkage and depletion of forest land and forest resources.

Develop and encourage the use of substitutes for forest products.

Conserve wildlife and bio-diversity, strengthen related research and help dissemination and exchange of knowledge in this field.

Conserve and develop wetlands and protect migratory birds.

8. **Fisheries and Livestock**

Ensure appropriate environment for the development and conservation of Fisheries and Livestock.

Prevent activities which diminish the wetlands/ natural habitats of fish and encourage promotional measures in this regard.

Ensure that development activities in fisheries and livestock do not create any negative impacts on the mangrove forest and other ecosystems.

Re evaluate the water resources, flood control and irrigation projects responsible for the depletion of fisheries resources and adopt measures to augment environmental conditions for alternative pisciculture systems.

9. **Food**

Ensure hygienically and environmentally sound methods for production, preservation, processing and distribution of food.

Dispose of rotten food stuff in an environmentally acceptable method.

Prohibit import of food item likely to create adverse effect on the environment and public health.

10. **Coastal and Marine Environment**

Ensure environmentally sound conservation and development of coastal and marine eco-systems and resources in the country.

Prevent all internal and external polluting activities in the coastal and marine areas.

Strengthen necessary research to preserve and develop coastal and marine environment and resources.

Limit coastal and marine fish catch within tolerable regeneration/ respawning limits.

11. **Transport and Communication**

Ensure that the road, rail aviation and inland water transport system do not pollute the environment or degrade the resources and conduct Environmental Impact Assessment before undertaking such project.

Ensure that all the vehicles and people using roads, rails, air and inland waterways do not get involved in activities leading to environmental pollution and to take up steps to protect health of the workers engaged in the vehicles.

Control activities of inland ports and dockyards leading to water pollution and local environment pollution.

12. **Housing and Urbanisation**

Integrate environmental considerations into all housing and urban planning and research.

Expand environmentally sound facilities/ amenities to all the existing urban and rural housing areas in phase.

Control housing and urbanization having adverse impacts on the local and overall environment.

Attach greater importance to water bodies for the enhancement of environmental aesthetics of cities.

13. **Population**

Ensure integrated, well planned and environmentally sound utilization of manpower.

Integrate environmental preservation and improvement ideas into the population policies and action programmes of the Government.

Ensure the role of women in all development efforts.

Encourage utilisation of unemployed manpower in all development activities.

14. **Education and Public Awareness**

Adopt measures for illiteracy eradication and rapid increase of literacy rate to integrate people in education propagation and overall development of the country.

Create widespread mass awareness regarding environmental preservation and improvement, sustainable, long term and environmentally sound utilization of all national resources.

Ensure inclusion and dissemination of environmental knowledge and information into formal and informal systems of education and media.

Induce spontaneous and direct participation of people in all environment related works.

Include subjects on environment in all training programmes for government and non-government officials and employees and for workers engaged in industries and commercial enterprises.

15. **Science, Technology and Research**

Include environment pollution supervision and control measures into National Science and Technology policy.

Encourage necessary research and evolving of technology to ensure long term, sustainable and environmentally sound utilization of all national resources in preservation and improvement of environment.

Integrate environmental considerations into areas identified as priorities for research and development within the framework of National Science and Technology policy (1986), as well as all research and development organizations.

Legal Framework

1. Amend and update all laws and regulations related to protection of environment, conservation of natural resources, and control of environment pollution and degradation.

2. Enact new legislation in all necessary sectors to regulate activities related to environmental pollution and degeneration.

3. Ensure compliance with all clauses of relevant laws/ regulations and create widespread mass awareness in this regard.

4. Ratify all environment related international laws/ conventions/ protocols which Bangladesh considers rectifiable and amend/ modify existing laws/ regulations in line with the rectified laws/ conventions/ protocols.

Institutional Arrangements

1. The Ministry of Environment and Forest will coordinate the implementation of this policy.

2. A National Environment Committee with the Head of Government as the Chairperson will be constituted to give overall direction for implementation of the environment policy.

3. The Ministry of Environment and Forest will take timely steps for appropriate amendment and adjustment of this policy in the state of environment and socio-economic and other needs of the country.

4. The Department of Environment will undertake the review and approved of all EIAs.
(Translated from original Bengali version of 23/ 03/ 1992)

2. SELECTED LAND USE AND OTHER SECTORAL RECOMMENDATIONS FROM DRAFT ENVIRONMENT MANAGEMENT PLAN

Land

1. A comprehensive National Landuse plan should be prepared by 1993 reflecting environmental concerns and comparative priorities of agriculture, forest, industry, urbanisation, housing and other sectoral uses to ensure best use of available land.

2. Integrated land development schemes should be immediately undertaken to prevent expansion of the process of desertification in the northern areas of the country.

3. Appropriate area specific steps should be undertaken to stop land erosion and depletion, preservation and enrichment of soil fertility and land reclamation, protection and development in the coastal areas.

4. Destruction of natural topographies including indiscriminate levelling, digging and quarrying of hills and hillocks should be prohibited. Priority should be accorded to the environment oriented management of watershed areas.

5. Appropriate legislation should be enacted to ensure planned land use in the country.

Forest, Wildlife and Biodiversity

1. Emergency steps should be taken to bring all Government forest lands under tree cover by 2000.

2. Top priority should be given to social and village forestry programmes for enrichment of homestead forests.

3. Agro-forestry activities should be encouraged and expanded to supplement multiple-land use, economic development and environmental upgradation.

4. The forest-based industries should take direct and indirect steps to procure and alternate raw materials by 1995.

5. The Government decision to include afforestation component in all relevant development schemes should be strictly implemented.

6. Village and Thana level participation of women should be ensured in all afforestation programmes.

7. Wildlife protection activities should be accorded priority and development schemes and research should be undertaken to help preservation of the endangered species.

8. Ban of hunting and export of wildlife and wildlife products should continue. Creation of wildlife sanctuaries and habitats should accorded priority.

9. Development activities, research, and exchange of knowledge and expertise should be expedited to protect and expand biodiversity. Necessary information and research centres should be set up for this purpose. A study should be conducted to determine the state of the biodiversity and wildlife in the country immediately.

Coastal and Marine Environment

1. To determine the existing state of the marine and coastal environment, eco-systems and resources a position paper should be prepared by 1991. The Planning Commission should set up a separate unit to accelerate the process of protection and development of the coastal and marine environment, eco-systems and resource base.

2. A special cell should be constituted in the Ministry of Environment and Forest to co-ordinate and supervise all activities related to the protection and development of the Coastal and Marine environment.

3. The Bangladesh Navy should guard against cases of pollution of the territorial water of the country. The Department of Shipping should monitor such activities.

4. Facilities for transportation of wastes from ships and loading and disposal of waste oil and other related wastes should be developed in Chittagong and Mongla Ports on an emergency basis.

5. The Ministry of Shipping should create a special cell by 1991 to determine the composition, nature and environmental impact of wastes before allowing their dumping into the sea.

6. A "Coast Guard" should be raised in the Ministry of Shipping to help inter-alia environment oriented management of the Coastal and Marine areas and resources.

Institutional Arrangements

1. All ministries, departments and public agencies should take necessary steps for the implementation of the respective proposals in the action plan related to them.

2. Active participation by Non-government Organisations (NGOs) in all environment related activities should be encouraged and enlisted.

3. The Ministry of Environment and Forest would co-ordinate the implementation of the environmental action plan.

4. A National Environment Council would be constituted under the Chairmanship of the Hon'ble President to guide the implementation of the action plan. Ministers of all relevant ministries would be members of this council. Secretary, Ministry of Environment and Forest would be the member secretary of this council. The council would meet at least once, a year.

5. In view of the compulsory requirement to carry on environmental impact assessment (EIA) for all development projects, the technical capability and manpower strength of the Ministry of Environment and Forest and the Department of Environment (DOE) should be expanded.

6. A separate "Environment and Forest" wing should be constituted in the Planning Commission.

7. A Committee chaired by the Minister, Environment and Forest would quarterly evaluate the implementation of the Policy and the Action Plan. Secretaries of all relevant ministries would be members of this committee.

8. The Ministry of Environment and Forest would prepare, publish and distribute a status paper regarding the "State of the Environment" every five years. The first such report should come up before 31 December 1991.

9. The Ministry of Environment and Forest would take necessary steps to revise and reformulate the environment Policy and the Action Plan as and when needed in future.

APPENDIX 5
ADOPTION OF AGREEMENTS ON FOREST DEVELOPMENT

ENVIRONMENT AND LANDUSE

APPENDIX 5
ADOPTION OF AGREEMENTS ON ENVIRONMENT AND DEVELOPMENT

Non-legally binding authoritative statement of principles for a global consensus on the management, conservation and sustainable development of all types of forests

PREAMBLE

a. The subject of forests is related to the entire range of environmental and development issues and opportunities, including the right to socio-economic development on a sustainable basis.

b. The guiding objective of these principles is to contribute to the management, conservation and sustainable development of forests and to provide for their multiple and complementary functions and uses.

c. Forestry issues and opportunities should be examined in a holistic and balanced manner within the overall context of environment and development, taking into consideration the multiple functions and uses of forests, including traditional uses, and the likely economic and social stress when these uses are constrained or restricted, as well as the potential for development that sustainable forest management can offer.

d. These principles reflect a first global consensus on forests. In committing themselves to the prompt implementation of these principles, countries also decide to keep them under assessment for their adequacy with regard to further international cooperation on forest issues.

e. These principles should apply to all types of forests, both natural and planted, in all geographic regions and climatic zones, including austral, boreal, subtemperate, temperate, subtropical and tropical.

f. All types of forests embody complex and unique ecological processes which are the basis for their present and potential capacity to provide resources to satisfy human needs as well as environmental values, and as such their sound management and conservation is of concern to the Governments of the countries to which they belong and are of the value to local communities and to the environment as a whole.

g. Forests are essential to economic development and the maintenance of all forms of life.

h. Recognizing that the responsibility for forest management, conservation and sustainable development is in many states allocated among federal/ national, state/ provincial and local levels of government, each state, in accordance with its constitution and/or national legislation, should pursue these principles at the appropriate level of government.

PRINCIPLES/ ELEMENTS

1. (a) "States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies and have the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states or of areas beyond the limits of national jurisdiction".

   (b) The agreed full incremental cost of achieving benefits associated with forest conservation and sustainable development requires increased international cooperation and should be equitably shared by the international community.

2. (a) States have the sovereign and inalienable right to utilize, manage and develop their forests in accordance with their development needs and level of socio-economic development and on the basis of national policies consistent with sustainable development and legislation, including the conversion of such areas for other uses within the overall socio-economic development plan and based on rational land-use policies.

   (b) Forest resources and forest lands should be sustainably managed to meet the social, economic, ecological, cultural and spiritual human needs of present and future generations. These needs are for forest products and services, such as wood and wood products, water, food, fodder, medicine, fuel, shelter, employment, recreation, habitats for wildlife, landscape diversity, carbon sinks and reservoirs, and for other forest products. Appropriate measures should be taken to protect forests against harmful effects of pollution, including air-borne pollution, fires, pests and diseases in order to maintain their full multiple value.

   (c) The provision of timely, reliable and accurate information on forests and forest ecosystems is essential for public understanding and informed decision-making and should be ensured.

(d) Government should promote and provide opportunities for the participation of interested parties, including local communities and indigenous people, industries, labour, non-governmental organizations and individuals, forest dwellers and women, in the development, implementation and planning of national forest policies.

3. (a) National policies and strategies should provide a framework for increased efforts, including the development and strengthening of institutions and programmes for the management, conservation and sustainable development of forests and forest lands.

(b) International institutional arrangements building on those organizations and mechanisms already in existence, as appropriate, should facilitate international cooperation in the field of forests.

(c) All aspects of environmental protection and social and economic development as they relate to forests and forest lands should be integrated and comprehensive.

4. The vital role of all types of forests in maintaining the ecological processes and balance at the local, national, regional and global levels through, inter alia, their role in protecting fragile ecosystems, watersheds and freshwater resources and as rich storehouses of biodiversity and biological resources and sources of genetic material for biotechnology products, as well as photosynthesis, should be recognized.

5. (a) National forest policies should recognize and duly support the identity, culture and the rights of indigenous people, their communities and other communities and forest dwellers. Appropriate conditions should be promoted for these groups to enable them to have an economic stake in forest use, perform economic activities, and achieve and maintain cultural identity and social organization, as well as adequate levels of livelihood and well-being, through, inter alia, those land tenure arrangements which serve as incentives for the sustainable management of forests.

(b) The full participation of women in all aspects of the management, conservation and sustainable development of forests should be actively promoted.

6. (a) All types of forests play in important role in meeting energy requirements through the provision of a renewable source of bio-energy, particularly in developing countries, and the demands for fuelwood for household and industrial needs should be met through sustainable forest management, afforestation and reforestation. To this end, the potential contribution of plantations of both indigenous and introduced species for the provision of both fuel and industrial wood should be recognized.

(b) National policies and programmes should take into account the relationship, where it exists, between the conservation, management and sustainable development of forests and all aspects related to the production, consumption, recycling and/or final disposal of forest products.

(c) Decisions taken on the management, conservation and sustainable development of forest resources should benefit, to the extent practicable, from a comprehensive assessment of economic and non-economic values of forest goods and services and of the environmental costs and benefits. The development and improvement of methodologies for such evaluations should be promoted.

(d) The role of planted forests and permanent agricultural crops as sustainable and environmentally sound sources of renewable energy and industrial raw material should be recognized, enhanced and promoted. Their contribution to the maintenance of ecological processes, to offsetting pressure on primary/old-growth forest and to providing regional employment and development with the adequate involvement of local inhabitants should be recognized and enhanced.

(e) Natural forests also constitute a source of goods and services, and their conservation, sustainable management and use should be promoted.

7. (a) Efforts should be made to promote a supportive international economic climate conducive to sustained and environmentally sound development of forests in all countries, which include, inter alia, the promotion of sustainable patterns of production and consumption, the eradication of poverty and the promotion of food security.

(b) Specific financial resources should be provided to developing countries with significant forest areas which establish programmes for the conservation of forests including protected natural forest areas. These resources should be directed notably to economic sectors which would stimulate economic and social substitution activities.

8. (a) Efforts should be undertaken towards the greening of the world. All countries, notably developed countries, should take positive and transparent action towards reforestation, afforestation and forest conservation, as appropriate.

(b) Efforts to maintain and increase forest cover and forest productivity should be undertaken in ecologically, economically and socially sound ways through the rehabilitation, reforestation and re-establishment of trees and forests on unproductive, degraded and deforested lands, as well as through the management of existing forest resources.

(c) The implementation of national policies and programme aimed at forest management, conservation and sustainable development, particularly in developing countries, should be supported by international financial and technical cooperation, including through the private sector, where appropriate.

(d) Sustainable forest management and use should be carried out in accordance with national development policies and priorities and on the basis of environmentally sound national guidelines. In the formulation of such guidelines, account should be taken, as appropriate and if applicable, of relevant internationally agreed methodologies and criteria.

(e) Forest management should be integrated with management of adjacent areas so as to maintain ecological balance and sustainable productivity.

(f) National policies and/or legislation aimed at management, conservation and sustainable development of forests should include the protection of ecologically viable representative or unique examples of forests, including primary/old-growth forests, cultural, spiritual, historical, religious and other unique and valued forests of national importance.

(g) Access to biological resources, including genetic material, shall be with due regard to the sovereign rights of the countries where the forests are located and to the sharing on mutually agreed terms of technology and profits from biotechnology products that are derived from these resources.

(h) National policies should ensure that environmental impact assessments should be carried out where actions are likely to have significant adverse impacts on important forest resources, and where such actions are subject to a decision of a competent national authority.

9. (a) The efforts of developing countries to strengthen the management, conservation and sustainable development of their forest resources should be supported by the international community, taking into account the importance of redressing external indebtedness, particularly where aggravated by the net transfer of resources to developed countries, as well as the problem of achieving at least the replacement value of forests through improved market access for forest products, especially processed products. In this respect, special attention should also be given to the countries undergoing the process of transition to market economies.

(b) The problems that hinder efforts to attain the conservation and sustainable use of forest resources and that stem from the lack of alternative options available to local communities, in particular the urban poor and poor rural populations who are economically and socially dependent on forests and forest resources, should be addressed by Governments and the international community.

(c) National policy formulation with respect to all types of forests should take account of the pressures and demands imposed on forest ecosystems and resources from influencing factors outside the forest sector, and intersectoral means of dealing with these pressures and demands should be sought.

10. New and additional financial resources should be provided to developing countries to enable them to sustainably manage, conserve and develop their forest resources, including through afforestation, reforestation and combating deforestation and forest and land degradation.

11. In order to enable, in particular, developing countries to enhance their endogenous capacity and to better manage, conserve and develop their forest resources, the access to and transfer of environmentally sound technologies and corresponding know-how on favourable terms, including on concessional and preferential terms, as mutually agreed, in accordance with the relevant provisions of Agenda 21, should be promoted, facilitated and financed, as appropriate.

12. (a) Scientific research, forest inventories and assessments carried out by national institutions which take into account, where relevant, biological, physical, social and economic variables, as well as technological development and its application in the field of sustainable forest management, conservation and development, should be strengthened through effective modalities, including international cooperation. In this context, attention should also be given to research and development of sustainably harvested non-wood products.

(b) National and, where appropriate, regional and international institutional capabilities in education, training, science, technology, economics, anthropology and social aspects of forests and forest management are essential to the conservation and sustainable development of forests and should be strengthened.

(c) International exchange of information on the results of forest and forest management research and development should be enhanced and broadened, as appropriate, making full use of education and training institutions, including those in the private sector.

(d) Appropriate indigenous capacity and local knowledge regarding the conservation and sustainable development of forests should, through institutional and financial support, and in collaboration with the people in local communities concerned, be recognized, respected, recorded, developed and, as appropriate, introduced in the implementation of programmes. Benefits arising from the utilization of indigenous knowledge should therefore be equitably shared with such people.

13. (a) Trade in forest products should be based on non-discriminatory and multilaterally agreed rules and procedures consistent with international trade law and practices. In this context, open and free international trade in forest products should be facilitated.

(b) Reduction or removal of tariff barriers and impediments to the provision of better market access and better prices for higher value-added forest products and their local processing should be encouraged to enable producer countries to better conserve and manage their renewable forest resources.

(c) Incorporation of environmental costs and benefits into market forces and mechanisms, in order to achieve forest conservation and sustainable development, should be encouraged both domestically and internationally.

(d) Forest conservation and sustainable development policies should be integrated with economic, trade and other relevant policies.

(e) Fiscal, trade, industrial, transportation and other policies and practices that may lead to forest degradation should be avoided. Adequate policies, aimed at management, conservation and sustainable development of forests, including where appropriate, incentives, should be encouraged.

14. Unilateral measures, incompatible with international obligations or agreements, to restrict and/or ban international trade in timber or other forest products should be removed or avoided, in order to attain long-term sustainable forest management.

15. Pollutants, particularly air-borne pollutants, including those responsible for acidic deposition, that are harmful to the health of forest ecosystems at the local, national, regional and global levels should be controlled.

APPENDIX 6
SELECTED PRINCIPLES OF THE INTERNATIONAL CONVENTION ON BIOLOGICAL DIVERSITY

ENVIRONMENT AND LANDUSE

APPENDIX 6
SELECTED PRINCIPLES OF THE INTERNATIONAL CONVENTION ON BIOLOGICAL DIVERSITY

IDENTIFICATION AND MONITORING

1. Identify components of biological diversity important for its conservation and sustainable use having regard to the indicative list of categories as follows:

   a. Ecosystems and habitats: containing high diversity, large numbers of endemic or threatened species, or wilderness; required by migratory species; of social, economic, cultural or scientific importance; or, which are representative, unique or associated with key evolutionary or other biological processes;

   b. Species and communities which are: threatened; wild relatives of domesticated or cultivated species; of medicinal, agricultural or other economic value; or social, scientific or cultural importance; or importance for research into the conservation and sustainable use of biological diversity, such as indicator species; and

   c. Described genomes and genes of social, scientific or economic importance.

2. Monitoring through sampling and other techniques, the components of biological diversity identified pursuant to subparagraph (1) above; paying particular attention to those requiring urgent conservation measures and those which offer the greatest potential for sustainable use.

3. Identify processes and categories of activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity, and monitor their effects through sampling and other techniques.

4. Maintain and organize by any mechanism data derived from identification and monitoring activities pursuant to subparagraphs 1, 2 and 3 above.

IN-SITU CONSERVATION

1. Establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity.

2. Develop, where necessary, guidelines for the selection, establishment and management of protected areas or areas where special measures need to be taken to conserve biological diversity.

3. Regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas with a view to ensuring their conservation and sustainable use.

4. Promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings.

5. Promote environmentally sound and sustainable development in areas adjacent to protected areas with a view to furthering protection of these areas.

6. Rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, inter alia, through the development and implementation of plans or other management strategies.

7. Establish or maintain means to regulate, manage or control the risks associated with the use and release of living modified organisms resulting from biotechnology which are likely to have adverse environmental impacts that could affect the conservation and sustainable use of biological diversity taking also into account the risks to human health.

8. Prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species.

9. Endeavour to provide the conditions needed for compatibility between present uses and the conservation of biological diversity and the sustainable use of its components.

10. Subject to its national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices.

11. Develop or maintain necessary legislation and/or other regulatory provisions for the protection of threatened species and populations.

12. Where a significant adverse effect on biological diversity has been determined pursuant to Article 7, regulate or manage the relevant processes and categories of activities.

13. Cooperate in providing financial and other support for in-situ conservation outlined in subparagraphs 1 to a above, particularly to developing countries.

EX-SITU CONSERVATION

1. Adopt measures for the ex-situ conservation of components of biological diversity, preferably in the country of origin of such components.

2. Establish and maintain facilities for ex-situ conservation of and research on plants, animals and micro-organisms preferably in the country of origin of genetic resources.

3. Adopt measures for the recovery and rehabilitation of threatened species and for their reintroduction into their natural habitats under appropriate conditions.

4. Regulate and manage collection of biological resources from natural habitats for ex-situ conservation purposes so as not to threaten ecosystems and in-situ populations of species except where special temporary ex-situ measures are required under subparagraph 3 above.

5. Cooperate in providing financial and other support for ex-situ conservation outlined in subparagraphs 1 to 4 above and in the establishment and maintenance of ex-situ conservation facilities in developing countries.

SUSTAINABLE USE OF COMPONENTS

1. Integrate consideration of the conservation and sustainable use of biological resources into national decision-making.

2. Adopt measures relating to the use of biological resources to avoid or minimize impacts on biological diversity.

3. Protect and encourage customary use of biological resources in accordance with traditional cultural practices that are compatible with conservation or sustainable use requirements.

4. Support local populations to develop and implement remedial action in degraded areas where biological diversity has been reduced.

5. Encourage cooperation between its governmental authorities and its private sector in developing methods for sustainable use of biological resources.

RESEARCH AND TRAINING

1. Establish and maintain programmes for scientific and technical education and training in measures for the identification, conservation and sustainable us of biological diversity and its components and provide support for such education and training for the specific needs of developing countries.

2. Promote and encourage research which contributes to the conservation and sustainable use of biological diversity, particularly in developing countries, inter alia, in accordance with decisions of the Conference of the Parties taken in consequence of recommendation of the Subsidiary Body on Scientific, Technical and Technological Advice.

3. Promote and cooperate in the use of scientific advances in biological diversity research in developing methods for conservation and sustainable use of biological resources.

IMPACT ASSESSMENT AND MINIMIZING ADVERSE IMPACTS

1. Introduce appropriate procedures requiring environmental impact assessment of proposed projects that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimizing such effects and where appropriate, allow for public participation in such procedures.

2. Introduce appropriate arrangements to ensure that the environmental consequences of programmes and policies that are likely to have significant adverse impacts on biological diversity are duly taken into account.

3. Promote, on the basis of reciprocity, notification, exchange of information and consultation on activities under their jurisdiction or control which are likely significantly to affect adversely the biological diversity of other States or areas beyond the limits of national jurisdiction, by encouraging the conclusion of bilateral, regional or multilateral arrangements as appropriate.

4. In the case of imminent or grave danger or damage originating under its jurisdiction or control to biological diversity within the area under jurisdiction of other States or in areas beyond the limits of national jurisdiction, notify immediately the potentially affected States of such danger or damage, as well as initiate action to prevent or minimize such danger or damage.

5. Promote national arrangements for emergency responses to activities or events, whether caused naturally or otherwise, which present a grave and imminent danger to biological diversity and encourage international cooperation to supplement such national efforts and, where appropriate and agreed by the Status or regional economic integration organizations concerned, to establish joint contingency plans.

APPENDIX 7
SELECTED LIST OF ENVIRONMENTAL NGOS

ENVIRONMENT AND LANDUSE

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1. ENVIRONMENTAL NGOS

Bangladesh Centre for Advanced Studies - BCAS is an independent research organization working on resource management, environment and developmental (RMED) issues, particularly in multi-disciplinary and inter-disciplinary areas. It develops scientific methodologies to address long term planning and people's issues, maintains a library and data base, and also functions as a policy institute. Some of the issues it has examined include: (a) Urban environment and urban health; (b) Energy, including biomass and agro-forestry; (c) Entrepreneurship; (d) Global climatic change and its impacts on Bangladesh; and (e) Natural hazard management, both as scientific and policy issues and grassroots perceptions and coping strategies.

The agency has worked with local experts and local groups in the forestry sector. The main focus has been on: (i) Trees and tenure (several on-going research projects); (ii) Trees and women; (iii) Homestead forestry; (iv) Trees and conflicts; (v) National capability and training in social forestry; and (vi) Forestry policy issues.

BCAS is the coordinator and the implementing agency of the State of the Environment Report (SOER): A Citizens Report. This report is funded by a consortium of more than 20 national NGOs and attempts to address people's own perceptions and definitions of their environment, needs and priorities, as well as indigenous technology and knowledge.

BCAS raises RMED issues of national importance, engages in consensus building, identifies research agendas, and directly undertakes interdisciplinary and multidisciplinary research projects. It relies on a large number of BCAS Fellows, both nationals and expatriates, from a wide range of disciplines including natural, engineering, health and social sciences. BCAS has developed a broad spectrum of relationships with a number of national and international agencies. On a national level these include the Government of Bangladesh and agencies such as the Ford Foundation, NORAD, USAID, DANIDA, CIDA, and UNDP. The Centre maintains a list of persons and institutions with environmental expertise.

International linkages are built on a project by project basis, e.g., BCAS is associated with the universities of Berkeley and Yale in the USA in the field of social forestry. On other environmental issues BCAS works with the IIED, London, Centre for Environmental Management and Planning (CEMP), Aberdeen University, U.K., the IUCN, and the World Resources Institute.

Institute for Environment and Development Studies (IEDS) - The agency deals with a broad spectrum of environmental issues, focusing on (i) Research activities such as natural substitutes for poisonous chemicals; (ii) training environmental volunteers; (iii) environmental publications; and (iv) undertaking specific action programmes.

Projects have included: frog legs, intensive organic farming, literacy to marginal people, and environmental awareness. Forestry sector projects have included social forestry , and plantation studies using Derris- natural substitutes for pesticides. They have conducted campaigns on the frog legs trade ban, water and air pollution, organic farming, various forestry issues and wetlands.
Publications include books and periodicals, and posters / pamphlets/ stickers on specific environmental issues. They publish a quarterly environment newsletter. A recent issue included articles on forest preservation and protection, tree planting and global climate change, and threats to biodiversity in tea gardens. The action programmes consisted of activities such as demonstrations and public rallies, media exposition, and contributing to special events such as World Environment Day. It is the Bangladesh representative of Friends of the Earth International.

Climate Action Network South Asia - South Asian NGOs have played a leading role in raising regional and global issues of science and policy, particularly on equity, consumption, data output and their interpretation. Global climatic change (GCC) has been one of these issues. The scientific capability for research on this issue varies considerably among the governments of South Asia. A number of scientists of the region felt that the needs and concerns of South Asia merited special attention. CANSA was formed in 1991, and a secretariat has been established at the Bangladesh Centre for Advanced Studies. The progress to date includes: (i) A CANSA Resource Centre has been established with over 1,000 items of publications; (ii) the first regional meeting was held in Dhaka in November 1991; (iii) consensus on a research agenda has been developed; (iv) linkages have been created with other Climate Action Network (CAN) members and networks in North America, Europe, and Africa.

Activities include: (a) Awareness building and information dissemination among government, NGOs,academics and institutions, the media and public; (b) A News letter -- Clime Asia which provides information about the climate change issues; (c) Exchange of personnel for training and national capacity building; (d) Research output and information materials, such as distribution of a summary of IPCC reports produced by Greenpeace and INC documents amongst CANSA members; (e) Meetings and workshops; (f) research on: (i) climate and poverty; (ii) climate, environment and population; and (iii) climate and natural hazards/ disasters.

Research has been undertaken on methane emissions, existing estimates for GHG emissions, mitigation strategies, and potential impact studies of sea-level rises. CANSA will provide inputs to the INC, governments and interested parties in the form of technical and background papers. The agency will also perform an advocacy role with South Asian Governments and NGOs.

Multidisciplinary Action Research Centre (MARC) - MARC is the combination of a research institute, consulting firm, and NGO. It attempts to bridge the gap between theory and practice. It undertakes research and information studies and action programmes as well. Areas of current emphasis are human resources, institutions, technology, and natural resources, particularly in agriculture, water resources, and forestry sectors. The firm's services include: (i) pre-appraisals, monitoring and evaluation of development projects; (ii) design and implementation of pilot projects; (iii) preparation of training materials and organizing seminars and workshops; and (iv) statistical surveys and data processing and computer modelling.

The firm has a pool of about 20 experts from various disciplines, and has board representation from some major NGOs in Bangladesh. Projects completed include: (1) Perceptions of Environmental Data Needs by Managers of Natural Resources, and (2) Benchmark Survey on Environmental Knowledge, Awareness and Practice (KAP).

The survey on perceptions of environmental data was carried out under an IUCN-supported project on Natural Resource Information Centre. The main goal of this survey was to assess the need for centres of natural resource information in the process of natural resources management at thana, union and village levels. Twelve thanas were selected to ensure an adequate representation of various important ecological regions of Bangladesh, i.e., forests, flood plains, Barind Tract, haors and off-shore islands. Interviews were held at the thana level with all the officials of relevant sectors. At the union level, UP chairmen were interviewed as well as government extension officers from DAE. At village level farmers (large and marginal), landless labourers and teachers were interviewed.

Two surveys were undertaken under an IUCN/NORAD supported project on Environmental Education. The main objectives of the study were to establish benchmarks on the current level of environmental knowledge and awareness, and to identify the training and education needs of different categories of people. In one of the studies (KAP) an indepth survey on environmental knowledge, awareness and practice was carried out in two different ecological zones, i.e., (1) Chunati Harbang Rainforest Area in Chittagong and Cox's Bazar districts, and (2) Brahmaputra-Jamuna Flood Plain Area in Sirajganj district.

In the second study, a nationwide environmental KAP survey, questionnaires were given to 7,300 persons of different occupational categories. They queried respondents' management of natural resource such as land, water, trees, animals etc. In additional, a number of other reports have been completed relating to natural resources:

- A proposal on Afforestation and Reforestation in Bangladesh
- Sustainable Development: A conceptual Framework
- The Himalayan Initiative
- People's Perceptions About Environmental Stress in Rural Bangladesh
- Sustainable Development of Forest Resources of Bangladesh
- Resources Sustainable Development and Economic Institutions

Of particular relevance are papers on the flora and fauna of Chunati Wildlife Sanctuary, and a pilot project model for management of Chunati.

Nature Conservation Movement(NACOM) - The organization consists of a number of multi disciplinary individuals comprising wildlife biologists, naturalists, sociologists, historians and journalists, etc. Its aims and objectives are to: (a) stimulate public awareness of environmental issues; (b) to promote creation of a data bank, library, information centre and a natural history museum; (c) conduct species inventories, breeding atlases, and create captive breeding centres; (d) to facilitate policy formulation; (e) establish training centres; (f) to carry out and disseminate surveys and research on nature and natural resources; and (g) identify traditional sustainable resource utilisation techniques and methodologies in rural ecosystems.

The organisation has a holistic approach to the environment, natural resource conservation, and has the following activities:

- a survey for developing an elephant management plan for Cox's Bazar;
- collaboration with eminent wildlife scientists, resulting in several publications;
- research and surveys of wetlands in Bangladesh, both in coastal areas and inland; this has involved collaboration with the Asian Wetland Bureau, and surveys for the World Bank Forest Resources Management Project as well as the Northeast Regional Water Management Project (FAP-6);
- migratory waterfowl censuses, which have identified some of the world's highly endangered species in the coastal wetlands of Bangladesh, and helped to establish the importance of Bangladesh as an internationally important wetland under several of the Ramsar Convention criteria;
- establishment of people's participatory conservation programs at Mashok, Kapassia, under Gazipur District, Gulotia in Manikganj District and Whykeong in Cox's Bazar District; an achievement in Kapassia has been the creation of a local organization, named Mashok Gram Unnayan Sangshta which has initiated and maintained a conservation centre and library with NACOM guidance and support; Gulotia in Manikganj and Whykeong in Cox's Bazar are being developed as conservation centres also;
- nature education program have been conducted since 1986 in different degraded ecosystems;
- a study of otters in Bangladesh, resulting in a contribution to an IUCN international action plan for otter conservation, and the collaboration with BBC on a film about the interaction of otters and fishermen in Bangladesh;
- an assessment of impact of the cyclone and tidal surge of April, 1991 on the natural resources of the coastal area;

- training programmes in forestry, wetlands, wildlife, geomorphology, etc;

- seminars and workshops, which have included : conservation and sustainable development; wetlands and crane conservation; biology and conservation of turtles in Asia; world primate population and conservation of primates in Bangladesh; community-based nature and natural resources conservation; conservation of biodiversity;

- conducting nature walks in various ecosystems;

- provision of consultancy and technical services.

Wildlife and Nature Conservation Society of Bangladesh - The agency has collaborated in some research activities with POUSH, NACOM, and SCONE. Video films have been produced on wetlands, wildlife, including full coverage of a wildlife workshop held in the Goethe Cultural Institute, Dhaka,in 1986. The society also participates regularly in national and international seminars and workshops such as the Montreux (Ramsar Convention) Switzerland in 1990, and the South Asian Wetland Workshop in Karachi in 1991. The agency sent a representative to a symposium on Asian wetlands held in Japan in late 1992.

A public awareness campaign on nature conservation, wildlife management, and development of National parks and protected areas is being promoted among the public, local communities and NGOs. Via nature magazines, lectures, and other media, presentations have been given on "recreation forestry- wildlife tourism". In addition, project proposals and profiles have been prepared for the conservation of wildlife and biodiversity in a captive breeding centre at Dulahazara, the Chunati Wildlife Sanctuary, and an elephant sanctuary in Himchari and Teknaf.

Proposals have also been developed for nature conservation in protected forest areas in the forests of Chittagong, and for the "Tiger Project" in the Sundarban Wildlife Sanctuaries.

Wildlife Preservation and Nature Conservation Association - The agency fundamentally aims for public motivation for environmental protection, with specific interests in forestry, flora and fauna. It is based in Chittagong. Their goal is to create effective local units in the remaining forested thanas. The agency plans to initially operate in ten thanas, and subsequent to evaluation, attempt to relictae the working areas. There will be four field workers in each thana, recruited from University graduates in natural sciences such as zoology, botany, forestry, fisheries, and social sciences.

Palli Unnayan Sangstha (POUSH) - Poush has a number of programmes which include: (a) health and sanitation, with components for health, nutrition, sanitation, and clean water; (b) an education programme , with adult education and primary education; (c) disaster preparedness; (d) embankments and cyclone shelters; (e) income-generating activities, including fisheries, bamboo handicrafts, garments tailoring, and net making.

The organization has begun to experiment with an "eco-village" concept in four villages in 1991, in Cox's Bazar, Chakaria, and Kaliakoir. The programme is in a nascent stage only, but intends to include tribal villages in Jhenaigati and Lama thanas.

There is an afforestation programme, begun in 1986, which has been expanded in 1991 through the support of the World Food Programme. Existing programmes were expanded to new areas in Netrokona and Bandarban districts. POUSH has initiated afforestation programmes in Lama, Naikhongchhari and Bandarban thanas, and local response to its model for participatory forestry has been encouraging.

POUSH planted about 500,000 trees in 1991. Their survival rate have reportedly been quite high. There is emphasis on planting a variety of indigenous tree species for local use, rather than faster-growing exotics. Approximately 30 species are used. Some POUSH activities have been included in a World Food Programme documentary video entitled "Trees For Life". POUSH personnel participated in a six-day social forestry training course arranged by the Forest Department in Cox's Bazar.

The goal for 1992 is to plant one million trees, including mulberry for a potential sericulture project. Under their "Harbang Model" the agency has established eleven nurseries. A network of contract growers included about 1000 families in 1991 under its participatory forestry programme. In Kaliakoir a small scale tree planting and maintenance programme initiated in 1990 was successful and in 1991 it was increased several fold. Nurseries have been established in Kaliakoir, Noakhali and Feni, along with poultry raising. New centres have been initiated in 1992 in Rajshahi, Tangail, Joypurhat, as well as Bagherhat and Patuakhali.

The organization participated in the National Conservation Strategy (NCS), UNCED and the National Environment Management Plan (NEMAP), in which the chief executive had a major role, as well as in policy formulation. The organization also conducted relief and rehabilitation activities subsequent to the cyclone of 1991, where POUSH projects in Cox's Bazar district were directly affected.

There was a contribution to the conservation of natural resources via the establishment of a small Nature Conservancy Centre at Nhila in Teknaf thana, and a project to improve the water supply for animals in the Deer Breeding Centre at Dulahazara late in 1991. The latter has been initiated with the collaboration of the Wildlife and Nature Conservation Society and the Jahangirnagar University Institute of Life Sciences. Some preliminary surveys were carried out on the status of the ecological status of the Teknaf Game Reserve and Chunati Wildlife Sanctuary, and the agency has planned to set up observation centres around the Chunati Wildlife Sanctuary and do some tree planting in Harbang, Banshkhali and Chunati.

POUSH has initiated some surveys on socio-economic profiles of its areas of operation. A country-wide sample survey is being conducted on use of fuelwood and the potential demand for fuel-efficient chulas (stoves). In collaboration with PACT Inc. a series of fact sheets on land and water resources, forests, fisheries and industries have been completed and distributed in both English and Bangla.

Centre For Environmental Research - The centre, at Rajshahi University, is involved in the collection of field data on land use, degraded ecosystems, forest ecology and conservation. They feel that no qualitative and quantitative account of any of these exist for any region of this country, and in particular for the erosion of biodiversity in the devastated forests of northern Bangladesh.

The centre has been compiling data and descriptions of various species of plants and animals of the region, including the remnant patches of Sal forests of Northwestern Bangladesh, vegetation of the Barind Tracts, and chars, river banks, and sand-dunes of the Padma and the Sundarbans. The plants have been described and conserved in a herbarium, and threatened and endangered species lists are under preparation. The carrying capacity of many landscapes of this region and sustainability of agricultural production are at risk due to land use changes over the last few decades. The agency promotes the use of the Barind Tract within a planned, multi-layered agro-forestry system to protect the soil from further degradation, concomitantly facilitating sustainable agricultural production within the reality of poverty and population pressures. Agriculture and forestry should not compete, but rather co-exist.

The Centre has published research papers, and given presentations on vegetation, forestry, environment and other related issues. Three videos have been made. Symposia and workshops have been organized by the Centre in the University, local colleges and other institutions on environment, forests and biodiversity. The staff associated with the centre offer courses on ecology, biodiversity, floristic composition, forest ecology, reproductive biology, and population genetics. M.Sc. and Ph.D. candidates are supervised in such disciplines.

Studies on biodiversity and on deteriorating germplasm are being conducted. Threatened species are being identified, collected, documented and preserved in the Botanical Garden, the University campus, and in private collections insitu under the direct supervision of the Centre. It maintains contacts with the National Park Service (US Dept. of Interior) and numerous other agencies involved with nature conservation, wildlife management and protected areas. The Centre has surveyed the regional flora and fauna. Field work for such systematic data and material collection is regular and ongoing. Consultancy, advisory and technical services are also provided.

IUCN Bangladesh - This agency is the Bangladesh representative of the World Conservation Union. The It participated in the formulation of the National Conservation Strategy (NCS) initiated in 1987. A liaison office was set up in 1989 at the invitation of MOEF, and a country representative was appointed late in 1991. Its programme priorities are: (a) policy formulation; (b) promotion of biodiversity; (c) environmental education and awareness; and (d) provision of technical and advisory services to donors, NGOs, and GOB. The agency has provided support for and done evaluations of the National Herbarium, National Botanical Gardens, and the NEMAP.

The agency has access to strong international technical support services through its linkages to IUCN headquarters. Locally, it has initiated recruitment of some member agencies. Its immediate goals are to undertake a number of projects for which it is seeking funding and which include:

- a workshop on wetlands issues, held in November, 1992
- a symposium on population, development and environment
- implementation of some components of the NCS
- development of natural resource information centres throughout the country
- environmental educational training and awareness
- institutional support for conservation of biodiversity
- resource planning for sustainable rural development, based on eco-village concepts, in three different ecological zones

The above agencies illustrate the range of NGO involvement in environmental issues. A number of other agencies are listed below, which are also involved in various issues:

Like-Minded Environmental Activist Group

Centre for Environmental Studies and Research

Centre for Environment and Development

Forum of Environmental Journalists

National Forum of Environmental NGOs

Society for the Conservation of Nature and the Environment (SCONE)

Society for the Conservation and Protection of the Environment

Community Development Library (CDL)

Wildlife Society of Bangladesh

Bangladesh Bird Preservation Society

Barind Protection Society

Bangladesh Zoological Society

Prothikrit

Coastal Area Resource Development Management Association (CARDMA)
International Institute of Environment Studies and Disaster Management

The matter was finally sent to the Ministry in Dhaka for formal permission, which took another 3 months.

After 14 months, permission to extract 50 percent of the number of trees applied for was issued on FORM "B". Permission period was restricted to 5 weeks within which to find customers, section the trees in transportable sizes according to buyers' wishes, arrange transport over jungle and hilly roads and at the same time to fulfil the myriad procedures of the remaining FORMS "C", "D", "E" & "F" and the Work Plan.

The Permit on Form "B" itself contains many requirements which are ridiculous and impractical. Trees must be retained where felled, till the range officer inspects same, matches the blaze and numbers and measurements with those taken nearly 1.5 years earlier. If the trees, especially the newly introduced Eucalypts & Acacias have in the meantime, with total disregard to the Forest Act 1927, repaired the blaze marks and the numbers and if they have grown by about 10-20 percent, then the Owner is taken to task and must atone for this "irregularity".

After the Range Officer submits his report to the DFO at Chittagong then the Transit Pass (T.P) is issued. Only then can the trees be transported out within the 24 hours period for which most T.Ps are valid. If it rains, if there is a hartal or even if the truck breaks down, then it's back to square one.... No exception is made to dispose of diseased, damaged, up-rooted or for the normal thinning and de-branching so necessary for the good health of plantations. Even trees up-rooted in the cyclone last year were allowed to rot rather than to be used for emergency repairs or to be transported to markets where they were urgently required. Even a headload of firewood taken to village bazars requires the same formalities (FORM "C").

Mention is made of:

- "unbridled corruption"
- "transfers to lucrative posts are wangled against proportional cash layouts...."
- "favoured traders are encouraged to transport in bulk against the notorious Cigarette Packet Permits"
- "a select band of traders & merchants who willingly toe the line have monopolized the trade and in their wake are the ancillary horde of middlemen, touts, sawyers, labourers and carriage contractors".

While such opinions are unsubstantiated, the important factor highlighted here is that the perception of the Forest Department is uniformly poor, not only in this case study but the others as well. The fact that there are diligent and scrupulously professional persons in the Department is overshadowed by the all-pervasive and lingering cynical outlook of Departmental integrity. This was reflected also in the institutional survey conducted by the FMP, as well as by the majority of contacts within this sub-team. In the case of the institutional survey, it was Forest Department employees themselves who had a negative view of the Department's lack of accomplishments.

CASE STUDY NO. 4

SELECTED PUBLIC ATTITUDE SURVEY RESULTS

The following have been excerpted from the original village forest inventory conducted during the FMP. A number of basic conclusions can be drawn from the responses: (i) there is a widespread perception that deforestation is related to increased levels of flooding and land degradation; (ii) there is a need identified by villagers for some technical assistance; (iii) fuel and fodder are becoming increasingly difficult to obtain; and (iv) the impacts of deforestation are more severe on the poor than the better-off respondents (the top column stratifies respondents by size of landholdings in hectares).

More than 80 percent of respondents felt that large scale tree removal resulted in floods, land deterioration and desertification. The majority (69.1 percent) felt government was not satisfactorily reversing this trend, which could best be done through planting more trees. More than 90 percent of respondents stated categorically that the number of trees in their village had decreased over the past five years. People were reluctant to respond to the question of whether benefits from government-sponsored plantation programmes were distributed fairly, and less than 20 percent said yes. They felt that the best method of plantation protection was through small farmers (75.6 percent) while about 20 percent felt that individual effort was the best means.

Most villagers collected seedlings from their own source (about 40 percent), followed by private nurseries (approximately 20 percent) and about 20 percent had unspecified other sources. The Forest Department accounted for only 5.4 percent of seedling source among male respondents and only 3.1 percent among females- a rather dismal reflection of the ineffective extension services to date. Other government departments with some tree plantation programmes fared even worse. More than half of respondents felt they received inadequate advice about growing trees, whereas about 40 percent thought it was reasonably adequate. Similarly both men and women were evenly split over whether they received the species of their choice. Assistance with species choice was the major technical advice requested by villagers, followed by planting methods, and land suitability.

More than half of all respondents noted a large decrease in fuel availability, while about one third observed only a slight decrease. About 40 percent of respondents spent between 20-30 hours weekly gathering fuel, and about 30 percent spent between 10-20 hours per week on fuelwood collection. The majority of respondents (70 percent) had to travel less than one mile for fuel, whereas about 15 percent had to travel between one and three miles. Similarly for fodder, the majority source was agricultural residues, and most could locate fodder within one mile. With regard to time spent on fodder collection, here too, the time spent was mostly 20-30 hours weekly, with between 35-40 percent spending between 10-20 hours.

Significantly, the poorest landholders spent more time and travelled further to acquire these necessities. Women often spent more time than men in such activities, and travelled further as well. Among male respondents, for example, only 1.9 percent spent between 30-42 hours weekly on fuelwood collection, compared to 8.3 percent of women. Two percent of males spent between 30-40 hours collecting fodder, whereas 6.8 percent of women did so, clearly showing gender disparity in terms of impact on workload and time allocation.

How far do you go to collect your fuel ?

		Men only				Women only			
Item	<	>0.5-2.50	2.5-7.50	>7.50	Total	>0.5	>0.5(2.50	>2.5(7.5	>7.50	Total
NA. or Not Answered	12.1%	19.5%	28.4%	32.9%	17.3%	7.0%	14.7%	19.5%	28.5%	11.8%
Less than one mile	72.7%	67.8%	64.2%	61.4%	69.7%	74.1%	70.1%	68.3%	62.6%	71.7%
1-3 miles	15.2%	12.1%	6.3%	4.3%	12.6%	16.8%	13.9%	10.4%	7.8%	14.7%
More than 3 miles	0.0%	0.7%	1.1%	1.4%	0.4%	2.2%	1.4%	1.8%	1.1%	1.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

How long does it take to collect the fuel?

		Men only				Women only			
Hours/WK	>0.5	0.5-2.50	2.5-7.50	>7.50	Total	>0.5	>0.5(2.50	>2.5(7.5	>7.50	Totals
Nil	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Less than 2	0.9%	0.8%	0.8%	0.5%	0.9%	0.0%	0.0%	0.0%	0.1%	0.0%
2-4	1.1%	2.8%	1.0%	1.5%	1.6%	0.2%	0.7%	1.4%	0.8%	0.5%
4-6	4.3%	5.3%	11.4%	8.5%	5.8%	0.4%	1.7%	0.6%	1.1%	0.9%
6-8	8.7%	21.6%	25.5%	38.4%	15.9%	2.6%	3.9%	7.4%	4.1%	3.7%
8-10	0.6%	6.4%	9.0%	12.1%	3.9%	3.9%	7.1%	7.4%	7.6%	5.5%
10-20	29.6%	28.9%	18.9%	9.3%	27.3%	31.3%	39.8%	43.7%	47.3%	36.2%
20-30	53.7%	32.4%	27.5%	29.7%	42.7%	49.7%	41.1%	37.9%	32.7%	44.9%
30-42	1.1%	1.7%	5.9%	0.0%	1.9%	11.8%	5.7%	1.5%	6.4%	8.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Aver hours/ week	13.5	11.3	9.4	8.1	10.6	16.1	8.5	7.4	9.9	12.1

How has fuel availability changed during the last five years ?

		Men only				Women only			
Items	>0.5	>0.5<2.50	>2.5<7.50	>7.50	Total	>0.5	>0.5<2.50	>2.5<7.5	>7.50	Totals
NA. or Not Answered	3.1%	1.4%	4.4%	2.9%	2.8%	2.2%	1.4%	1.4%	2.3%	1.8%
Decrease										
Large	60.9%	53.7%	49.5%	52.9%	56.9%	65.2%	53.7%	46.6%	42.9%	58.3%
Slight	31.3%	38.8%	38.5%	33.8%	34.7%	30.9%	41.6%	44.7%	46.9%	36.6%
No Change	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Increase										
Slight	0.0%	2.0%	2.2%	1.5%	1.0%	0.0%	1.7%	1.8%	2.9%	0.9%
Large	3.1%	0.7%	2.2%	1.5%	2.2%	0.6%	0.0%	1.4%	0.0%	0.5%
Don't know	0.0%	0.7%	0.0%	0.0%	0.2%	0.6%	0.3%	0.0%	0.0%	0.4%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

What kind of fodder do you grow or collect ?

		Men only				Women only			
Item	>0.5	>0.5<2.50	>2.5<7.50	>7.50	Total	>0.5	>0.5(2.50	>2.5(7.5	>7.50	Total
Agric Waste	92.4%	92.6%	92.6%	91.4%	92.5%	94.6%	93.1%	94.1%	95.5%	94.1%
Fodder crop	6.1%	6.7%	7.4%	7.1%	6.5%	4.9%	6.4%	5.4%	3.4%	5.4%
Tree	1.5%	0.7%	0.0%	1.4%	1.0%	0.5%	0.5%	0.5%	1.1%	0.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

What distance do you travel to collect fodder ?

		Men only				Women only			
Item	>0.5	>0.5<2.50	>2.5<7.50	>7.50	Total	>0.5	>0.5<2.50	>2.5<7.5	>7.50	Total
<1 Mile	90.9%	85.9%	89.4%	84.3%	88.9%	91.4%	79.5%	77.9%	80.4%	85.5%
1-3 Mile	9.1%	12.8%	9.6%	15.7%	10.5%	7.6%	19.4%	19.4%	19.0%	13.2%
>3 Mile	0.0%	1.3%	1.1%	0.0%	0.6%	1.1%	1.1%	2.7%	0.6%	1.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

How many hours per week spent collecting fodder ?

	Men only					Women only				
Hours/ WK	>0.5	>0.5 <2.50	>2.5 <7.50	>7.50	Total	>0.5	>0.5 <2.50	>2.5 <7.5	>7.50	Total
Nil	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Less than 2	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2-4	0.0%	0.7%	0.8%	0.0%	0.3%	0.0%	0.1%	0.0%	0.0%	0.0%
4-6	0.0%	0.7%	0.5%	0.7%	0.3%	0.5%	0.4%	0.2%	0.5%	0.4%
6-8	3.2%	4.0%	2.9%	3.3%	3.4%	6.4%	5.1%	3.8%	3.0%	5.5%
8-10	10.9%	2.0%	5.5%	0.0%	7.1%	2.1%	1.8%	1.9%	4.0%	2.1%
10-15	19.4%	25.1%	21.1%	25.6%	21.6%	28.5%	23.2%	20.2%	16.8%	25.3%
15-20	24.4%	14.8%	13.8%	7.2%	19.4%	7.0%	16.2%	11.3%	5.7%	10.4%
20-30	42.1%	48.0%	52.5%	59.3%	45.9%	47.3%	47.4%	59.3%	62.2%	49.4%
30-40	0.0%	4.6%	3.1%	3.9%	2.0%	8.2%	5.8%	3.4%	7.8%	6.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Aver Hours/ Week	6.7	10.0	14.0	12.9	10.2	7.1	11.7	13.6	14.7	11.8

Where did you get your seedlings ?

	Men only					Women only				
Item	>0.5	>0.5 <2.50	>2.5 <7.50	>7.50	Total	>0.5	>0.5 <2.50	>2.5 <7.5	>7.50	Total
NA. or Not Answered	9.1%	2.7%	1.1%	2.9%	5.8%	8.1%	2.2%	0.5%	1.1%	5.0%
Incomplete answer	0.0%	0.0%	0.0%	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	
Own	42.4%	43.6%	38.9%	47.1%	42.5%	42.7%	43.8%	46.4%	43.6%	43.6%
Friend	3.0%	6.0%	5.3%	0.0%	4.2%	6.5%	3.0%	3.2%	4.5%	4.9%
Private Nursery	24.2%	20.1%	24.2%	24.3%	23.0%	14.1%	22.7%	23.9%	25.1%	18.4%
Forest Dept	6.1%	3.4%	7.4%	4.3%	5.4%	1.6%	5.0%	4.1%	5.6%	3.1%
Other Govt	0.0%	1.3%	1.1%	1.4%	0.6%	1.6%	0.8%	1.8%	1.7%	1.4%
Other	15.2%	22.8%	22.1%	18.6%	18.6%	25.4%	22.4%	20.3%	18.4%	23.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Do you get the kind of species you want ?

	Men only					Women only				
Item	>0.5	>0.5 <2.50	>2.5 <7.50	>7.50	Total	>0.5	>0.5 <2.50	>2.5 <7.5	>7.50	Total
NA. or Not Answered	10.6%	7.4%	9.5%	1.4%	9.2%	10.8%	2.2%	1.8%	1.1%	6.6%
Incomplete answer	0.0%	0.0%	0.0%	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Yes	34.8%	45.0%	48.4%	42.9%	40.1%	43.2%	47.6%	10.5%	44.1%	44.3%
No	54.5%	47.7%	42.1%	54.3%	50.7%	45.9%	50.1%	57.7%	54.7%	49.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Do you get good advice about tree growing ?

	Men only					Women only				
Item	>0.5	>0.5 <2.50	>2.5 <7.50	>7.50	Total	>0.5	>0.5 <2.50	>2.5 <7.5	>7.50	Total
NA. or Not Answered	6.1%	0.0%	0.0%	0.0%	3.2%	3.3%	0.6%	1.4%	1.7%	2.1%
Yes	34.8%	47.7%	44.2%	52.9%	40.7%	34.2%	43.2%	41.0%	49.2%	38.4%
No	59.1%	52.3%	54.7%	45.7%	56.0%	62.0%	55.7%	55.9%	48.6%	58.8%
Incomplete answer	0.0%	0.0%	1.1%	1.4%	0.2%	0.5%	0.6%	0.9%	0.0%	0.6%
Incomplete answer	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%	0.6%	0.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

What kind of advice do you need to grow trees better ?

	Men only					Women only				
Item	>0.5	>0.5 <2.50	>2.5 <7.50	>7.50	Total	>0.5	>0.5 <2.50	>2.5 <7.5	>7.50	Total
NA. or Not Answered	10.0%	2.1%	4.4%	2.9%	6.5%	2.2%	1.4%	0.5%	1.7%	1.7%
Species Choice	48.3%	45.2%	41.8%	39.7%	46.2%	37.6%	35.1%	36.3%	33.5%	36.5%
Land Suitability	10.0%	7.5%	6.6%	11.8%	8.8%	12.7%	12.6%	13.6%	10.8%	12.8%
Planting Method	33.3%	37.7%	37.4%	38.2%	35.4%	36.5%	35.1%	34.8%	36.4%	35.8%
Tending Methods	5.0%	3.4%	3.3%	4.45	4.3%	7.2%	8.1%	7.7%	9.7%	7.6%
Product Marketing	0.0%	2.7%	6.6%	0.0%	1.8%	0.0%	2.2%	1.4%	1.1%	0.9%
Product Types	1.7%	0.0%	2.2%	1.5%	1.2%	2.2%	0.8%	2.3%	2.8%	1.8%
Fertilizers	0.0%	2.1%	2.2%	1.5%	1.0%	1.7%	3.9%	1.8%	3.4%	2.4%
Pesticides	1.7%	0.7%	0.0%	1.5%	1.1%	0.0%	0.6%	1.8%	1.7%	0.5%
Other	0.0%	0.7%	0.0%	1.5%	0.3%	2.2%	1.4%	0.5%	0.6%	1.7%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Do you think that large scale tree removal causes floods, land deterioration and desertification ?

Item	All sexes				
	>0.5	>0.5<2.50	>2.5<7.50	>7.50	Total
NA, or Not Answered	0.4%	0.6%	0.6%	0.8%	0.5%
0	0.0%	0.0%	0.0%	0.4%	0.0%
Yes	78.9%	87.8%	87.7%	88.8%	83.2%
No	20.7%	11.6%	11.7%	10.0%	16.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

If so, do you think Government is doing enough to arrest the change ?

Item	All Sexes				
	>0.5	>0.5<2.50	>2.5<7.50	>7.50	Total
NA, or Not Answered	16.3%	9.4%	10.1%	6.4%	13.0%
Incomplete answer	0.4%	0.0%	0.0%	0.4%	0.2%
Yes	15.9%	20.0%	18.0%	17.7%	17.5%
No	67.3%	70.6%	71.3%	75.5%	69.1%
Incomplete answer	0.0%	0.0%	0.3%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

What do think you can do to lessen the effect ?

Item	All Sexes				
	>0.5	>0.5<2.50	>2.5<7.50	>7.50	Total
NA, or Not Answered	12.0%	8.2%	7.6%	6.0%	10.0%
Incomplete answer	0.0%	0.0%	0.3%	0.4%	0.1%
Plant more trees	74.1%	79.6%	82.0%	84.3%	77.2%
Better protection	3.2%	2.9%	2.8%	2.8%	3.1%
Reduce cutting	3.2%	5.1%	4.1%	2.0%	3.9%
Don't know	7.6%	3.5%	2.8%	4.0%	5.5%
Incomplete answer	0.0%	0.6%	0.3%	0.4%	0.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Do you agree with how the benefits have been distributed ?

Item	Men only					Women only				
	>0.5	>0.5<2.50	>2.5<7.50	>7.50	Total	>0.5	>0.5<2.50	>2.5<7.5	>7.50	Total
NA, or Not answered	62.1%	67.8%	51.6%	60.0%	62.3%	66.5%	67.3%	63.1%	55.9%	65.9%
Yes	16.7%	14.8%	30.5%	20.0%	18.1%	17.3%	20.2%	20.7%	22.9%	18.8%
No	21.2%	17.4%	16.8%	20.0%	19.4%	16.2%	12.2%	16.2%	21.2%	15.1%
Incomplete	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.1%
Incomplete	0.0%	0.0%	1.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

In your opinion, has the number of trees in your village increased during the last five years ?

Item	Men only					Women only				
	>0.5	>0.5<2.50	>2.5<7.50	>7.50	Total	>0.5	>0.5<2.50	>2.5<7.5	>7.50	Total
NA, or Not answered	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	0.3%	0.0%	0.0%	0.4%
Increase	1.5%	4.7%	9.5%	7.1%	3.8%	4.9%	4.2%	5.0%	10.1%	4.8%
Decreased	95.5%	91.3%	85.3%	85.7%	92.4%	90.8%	91.4%	90.5%	89.4%	90.9%
No change	3.0%	2.7%	5.3%	7.1%	3.4%	3.2%	3.3%	3.6%	0.6%	3.2%
Don't know	0.0%	0.7%	0.0%	0.0%	0.2%	0.5%	0.6%	0.9%	0.0%	0.6%
Incomplete answer	0.0%	0.7%	0.0%	0.0%	0.2%	0.0%	0.3%	0.0%	0.0%	0.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

What do you think is the best method of protecting forest/ plantations ?

Item	All Sexes				
	>0.5	>0.5<2.50	>2.5<7.50	>7.50	Total
NA, or Not answered	1.6%	0.4%	0.9%	0.0%	1.1%
Individual effort	16.3%	20.8%	26.2%	29.7%	19.5%
Small farmers	78.5%	74.5%	69.4%	65.9%	75.6%
Don't know	3.2%	3.1%	2.8%	2.0%	3.1%
Others	0.4%	1.2%	0.6%	2.4%	0.7%
Incomplete answer	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

CASE STUDY NO. 5

GENDER DIFFERENTIALS IN ACCESS TO FORESTRY RESOURCES

The following case study extracts pertinent women's issues from a broader case study of five villages in Barisal District. It is presented within its specific ecological adaptations to local conditions. In the study area, the most significant parameter of the social and community homestead forestry system was land tenure. There were three primary tenurial categories, i.e.:

- barga, whereby the share cropping arrangement is an annual lease, with the owner getting half the proceeds;
- bandhok, whereby a combination sharecrop/ sale is invoked by the owner giving out full rights on land use to a lessee who pays about half the value of the land in cash; when the cash is repaid the land is returned; in effect this is a medium-term tenure resorted to by marginal farmers when they are short of cash; if funds are not repaid, the lessee has the option to buy the land by paying less than the remaining value;
- leasing, under varying terms, in this particular area may sometimes be for terms of up to 12 years, which provides some reasonable security of tenure in the case of the growing tendency towards alley cropping in the study area; the major tree species are guava, betel and amra - a multi-layered system tailored to non-saline tidal fluctuations.

The role of women in various tree related activities merits examination. Firstly, women's labour in tree plantation nurseries, alley cropping and in the homesteads was examined in the context of 19 identified activities:

1. Nursery land selection
2. Nursery land development
3. Nursery earthwork
4. Nursery seed planting
5. Nursery fencing
6. Nursery bed weeding
7. Grafting
8. Watering of plants
9. Species selection
10. Sale of seedlings/ cuttings
11. Growing homestead seedlings
12. Nurturing homestead plants
13. Vegetable garden plant nurturing
14. Vegetable garden seed planting
15. Tree planting in alley
16. Nurturing plants in alley
17. Vegetable gardening inside homestead
18. Vegetable gardening in vegetable garden
19. Vegetable gardening in alley

Women's share of work was categorized on the basis of quartiles comprising four classes with intervals of 25 percent of total workload. The highest participation of women in tree related activities were found in the village Akalam where nursery was the main production system, whereby fully one-quarter of them performed all plantation related work in the nurseries well in addition to alley cropping. About one-third carry out 75 percent or more of the plantation related work the remainder did less than 50 percent of the total work required.

In Razzakpur village about half of the women do all the work related to homestead plantation, but nursery and alley cropping were insignificant in this village. Generally, in areas where nurseries and tree related activities are reduced, the participation of women in percentage terms exhibited a corresponding decline.

Daily working hours by women in tree related activities were also directly proportional, varying from one to two hours in villages where few trees were grown to as many as 7 to 8 hours a day for at least 25 percent of the women in one village. Child labour in agroforestry was broadly related to the same extent as the women's participation in terms of time and types of activities.

Differential wage rates between men, women and children were apparent, with men's wages about 50 percent higher uniformly throughout the study area. Partly this was due to the perception that such work for women and children was "family labour" and was therefore not costed at prevailing market wages. Such undervaluation of women's work is unfortunately prevalent in Bangladeshi society and contributes to maintaining myths about the lack of productivity of women.

It was readily observed, furthermore, that women's opinions were given only cursory attention in the decision making process related to trees, particularly those associated with planting, species choice, leasing and sale of products.

Some gender-specific legal issues were noted, in addition to the prevailing social, economic, political, and religious disadvantages. Article 29 (2) of the Constitution of Bangladesh does not allow sex discrimination related to employment, and minimum wages rules of 1961 do not permit differential rates of pay for men and women for work of equal value

The Muslim Law of Inheritance also discriminates against women's access to productive resources such as homestead trees, since women can only inherit half of the amount to which men are entitled. This clearly mitigates against women's basic rights. Not a single woman had title to any property in any of the five study villages.

The existing forestry legislation compounds the problem by alienating the public at large from the permanent forest estate. If social forestry is to be successful in future, archaic legal frameworks will have to be remodelled to reflect equal

opportunity for women. Particularly, given the fact that village homesteads are far more productive than government forests, existing tenurial arrangements, and usufructuary rights will require amendment.

National Workshop on Women and Environment:

Policies for Sustainable Management of Natural Resources

In November, 1991, ADAB and UNIFEM jointly convened a workshop on women and environment.The objective was to learn directly from women their perceptions of environment, to investigate the causes and impacts of environmental degradation on women, and to explore solutions. The dialogue involved 121 women from 66 organizations from 52 out of 64 districts. It was a culmination of previously-arranged local level workshops in 13 locations. Similar national level workshops were held elsewhere in South Asia and were presented at UNCED as "The Voices of the South Asian Rural Women".

Different physiographic regions and ecological zones were represented, including: (i) Barind; (ii) Wetlands; (iii) Riverine Erosion-Prone Areas; (iv) Coastal Areas; (v) Urban slums; (vi) Industrial Areas; (vii) Tribal Areas; and (viii) general areas.

Women described both natural and man-made environments, e.g.:

> "God-given things are those given to us in nature- air, water, soil, trees, mountain, sky etc. and man-made things are constructed by people such as factories, roads, bridges, cars, trains etc. Social environment i.e. the social condition under which we live in is a large part of man-made environment".

The major environmental problems identified were degradation of land, water and air. The causes included deforestation, about which was said:

> "Most of the forests are being destroyed in Bangladesh. Business people are destroying forest to get timber, to clear land for plantation. Poor people are cutting trees for poverty, to build houses and to clear land for cultivation. Most trees are destroyed for commercial reasons i.e. timber to make furniture, fuel in brick field, used in road and culvert/ bridge construction etc."

The effects included:

- siltation of canals and rivers, through soil erosion and floods;
- shortage of fuelwood results in use of biomass, exacerbating pollution from inorganic fertilizers;
- trees retain moisture in their roots, contributing to survival of small plants surrounding a big tree; as one woman put it "big trees are mother of little plants, they feed plants by holding water in their roots, if we cut one big tree, we destroy hundred small plants which depended on the mother tree";
- loss of tree cover causes less rainfall, increased temperatures, soil erosion, and ultimately-less oxygen, food,and malnutrition.

Problems particular to coastal areas were included. A woman described a recent incident with powerful coastal shrimp farming interest:

> "In November 9, 1990, the local people held a demonstration against the shrimp growers. The hired goons of a rich shrimp grower attacked the gathering, using firearms. One woman was killed, several injured. Later, the shrimp grower filed false cases against the local men and (had) them arrested. Later the goons again attacked the village, destroyed houses, assaulting women and children. Nothing happened to the rich man even if the local people filed a case against him".

In tribal areas, mention was made of deforestation, flash floods, loss of wildlife, encroachment of tribal land by outsiders, cheating and intimidation of tribal people, and jhum cultivation causing problems. One woman said:

> "We are the indigenous people of this land, we cleared the land and made it habitable. Later you people came, with your knowledge, learning, technology and civilization. We welcomed you and made it possible for you to stay here. But now you are destroying our forests, polluting our soil, water and air, destroying our livelihood. You are driving us from our own home. Why are you doing this? A country becomes beautiful and rich if it has various types of people and culture, just one language and culture in one country is not good. We are enriching our country by different languages, dialects, dress and culture. Our learning is less than yours, but do not leave us behind. Educate us so that we all can walk and live happily together".

The impact of the overall social environment also has had a negative role in accentuating inequities in access to productive natural resources, including:

- lack of control over their own income;
- women who work outside home continue to be harassed and censured by society for not observing purdah, in particular this applies to the poorest women;
- women have to bear the burden and responsibility for birth control methods disproportionately to men;
- beatings, mutilations and murder continue as a result of dowry;

- lack of equal opportunities to health services / education / training / skills results in low paying jobs for survival;

The specific environment of poverty has had very significant social impact which has disadvantaged women in particular:

a. the breakdown of extended families, and increase in female-headed households, both through male migration for employment and abandonment and divorce;

b. in the past, access to common property renewable resources had provided resources such as fish, grazing lands, fodder and forestry products for cooking, house construction, medicinal plants, and edible forest products; these are less available now;

c. increased salinity in the southern region of Bangladesh, has been found to cause respiratory ailments and debilitating effects in many pregnant women in the area; Possibly the mother's kidneys may be permanently impaired in extreme cases and the foetus may be damaged also;

d. many women sustain severe neck injuries from carrying heavy loads, such as water or fuelwood for long distances.

CASE STUDY NO.6

COMMUNITY FOREST MANAGEMENT MODELS

JOINT MANAGEMENT OF FOREST LANDS IN SOUTH ASIA

Three regions within South Asia have been closely examined for approaches for joint management of forest lands by communities (see Poffenberger, 1990) working in partnership with government agencies. These were: (i) a tribal zone in West Bengal; (ii) an arid zone in the Shivalik Hills of India; and (iii) a Himalayan hill zone in Nepal.

Land, forest, and water resources are being depleted at a rapid rate throughout the region, yet hundreds of millions of villagers continue to depend on these lands for fuel, fodder, and minor forest products. In India alone, between 1.3 and 1.5 million hectares of forest land are denuded annually, while in Bangladesh the rate has been noted by FAO to be about 37,000 annually. Projected demand for firewood and fodder will increase geometrically and may triple in India alone over the next 10 to 12 years, given current levels of consumption.

Some observations common to the region are that:

- there is growing concern over deforestation, soil loss through erosion, levels of reservoir sedimentation, and upland forest clearing and poor watershed management;

- reforestation and watershed management programs have wasted billions of dollars through failure to give sufficient attention to tenurial and usufructuary and protection rights of rural forest communities;

- rural communities infrequently have any formal role in management of forest lands; where they did once have them, these have been eroded through forest legislation;

- probably about 80 percent of the subcontinents's natural resources were common property historically before the introduction of such legislation;

- the erroneous assumption is still prevalent that deforestation is primarily caused by rural people and that only stricter policing, and bureaucratic regulation can control this situation;

- almost half a billion dollars have been spent on establishing massive social forestry programs, but few concentrated on common property and degraded state forest lands;

- regulating the felling and marketing of timber has frequently led to increased corruption, while alienating the individual and community;

- the lack of a policy environment within most governments, and the limited capacity of government agencies to enter into a dialogue with rural people regarding their resource rights and responsibilities has constrained the proper management of forest resources;

- indigenous management systems have gradually ceased to function through forest nationalization and abolition of many traditional management systems such as rotational grazing, seasonal restrictions, systems of fines for and taxes levied by communities, night watchmen, etc.;

- poor families in particular, according to one study derived 21 percent of their income and 77 percent of their fuel and fodder from common property resources versus 2 percent and 23 percent for upper income groups;

- deforestation has created particular problems for South Asia's tribal people and rural women who are often the primary forest collectors of grasses, fodder, fuel, and who are often the main processors and marketers of non-wood forest products;

- studies indicate women collectors may receive only 10 to 20 percent of the market value for most forest products, the largest share being grabbed by middlemen, forest officials, and government bureaucracies;

- studies in Orissa, Madhya Pradesh, Himachal Pradesh and Bihar indicate that up to 80 percent of forest families obtain between 25 and 50 percent of their food from the forest, thus directly impacting the most marginalized people such as tribals and women;

- more socially progressive government individuals and agencies have recognized the need for community-based management systems;
- pilot projects in West Bengal's Forest Department have worked with more than 2000 Forest Protection Committees, and social forestry has been a major element there for more than 15 years; in southwest Bengal, they have been particularly effective, and by 1989 more than 150,000 hectares of forest were being protected by 1989;

Tribal Communities and Forest Management: The Case of West Bengal

This program was successful by its transition from earlier custodial policing and bureaucratic controls to collaborative management with local communities. The state has a large and expanding population, shrinking forest lands, and the lowest per capita forest area (.02 hectares per person) in all of India. In these ways, there are some parallels with Bangladesh. Attempts to control misuse of forest resources were proving ineffective, and were increasingly leading to a state of perpetual conflict and mistrust between foresters and rural communities.

As in parts of Bangladesh, the dominant species in southwestern Bengal is Sal (Shorea robusta). In a pilot project, in return for protecting the sal forests, the Forest Department agreed to give the villagers 25 percent of all revenues generated from the sale of firewood and timber. This proved that even degraded natural sal forests would quickly send up shoots or coppice, if the root stock was healthy, and the tree was protected, and shoots properly thinned. This also greatly reduced expenditures in comparison to replanting.

Financial returns on investment were laudable. While in one village (Arabari) Rs. 1,000,000 was spent on forest related activities over a 14 year monitoring period, the value of the timber and fuelwood rose from practically nil to Rs. 12,600,000 in 1986. This created job opportunities, improved forester-villager relations, and contributed to the long term recovery of the badly degraded sal forests.

Key factors were the enthusiastic and sustained cooperation from beat and range officers in undertaking the programme, and the commitment of the state government towards the program, both of which are conspicuously absent in the case of Bangladesh.

The primary products from sal forest regeneration were poles and firewood, in the eyes of the West Bengal Forest Department. Market prices yield more than Rs. 20,000 per hectare from a regenerated sal forest after a 10 year rotation. Planting costs would only be one-tenth as much as replanting sal, and one-twentieth the cost of species such as arjun, leucaena, or cashew.

To the villagers, however, a more important and quick return consideration was the rapid increase in productivity of non-wood products from sal and companion species as the forest regenerates. Poffenberger notes that:

> "For example, in Pukuria village in south Bankura District a Santhal tribal community decided to protect a 130 hectare tract of degraded sal forest in 1982. Over the past six years the forest has regenerated rapidly, yielding substantial income in non-wood forest products to the community's 93 families. While the men work small-holdings of rainfed padi lands and migrate to Hooglyand Bardwan Districts for agricultural labour, the women of Pukuria spend four or more hours a day in the forest collecting a range of products including sal seeds, sal leaves, bidi leaves, tassar silk cocoons, mahua flowers for distillation, kalmegh and other medicinal herbs, bhurru fruit and gum, fodder grasses, and twigs and leaves for fuel. Sal seeds and leaves, and many other forest products need further processing in the home before they can be sold to the local buyer."

Some estimates predict that from income generated from all minor forest products in the village, one active woman could obtain up to Rs. 2500-3500 per year or Rs. 7-10 daily from one hectare of mixed sal forest after five to six years of regeneration, in contrast to only a 25 percent share from sal pole sales resulting in less than Rs. 1.4 per hectare.

In areas where the forests have degenerated greatly, consideration has been given to faster maturing species, cash crops such as cashew, fodder, sal enrichment planting, tassar silk raising on arjun trees and of course intercropping with papaya, bananas, mushroom, pineapple, beekeeping, etc.

The increased productivity is accompanied by increasing equity also, as often products are distributed equally among all village members. However, disadvantaged groups will likely be most affected at the outset, due to lack of access to maturing protected crops. They can be compensated by special measures. Over time, however, the system appears to disproportionately benefit women and low income families. Equity problems can easily arise when products are ready for harvesting, and care must be taken that benefits are not captured by village elites, corrupt officials, and middlemen. Equity questions are also applicable to inter-village distribution of production increases, since proximity to the forest will benefit some villages more than others.

The programmes appear to be contributing towards sustainability also, as degraded forests with healthy root system and stumps, are recovering, and improving the soil-holding capacity of upper watersheds, and reducing run-off. Moisture retention is also improved throughout the forest tracts and surrounding private agricultural lands. Systematic data collection on the ecological improvements are scarce, unfortunately. In the end, the ecological sustainability of the recovering forests will likely be determined by the viability of the village level institutions which are now protecting them. Formal agreements from the forestry authorities are a crucial factor in longterm sustainability of such programmes.

Specific areas requiring further research and attention include: (i) policy formulation to facilitate formal empowerment of community management groups; (ii) methodologies for joint planning; (iii) community-based and oriented programs; (iv) mechanisms and structures for conflict resolution, arbitration, and inter-group linkages; (v) substantial staff orientation programs; (vi) the possibility of using community-based microsite planning and forest protection as part of a larger rural development scheme; (vii) successful community management organizations are often comprised of groups of 10 to 50 families, and a forest department may deal with thousands of such communities, introducing administrative complexities; (viii) federations of community groups may be a feasible alternative to such perceived problems.

A review of FPC's experience in forest protection in West Bengal (see Malhotra and Poffenberger, 1989) concludes:

- community participation has been remarkably high in almost all the FPCs studied, and the custodial system is voluntary in all the FPCs studied, except for one location;
- in all five of these FPCs (most formed in the mid 1980s) the range and beat offices played facilitating roles in providing programme information and stimulating community participation, sometimes meeting communities as many as 20 times just to convince them of the possible environmental and economic merits;
- the organization and its production sharing rights and protection responsibilities were ratified through a meeting of all the villagers, the panchayat, and the range officer;
- most FPCs studied successfully attempted to restrict forest access through volunteer day time patrols;
- peer group pressure, small fines, and social upbraiding were frequently used by FPCs, and the Forest Department was only called upon for difficult situations;
- villagers were allowed by the Forest department to cultivate rice, fodder, sabai grass, maize and groundnut on some of the deforested land, as well as establish beehives;
- participating communities were given exclusive usufructuary rights to all minor forest products, including sal and kendu leaves, medicinal plants, selling of seeds and sal shoots, etc.;
- the FPC programme in West Bengal was substantially hindered by the delays in formal approval and particularly in the establishment of written production-sharing agreements

Table 1 - Characteristics of FPCs Studied

Year FPC formed	Arabarri 1977	Metal-Sitarampur 1986	Srirampur 1985	Pardi 1987	Hariharpur 1987	Jhantibani 1986
No. of villages in FPC	11	2	1	1	1	4
No. of families in FPC	618	99	20	150	27	107
% of village families involved in FPC	100%	94.2%	100%	100%	10%	89.1%
Forest area under the FPC in hectares	1,272	300	150	200	200	130
Forest area per household	2.5 ha	3 ha	7.5 ha	1.3 ha	7.4 ha	1.4 ha
Custodial system	Voluntary	Voluntary	Voluntary	Voluntary	Paid	Voluntary

Table 2 presents the average annual FPC household income.

Table 2 - Estimated Income from Forest-Based Activities in Sitarampur and Arabari

	Types of Activity	Annual Income per Family Value/ Unit	Sitarampur	Arabari
1.	Fuelwood collection (MSC, Twigs, leaves)	Rs. 15/ headload	Rs. 360	Rs. 180
2.	MSC Employment	Rs. 21.7/ day	Rs. 168	Rs. 34
3.	Mushrooms (Chatu)	Rs. 20/ kg.	Rs. 800	Rs. 60
4.	Sal Plates (Thal)	Rs. 15/ 1000	Rs. 502	Rs. 282
5.	Medicinals, Fruits and seeds	Rs. 500/ tree	Rs. 750	Rs. 49
6.	Kendu leaves for Bidis	Rs. 4/ 1000	Rs. 360	Rs. 117
	Total		Rs. 2,940 (Rs. 245/ month)	Rs. 722 (Rs. 60/ month)

DEFORESTATION AND GRASSROOTS INITIATIVES
FOREST PROTECTION GROUPS OF PROSHIKA

Proshika has been involved since 1976 in facilitating people's awareness of the linkage between environmental issues and poverty through participatory management of local resources. Its social forestry program is seen as a process in which the rural poor are empowered by gaining access to productive resources such as khas lands. They also benefit economically through meeting their subsistence needs of fuel, food and fodder.

Forest protection committees have been formed by organised groups of landless and marginal farmers in the sal areas of Kaliakoir, Mirzapur, Sakhipur and Sreepur. A total of about 2500 acres have been covered, basically protecting sal coppice to allow natural regeneration. The groups have been attempting to negotiate benefit-sharing arrangements with the Forest Department. Provided that the protection committees are cohesive and persuasive, individual poachers and small groups are less likely challenge them. The activities usually begin by selecting plots in relative proximity to family dwellings, and gradually expand coverage. Villages may have one or more protection groups, and patrolling systems are devised by the villagers themselves. Trees are thinned annually, and intermediate products are shared by the community, including non-members.

The Bangshinagar Forest Protection Groups

In 1985, four groups (two male and two female) decided to protect approximately 40 acres of degraded forests around their homesteads to counter the growing fuelwood scarcity. There was much scepticism and opposition from other villagers who felt that the forests, although ostensibly state property, were a common resource to which all had rights. The group persevered and undertook various strategies to create awareness and to secure the cooperation of neighbours, primarily through motivation of the potential benefits. This strategy eventually gained popular support.

However, illegal timber traders soon created opposition by filing false cases, and making accusations that group members belonged to political subversives, etc. These were eventually overcome. The groups at Bangshinagar were undertaking these activities not out of environmental concern, but out of pressing basic needs. They were convinced that the main cause of forest depletion was the large scale illegal poaching by timber traders in collaboration with local Forest Department and Revenue Department officials.

Pingabaho Forest Protection Groups

Five male groups in Pingabaho (including two tribal groups) have succeeded in protecting 200 areas of degraded sal coppice from 1988. The scarcity of forest products and training from Proshika combined to create the awareness of the need for protecting forests. The impressive results of neighbouring Shaldopara groups were an added incentive.

Most of the indigenous tribal people in the area tend to live in clusters which are segregated from more recent settlers and the general Muslim population. They have less access to land (out of which some were cheated, and others sold at distress prices subsequent to 1947) and many work as agricultural labourers at subsistence wages, particularly during the lean season. Brickfields and earth-cutting provide other sources of occasional seasonal work.

Local cropping patterns vary with land size. Paddy is cultivated in larger tracts while ginger, tumeric, yam, chilli, eggplant and other vegetables are grown on smaller tracts. Chemical fertilisers were used for paddy only, rather than vegetables.

The growing energy crisis of rural households is met by exploiting all available micro environments. Energy requirements for a family of 4 in Kaliakoir on a weekly basis consist of: i) 10 sacks of sal leaves; 2) 1 sack of "gohi" (part of the paddy plant left on the ground after threshing); 3) 1 sack of rice husk; 4) 100 sticks of dung. Puffed rice (muri) production is very common in this area. Sal leaves are the main source of energy for muri production.

ESTIMATED BENEFITS FROM FOREST PROTECTION ACTIVITIES

NAME OF FOREST PROTECTION	NUMBER OF YEARS OF PROTECTION	BENEFITS FROM THINNING	BENEFITS FROM PRUNING	CASH INCOME PER MEMBERS
1. SHALDOPARA	4	SAL LEAVES AND DEAD WOOD FOR THE LAST 4 YEARS	TK 4,000 FOR THE FIRST TIME IN 1990	TK 59.70
2. HATIBANDHA	3	SAL LEAVES AND DEAD WOOD FOR THE LAST 3 YEARS	TK 6,000 FOR THE FIRST TIME IN 1990	TK 176.47
3. PINGABAHO	ALMOST 2 YEARS	SAL LEAVES AND TWIGS WORTH TK 36 PER MEMBER		
4. GAENCHALA	2	SAL LEAVES AND TWIGS WORTH TK 48 PER MEMBER		

ESTIMATED GROWTH IN HEIGHT OF COPPICE

AREA	PROJECT NUMBER	YEAR PROJECT WAS STARTED	HEIGHT OF COPPICE WHEN PROJECT WAS STARTED (CM)	HEIGHT OF TREE IN 1990 (CM)	ANNUAL GROWTH (CM)
MIRZAPUR	FPP1	1988	45	320	137.50
SHAKIPUR	FPP 1	1985	75	800	145.00
	FPP 2	1987	60	578	172.66
	FPP 3	1988	65	300	117.50
	FPP 4	1989	70	300	230.00
	FPP 5	1989	135	375	240.00

Shaldopara Forest Protection Group

Fuelwood estimated at about Tk 4,000 will be sold this year from pruning. This will be the first time any cash benefits will be earned by group members from forest protection. The trees have been thinned every year for the first 4 years. These have been shared by the group members.

After the first year the group members had proposed that a benefit sharing scheme should be drawn out, and had been given some expectations informally by Proshika and the Forest Department. There had been discussion of a benefit sharing arrangement whereby all intermediate forest products would belong to group members and final forest crops would be shared on a fifty-fifty basis with the Forest Department.

However, the Forest Department was unwilling to enter into any kind of written contractual agreements or give preference to Proshika group members when choosing candidates for agroforestry or woodlot plantation schemes, although they had protected forests effectively. This was a tremendous disincentive, since the group had guarded the forests day and night for a year and a half. Guard duty was rotated so that each member would be needed once every 2 months. Under this system 2 members would be on patrol duty and a third member would act as supervisor.

The majority of the participants are agricultural wage labourers who are underemployed or unemployed about six months of the year, and institutional support must be given to such people to maintain the necessary motivation. Unclear demarcation of forest lands and conflicts over land jurisdiction between GOB agencies are also negative factors which create problems in securing legal benefits for their protection activities.

Paikpara Forest Protection Group

The following illustrates the typical frustrations of such groups:

> "In September 1990 local landowners and timber traders attacked the protected areas with tacit consent from local officials. When the female members tried to stop them they were assaulted by them. Two of the women were injured during this exchange. The women then went to get help and organised all the groups in their village.
>
> The group members surrounded the culprits and caught some of them, though a few managed to escape. A village court was held in the local primary school teacher's house that evening in the presence of all the villagers. The local Beat Officer was requested to attend this meeting. He turned up when the meeting was almost over. The offenders were let off without any penalties and they vowed never to engage in such activities again. But after a few days they returned with a larger force and launched a major attack on the protected areas. The Dhaka Office of Proshika was notified then. Journalists from a couple of news agencies travelled to the site with Proshika staff where various people involved in the incident were interviewed.
>
> The Beat Officer of Boali Beat said "We try to stop the destruction of forest. But we are often helpless as the trespassers are powerful and dangerous". He has filed 23 cases against people for illegal activities related to the forests.
>
> The Range and Beat Officers of the neighbouring areas said that they supported the work being done by Proshika's group members and would try to assist them in every possible way. This sort of activism has successfully reduced theft, at least temporarily. The group members expect more trouble in future. It is impossible for them to guard the forests constantly as they have to work. Without formal institutional support, it becomes even more difficult.
>
> The local people also expressed dismay at the uprooting of sal coppice by the Forest Department for the purpose of planting exotic monocultures.

Sustainability of Forest Protection Activities

Proshika-organized Forest Protection groups are emerging as a viable institutional alternative to protect, regenerate and manage the Sal Forest. The sustainability of such activities will depend on 1) gaining official recognition for, and written benefit-sharing contracts from, the Forest Department for the Forest Protection Groups; (2) increasing the interim benefits generated from the protection areas through intensified research and management interventions; (3) recognizing

that people's participation is central to successful and sustainable management of natural resources; (4) giving due emphasis to equity considerations; and (5) decentralizing information and development planning with full involvement of communities.

Source: Proshika Manobik Unnayan Kendra, 1992

HORTICULTURAL DEVELOPMENT PROJECT BANDARBAN

Caritas initiated this project in 1990 with a view to introducing sedentary agriculture among 12 tribal villages in two thanas of the CHT. The environmental context of the project consists of an area of traditional jhum cultivation in a physical area of depleted and eroded soils. Some of the problems associated with the project are:

- monoculture of short duration crops like ginger and avoids cause soil erosion, particularly at harvest time, as does tillage for planting seedlings, which could be minimized by reducing or eliminating such tillage;
- lack of experience with mulching and dispersed planting of crops such as guava and lemon also contribute to soil erosion, which could be countered with herbaceous plants as ground cover;
- lack of terracing;
- there was a lack of seedlings;
- pest outbreaks in the form of viral and fungal diseases caused significant losses, but government extension officials were unable to identify or remedy these;
- lack of irrigation water and no familiarity with composting and fertilizers caused problems;
- communication problems were apparent, since project staff could not speak the local dialect, which required extra time in translation;
- even after two years , some families had not yet received formal land title from the authorities;
- there are no demonstration plots, and only a limited number of tree species are used, and there has been little species to site experimentation.

There have also been marketing problems, and no nurseries established at village level. All these factors appear to suggest that the Forest Department and the Hill Tracts Development Board have been of extremely limited technical usefulness to the project. However, a number of positive features may also be noted, these being:

- there is growing cooperation between the tribals, the NGO and various government offices;
- in addition to positive environmental benefits which will result, the project has contributed to improved health and sanitation as well as education;
- cultural and religious traditions have been revived, and the project has strengthened group solidarity among the tribals.

AFFORESTATION IN THE UNCLASSED STATE FOREST OF CHITTAGONG HILL TRACTS

This was a Forest Department project implemented between 1980/81 to 1989/90, whereby the goal was to rehabilitate 1500 tribal jhumia families over an area of 20,240 hectares in Rangamati, Khagrachari, Bandarban and Lama. The result over the period was only 485 families and the reported plantation of 11,560 hectares. In addition to improving the overall socioeconomic condition of tribals, the project had the following objectives:

- the allotment of 2 hectares of land for participating families for agroforestry purposes and house construction, provided they planted five hectares of trees in surrounding land;
- community centres, primary schools, and dispensaries were to be constructed, as within 18 "rehabilitation centres";
- augment supply of raw materials (softwood for pulp) to industry;
- develop cottage industries;
- reduce navigational problems in the rivers by reducing siltation of watersheds;
- reduce siltation of the Kaptai hydel project;
- improve the environment and wildlife.

The project had relatively minor positive impact and was later abandoned due to the security situation prevailing in the CHT since the late 1980s. Other projects suffered similar lacklustre performance. The project "Reafforestation in the Denuded Hill Forests of Chittagong and Chittagong Hill Tracts, for instance, had a target of 17,200 hectares for replanting (1980/81- 1986/87), but achieved only 9,600 hectares. Such programmes, generally described by the Department as "successful" provide little scope for replication throughout the country, primarily because the size of land plots could not be duplicated in the plains with such a dense population. In fact, the project "Afforestation of Recovered and Encroached

Forest Land (Phase II), attempted in the northern and north central sal zones barely accomplished half their targets as well (target 6000 ha versus achievement of 3500 ha over the period 1980/81- 1984/85).

BETAGI AND POMORA SOCIAL FORESTRY

One of the more notable attempts at participatory forestry in Bangladesh has been the experiment at two villages in Rangunia Thana in Chittagong. Its objectives were to provide a means of livelihood to landless farmers, involve them in forest protection, and to rehabilitate degraded land through agroforestry.The project was initiated in 1979 and covers about 140 families in Pomora and some 80 families in Betagi. The following were among the observations of interest:

- as in other projects in Bangladesh, the target group (landless) was not strictly achieved; while they were meant to be selected from among the landless, in fact a number of wealthy farmers managed to infiltrate and benefit from the scheme; some were not even resident in the project villages;

- income and economic conditions have improved;, availability of credit and the existence of cooperatives contributed importantly towards this;

- tenurial security was highlighted as one of the major interventions which led to some measure of success; however, the long term sustainability requires resolving land status; in Betagi the land is mostly khas while in Pomora it is protected forest;

- training and extension services of the Forest Department were relatively ineffective, and it was the settlers themselves who innovated various agroforestry modules;

- the project benefited from a charismatic and flexible patron who was a forester working with negligible initial support from his Department; he believed in "not only willing, but joyous participation" as a sine qua non for success;

- there were marketing difficulties and attempts by middlemen and brokers to capture produce at artificially low prices;

- there was increased decision-making by women in those cases where they were allocated plots of land, versus those cases where the land was in the name of the husband;

- plots were on steep slopes, and crops such as ginger and arum lead to soil erosion; terracing and ground cover would mitigate soil loss;

Replicability of the project has not been done on any significant scale. As noticed in the Caritas project in Bandarban, similar problems prevail in some cases, yet these have not been documented in any detail. Areas with similar terrain throughout the hill tracts could benefit from the experience here. The size of land (two hectares) would not be replicable in the plains. The presence of well-organized cooperatives of the poor are a precondition for successful replication. Extension services, credit, and marketing all have to be developed as well, particularly with perishable crops vulnerable to reliable transport also. The settlers developed more than 70 different landuse patterns under various microsites. Flexibility is an essential determinant of success. The practice to date in Bangladesh of promoting specific agroforestry modules will limit future achievements unless the farmers themselves are encouraged to adapt to their microsites, select their own tree species and crops, and organize and control their own cooperatives.

APPENDIX 10
LANDUSE SCENARIO FOR CHITTAGONG FOREST DIVISION

ENVIRONMENT AND LANDUSE

APPENDIX 10
LANDUSE SCENARIO FOR CHITTAGONG FOREST DIVISION

CHITTAGONG FOREST DIVISION

General

The forests of the Chittagong Forest Division are strategically located for both the production of wood and non wood products, and to serve the recreational needs of the major population centres of Dhaka and Chittagong. The demand for pristine recreational areas will greatly increase in the future, as development initiatives result in more and more Bangladeshis becoming educated and joining the middle class. More educated future generations will have a greater appreciation of the value of biodiversity, and the natural ecosystems which support them.

In order to save the natural forests for these future generations, it is imperative that a sustainable landuse strategy be implemented now, which will result in the preservation of these natural forests. The present Forestry Master Plan will be judged on how successful it is in passing on the natural heritage of Bangladesh to future generations. Through the multiple use management of forest lands, this can be done while still producing a sustainable supply of wood and non wood products to help meet present and future needs.

Choudhury (1991b) summarizes the landuse for inventoried forest areas in the Chittagong forest Division as follows:

Table 1 - Summary of Landuse for Inventoried Forest Areas in the Chittagong Division

Landuse Type	Reserved Forest	Protected, Acquired and Vested Forest	Total (ha)	% of Total
Natural Forest	24,987 ha	4,683 ha	29,672	29.9
Scattered Trees	14,116 ha	7,195 ha	21,311	21.6
Plantations	14,390 ha	3,472 ha	17,862	18.0
Denuded	13,144 ha	367 ha	13,511	13.6
Agriculture and Water	16,728 ha	0 ha	16,728	16.9
Total	83,365 ha	15,717 ha	99,084	100.0

Another 13,067 ha of protected, acquired and vested forests has not been inventoried. It is estimated that only 60% of the non inventoried land is available due to encroachment.

There are at present 12,086 ha of forest set aside for management as Wildlife Sanctuaries. These have been established in Chunati, Jaldi, Baraiyadhala and Rangunia Ranges. These areas not only provide for the protection of the habitat for wildlife, but also provide for the preservation of the ecology and provide the potential for the continued existence of a natural gene pool of trees and plants indigenous to the region,

The areas presently constituted are as follows:

-	Chunati Wildlife Sanctuary	7,763 ha
-	Hazarikhil Wildlife Sanctuary	2,908 ha
-	Khurusia Wildlife Sanctuary	1,415 ha
	Total	12,086 ha

Note: The Hazarikhil and Khurusia Wildlife Sanctuary areas have been given protection for this purpose from 1978, but have not been notified as sanctuary. Their notification should be finalized as soon as possible.

Table 2 summarizes present landuse within these Wildlife Sanctuaries, based on 1985 inventory.

Table 2 - Landuse in Existing and Proposed Wildlife Sanctuaries in Chittagong Division

Sanctuary	Natural Forest (ha)	Scattered Trees (ha)	Plantations (ha)	Denuded (ha)	Other (ha)	Total
Chunati	1,925	2,575	1,300	1,308	830	7,938
Hazarikhil	1,971	71	349	28	36	2,455
Khurusia	915	87	35	133	348	1,518
Total	4,811	2,733	1,684	1,469	1,214	11,911

From this it can be seen that only 4,811 ha of natural forests are scheduled to be protected. Of this, only 1,925 have notified protection (Chunati Wildlife Sanctuary). This is not adequate to ensure the survival of biodiversity in this Division. For example, Khan (1990) lists 30 species which were recorded for the Chunati forest in 1925, which are absent from recent surveys. This suggests that biodiversity is declining. It is therefore imperative that a much larger area of natural forest be protected for the preservation of biodiversity, through the protection of ecological diversity.

Recommended Sustainable Landuse Strategy

Table 3 presents a sustainable landuse scenario for the Reserved Forests of the Chittagong Division, based on the "Core-Buffer-Multiple Use Strategy" for the management of natural resources within Multiple Use Management Areas.

Core Zone - Core areas would be maintained for the preservation of biodiversity through the preservation of ecological diversity. There would be no logging in the core areas, and access would be restricted. About 32.4% of the reserved forests, or 26,987 ha, would be designated as core zone.

A large core area is needed to protect viable populations of the main components of the ecosystem, both flora and fauna. The natural forests of the Chittagong Division now have a disjunct distribution. Therefore, the survival of the natural forest stands depends on the maintenance of local seed sources, and local breeding populations.

The forest designated as core area may be disturbed. This does not matter as long as the forest area contains seedlings and advanced growth of natural forest species, which will eventually grow to form a more or less natural forest.

The forest designated as core area also do not have to be in one block, but can be several separate blocks. It would however be highly desirable to have these core areas linked as much as possible through corridors of vegetation in the buffer zones and the multiple use zones. This would assist the movement of wildlife between core areas.

For this reason, it is highly desirable to keep as much of the natural vegetation with scattered trees intact as possible. These areas could be made more productive through enrichment planting, which would maintain the biodiversity and soil properties. Clearcutting, burning and plantation establishment would greatly reduce the biodiversity and would also change the physical and chemical properties of the soil.

Some of the old plantations may also have a rich undergrowth of native species, which would make them suitable for inclusion in buffer zones, and as corridors for wildlife. When the mature trees in these old plantations are removed, it would be better to replace them through enrichment planting with native species, rather than through clearcutting, burning, and plantation establishment. Enrichment planting would retain the accumulated biodiversity, and would help maintain the physical and chemical properties of the soil.

The moratorium on logging natural forest should be replaced by a policy calling for the permanent protection of these forests for the preservation of biodiversity and natural ecosystems. The natural vegetation with scattered trees should also be managed for the preservation of biodiversity, and should not be converted to plantations. They should instead be managed through enrichment planting, followed in the future by a limited selection logging system.

Table 3 - Sustainable Landuse Scenario for Reserved Forests in the Chittagong Division

Zone and Landuse Type	Area by Zone (ha)	% of Area	Area by Type (ha)	% of Area
Core Zones	26,987	32.4%		
Natural forest			24,987	30.0%
Natural vegetation with scattered trees			2,000	2.4%
Buffer Zone	14,000	16.8%		
Natural vegetation with scattered trees			10,000	12.0%
Old F.D. plantations			4,000	4.8%
Multiple Use Zone	42,378	50.8%		
F.D. plantations			22,000	26.4%
Participatory forestry area			19,000	22.8%
Water + Others			1,378	1.6
Total	83,365	100.0	83,365	100.0

Buffer Zone - The buffer zone would be managed in such a way as to protect the core areas, and extend the habitat available for wildlife. Timber could be extracted on a selection basis, if adequate regeneration and advanced growth of suitable species are available on the site. Bamboo and other non wood products could be extracted on a sustained yield basis, with annual extraction equal to annual increment. About 16.8% of the reserved forests, or 14,000 ha, would be designated as buffer zone. The extraction of wood and non wood products could be controlled by a permit system.

Multiple Use Zone - The multiple use zone would be intensively managed for the production of wood and non wood products. It is envisaged that the FD plantations would be medium to long rotation plantations, managed for quality timber. It may be possible to lease some established plantations on suitable sites to local people for underplanting with non wood products, such as cane, medicinal plants, spices, etc. The participatory forestry areas would be managed for a mixture of short rotation wood and non wood products, in order to provide a relatively short term income for the participants. About 50.8% of the reserved forests, or 42,378 ha, would be designated as multiple use zone.

Plantation Productivity

1. Past Practices and Results

Past management prescriptions have been based on the conversion of natural forests to plantations. Divisional records show that 38,852 ha of area have been planted since 1923.

The plantation area for the Reserved and Protected Forests of the Division has been shown by the inventory (De Milde et. al. 1985), updated to 1987, to cover approximately 17,862 ha. The figures of the inventory do not include undetermined area established in Acquired and Vested Forest, nor include all of the Protected Forest lands which could not be delineated on the aerial photography.

In the five year period, 1985-86 to 1990-91, 3028 ha of natural forests were felled for conversion to plantations. This was based on the calculated annual allowable cut. According to Choudhury (1991), the annual allowable cut (AAC) of natural forests has been calculated as 543 ha/annum and, therefore, the periodic cut should not exceed 2719 ha in any 5 year period.

Choudhury (1991) suggests that approximately 21,000 ha of planted area have been lost to encroachment, illicit felling and the ravages of the 1941-45 war and the 1971 liberation war periods. Included in this figure is an unknown quantity created by double entry of replanted area. Approximately 9,100 ha of plantation area has been assessed (1987) to be written off as failed.

Approximately 20% of the identified plantations is of poor stocking and condition and could be considered to be economically unmanageable. Lack of funds for post-establishment maintenance have to a very large extent hindered the growth of the majority of the plantations.

Extensive damage to the plantations has taken place due to the recent cyclone which swept over the area in 1991. At places, local people have entered into the plantation and collected posts/poles and other building materials indiscriminately and caused irreparable damage to the plantations.

2. Present Situation

The government has imposed a moratorium on the logging of natural forest, in order to preserve biodiversity and conserve the resource. This moratorium, which is to be in effect until the year 2000, has delayed plans for the conversion of natural forests to plantations.

It has recently been decided, however, to fell 100 ha of such forest annually for meeting the requirements of railway sleepers.

In spite of the setbacks and failures noted in i. above, the Forest Department is still focused on the establishment of more plantations. According to Choudhury (1991), proposals have been made to raise 23,890 ha of plantations during the plan period of 10 years (1991-92 to 2000-2001). These plantations are to be raised in natural high forest, natural forest with scattered trees, denuded areas, and regeneration cut area. The planting programme has also been detailed for various rotations, which are as follows.

Long rotation (40 years) -	14,379 ha
Short rotation (18 years) -	9,251 ha
Short rotation (6 years) -	260 ha

The fact that proposals being made in the Forest Management Plan for the Chittagong District 1991-92 to 2000-2001 continue to be based on the logging of natural forests and conversion to plantations suggest a lack of Forest Department support for the moratorium, and its rationale.

This is unfortunate, since it is only through the support of the Forest Department that the moratorium can be successful, and alternate management systems can be developed to replace the present destructive management system based on converting species rich natural vegetation to species poor plantations. Instead of focusing on enrichment planting management systems for the restocking of natural forests, the focus continues to be on the development of plantations through clearcutting, burning and planting.

It appears that the professional foresters have failed to grasp the importance of biodiversity, and its potential benefits for future generations of Bangladeshis. Instead, long term interests are being sacrificed for short term gains. It is unlikely that future generations of Bangladeshis will look kindly on foresters who allow their natural heritage to be sacrificed for very questionable economic benefits. The same foresters have failed to grasp the principles of sustainable development, where the present generation has an obligation to future generations to maintain the environment in such a way as not to compromise the interest of future generations.

Given the present landuse pattern in the reserved forests, the proposals given in the Management Plan may be too high. This is especially true in light of growing concerns for biodiversity and its conservation.

It is therefore recommended that the moratorium on the cutting of natural forests be replaced by a policy for the protection of the natural forest for the preservation of biodiversity and natural ecosystems. Also, more emphasis should be on the enrichment planting of natural vegetation with scattered trees with economic native species to increase stocking, rather than conversion to plantations.

Plantation establishment should focus on denuded areas, and the replanting of plantations as they mature and are harvested.

Past problems associated with the management of natural forests and plantations strongly suggest that the institutional capacity of the Forest Department has already been exceeded, and that there needs to be a consolidation of efforts to focus on what is institutionally possible, rather than constantly expanding plantations. The existing plantation area should first be managed to their maximum potential before expansion takes place.

3. Species and Site Selection

Long Rotation Plantations (40 years) - According to Choudhury (1991), Garjan (Dipterocarpus spp., Dipterocarpus turbinatus preferred) will be the main long rotation species to be established on large forest blocks which are not currently subject to any landuse other than forestry. High forest, "scattered tree" type, selected denuded areas, mature and degraded plantations will be the main areas prescribed for this rotation.

The selection of garjan as the main species is a major deviation from the previous practice of planting teak. It has, however, been shown by land capability and site assessment studies that sites best suited to teak are limited within the division.

In addition to garjan, Xylia dolabriformis (pynkado), Swietenia macrophylla (mahagony) and Syzygium grande (dhakijam) will also be planted on suitable sites. Tectona grandis (teak) will be planted only on those sites for which it is best suited, which are found mainly on Land Capability Class II.

These species have been selected using economic justification for establishment. Further planting of Artocarpus chaplasha (chapalish), Hopea odorata (telsur), Albizzia procera (koroi) and Chukrasia velutina (chikrassi) under this programme on suitable sites. These species plus Anisoptera glabra (boilam), Michelia champaca (champaful), Terminalia chebula (arjun), Duabunda grandiflora (banderhola), Lagerstroemia speciosa (jarul), Bischofia javanica (kainjal) and Swintonia floribunda (civit), may be established. However, if the site allows, there would be 40% teak and 60% other evergreen species. Teak to be planted on block mixture.

Site suitability will be determined according to the Land Capability of Physiographic Sites (de Lannoy 1985) for macro area suitability with the 1:50,000 map overlays, and by the use of the Handbook of Site Classification and Site Suitability Assessment (P.R. Stevens 1986) for micro area suitability.

This approach to long rotation plantations is a marked improvement on past practices. The emphasis on native species will help maintain biodiversity. This is especially true on sites classed as denuded, or in failed plantations. However, in areas presently under natural vegetation with scattered trees, the focus should be on enrichment planting, rather than conversion through clearcutting, burning, and artificial regeneration through planting. Enrichment planting would ensure greater biodiversity, and would help preserve the chemical and physical properties of the soil. Maintaining the soil in its natural condition would probably favour the growth of the native species being planted.

Short Rotation Plantations - According to Choudhury (1991), the short rotation plantation working circle is made up of two distinct silvicultural and management systems.

Under the first system, domestic wood plantations are established for the production of fuelwood for local demand utilizing Eucalyptus on a 6-year rotation (SR6) coppiced three times. SR6 plantations will be raised only for 1991-92, which is the last year for Forestry II Programme.

Under the second system, short rotation plantations are established for posts, poles, peeler utility timber and fuelwood, utilizing Acacia mangium, garjan, Xylia dolabriformis, Pinus carribaea, Dhakijam, Casuarina, Tectona grandis, Terminalia chebula, etc. on an 18-year rotation.

As noted by Choudhury (1991), the issue of raising plantations solely for fuelwood at 6-year rotation with Eucalyptus as main species has been reviewed. The performance of Eucalyptus is not good, and this has raised many questions. The main question is "who are the fuelwood plantations being raised for?" Most poor rural residents rely on agricultural residues, leaves, branches, waste bamboo, etc. for cooking. They cannot afford to purchase fuelwood at plantation costs. The recent ban on the use of wood materials for brickburning and switching to use of gas and coal will eventually reduce the demand for plantation-size fuelwood. Fuelwood will also come from coastal plantations. Also, many deficit areas are too far away from the plantations to allow the fuelwood to marketed profitably, and at a price which people could afford. Large quantities of fuelwood could come as a byproduct of short rotation (18 years) plantations and from long rotation (40 years) plantations. On these considerations, the short rotation (6 years) plantations are being discontinued. Instead, the future focus will be on short rotation (18 year) plantations. These are to be planted at 1.83m x 1.83m (6 feet x 6 feet) spacing.

For these plantations, Acacia mangium, Dipterocarpus spp., Acacia auriculiformis, Dalbergia sissoo, Pinus carribaea, Samanea saman, Albizzia procera and Eucalyptus camaldulensis will be the species to be use. A. auriculiformis may be preferred on badly degraded sites, where dense sungrass cover makes establishment particularly difficult. Further, Gmelina arborea is also suggested for planting on suitable sites.

In addition to the species mentioned above, Casuarina spp., Albizzia procera, Cedrela spp., Syzygium grande, Tectona grandis, and Terminalia chebula may also be considered where site conditions favour these species. Monocultures of Acacia mangium must be avoided in light of experiences in Indonesia and North Bengal, where heart rot and top drying were observed, respectively.

The focus on a range of species, instead of a few exotics, is a welcome improvement. However, the use of many different species makes all aspects of plantation establishment and management more complicated and therefore more difficult.

Field observations strongly suggests that the technical aspects of raising mixed plantations are still not well worked out.

For example, during field visits to nurseries, it was noticed that nursery techniques had yet to be standardized and nurserymen were not skilled in developing quality seedlings of the appropriate size to meet the planting schedule. This was especially true for nurseries preparing seedlings for mixed plantations. For example, months before the planting date, some seedlings were already very large with a poor shoot:root ratio. Other seedlings had been allowed to grow through the bottom of the polybags and were growing into the ground. Their tap root would be severely damaged when moved. At the same time, seedlings of other species were doing poorly and were small and weak. Additional water and fertilizer may improve their appearance in the nursery, but not their performance in the field. It is highly unlikely that many of the seedlings being raised would have the potential to produce a quality fast growing tree.

In nurseries producing Eucalyptus seedlings, many of the seedlings had badly twisted tap roots due to poor transplanting techniques. Seedlings with deformed roots would likely perform poorly in the field, especially on exposed sites which become extremely dry during the dry season. This may partly explain the poor performance of Eucalyptus camaldulensis in Bangladesh.

Based on field observations, it is recommended that nursery techniques and plantation establishment and maintenance practices be clearly worked out before extensive programmes are implemented.

4. Growth and Yield of Plantations

Table 4 gives a summary of plantation species yield potential extracted from the Forest Management Plan for Chittagong Division 1991-92 to 2000-2001.

It should be clearly understood that these are only potential yields, and not actual average yields. Actual average yields may be much less than these potential yields, due to site conditions and to poor plantation establishment and maintenance. These figures should only be used as a guide, but predictions should be based on realistic figures based on local experience, and actual management systems.

For example, the actual yield calculated for Paraserianthes falcateria plantations in Sylhet Division was 11 m3/ ha/ A, which is much less than 30-40 m3/ ha/ A given in the table. Also, actual yield from Tectona grandis plantations in the Chittagong Hill Tracts was calculated at about 2 m3/ ha/ A rather than the 4.8 m3/ ha/ A given in the table.

At actual low yields, plantations may not be economic, and may be a poor development investment. Also, low yielding plantations may not provide higher yield than properly managed natural forests using natural regeneration and enrichment planting.

Table 4 - Potential Yield of Some Plantation Species

Production	Species	MAI m3/ha/A	Rotation in Years	Number of Thinnings
High MAI greater than 20 m3/ha/A	Paraserianthes falcateria (Melocanna)	30-40	12-15	2
Good MAI 7-10 m3/ha/A	Dipterocarpus spp. (Garjan)	10.5	45	4
	Gmelina arborea (Gamar)	9.0	15	2
	Sonneratia apetala (Keora)	7.0	15	2
	Avicennia spp. (Baen)	7.5	15	2
Moderate MAI 5-7 m3/ha/A	Artocarpus chaplasha (Chapalish)	6.1	45	4
	Alstonia scholaris (Chatian)	5.5	50	4
	Syzygium grande (Dhakijam)	5.4	45	4
Poor mai less than 5 m3/ha/A	Tectona grandis (Teak)	4.8	45	4
	Teak/dhakijam/garjan mixed	4.9	45	4
	Shorea robusta (Sal)	4.8	45	3
	Lagerstroemia speciosa (Jarul)	4.2	50	4

Source: Choudhury, 1991b

5. Land Allocation for Sustainable Plantations

The sustainable landuse scenario for reserved forests in the Chittagong Division proposes that 22,000 ha of the division be set aside for the development of intensively managed plantations. Under existing institutional capacity, this would appear to be an appropriate target, given the Forest Department's other responsibilities.

In addition, a good percentage of the 14,000 ha of natural vegetation with scattered trees and old plantations proposed as buffer zone could be enrichment planted with economic native species. The economic trees could eventually be harvested on a selection basis for timber. This should be done in such a way as to preserve the biodiversity, and forest structure.

6. Participatory Forestry Areas

These are areas within the reserved forests which are set aside for participatory forest activities. Information for present forest landuse indicates that 16,728 ha of reserved forests in the Chittagong Forest Division are presently under agriculture and water, and another 13,144 ha is denuded.

It would be very difficult to force the people to stop using the land which is presently under agriculture. It is therefore proposed that these people be given long term leases to the land under condition that they maintain the land under a certain percentage of tree cover.

Leases should be granted to women as well as men. This would give the woman and her children a measure of financial security in case of divorce or widowhood.

Landuse Options

Some landuse options which could be used in the participatory forestry areas are:

- bamboo managed on 4-year rotation for providing raw materials for pulp, paper, rayon industries, or for building materials.
- pulpwood plantations managed on 8-12 year rotation for providing raw materials to pulp, paper, and rayon industries. The wood could also be sold for fuelwood, or as small size poles for house construction.
- short rotation plantations for providing suitable wood for veneer for making tea chests.
- multipurpose plantations managed on 20-30 year rotation for pulpwood (8-12 years), poles (15-18 years), and peelers (20-30 years).

- multipurpose plantations managed as above with cane planted underneath.
- nitrogen-fixing fodder trees which can be used as the basis for making concentrate for animal feeds. Nutritious grasses could be grown on vacant land outside the forest reserve, and be mixed with nutritious fodder from nitrogen-fixing trees.
- these same nitrogen-fixing trees (for example, Gliricidia) could be used as a cover tree for various spice, condiment, and medicinal plants.
- a secondary product of nitrogen-fixing tree plantations could be garden stakes for growing beans. These are in demand in the Chittagong District. Gliricidia is especially good for this purpose.
- rubber plantations (eventually giving timber when plantations are replaced) could be integrated with livestock production, as an integrated agroforestry system.
- fruit orchards under intensive, private management.
- mixed homestead types of plantations.
- mulberry for sericulture, and making sports equipment

Species selection and planting model would depend on local site conditions.

Many of the products produced in the reserved forest could be processed locally, and provide the basis for the development of local industries, both small scale and large scale. Industries could contract participating families to grow raw materials specifically for their industrial needs. This would benefit industries by ensuring the supply of raw materials, and benefit the people by having a guaranteed market. By focusing on perennial tree crops and associated vegetation, there will be benefits for soil conservation and watershed management. Soil conservation would reduce the deterioration of the soil, and would slow down silting of rivers and reservoirs.

1. Involvement of NGOs

Participatory forestry activities would benefit from the involvement of dedicated NGOs. NGOs often have considerable experience in working with disadvantaged people, and in group development for the management of resources. Once groups have been formed by NGOs, it is easier for the government extension staff to provide training an distribute subsidies associated with the participatory forestry activities. NGOs have credit programmes which could be used by groups to fund some of their activities. They also have training programmes for income-generating activities, based on the processing of raw materials. By linking income-generating activities with health and education activities, NGOs tend to improve the overall socioeconomic conditions of the target groups. NGOs are often more sensitive to the development needs of women, and support the active involvement of women in programme activities.

In order to serve the needs of women participants, it is important that the NGOs and government agencies involved in programmes associated with participatory forestry have significant numbers of female staff. Women staff should be in decision-making positions, as well as being extension workers and trainers.

It is encouraging to note that many NGOs have already carried out pilot projects for participatory forestry activities of this type. This experience should assist them in developing programmes for wider implementation.

2. Designation and Management

To facilitate the management of the reserved forest using the "core-buffer-multiple use strategy", it is recommended that the present forest lands be designated as Multiple Use Management Areas (MUMA), as defined using the IUCN classification system.

The protected core areas in each Multiple Use Management Area may in some cases be designed as Nature Reserves or National Parks, in order to increase their status and facilitate their management and development.

The Multiple Use Management Areas must have an integrated management plan. The formulation and implementation of such a plan would require coordination between the institutions for Conservation, Participatory Forestry, and traditional Forest Management.

3. Impact on National Landuse

Using this strategy, approximately 99,084 ha would be brought into the national protection system. This represents 0.7% of the land area of Bangladesh. This would contribute to the preservation of the biodiversity of Bangladesh.

Through better management of the buffer zone and the multiple use zone, the supplies of wood and non wood products would also be increased.

APPENDIX 11
PREDICTED IMPACTS OF GLOBAL WARMING ON BANGLADESH

ENVIRONMENT AND LANDUSE

APPENDIX 11
PREDICTED IMPACTS IF GLOBAL WARMING ON BANGLADESH

Table 1 - Existing Housing units and Educational Institutions likely to be Affected due to 1 metre Sea level Change

Type of Structures	Number	Percent
A. Dwelling Units		
1. Used only as dwelling units		
(a) Poor/ Kutcha House	951,223	50.9
(b) Middle semi pucca House	698,552	36.9
(c) Good pucca House	207,379	11.1
2. Business/ Industrial Units (Used both for living and business/ manufacturing)		
Subtotal	1,867,308	100.0
B. Educational Institutions		
(a) Primary Schools	4,900	
(b) High Schools	120	
(c) College	111	
(d) Madrashas	2,062	
Subtotal	8,273	

Table 2 - Summary of Physical Assets, Infrastructures etc. Likely to be Affected due to 1 metre Sea Level Rise

Physical Assets/ Infrastructures etc.	Number (if not mentioned otherwise	Value in Million Tk
1. Land Area (.000 Acres)Total		56079
a) Not Available for cultivation	87.9	8,744.92
b) Current Fallow	77.4	3,877.00
c) Single Cropped Area	202.8	121,248.00
d) Double Cropped Area	744.9	55,867.50
e) Triple Cropped Area	149.6	11,968.00
f) Forest	1,304.1	-
g) Others	1,223.7	61,185.00
2. Dwelling Units	1,867,308	123,274.58
3. Business/ Industry Household	20,154	4,227.45
4. Institutional Household	7,602	1,900.50
5. Educational Institutions	8,273	1,907.24
a) Primary School	4,900	1,078.00
b) Secondary School	1,200	552.00
c) College	111	7104
d) Madrasha	2,062	206.20

6.	Rural Electrification Village	543	497.75
7.	Communication		
	a) Railway Track	1,466 km	-
	b) Metalled Road	706 km	3,838.91
	c) unmetalled Road	19,772 km	26,199.52
	d) Bridge/ Culverts (Nos.)	10383	10,383.00
	e) T&T Office (Nos.)	148	-
8.	Godowns of		
	a) Food	281	196.70
	b) Fertilizer	94	66.45
9.	Hats and Bazars (market centres)	1,757	-
10.	Industries		
	a) Cottage Industries (Households)	97,777	988.32*
	b) Small Industries	1,911	89.39
11.	Health Centres		
	a) Health Complex	49	490.00
	b) Health & F.P. Centre	133	399.00
12.	Livestock & Poultry (000 Numbers)	13,545	4,601.94
	a) Cattle & Buffalo	2,734	4,217.92
	b) Goats & Sheep	986	236.64
	c) Poultry	9,825	147.38

13. Annual Production Value of Crops (1986-87)

Crops	Area 000 Acres	Production 000 Tons	Production Value (Million Tk)
a. Rice			
Aus 837	288	3,168.00	
Aman	2,067	1264	15,642.00
Boro	180	179	2,092.10
HYV	161	293	3,223.00
b. Wheat	13	13	70.07
c. Jute 42	10	74.29	
d. Sugarcane	14	214	158.90
e. All Pulses	335	97	1,150.34
f. All Oilseeds	102	37	412.60
g. All Vegetables	22	405	1,671.00
h. All Species	116	97	2,052.08
i. Cotton	.09	.01	-
j. Crops	2,312	-	-

14. Annual Production Value of

a. Cottage Industries	98,207.12
b. Small Industries	325.78

* Note: Fixed Assets

Table 3 - Contribution of the Area (Likely to be Affected due to 1 Metre MSL Change) to GDP of the Country (1984-85)

(Million Tk)

Sectors	Faridpur	Noakhali	Khulna	Barisal	Patuakhali	Total affected area	% of the Country
Agriculture	1,311	3,541	8,115	9,335	5,059	27,382	13.05
Crops	927	2,889	4,709	7,332	3,822	19,679	12.72
Forestry	4	22	2,111	53	66	2,256	16.45
Livestock	4,150	450	950	1,319	670	3,539	13.24
Fisheries	230	180	345	652	501	1,908	13.03
Mining and Quarrying	-	-	-	-	-	-	-
Industry	43	315	1,236	226	81	1,901	5.48
Large Scale	13	48	1,008	7	1	1,077	5.56
Small Scale	30	267	228	219	80	824	5.39
Construction	157	474	735	1,295	506	3,167	13.93
Power, Gas Water & Sanitary Services	7	30	89	75	30	231	9.84
Transport, Storage & Communications	179	458	1,295	1,411	352	3,695	13.55
Trade Services	197	562	1,361	1,395	748	4,263	12.08
Housing Services	195	590	914	1,610	629	3,938	14.07
Public Admn. & Defence	120	342	569	939	373	2,343	13.24
Banking* Insurance	36	125	227	292	146	826	11.99
Professional and Misc Services	179	682	1,249	2,125	632	4,867	14.17
GOP at current Market Prices	2,424	7,119	15,790	18,724	8,556	52,613	12.56
Indirect Tax net of subsidies	148	423	701	1157	450	2889	13.26
GOP at current Factor Cost	2,276	6,696	15,067	17,567	8,096	49,724	12.52

APPENDIX 12
OBSERVED IMPACTS OF CYCLONE ON VEGETATION

PROJECT 372001/30
FORESTRY MASTER PLAN,
BANGLADESH (TA NO.1355-BAN)

ASIAN DEVELOPMENT BANK
MANILA PHILIPPINES
DATE: JANUARY 1993

ENVIRONMENT AND LANDUSE

APPENDIX 12
OBSERVED IMPACTS OF CYCLONE ON VEGETATION

Plant species	Nature and percentage of overall damage	Additional observation
1. Acacia auriculiformis	Damage to branchlets and leaves (20%)	In Chunati plantation
2. A. mangium	Branchlets broken (20%)	Damage in Chunati plantation
3. Alangium salvifolium (Ankura)	Branches broken, no leaf damage (15%)	Mostly at Chittagong
4. Albizzia chinensis	Mostly defoliated, uprooted (60%)	
5. A. lebbeck (Siris)	Defoliated, now with new leaves (10%)	
6. A. lucida (Sil koroi)	Negligible damage to stems (6%)	Greater damage in Banskhali
7. A. procera (Silkoroi)	" " "	
8. Anogeissus lanceolata (Hingori)	Uprooted, damage to branches (10%)	
9. Anthocephalus chinensis (Kadam)	Mostly uprooted, branches torn (50%)	
10. Areca catechu (Supari)	Leaves scorched at the end (5%)	Stem damage in Moheshkhali and Banskhali
11. Artocarpus heterophyllus (Kanthal)	Excepting fruits, all parts damaged 40%)	
12. A. lakoocha (Deophal)	Some damage to stems and branches (30%)	
13. Avicennia spp. officinalis (Baen)	Leaves scorched but stems intact (5%) Negligible damage (5%)	Stands on Sonadia island
14. Azadirachta indica (Neem)	Columns prostrate (50%)	
15. Bambusa spp.(Bans)	Least damage (1%)	Mostly in Moheshkhali
16. Barringtonia acutangula	Stem intact, top branches broken (20%)	
17. Bombax ceiba (Simul)	Slight scorching at the end of leaves (3%)	
18. Borassus flabellifera (Tal)	Some damage to branches and leaves (15%)	Nests of weaver birds
19. Bursera serrata (Gugutiya)	Tops blown off, stems prostrate (40%)	
20. Carica papaya (Pepe)	Leaves scorched, damage to branches (10%)	At moheshkhali
21. Cassia fistula (Sonalu)	Damage negligible (5%)	
22. C. siamea (Minjuri)	Uprooted, branch damage (25%)	
23. Casuarina littorea (Jhau)	Least damage (1%)	Sea beach, Cox's Bazar
24. Clinogyne dichotoma (Patipata)	Damage negligible (3%)	At banskhali
25. Cocos nucifera (Narikel)	Leave and stems least affected (5%)	More damage in Banskhali
26. Dalbergia sissoo (sishoo)	Very little damage (1%)	
27. Delonix regia (Krishnachura)	Slight damage to leaves (3%)	
28. Diospyros peregrina (Gab)	Much damage to branches (40%)	
29. Dipterocarpus alatus (Garjan)	Stems unaffected (35)	
30. D. costatus (Garjan)	" " " (3%)	
31. D. turbinatus (Garjan)	A few trees uprooted (40%)	
32. Erythrina ovalifolia (Mandar)	Slight damage to leaves (3%)	Most damage in Banskhali

Plant species	Nature and percentage of overall damage	Additional observation
33. Eucalyptus spp.	Stems unaffected (3%)	On Chunati Cox's Bazar road.
34. Ficus bengalensis (Bot)	Slight damage to branches (5%)	
35. F. religiosa (Assawath)	" " "	
36. F. rumphii (Gaya assawath)	" " "	
37. Garuga pinnata (Bhadi)	Stems intact, branches broken (15%)	
38. Gmelina arborea (Gamar)	Uprooted, stems broken (20%)	
39. Grewia spp.	Least affected (2%)	Mostly in Moheshkhali
40. Hevea brasilliensis (Para rubber tree)	Damage to branches (20%)	in Ramu plantation
41. Ipomoea fistulosa (Dhol Kalmi)	Completely unaffected (0%)	Thriving in all environments
42. Lagerstroemia speciosa (Jarul)	One of the worst affected (40%)	Most damage to branches
43. Lannea coromandelica (Jika)	Branch damage,leaves fallen (15%)	
44. Litsea spp.	Only slight damage to branches (8%)	
45. Mangifera indica (Am)	Uprooted, branches broken, leaves scorched (40%)	
46. Melia azaderach (Gora neem)	Some branch damage (5%)	
47. Michelia champaca (Champa)	Damage to branchlets only (2%)	
48. Momordica charantea (Karulla)	Complete destruction (90%)	Near Sitakundu and Ctg.
49. Musa paradisiaca var. sapientum (Kola)	Severe damage to clumps (60%)	Most damage in Chokoria
50. Oryza sativa (Dhan)	Crops perished, harvested grain washed away(100%)	
51. Peltophorum pterocarpum (Halud Krishnachura)	Damage to branches and leaves (40%)	
52. Phoenix sylvestris (Khejur)	Some scorched effect on leaves (5%)	Little damage to stems
53. Piper betel (pan)	Extensive damage to plantation (80%)	From Sitakundu-Ctg.
54. Polyalthia longifolia (Debdaru)	Branches broken, no leaf damage (35%)	
55. Psidium guajava (Pyara)	Leaves and fruits show scorched effects (40%)	
56. Pterocarpus indicus (Padauk)	Damage to branches and leaves (7%)	
57. Saccharum officinarum (Ikkhu)	Damage negligible (3%)	From Sitakundu-Ctg
58. Samanea saman (Rain tree)	Defoliation, damage to branches (50%)	Uprooted in Banskhali
59. Streblus asper (Asshaora)	Canopy with unilateral damage (15%)	
60. Swietenia macrophylla (Mahogany)	Stems intact, leaves scorched (10%)	Mostly at Ctg.
61. S. mahogany (Mahogany)	" " "	and Cox's Bazar
62. Syzygium cumini (Kalo jam)	Damage negligible (2%)	
63. S. grande (Dhaki jam)	" " " (25)	Least damage in plantation
64. Tamarindus indica (Tetul)	Least damage (2%)	
65. Tectona grandis (Shegun)	Uprooted, branches and leaves damaged *75%)	Great damage
66. Terminalia arjuna (Arjun)	Occasional damage to branches (10%)	in forest plantations
67. T. catappa (Kat badam)	Trees decapitated, to leaf damage	
68. Trewia polycarpa (Petali)	Mostly unaffected (10%)	
69. Zanthoxylum rhetsa (Bajna)	Mostly uprooted (60%)	

APPENDIX 13
IUCN MANAGEMENT CATEGORIES AND DESCRIPTION OF CONSERVATION AREAS

ENVIRONMENT AND LANDUSE

APPENDIX 13
MANAGEMENT CATEGORIES AND DESCRIPTION OF CONSERVATION AREAS

CATEGORY I - Scientific Reserve/ Strict Nature Reserve

Introduction - The rapid alteration of many natural environments has created a need for a category of management which will ensure areas free of human intervention and available exclusively for scientific research and environmental monitoring. These natural areas provide locations for research where a complete understanding of natural processes can be attained. In some situations, scientific research may be limited to non-manipulative (observational) research in order to restrict the influence of human activity on the natural ecosystem.

Management objective - To protect nature (communities and species) and maintain natural processes in an undisturbed state in order to have ecologically representative examples of the natural environment available for scientific study, environmental monitoring, education, and for the maintenance of genetic resources in a dynamic and evolutionary state. Research activities need to be planned and undertaken carefully to minimize disturbance.

Criteria for Selection and Management - These areas possess some outstanding ecosystems, features and/ or species of flora and fauna of national scientific importance or are representative of particular natural areas; they often contain fragile ecosystems or life forms, areas of important biological or geological diversity, or areas of particular importance for the conservation of genetic resources. Size is determined by the area required to ensure the integrity of the area to accomplish the scientific management objective and provide for the protection of the area.

Natural processes are allowed to take place in the absence of any direct human interference; tourism, recreation, and public access are generally prescribed. Ecological processes may include natural acts that alter the ecological system or physiographic features such as naturally occurring fires, natural succession, insect or disease outbreaks, storms, earth-quakes and the like, but necessarily exclude man-made disturbances.The educational function of the site is to serve as resource for studying and obtaining scientific knowledge.

Use of the reserve should in most cases be controlled by central government. Exceptions may be made where adequate safeguards and controls for long-term protection are ensured and where the central government concurs.

CATEGORY II - National Park

Introduction - Governments have for some time recognized the desirability of establishing protective regimes over outstanding natural areas representative of the diversity of ecosystems in their countries and areas of jurisdiction, so as to guarantee their protection ad use for present and future generations. Rapid exploitation of natural resources has demonstrated that, unless governments take decisive action to protect the most outstanding examples of the country's natural heritage, these resources may be lost. The continued trend of urbanization has increased the need to provide opportunities for outdoor recreation and tourism in natural settings. Furthermore, the need for people to understand more fully the natural environment is of particular concern in an age of rapidly diminishing natural resources. Outstanding representative areas of a nation can serve to contribute to this understanding.

Management Objectives - To protect natural and scenic areas of national or international significance for scientific, educational, and rational use. The area should perpetuate, in a natural state, representative samples of physiographic regions, biotic communities and genetic resources, and species in danger of extinction to provide ecological stability and diversity.

Criteria for Selection and Management - National parks are relatively large areas which contain representative samples of major natural regions, features or scenery where plantational and recreational interest. They contain one or several entire ecosystems that are not materially altered by human exploitation and occupation. The highest competent authority of the country having jurisdiction over the area has taken steps to prevent or eliminate as soon as possible exploitation of occupation in the area and to enforce effectively the respect of ecological, geomorphological, or aesthetic features which have led to its establishment.

The resource is managed and developed so as to sustain recreation and education activities on a controlled basis. The area is managed in a natural or near-natural state. Visitors enter under special conditions for inspirational, educational, cultural and recreational purposes; sport hunting is not a compatible use, but culling for management purposes is sometimes required.

CATEGORY III - Natural Monument/ Natural Landmark

Introduction - Most countries possess natural features of particular scientific and educational interest; however, they often receive no special national recognition. The features might include spectacular waterfalls, caves, craters, volcanoes, unique species of flora and fauna, sand dunes, etc., of such scenic, scientific, educational and inspirational importance that they merit special designation and protection; because of their uniqueness, these areas deserve greater protection for both scientific and public enjoyment.

Management Objectives - To protect and preserve nationally significant natural features because of their special interest

or unique characteristics and, to the extent consistent with this, provide opportunities for interpretation, education, research, and public appreciation.

Criteria for Selection and Management - This category normally contains one or more of several specific natural features of outstanding national significance which, because of uniqueness or rarity, should be protected. The specific feature to be protected ideally has little or no evidence of man's activities. These features are not of the size, nor do they contain a diversity of features or representative ecosystems which would justify their inclusion as a national park. Size is not a significant factor; the area only needs to be large enough to protect the integrity of the site.

Although Category III areas may be recreational and touristic value, they should be managed to remain relatively free from human disturbance. These areas may be owned and managed by either central or other government agencies, or non-profit trusts or corporations, as long as there is assurance that they will be managed to protect their inherent features for the long term.

CATEGORY IV - Nature Conservation Reserve/ Managed Nature Reserve/ Wildlife Sanctuary

Introduction - Although most of the other categories of management play important roles in protecting habitat for flora and fauna, it is essential that areas be established where manipulative management techniques can be applied to guarantee the stability or survival of certain species of plants and animals, through protection of breeding populations, feeding and breeding grounds, and critical habitat for protection or rare and endangered floral and faunal species.

Management Objectives - To assure the natural conditions necessary to protect nationally significant species, groups of species, biotic communities, or physical features of the environment where these required specific human manipulation for their perpetuation. Scientific research, environmental monitoring, and educational use are the primary activities associated with this category.

Criteria for Selection and Management - A Category IV area is desirable when protection of specific sites or habitats is essential to the continued well-being of resident or migratory fauna of national or global significance. Although a variety of areas fall within this category, each would have as its primary purpose the protection of nature; the production of harvestable renewable resources may play a secondary role in the management of a particular area. The size of the area is dependent upon the habitat requirements of the species to be protected; these areas could be relatively small, consisting of nesting areas, marshes, or lakes, estuaries, forest, or grassland habitats, or fish spawning areas, or seagrass feeding begs for marine mammals.

The area may require habitat manipulation to provide optimum conditions for the species, vegetative community, or feature according to individual circumstances. For example, a particular grassland or heath community may be protected and perpetuated through a limited amount of livestock grazing; a marsh for wintering waterfowl may required continual removal of excess reeds and supplementary planting of waterfowl food, or a reserve from an endangered animal may need protection against predators. Limited areas may be developed for public education and appreciation of the work of wildlife management.

Ownership may be by the central government or with adequate safeguards and control, by lower levels of government, non-profit trusts or colorations, or private individuals or groups.

CATEGORY V - Protected landscape or Seascape

Introduction - In many areas of the world, distinctive landscape patterns are created by the integration of specific natural and cultural features that present aesthetically attractive land and water settings.These may result through traditional land-use practices which have retained relatively large and scenic natural or semi-natural areas near urban centres.

At the same time, increasing population and leisure time and expanding urban areas are creating demand for additional recreation and tourism areas and facilities in aesthetic environments for citizens and visitors.

These natural and cultural areas are important because of their potential as reservoirs of genetic material and for their social customs and land-use practices, which may be disappearing under the influence of modern technology.

Management Objectives - To maintain nationally significant natural landscapes which are characteristic of the harmonious interaction of man and land while providing opportunities for public enjoyment through recreation and tourism within the normal life style and economic activity in these areas. These areas also provide for ecological diversity and serve scientific, cultural and educational purposes.

Criteria for Selection and Management - The scope of areas that fall within this category is necessarily broad because of the wide variety of semi-natural and cultural landscapes that occur within various nations. This may be reflected in two types of areas: those whose landscapes possess special aesthetic qualities which are the result of the interaction of man and land, and those that are primarily natural areas managed intensively by man for recreational and tourism uses.

In the former case, these landscapes may demonstrate certain cultural manifestations such as: customs, beliefs, social organization, or material traits as reflected in lad-use patterns. These landscapes are characterized by either scenically attractive or aesthetically unique patterns of human settlement. Traditional land-use practices associated with agriculture, grazing, and fishing are dominant. The area is large enough to ensure the integrity of the landscape pattern.

The latter case often includes natural or scenic areas found along coastlines and lake shores, in hilly or mountainous terrain, or along the shores of rivers, often adjacent to tourist highways or population centres; many will have the potential to be developed for a variety of outdoor recreational uses with national significance.

In some cases, the area may be privately held and the use of either central or delegated planning control would be necessary to ensure the perpetuation of both the land use and life style. Means of government assistance might be required to improve the standard of living while maintaining the natural quality of the site through appropriate

management practices. In other instances, the areas are established and managed under public ownership or a combination of public and private ownership.

CATEGORY VI - Resource Reserve

Introduction - Despite the rapidly increasing utilization of the natural resources in the world, there still remain land and water areas for which the most appropriate utilization has yet to be determined. If these lands are not protected, occupation and use are likely to occur on an unplanned, single-use and short-term economic exploitation basis. This utilization without sufficient knowledge may result in resource deterioration and loss of longer-term economic and social benefits.

Management Objectives - To restrict use of these areas until adequate studies have been completed on how to best utilize these remaining resources, to protect the natural resources of the area for future use and prevent or contain development activities that could affect the resource pending the establishment of objectives which are based upon appropriate knowledge and planning.

Criteria for Selection and Management - Category VI areas will normally comprise an extensive and relatively isolated and uninhabited area having difficult access, or regions that are lightly populated, yet may be under considerable pressure for colonization and greater utilization. In many cases, there has been little study or evaluation of these areas, so the consequences of converting these areas to agriculture, mineral or timber extraction, the construction of roads, or intensive fishing, dredging or mariculture are unclear. Similarly, use of the resources may not be appropriate because of the lack of technology, human or financial resource restrictions, or alternative national priorities. Consequently, natural, social and economic values are not sufficiently identified to permit the area to be managed for specific objectives or to justify its conversion to other uses. On land, restricted access is implied, so areas will normally require control, depending upon the pressures to enter and utilize the area. Areas may be owned of administered by government or public corporations.

Maintenance of existing conditions to allow studies on the potential use for the designated areas is a prerequisite. No exploitation should occur, with the exception of use of resources by indigenous inhabitants; ongoing ecologically sound activities are acceptable.

CATEGORY VII - Natural Biotic Area/ Anthropological Reserve

Introduction - In some countries there may be a need for protecting natural areas in which man is component and obtains his livelihood by means that do not involve extensive cultivation or other major modifications of the vegetation and animal life. These individuals or societies may require special protection to maintain their existence.

Management Objectives - To allow the way of life of societies living in harmony with the environment to continue undisturbed by modern technology. Research into the evolution of man and his interaction with the land would be a secondary objective.

Criteria for Selection and Management - Category VII areas are characterized by natural areas where the influence or technology of modern man has not significantly interfered with or been absorbed by the traditional ways of life of the inhabitants. These areas may be remote and isolated and their inaccessibility may be maintained for a considerable period of time. The societies are of particular significance to the maintenance of cultural diversity; there is a strong dependence of man upon the natural environment for food, shelter and other basic material to sustain life. Extensive cultivation or other major modifications of the vegetation and animal life is not permitted.

Management is oriented towards the maintenance of habitat for traditional societies, so as to provide for their continuance within their own cultural mores.

CATEGORY VIII - Multiple-Use Management Area/ Managed Resource Area

Introduction - Some terrestrial and marine areas can both provide protection to natural resources and ecological systems and yet contribute significantly to economic, social and material needs of nations. The multiple function of these lands or waters can provide for a sustained yield or a series of natural products and services under proper management as well as for preservation of genetic diversity and protection of natural features and systems. Watershed protection, for example, may be of particular importance in addition to the timber, forage of wildlife aspect of the area. In the case of marine areas, protection of areas of great biological diversity may be of importance in sustaining the production of fish or other marine products.

Management Objectives - To provide for the sustained production of water, timber, wildlife (including fish), pasture or marine products, and outdoor recreation. The conservation of nature may be primarily oriented to the support of the economic activities (although specific zones may also be designated within these areas to achieve specific conservation objectives), or conservation may be a primary objective in its own right and given the same importance as economic and social objectives. Within the overall area, zones may be established in which either the conservation of nature or sustainable development is the primary objective.

Criteria for Selection and Management - A category VII area is large, containing considerable territory suitable for production of wood products, water, pasture, wildlife, marine products and outdoor recreation; parts of the area may be settled and may have been altered by man. The area may possess nationally unique or exceptional natural features, or may as a whole represent a feature or area of international or national significance.

Planning programmes to ensure the area is managed on a sustained yield basis is a prerequisite. Land ownership is under government control. Through proper zoning, significant areas can be given specific additional protection. For instance, the establishment of wilderness-type areas is consistent with the purpose of these areas as would be establishing nature reserves. Multiple use, in the context of Category VIII, is considered to be the management of all renewable resources utilized in some combination to best meet the needs of the country. The major premise in the management of these areas

is that they will be managed to maintain their overall productivity and their resources in perpetuity.

CATEGORY IX - Biosphere Reserve

Introduction - One focus of the UNESCO Man and the Biosphere Programme, initiated in 1970, is to conserve representative natural areas throughout the world through the establishment of a network of biosphere reserves.

Management Objectives - To conserve for present and future use the diversity and integrity of biotic communities of plants and animals within natural ecosystems, and to safeguard the genetic diversity of species on which their continuing evolution depends. Biosphere reserves provide opportunities for ecological research, particularly baseline studies, both within natural and altered environments. These reserves have particular value as bench marks or standards for measurement of long-term changes in the biosphere as a whole and are consequently important sites for environmental monitoring. Biosphere reserves provide facilities for education and training.

Criteria for Selection and Management - Each biosphere reserve will include one of more of the following: representative examples of natural biomes, unique communities or areas with unusual natural features or exceptional interest, examples of harmonious landscapes resulting from traditional patterns of land use, and examples of modified or degraded ecosystems capable of being restored to more natural conditions.

A biosphere reserve must have adequate long-term legal protection. Each biosphere reserve is large enough to be an effective conservation unit and to accommodate different uses without conflict. Each reserve must be approved by the Man and the Biosphere International Coordinating Council before it can receive designation as a biosphere reserve.

Each biosphere reserve will be zoned to provide direction as to its management. Four zones may be delineated as follows: natural or core zone, manipulative or buffer zone, reclamation or restorative zone, and stable cultural zone.

CATEGORY X - World Heritage Site (Natural)

Introduction - The International Convention concerning the Protection of the World Cultural and Natural Heritage (Unesco, 1972) provides for the designation of areas of "outstanding universal value" as World Heritage Sites. These exceptional areas must be recommended by the signatory national responsible for the site for declaration by the international World Heritage Committee. The sites include many previously designated protected areas.

Management Objectives - To protect the natural features for which the area was considered to be of world heritage quality, to provide information for world-wide public enlightenment, and to provide for research and environmental monitoring.

Criteria for Selection and Management - Areas to be considered under the Convention will be restricted to those which are truly of international significance. Natural sites must represent one or more of the following criteria:

a. be outstanding examples representing the major stages of the earth's evolutionary history;

b. be outstanding examples representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment;

c. contain unique, rare or superlative natural phenomena, formations or features, or areas of exceptional natural beauty; and

d. be habitats where populations or rare of endangered species of plants and animals still survive.

Natural Heritage Sites must also fulfil conditions on the integrity of the site. Management of these sites stresses the maintenance of the heritage values, ensures the continuation of legal protection, and promotes the significance of each site for the country, its people and the world.

All sites have strict legal protection and are owned by government or non-profit corporation or trust for the long term. While recreation and on-site interpretation will generally be developed, some sites may be of such significance that public use will either be strictly controlled or prohibited.

APPENDIX 14
LIST OF THREATENED AND ENDANGERED SPECIES IN BANGLADESH

ENVIRONMENT AND LANDUSE

APPENDIX 14
LIST OF THREATENED AND ENDANGERED SPECIES IN BANGLADESH

RARE AND ENDANGERED WILDLIFE SPECIFIES IN BANGLADESH

Key to Status: 1 = Very Common, 2 = Fairly Common, 3 = Common, 4 = Uncertain, 5 = Threatened, 6 = Endangered

CATEGORY/NAME	PAST STATUS (@ 1940)	PRESENT STATUS
MAMMALS		
Slow Loris (Nycticebus coucang)	2	6
Common Macaque (Presbytis entellus)	2	6
Crab Eating Macaque (Macaca fascicularis)	2	5
Hoolock Gibbon (Hylobates hoolock)	3	6
Large Civet (Viverra zibetha)	3	6
Fishing Cat (Felis viverrina)	2	6
Jungle Cat (Felis chaus)	2	5
Tiger (Panthera tigris)	2	6
Leopard (Panthera pardus)	3	5
Clouded Leopard (Neofelis nebulosa)	2	6
Asiatic Elephant (Elephas maximus)	3	6
Barking Deer (Muntiacus muntjak)	3	5
Sambar (Cervus unicolor)	3	5
Serow (Capricornis sumatraensis)	2	6
Hispid Hare (Caprolagus hispidus)	3	6
REPTILES		
Estuarine Crocodile (Crocodylus porosus)	3	6
Gharial (Gavialis gangeticus)	3	6
Olive Ridley Turtle (Lepidochelys olivacea)	3	6
Green Turtle (Chelonia mydas)	3	6
Hawksbill Turtle (Eretmochelys imbricata)	3	6
Loggerhead Trutle (Caretta caretta)	3	6
Leatherback Turtle (Dermochelys coriaec)	3	6
Batagur Turtle (Batagur baska)	3	6
Bostami Turtle (Trionyx nigricans)	3	6
Land Tortoise (Geochelone emys)	3	6
Grey Lizard (Varanus bengalensis)	3	5
Monitor/ Ring Lizard (Varanus salvator)	1	5
Yellow Lizard (Varanus flaviscens)	3	5
Clouded/ Black Lizard (Varanus nebulosa)	3	5
Rock Python (Python molurus)	2	6
King Cobra (Ophiophagus hannah)	2	6
Dog-faced Water Snake (Cerberus rhynchops)	3	5
Hook-nosed Sea Snake (Enhydrina schistosa)	1	5
Banded Sea Snake (Hydrophis fasciatus)	4	5
Estuarine Sea Snake (Hydrophis obscurus)	3	5
Common Narrow-headed (Microcephalophis gracilis)	3	5
Cantor's Narrow-headed Sea Snake (Microcephalophis cantoris)	3	5
Amphibians Bull Frog (Rana tigrina)	1	5
Green Frog (Rana hexadactyla)	4	5

BIRDS

Little Grebe (Podiceps ruficollis)	1	5
Darter (Anhinga rufa)	2	5
Purple Heron (Ardea purpurea)	2	6
Grey Heron (Ardea cinerea)	3	5
Openbill Stork (Anastomus oscitans)	3	6
Lesser Adjunct (Leptoptilus javanicus)	2	6
Whitenecked Stork (Ciconia episcopus)	2	6
Glossy Ibis (Plegadis falcinellus)	2	6
Spoonbill (Platalea leucorodia)	2	6
Greater Whistling Teal (Dendrocygna bicolor)	3	6
White Winged Wood Duck (Cairina scutulata)	2	6
Comb Duck (Sarkidiornis melanotos)	2	6
Black Winged Kite (Elanus caeruleus)	3	6
White Bellied Sea Eagle (Haliaeetus leucogaster)	3	6
Pallas's Fishing Eagle (Haliaeetus leucorpyphus)	2	6
Greyheaded Fishing Eagle (Ichthyophaga ichthyaetus)	3	5
White Backed Vulture (Gyps bengalensis)	1	5
Assam Black Patridge (Francolinus francolinus)	2	6
Rain Quail (Coturnix coromandelica)	3	6
Common Peafowl (Pavo cristatus)	2	6
Pheasant-tailed Jacana (Hydrophasianus chirurgus)	2	5
Painted Snipe (Rostratula bengalensis)	2	5
Brown Fish Owl (Bubo Zeylonensis)	2	6
Great Hornbill (Buceros bicornis)	3	6
Hill Myna (Gracula religiosa)	3	5
Paradise Flycatcher (Terpsiphone paradisi)	2	5

Source: MOEF, Draft National Conservation Strategy, July 1991.

THREATENED FLORA

PTERIDOPHYTA		DISTRIBUTION
Psilotum triquetrum	-	Khulna
Tectoria chattagramica	-	Barisal
ANGIOSPERMS		
Aglaonema clarkei	-	(endemic) Chittagong
Aldrovanda vesiculosa	-	Bandarban
Aquillaria agallocha	-	Dhaka, Rajshahi
Cirrhopetalum roxburghii	-	Sylhet
Cymbopogon osmastonii	-	(endemic) Sunderban
Debregeasia dentata	-	Bogra, Dhaka
Elaeocarpus lucidus	-	Chittagong
Hippocratea macrantha	-	Chittagong
Homalium schichtii	-	Chittagong
Justica oreophila	-	Chittagong
Knema bengalensis	-	Chittagong
Limnophila cana	-	(endemic) Cox's Bazar
Mantisa spathulata	-	(endemic) Jamalpur, Pabna, Dhaka
Marsdenia thyrsiflora	-	(endemic) Chittagong, Sylhet
Ophiorrhiza villosas	-	Central Regions
Phrynium imbricatum	-	Chittagong
Quercus acuminata	-	Chittagong
Rotala simpliciuscula	-	Chittagong
Semecarpus subpanduriformis	-	(endemic) Chittagong, Sylhet
Sibberatua griffithii	-	Chakaria, Sundergans
Spatholobus listeri	-	(endemic) Chittagong
Toournefortia roxburghii	-	Chittagong, Rangamati
Typhonium listeri	-	Chittagong
Vatica scaphula	-	(endemic) Chittagong
Vernonia thomsonit	-	Chittagong

Source: MOEF, Draft National Conservation Strategy, July, 1991.

APPENDIX 15
AREA AND VOLUME SUMMARIES FOR SELECTED FOREST AREAS

PROJECT 372001/30
FORESTRY MASTER PLAN
BANGLADESH TA 1355-BAN

ASIAN DEVELOPMENT BANK
MANILA PHILIPPINES
DATE: JANUARY 1993

ENVIRONMENT AND LANDUSE

APPENDIX 15
AREA AND VOLUME SUMMARIES FOR SELECTED FOREST AREAS

Table 1 - Area and Volume for Natural Forests of Chittagong and Cox's Bazar Forest Divisions by Forest Types

Forest Type	Chittagong Forest Division		Cox's Bazar Forest Division	
	Area (ha)	Vol. (Cu m)	Area (ha)	Vol. (Cu m)
Large crowned (HF)	7,456	672,531	12,891	1,490,200
Small crowned (LF)	22,037	1,004,887	17,882	1,022,850
Garjan forest (GF)	510	45,441	521	62,728
Scattered (ST) & Brush	22,468	548,219	3,205	120,829
Total	52,471	2,271,078	34,499	2,696,607

Source: De Milde, R. et al. 1985. The High Forest in the Chittagong District. Field document No. 11, Vol. 1 FAO/UNDP Project, BGD/79/017.

Table 2 - Area and Volume (merchantable) of the Sundarbans Forest by Forest Types

Forest types	Area (Sq. km)	Volume ('000 cu m)
Sundri + other species mixed with sundri	2,083	6,798
Gewa + other species mixed with gewa	1,801	1,793
Keora + other species mixed with keora	33	476
Others (Passur, kankra, dhundai, baen)	32	1,579
	3,956	10,646

Notes: Total Standing Volume (10 cm top dia underbark) of sundri (dbh > 17cm), gewa (dbh > 12 cm) and keora (> = 30 cm) of sound timber only.
Source: Chaffey, et al. 1985. Forest Inventory of the Sundarbans, Bangladesh.

Table 3 - Area and Volume of Sylhet Forest Division by Forest Types

Forest Cover Type	Area (ha) (1987)	(%)	Vol. (Estimated) ('000 cu m)
Plantation	11,502	28.6	643.8
Natural Forest	6,169	15.4	276.2
Bamboo	13,933	34.6	222.4+
Denuded	3,407	8.5	-
Non-Forest	5,161	12.9	-
Total	40,172	100.0	920.0

Note: * Gross Volume from closed canopy natural forest (226,200 cu m) and open canopy natural forest (50,000 cu m).
+ Figure in AD ton.
Source: Drigo, et al. 1988. Inventory of Forest Resources of Southern Sylhet Forest Division. Field Document No. 3, FAO/UNDP Project.

Table 4 - Area and Volume of the Natural Forests of Kassalong and Rankhiang by Forest Types

Location	Forest cover type	1963		1983	
		Area (ha)	Vol. ('000 cu m)	Area (ha)	Vol. ('000 cu m)
Kassalong	Timber-types	52,689	7,002.4	46,395	6,337.6
	Timber-bamboo	23,506	2,818.0	14,878	1,679.7
	Bamboo-timber	31,972	1,725.8	23,525	1,270.3
	Bamboo types	41,366	714.6	12,653	218.9
	Plantation	5,013	-	14,330	-
	Non-forest and non-productive areas	9,981	-	52,667	-
Total		164,527	12,260.8	164,448	9,506.5
Rankhiang	Timber-types	20,325	3,285.5	7,116	1,220.4
	Timber-bamboo	6,933	988.5	3,228	393.8
	Bamboo-timber	17,519	809.0	6,194	286.2
	Bamboo types	27,907	563.1	13,606	274.8
	Plantation	2,011	-	8,873	-
	Non-forest and non-productive areas	2,409	-	38,087	-
Total		77,104	5,646.1	77,104	2,175.2
Grand total		241,631	17,909.9	241,552	11,681.7

Source: De Milde, R. et al. 1985. The Kassalong and Rankhiang Reserve Forests in the Chittagong Hill Tracts. Field Document No. 10. FAO/UNDP Project, BGD/79/017.

Table 5 - Area Statement Central Sal Forest Areas in 1974 and 1989

District	Thana	Total Legal Forest (ha)	Wooded Forest			Blank/ Encroachment 1989 (ha)
			1974 (ha)	1989 (ha)	% Wooded Forest, 1989	
Jamalpur	Jamalpur	465	36	-	0	465
Total		465	36	-	0	465
Mymensingh	Bhaluka	7,680	932	440	5.7	7,240
	Muktagacha	2,548	452	285	11.2	2,263
	Fulbaria	1,823	796	122	6.7	1,701
Total		12,051	2,180	847	7.0	11,204
Tangail	Ghatail	8,134	1,955	351	4.3	7,784
	Madhupur	15,455	7,830	5,639	36.5	9,816
	Basail	8,651	3,153	998	11.5	7,653
	Mirzapur	2,120	1,102	319	15.1	1,800
	Kalihati	5,478	1,315	371	6.8	5,107
Total		39,838	15,355	7,678	19.3	32,160
Dhaka	Kaliakoir	6,027	3,088	290	4.8	5,737
	Sripur	9,246	4,116	2,807	30.3	6,440
	Joydebpur	5,296	3,629	1,700	32.1	3,596
	Savar	208	73	-	-	208
	Kapasia	767	489	288	37.6	479
Total		21,544	11,395	5,085	23.6	16,460
Grand total		73,898	28,966	13,610	18.4	60,289

Source: Adapted from Ghani et al. (1990), P. 34

Table 6 - Area Statement of Northern Sal Forests for Rangpur, Dinajpur, Rajshahi Divisions

Thana	Notified Forest area (ha)	Wooded land (ha)	Degraded land (ha)	Plantations (ha)	Encroachments (ha)
Dinajpur Division					
Ghoraghat	184	-	-	20	164
Nowabganj	3,545	175	61	978	2,330
Birampur	858	80	24	471	283
Parbatipur	894	46	-	791	57
Birol	1,088	272	267	354	195
Birganj	499	211	77	142	69
Kaharol	21	-	-	21	-
Dinajpur	124	-	-	-	-
Pirganj	344	150	86	57	51
Baliadangi	311	-		53	258
Thakurgaon	12	-		9	3
Panchagarh	572	-		88	484
Tetulia	423	-		36	387
Debiganj	522	-		244	278
Boda	265	12		196	57
Total	9,538	946	515	3,460	4,617
Rajshahi Division					
Patnitala	1,220	8	14	405	1,793
Shapahar	848	-		239	609
Dhamoirhat	604	121		126	357
Niamatpur	203	-		89	114
Porsha	18	-		-	18
Total	2,893	129	14	859	1,891
Rangpur Division					
Mithapukur	973	59	-	518	396
Pirganj	522	-	-	380	142
Baduiganj	418	-	-	204	214
Domar	285	-	-	176	109
Dimla	911	-	-	466	445
Nageshwari	52	-	-	-	52
Hatibanda	34	30	-	2	2
Total	3,195	84	-	1,746	1,360
Grand total	15,626	1,164	529	6,065	7,868

Source: Adapted from Ghani et al. (1990), p. 36

Table 7 - Area and Status of Coastal Plantations

Coastal Division	Gross Area	Eroded	Failed	Encroached	Net	% EN	% FA	% EN
Noakhali	33,810	7,753	2,286	14	23,757	22.9	6.8	-
Bhola	18,986	5,255	3,415	939	9,377	27.7	18.0	4.9
Patuakhali	16,189	1,833	3,861	679	9,816	11.3	23.8	4.2
Chittagong	29,652	5,717	7,917	3,331	12,691	19.2	26.7	11.2
Total	98,547	20,588	17,475	4,963	55,641			

Notes: 1. Number may not match due to rounding. Figures received incomplete for some beats.
2. Average erosion 20.9%
3. Average failed plantation 17.7%
4. Average encroachment 5.0%

Source: Compiled from RIMS data.

APPENDIX 16
FAO CALCULATION OF DEFORESTATION IN BANGLADESH

ENVIRONMENT AND LANDUSE

APPENDIX 16
FAO CALCULATION OF DEFORESTATION IN BANGLADESH

The following set of tables summarize the standardized results for incorporation in the global database.

Table 1 - State of Forest Cover Inventory

Date of Surveys/ maps	Area Coverage	Reliability Classes	Source
1959	Partial	3	(1)
1981	Partial	3	(2)
1984	Partial	1	(3)
1986	Partial	1	(4)

Reliability Classes are: 1 = High
2 = Average
3 = Low

Comments on Table 1:

a. A forest inventory of the Kassalong and Rankhiang Reserved Forests based on aerial photography taken in 1959 was carried out by Canada.

b. The Overseas Development Administration of the UK executed a forest inventory of the Sundarbans based on aerial photography (scale: 1:30,000) taken in 1981.

c. The FAO/ UNDP Project BGD/ 79/ 017 carried out forest inventories for several regions in Bangladesh using aerial photography (scale: 1:50,000 and 1:15,000) dating from 1982 and 1984.

d. the FAO/ UNDP Project BGD/ 85/ 085: "Inventory of Forest Resources of Southern Sylhet Forest Division" carried out an inventory of the Southern Sylhet Forest during the period 1986-87, which was based on interpretation of SPOT images from 1986 and aerial photography (scale: 1:50,000) from 1984.

e. The inventory data corresponding to the survey date indicated in bold (reference date) have been used to construct table 2 (Baseline Forest Cover Data in line with the FRA 1990 Classification). The forest areas not included in this survey have been assessed through visual interpretation of LANDSAT MSS imagery from 1984. As this assessment was not supported by field checking the results should be considered as indicative only.

Table 2 - Baseline Forest Cover Area Data in line with the FRA 1990 Classification
(All areas in thousands of hectares)

Reference Year	Country Area	Forest Area	Forest Fallow
1984	14,400	998	433

Table 3 - Reported Area of Forest Plantations
(All areas in thousands of hectares)

Reported Plantation Area 1980	Reported Plantation Area 1990	Estimated Annual Plantation Area Change 1981-90	Estimated Annual Plantation Area Change Rate (%) 1981-90
160	335	+18	+11

Comments on Table 3:

The reported plantation areas are based on country estimates submitted to FAO Regional Forestry Commissions, 10th World Forestry Congress or other country documents. The estimates are used without any adjustment if they refer to years 1980 and 1990, otherwise an adjustment is applied based on plantation area trends in the country to obtain the standardized results.

Table 4 - Standardized Results
(All areas in thousands of hectares)

Land Area	Estimated Forest Cover Area 1980	Estimated Forest Cover Area 1990	Estimated Annual Forest Cover Area Change 1981-90	Estimated Annual Forest Cover Area Change Rate(%) 1981-90
13,017	1,145	769	-37.6	-3.3

Comments on Table 4:

a. Standardized results are intended for global estimates only and are obtained from country baseline data through an adjustment process (see S.12). The figures will be updated regularly as new country data becomes available.

b. It may be noted that computed values of forest cover area and forest cover area change refer to forests of natural origin. Replacement of natural forest cover area by plantation is accounted for by taking out the corresponding area from natural forest and addition the same to the plantation area. In view of the above, the rate of deforestation and the rate of plantation should be considered together to get a complete picture of the forest cover area change.

c. Land Area has been taken from FAO Production Yearbook, Vol. 45. Land Area excludes inland water surface. By adding land and water area one will get the Country Area.

d. The simple interest formula has been used to calculate Annual Forest cover Area Change Rate 1981-90.

Source: FAO Project Coordinator, Forest Resources Assessment 1990 Project, 1992

APPENDIX 17
FOREST DIVERSITY: SPECIES AND SITES

ENVIRONMENT AND LANDUSE

APPENDIX 17
FOREST DIVERSITY: SPECIES AND SITES

Table 1 - Species of Good Palatability in Order of Priority

Scientific names	Vernacular names
Acacia nilotica	Babul, Babla
Leucaena leucocephala	Ipil-ipil
Albizzia procera	Jat koroi,Sada koroi
Bambusa balcooa	Barak bans, Sil Barua, Teli Barua, balku
B. tulda	Mitinga, Mahal, Talla
B. vulgaris	Jai, Baijja, Jawa bans
Acacia catechu	Khair
Streblus asper	Shaora
Artocarpus heterophyllus	Kanthal
A. chaplasha	Chapalish, Cham
Ficus bengalensis	Bot
F. hispida	Kakdumur
F. racemosa	Jagadumur
Morus indica	Tunt
Albizzia chinensis	Chaka koroi, Sesra koroi
A. odoratissima	Tentua koroi, Moroi
Bridelia retusa	Kanta kosoi
Lannea coromandelica	hadi, Jiga, Jiyal
Pithecellobium dulce	Belati amli, Dekhini babul
Zizyphus mauritiana	Kul, Boroi
Sonneratia apetala	Keora
Garuga pinnata	Kapila, Sil bhadi
Cordia dichotoma	Bohul

Table 2 - List of Species showing High Percentage of Crude Protein and Crude Fibre

Name of species	Crude protein (%)	Crude fibre (%)
Acacia catechu	13.0	22.6
Aegle marmelos	15.0	16.4
Albizzia chinensis	15.1	31.6
A. lebbeck	31.7	22.0
Bambusa vulgaris	19.0	28.8
Bauhina variegata	15.7	31.9
Bombax ceiba	12.6	22.3
Cassia fistula	17.6	30.2
Cordia dichotoma	15.1	16.4
Dalbergia sissoo	24.1	12.5
Ficus infectoria	16.0	27.7
Gliricidia sepium	20.5	30.2
Hibiscus rosa-sinensis	15.4	15.5
Leucaena leucocephala	27.0-34.0	20.4
Mallotus philippinensis	13.4	29.7
Melia ajedarach	13.3	15.3
Moringa oleifera	17.8	9.7
Morus indica	15.5	15.3
Pithecellobium dulce	29.0	17.5
Samanea saman	24.7	22.1
Sesbania grandiflora	36.1	9.3
Zizyphus mauritiana	11.8	14.3

Species listed contain more than 10% by weight of crude protein.

Table 3 - Biomass Production: Illustrating Genetic Differences Between Best and Worst Seed Sources

Species, seed source no. and collection locality	Green Weight			Air-Dry Weight			Oven-Dry Weight		
	kg/tree	t/ha	MAI t/ha/yr	kg/tre	t/ha	MAI t/ha/yr	kg/tree	t/ha	MAI t/h/yr
A. Charkai (POOR SITE)									
E.camaldulensis 12346 Gibb River, WA (best)	14.5	146	29	8.0	80	16.1	6.0	60	12.1
12187 Irvinebank, Qld (worst)	5.5	42	8.4	3.0	23	4.6	2.5	19	3.8
E. tereticornis 10952 E Normanby Range, Qld (best)	15.5	106	21	8.5	58	11.6	6.5	44	8.9
12377 WNW Mareeba, Qld (worst)	6.0	36	7.2	3.5	21	4.2	3.0	18	3.6
E. brassiana 10973 SE Coen, Qld (best)	18.0	164	33	10.0	19	18.2	7.5	64	13.6
10972 N Moreton, Qld (worst)	2.5	24	4.8	1.8	17	3.4	1.7	16	3.3
B. CHARAIJANI (good site)									
E. camaldulensis 12186 Petford (Emu Creek),Qld(best)	100	787	150	53.5	422	80.4	46.1	364	69.3
12350 Fitzroy River, Qld (worst)	35	306	61	19.0	166	33.2	15.8	138	27.6
E. tereticornis 10954 Helenvale, Qld (best)	66	473	95	35.0	251	50.2	30.0	215	43.1
10826 Popondetta, PNG (worst)	30	172	34	16.5	95	18.9	13.8	79	15.8
E. brassiana 10973 SE Coen, Qld (best)	32	260	52	17.5	142	28.5	14.8	120	24.1
10960 Cooktown, Qld (worst)	17	61	12	9.3	33	67	7.3	26	5.2
Leucaena K-8 Salvador (best)	20.5	154	31	14.3	108	22	10.2	77	15.4
leucocephala K-28 Salvador (worst)	4	14	2.7	2.4	8	1.6	2.0	7	1.4

Air dry = Samples dried in air under cover for about 9 months;
Oven dry = Dried to constant weight at 80oC;
t = Metric tons;
kg = Kilogram;
Green = Freshly felled;
ha = Hectare;
yr = Year;
cm = Centimetre;
m = Metre;
WA = Western Australia;
Qld = Queensland, Australia;
PNG = Papua New Guinea;
SE = South East;
N = North;
E = East;
WNW = West North West;
MAI = Mean Annual Increment;

Table 4 - Species for Lowlying Lands

Scientific name	Local name	Ecology	Occurrence in Bangladesh
Acacia auriculiformis	Akashmoni	It grows mainly in low altitudes on dissected low lands and alluvial coastal plains. It has a wide range of adaptability. This species tolerates infertile clayey, sandy, acid, alkaline, saline or seasonally waterlogged soils and long dry seasons	In Bangladesh it is planted as an ornamental tree. Recently it has been included in the plantation programme as a fast growing species and to rehabilitate the denuded hills.
Acacia mangium Wild	Mangium	It is found mainly on well drained, acid soils with a shallow sandy loam overlying a heavy clay, and sometimes on imperfectly drained soils subject to brief flooding in the wet season and rapid drying out in the dry season. Fairly light demanding	In Bangladesh it has been included in the plantation programme as a fast growing species
Acacia nilotica	Babul, babla	It grows in a variety of soils even in the poor ones from sub-humid to very dry soils. It can stand periodic flooding. It is light demanding	Planted in the northern districts of Bangladesh
Achras sapota	Sofeda, sapota	Grows well in loamy soils. Can tolerate periodic flooding and survives also along water edges	In Bangladesh it is cultivated in many districts.
Albizzia chinensis	Chakuakoroi, sasrakoroi	It grows on a variety of soils and prefers moist conditions. The tree is moderately light demander and can withstand certain amount of shade. It can tolerate periodic flooding	Occurs in the forest areas, and also planted in villages of many districts
Albizzia lebbeck	Siris, kalakoroi	The tree thrives on variety of soils; though it prefers moist conditions and grows well on drained loam. It can stand periodic flooding and salinity. Young plants are capable of standing moderate amount of shade.	It is a tree of mixed deciduous, semi-evergreen or evergreen forests, occurring scattered and not gregariously. Also planted in most of the districts of Bangladesh.
Albizzia procera	Jatkoroi, sadakoroi, silkoroi	It grows on alluvial soils and moist places along the river banks. It is a light demanding species. It is drought tolerant. It can tolerate periodic inundation.	It occurs in the forests of Sylhet, Chittagong and Dhaka-Mymensingh. Also planted in many districts of Bangladesh
Alstonia scholaris(Linn.)R.Br	Chatim, chatian, khami, satni	Lowlands to hills. Also found in secondary forest. Can stand periodic flooding	Found in the forests of Sylhet, Chittagong, Hill Tracts and Sal Forests. Also planted in villages, generally in marshy places.
Anthocephalus chinensis	Kadam	It prefers moist, loamy soils, grows in swampy ground. It is strongly light demanding.	It is a tree of the moist deciduous and evergreen forests of Sylhet and Chittagong. Also occurs on alluvial ground along rivers and on swampy ground. Planted in many districts.
Aphanamixis polystachya	Pitraj, raina, beri rata, baddiraj	In evergreen forests; along the river banks, streams and moist shady localities. Can withstand periodic flooding.	In villages throughout the country and in evergreen forests of Chittagong, Hill Tracts and Sylhet.

Scientific name	Local name	Ecology	Occurrence in Bangladesh
Barringtonia acutangula	Hijal	It grows chiefly on the banks of streams, water edges, moist places and fresh water swamps.	Occurs in all districts along the edge of the haors and jheels.
Barringtonia racemosa	Sumundraphal	Mostly coastal, in periodically flooded sites, also inland along rivers, ditches, lowlands; sometimes cultivated.	Occurs in the coastal areas and along the rivers of the southern districts.
Bauhinia malabarica Roxb	Nanki, Jhanki, Karmai	In evergreen and deciduous forests. It can tolerate periodic stagnancy. It is light demander	Occurs in the forests of Chittagong and Madhupur.
Bischofia javanica	Kanjal bhadi, Kanjal, Kechra, Kanja bai,	Generally grows on moist shady ravines, river banks and swamps. It is also found in sandy alluvium. Stands moderate shade and water logging.	Occurs in the forests of Sylhet and Chittagong. Also planted in other districts. Occurs in homesteads of Barisal and Patuakhali districts.
Bombax ceiba Linn	Simul	The tree grows well on silt. Growth reaches large dimensions in deep soil. It also grows on dry soils. It can tolerate periodic flooding.	Generally planted in most of the districts. Also occurs in the natural forests.
Butea monosperma(Lam.) Kuntz	Palash	It thrives in a variety of soils and survives in saline and poorly drained soils. It is drought resistant and moderately light demander. It can withstand some shade and can tolerate periodic flooding.	Found in the forests of Tangail and Mymensingh. Also planted in many districts.
Calophyllum inophyllum Linn	Sultana champa, gulab, pannyal, punnag, nagchampa	Rocky and sandy coasts, sand dunes near the sea; often cultivated as a road side tree. It can stand periodic flooding.	Found on the raised sandy land near the sea in southern districts of Bangladesh.
Cassia fistula Linn.	Sonalu, bandor lathi	It is found in a variety of soils and will grow on poor shallow soil. It can stand periodic flooding and moderate amount of shade.	Planted as a ornamental tree in all districts. Also occurs in hill forests.
Cassia siamea Lamk	Minjiri	The plant grows in deep, well-drained, relatively rich soils. It does not fix nitrogen. It can stand periodic flooding.	Planted in most districts of Bangladesh.
Cordia dichotoma Forst.f	Bohal, Bahanari, Bohari,	Grows well in most loamy soils but also thrives in dry soils. The tree stands moderate shade. It can stand periodic stagnation.	Occurs in most of the districts from forests to the village homesteads and in lowlying areas of Sylhet and Sunamgonj districts.
Crataeva nurvala, Buch-ham	Barun, baruna, bonna, Pithagola	In marshy places and along the water edge. It can stand prolonged waterlogging.	It inhabits the lowlying areas in all the districts.
Dalbergia sissoo Roxb. ex. DC	Sisso	It grows on variety of soils, also in dry regions. In its natural state it grows most typically on alluvial ground. The tree avoids stiff clay prefering porous soil or sand. It is light demander. It can stand periodic flooding and grows well on riverchars which go under water for months.	Introduced and planted all over the country

Scientific name	Local name	Ecology	Occurrence in Bangladesh
Dillenia Indica Linn.	Chalta	Generally planted in homesteads. It is shade bearer. It thrives best in damp situations. Also found wild in the moist evergreen forests. it is often found growing near streams and can stand periodic flooding.	In Bangladesh it is cultivated in most of the districts and found in the evergreen forests of Chittagong and Sylhet.
Diospyros peregrina Gurke.	Gab	Grows in all soils, prefers moist shady places along water edges. It can stand periodic flooding. Young plants develop freely under fairly heavy canopy.	Cultivated throughout Bangladesh.
Duabanga grandiflora (Roxb. ex DC) Walp	Banderhola, kacha, barpati, ramdalu, kadula jarul	It inhabits on banks of streams and rivers. It can stand periodic flooding.	It inhabits in the hill forests of Chittagong, Sylhet and Hill districts.
Ehretia serrata Roxb.	Kalahouja	It grows in sandy loam soils and can tolerate short flooding period.	Occurs in Chittagong and Sylhet. Occasionally planted as an ornamental tree in Chittagong city.
Elaeocarpus floribundus Bl.	Belphoi	Cultivated around the homesteads in most of the districts. The tree can stand periodic flooding.	It is cultivated in all districts of Bangladesh. Also occurs in the evergreen forests of Chittagong and Sylhet.
Elaeocarpus robustus Roxb.	Jalpai	Along the margin of the evergreen forests and along the edges of marshy lands.	In Bangladesh it occurs in the forests of Chittagong and Sylhet.
Erythrina indica	Painya mandar	Grows in wide range of soils. Performs better in moist alluvial soils. It can stand water-logging for prolonged period.	Cultivated in all districts along the water edge.
Erythrina variegata L.	Mandar, Madar	Sandy beaches along the coasts, homesteads, marshy places. It can tolerate periodic flooding.	Commonly planted in the villages in all the districts. Sometimes planted as living prickly fence.
Eugenia formosa Wall.	Paniyajam, phuljam,	Evergreen forests; along the streams.	Occurs in the forests of Chittagong and Sylhet.
Feronia limonia (Linn.)Swingle.	Kadbel	Grows specially in the drier soils. Can tolerate periodic flooding or partial swampiness.	It is cultivated in many districts of Bangladesh. Very common in Rajshahi and northern districts.
Ficus bengalensis Linn.	Bot	Grows in the plain lands. Can stand periodic flooding.	Planted in all the districts of Bangladesh.
Ficus hispida Linn. f.	Dumur, Kak-dumur, Thoska	Common in most habitats, usually in shady places, also on retaining walls. It is moderately shade bearer.	Grows in all the districts.
Ficus racemosa Linn.	Jaga dumur, Gulana-dumur	Generally found in the plain lands in the moist localities. Thrives in moist soils to rocky hill slopes and water edges. It is shade tolerant and can stand periodic flooding. It is light demander.	Cultivated in many districts of Bangladesh.
Ficus religiosa Linn.	Assawath, panbot, Pipal	Found in plain lands, prefers moist climate. It can stand periodic flooding. It is light demander.	Occurs in all the districts of Bangladesh.

Scientific name	Local name	Ecology	Occurrence in Bangladesh
Ficus rumphil Bl.	Hijulia, Gaya assawath	Grows well in damper parts of the plains. It can tolerate periodic flooding. It is light demander.	Occurs in many districts of Bangladesh.
Lagerstroemia speciosa (Linn.)Pers.	Jarul	It grows in fresh water swamps, in marshy places of evergreen forests and along the water edge. Also planted along the road sides.	In swampy areas of all hill forests and sal forests. It is also planted throughout the country.
Lannea coromandelica (Houtt.) Merr.	Bhadi, Jial bhadi, jika, kafila, jiga	Grows well in damp soils along water edge. It can tolerate periodic flooding and it is moderately light demanding.	Occurs in the hill forests, sal forests and in homesteads. Widely cultivated in most of the districts.
Litsea glutinosa (Lour.) Rob.	Kukurchita, Rattan, karjiuki, phulgach	Found usually in valleys and fairly moist places. The tree stands a fair amount of shade and periodic flooding.	It is common in the Sal forests and occurs in all districts.
Litsea lancifolia Roxb. ex wall.	-	In tropical rain forests along the water edge. Can tolerate periodic inundation and flooding.	It occurs in the forest along the Karnafuli river from Kaptai to downwards and in lowlying areas of Sunamgonj.
Macaranga denticulata (Bl.) Muell. Arg.	Bura, Ratabura, Madla	It thrives in moist warm climates and can tolerate drought. It also can tolerate periodic waterlogging and quickly invades open ground. Generally light demander.	Grows in clearings in the forests of Sylhet, Chittagong and Chittagong Hill Tracts.
Mangifera indica Linn.	Am	It grows in a wide variety of soils from ravines to moist places. It can tolerate periodic water stagnation.	Extensively cultivated in all districts of Bangladesh.
Melia ajadirach Linn.	Goranim, kowanim, bokain	Wide range of soils but does well on black soil and can thrive in dry conditions. Can stand periodic flooding. Light demander.	Planted in most of the districts of Bangladesh.
Microcos paniculata Linn.	Assar, Asar, patka	In evergreen, mixed evergreen forests and villages often nearby streams. It can stand periodic water logging.	Occurs in all forests except mangroves and villages of Bangladesh.
Mimusops elengi Linn.	Bakul	A cultivated ornamental tree. It can stand periodic flooding. It grows well in shady places.	Planted throughout the country as ornamental
Peltophorum pterocarpum (D.C.) Baker ex Heyne	Halud krishnachura	In its native habitat it occurs in sandy and rocky coasts. It can stand periodic flooding.	It is planted as an ornamental tree along roadsides.
Pithecellobium dulce (Roxb.) Benth.	Halud Krishnachura	It has great adaptability and grows well on moist soil and along water edge. Stands a good deal of shade and tolerates periodic inundation.	Grows in all the districts of Bangladesh. Found sporadically in southern parts of the country.
Polyalthia longifolia (Sonn.) Hook. f. et. Thom	Debdaru, Debdar	It grows on roadsides and variety of soils. it can stand periodic flooding.	Cultivated along the roadsides in most of the districts.
Polyalthia suberosa (Roxb.) Thw.	Barachali	Village thickets and shrubberies. It can tolerate standing water and periodic flooding.	In Bangladesh it grows in village thickets; common in northern districts.

Scientific name	Local name	Ecology	Occurrence in Bangladesh
Pongamia pinnata (Linn.) Pierre.	Kerung, karanja, Karamcha	A wonderful tree for adapting itself to diverse conditions, growing well with its roots in salt water or fresh water. Highly tolerant of salinity. It tolerates shade well.	Occurs in the tidal forests, often also along river and canal banks and along the ditches.
Putranjiva roxburghii Wall	Ghomiphal, japhuta, jiapura	Usually on alluvial ground along rivers or in swamps. It can stand periodic flooding. Young plants stand moderate shade but become suppressed in dense shade.	It is planted along roadsides in many cities and villages.
Randia uliginosa DC	Pedalu, piralu	In a wide variety of soils. It can tolerate periodic flooding.	Occurs in sal forests, drier zones of the hill forests and in fallow lands along the water edge of lowlying areas.
Salix tetrasperma Roxb.	Bias, panijoma, Baishakhi,	Found growing along the banks of streams and in wet places. It is shade tolerant and can stand flooding.	Generally cultivated; but also occurs naturally in the forests of Sylhet and Cox's Bazar.
Samanea saman (Jacq.) Merrill	Rain tree, randi, Fulkoroi,	Thrives in a wide variety of soils and water edge. It is a strong light demander and can tolerate permanent stagnation.	Planted in all districts as an avenue tree and in homesteads.
Sapium baccatum Roxb.	Billa, kalabel, champata	Evergreen forests. It can tolerate short period of flooding.	In the forests of Sylhet and Chittagong.
Sapium indicum Willd.	Harua, batul, urmel, Bolas	Mainly along rivers and inland edge of mangrove swamps.	Along the rivers towards sea in the districts of Barisal, Khulna, Patuakhali, Chittagong.
Saraca indica L.	Ashoke	It is found wild along streams in evergreen forests. It thrives best in shades. It can tolerate periodic flooding.	In Bangladesh it occurs in the evergreen forests of Chittagong. Sylhet and Hill districts. Also it is cultivated in temples and gardens.
Streblus asper Lour	Shaora, Asshoara, Harbi, Hekra, harbou	Grows along the roadsides in moist to dry soils. It can stand moderate amount of shade and periodic flooding.	Grows in all districts in village thickets, roadsides and water edges.
Syzygium cumini (Linn.) Skeels	Jam, kalojam	It is found in a variety of situation but most preferably in moist places. It can stand prolonged stagnation.	Cultivated in all districts in the villages.
Syzygium nervosum DC	Daphajam, nadajam, godajam, bhutijam, thola	In deciduous and mixed forests. It can tolerate periodic waterlogging.	Forests of Sylhet, Chittagong and in the Sal forests.
Tamarix dioica Roxb. ex. Roth	Laljhau, Urusia	This tree occurs mostly in river beds and near sea coasts, on sandy soils and edges of marshes. Generally goes under water during the rains.	In the riverbeds of Barisal, Kushtia, Patuakhali and coastal sand of the Sunderbans.
Terminalia arjuna (Roxb.) Wt. & Arn.	Arjun	Grows well in fertile, alluvial soils along the rivers, streams and water courses. The tree is a moderate shade bearer but can not tolerate dense overhead shade. It has more or less superficial root system. It can stand periodic waterlogging.	It occurs in cultivated form in many districts of Bangladesh.

Scientific name	Local name	Ecology	Occurrence in Bangladesh
Terminalia bellerica (Gaertn.) Roxb.	Bahera, Boragach	It grows in the semideciduous dry forests. It is a light demander. It can tolerate periodic flooding.	Grows in the semideciduous forests of Sylhet, Chittagong and Chittagong Hill Tracts. It is also planted in homesteads.
Terminalia catappa Linn.	Kat badam, Bangla badam, Deshi badam	Grows in sandy beaches and alluvial soils. It can tolerate waterlogging. It is light demanding.	It is cultivated in homegardens and road sides.
Tetrameles nudiflora R. Br.	Chundul, Tairul, Mainakat	It inhabits the deciduous and semideciduous hill forests in low undulating lands and riverine alluvial flats. Sometimes it can tolerate periodic waterlogging.	Occurs in the hill forests of Sylhet, Chittagong and hill districts.
Thespesia populnea (Linn.) Sol. ex Correa	Paresh, pareshpipal, Dumbula, Gajasundhi	Mangrove swamps, and sandy and rocky coasts.	In Bangladesh it occurs in southern districts on sand dunes and sea shores. Also found planted along the roadsides.
Trema orientalis (Linn.) Bl.	Jiban, Jinal, Chikun, Simutta, Naricha, Banjiga	The species has no particular soild requirements. It easily colonizes in denuded hill slopes, fallow or poor soils. It also grows in homesteads along the water edges and can stand periodic waterlogging.	Occurs in denuded hill forests. Also grows in the villages all over the country.
Trewia nudiflora Linn.	Gota-gamar, mera goda, mera, pitari, Bhetul	Chiefly found in the moist forests, particularly along the streams and in moist and swampy places. It can stand prolonged flooding.	It grows in low lying areas, along the swamps in all districts of Bangladesh.
Vatica lanceifolia (Roxb.) Bl.	Sutagola, lechua garjan, Rajarani	In the evergreen forests. It can tolerate periodic flooding and stagnation.	Forests of Chittagong, and Hill Tracts.
Vitex glabrata Br.	Horina, Asdol, Betriasal, Bashkura	In deciduous and mixed evergreen forests. It can stand periodic flooding and water logging.	Occurs in the forests of Chittagong, Hill Tracts, Sylhet and Sal forests of Madhupur.
Vitex pinnata Linn.	Goda, harina, awal	The tree is mostly met along the banks of the streams in evergreen forests. It can grow in rather poor soils. It can stand periodic waterlogging.	Occurs in the forests in Chittagong, Sylhet and Madhupur.
Zizyphus mauritiana Lamk.	Kul, boroi.	Grows on a variety of soils but shows best performance on sandy alluvium and on arable lands. It can stand periodic flooding.	Cultivated as a fruit tree in all districts of Bangladesh.

Table 5 - Coppicing Ability

Excellent:

Calliandra calothyrsus
Derris indica
Eucalyptus brassiana
Eucalyptus citriodora
Eucalyptus tereticornis
Leucaena leucocephala
Samanea saman

Good:

Acacia mangium
Paraserianthes falcateria
Albizzia lebbeck
Azadirachta indica
Cajanus cajan
Cassia siamea
Gliricidia sepium
Gmelina arborea
Melia azedarach
Moringa oleifera
Sesbania bispinosa
Sesbania grandiflora
Sesbania sesban
Syzygium cumini

Fair:

Acacia catechu
Acacia nilotica
Paraserianthes falcateria
Albizzia lebbeck
Albizzia procera
Dalbergia sissoo
Syzygium cumini

Poor:

Acacia auriculiformis
Acacia catechu
Acacia nilotica
Artocarpus heterophyllus
Casuarina equisetifolia
Phyllanthus embelica

Table 6 - Species with Nitrogen-Fixing Ability

Acacia auriculiformis
Acacia catechu
Acacia mangium
Acacia nilotica
Paraserianthes falcateria
Albizzia lebbeck
Albizzia procera
Cajanus cajan
Calliandra calothyrsus
Casuarina equisetifolia
Dalbergia sissoo
Derris indica
Phyllanthus embelica
Gliricidia speium
Leucaena leucocephala
Samanea saman
Sesbania bispinosa
Sesbania grandiflora
Sesbania sesban

Table 7 - Species Lacking the Ability to Fix Nitrogen

Artocarpus heterophyllus
Azadirachta indica
Cassia saimea
Eucalyptus brassiana
Eucalyptus camaldulensis
Eucalyptus citriodora
Eucalyptus tereticornis
Gmelina arborea
Melia ajedarach
Moringa oleifera
Syzygium cumini
Eucalyptus tereticornis
Gmelina arborea
Melia ajedarach
Moringa oleifera
Syzygium cumini

Table 8 - Species Tolerant of Flooding, Waterlogging

Casuarina equisetifolia
Eucalyptus camaldulensis
Sesbania bispinosa
Sesbania sesban

Table 9 - Species Particularly Intolerant of Flooding, Waterlogging

Azadirachta indica
Cajanus cajan
Leucaena leucocephala

Table 10 - Species Preferring Some Soil Moisture All Year Round

Paraserianthes falcateria
Albizzia lebbeck
Albizzia procera
Phyllanthus embelica
Sesbania grandiflora
Syzygium cumini

Table 11 - Species Tolerant of Dry Weather

Acacia mangium
Artocarpus heterophyllus
Azadirachta indica
Gliricidia sepium
Leucaena leucocephala

Table 12 - Species Very Tolerant of A Long Dry Season

Acacia auriculiformis
Calliandra calothyrsus
Cassia siamea
Dalbergia sissoo
Eucalyptus citriodora
Eucalyptus tereticornia
Gmelina arborea
Samanea saman

Table 13 - Species Tolerant of Prolonged Drought

Acacia catechu
Acacia nilotica
Casuarina equisetifolia
Eucalyptus brassiana
Eucalyptus camaldulensis

Table 14 - Summary of Important Attributes of the Ground-Cover Legume

Legume	Annual Rainfal Range		Tolerance to:		Low Fertility Soils
	Inches	Millimetres	Dought	Water-Logging	
Centro (Centroseme pubescens)	60+	1525+	F	G	F
Greenleaf Desmodium (Desmodium into	35-50	890-1270	G	G	F
Silverleaf Desmodium (Desmodium uncin	35-50	890-1270	F	F	F
Highworth Dolichos (Lablab purpureus)	20-60	510-1525	G	F	F
Archer Dolichos (Macrotyloma axillare)	20-60	510-1525	G	F	F
Rongai Dolichos (Lablab purpureus)	20-60	510-1525	G	F	F
Tinaroo Glycine (Neonotonia wightii)	30-60	760-1525	G	P	P
Puero (Pueraria phaseoloides)	60+	1525+	P	G	F
Siratro (Macroptilium atropurpureum)	30-70	760-1780	VG	F	G
Cook Stylo (Stylosanthes guyanensis)	60+	1525+	G	F	G
Schofield Stylo (Stylosanthea guyanensis)	60+	1525+	G	F	G
Endeavour Stylo (Stylosanthes guyanensi	60+	1525+	G	F	G
Townsville Stylo (Stylosanthes humilis)	20-50	510-1270	VG	F	G
Verano Stylo (Stylosanthes hamata)	60+	1525+	V	F	G

Note: All these legumes need pre-treatment of seed: (1) Pour boiling water over the seeds, allow to stand 30 minutes, drain, wash in cold water, air dry and sow; or (2) cover with warm water and soak overnight. All require seed inoculation with appropriate rhizobia. VG =very good. G = Good. F=Fair, P= Poor.

Table 15 - Estimated Biomass Yields from Ground-cover legumes Triedat Various Field Stations of the Bangladesh Forest Research Institute (Tonnes/Ha after Five Month's Growth)

Station/Legume	Green Weight	Dry Weight
Hathazari		
Schofield Stylo	36.3	15.3
Cook Stylo	28.8	12.0
Endeavour Stylo	28.8	10.8
Townsville Stylo	9.6	3.3
Verano Stylo	9.6	3.0
Highworth Dolichos	6.6	3.0
Chittagong		
Schofield Stylo	33.6	12.0
Cook Stylo	20.4	9.0
Endeavour Stylo	28.8	6.0
Townsville Stylo	18.0	5.4
Verano Stylo	10.5	4.2
Highworth Dolichos	9.6	3.0
Chainda		
Cook Stylo	24.0	9.0
Schofield Stylo	26.4	7.2
Endeavour Stylo	26.7	6.0
Townsville Stylo	16.8	4.2
Rongai Dolichos	9.6	3.0
Highworth Dolichos	7.2	3.0
Lawachara		
Cook Stylo	23.4	8.4
Schofield Stylo	29.4	6.6
Endeavour Stylo	19.2	4.2
Townsville Stylo	16.8	4.2
Highworth Dolichos	11.4	3.0
Verano Stylo	7.2	2.6

Table 16 - Summary of Important Attributes of the Ground-Cover Grasses

Grasses	Annual Rainfal Range		Tolerance to:		Low Fertility Soils
	Inches	Millimetres	Dought	Water-Logging	
Blue Panic (Panicum antidotale)	20-30	510-760	VG	F	P
USA Buffel (Cenchrus ciliaris)	12-35	305-890	VG	P	F
Biloela Buffel (Cenchrus ciliaris)	12-35	305-890	VG	P	F
Gayndah Buffel (Cenchrus ciliaris)	12-35	305-890	VG	P	F
Guinea Grass (Panicum maximum)	40+	1015+	F	F	P
Green Panic (Panicum maximum)	22-70	560-1780	G	F	F
Rhodes Grass (Chloris gayana)	25-40	635-1015	G	F	F
Kazungula Setaria (Setaria anceps)	35-60	890-1575	F	G	P
Nandi Setaria (Setaria anceps)	35-60	890-1575	F	G	P
Signal Grass (Brachiaria decumbens)	60+	1525+	F	F	G

Note : V = Very good; G = Good; F = Fair; P = Poor.

APPENDIX 18
GUIDELINES FOR CONSERVATION OF BIODIVERSITY

PROJECT 372001/30
FORESTRY MASTER PLAN,
BANGLADESH (TA NO.1355-BAN)

ASIAN DEVELOPMENT BANK
MANILA PHILIPPINES
DATE: JANUARY 1993

ENVIRONMENT AND LANDUSE

APPENDIX 18
GUIDELINES FOR CONVERSATION OF BIODIVERSITY

POLICY AND LEGISLATION

1. Provide a national agency, or reform and strengthen existing institutions to include biodiversity conservation in their mandate.

2. Provide this agency with sufficient human and financial resources to effectively achieve integrated biodiversity conservation involving both the TPA and production forest systems.

3. Develop practical biodiversity appraisal systems to guide forest land use allocations at both the landscape level and within the management units of production forests. Where forest exploitation or changes in forest land use are occurring rapidly, give attention to the development of rapid appraisal systems that can provide guidance to forest planners in a relevant time period.

4. Develop practical techniques for predicting the consequences of different forest management techniques on biodiversity. Incorporate biodiversity monitoring into on-going management programmes for all forests.

BIODIVERSITY AT LANDSCAPE LEVEL

5. Identify, survey and delineate the various categories of the Permanent Forest Estate in consultation with forest dwellers and surrounding populations, taking into account their present and future needs for agricultural land and their customary use of the forest.

6. Within the constraints of prevailing social and economic circumstances, design TPA's to cover as large an area of natural forest as socially and economically feasible, with due attention to optimizing their shape. Surround these TPA cores with sympathetically managed near-natural production forests to minimize edge effects, and ensure the protection of ecological function.

7. Link TPA reserves by providing "corridors" of natural forest and ensuring that the habitat at known major resting sites and the known ends of migration routes are retained. Locate production forests to maximize the connectivity between natural forest TPA's at the landscape level.

BIODIVERSITY AT MANAGEMENT UNIT LEVEL

8. Particular care should be taken in applying silvicultural treatments to ensure that adequate populations of species which are important in food chains or in providing ecological functions (keystone species) are retained.

9. Trees with hollows, standing dead trees (snags) and decomposing fallen trees all have ecological importance for a range of species and not all should be removed from the forest in any silvicultural treatment to improve timber yields.

10. The use of pesticides or other chemicals should be kept to a minimum in any silvicultural treatment, and the manufacturers instructions for the use of each product should be strictly observed.

11. In forest areas of recognized importance for biodiversity conservation incorporate consideration of the effects of rotation length, felling cycles, girth limits and size of the annual area cut-over in deciding the allocation of the AAC.

12. When determining yield allocations and rotation lengths for particular management units, plan logging operations so that a mosaic of recently logged and old growth forests are maintained over time.

13. Within each major management area, a system of small virgin reserves should be designated on the management plan and maps. The boundaries of these reserves should be marked in the field where feasible.

14. Management inventories should aim to locate key areas within all production forest units that are known to have higher biodiversity values as outlined in Principle 12.

15. Working plans should prescribe appropriate management measures in accordance with the specific biodiversity value of these key areas. Buffer strips of no intervention should be established along streams and around lakes and wetland areas.

16. Reduce individual gap size as far as possible, unless specifically required for the regeneration of key species. Avoid creating very large gaps that equate to areas of local clearfelling.

17. Minimize machinery and felling damage to the residual stand, undergrowth and soil.

18. Utilize market mechanisms and economic incentives at the national and international level to encourage maintenance of biodiversity services. Expand programmes of training, technical assistance, education and information sharing. It may also be necessary to consider other mechanisms of international cooperation to meet costs of biodiversity conservation.

19. Efforts should be made to involve local people in the management of the forests, and to ensure that they obtain benefits, which will motivate the people themselves to use their traditional knowledge in support of the conservation of biodiversity.

20. Investigate and adapt existing systems to develop locally specific, rapid, cost-effective and efficient biodiversity surveys and monitoring systems that could be carried out by, or in conjunction with, forest inventory teams during their survey activities. Implement such systems as a part of normal forest inventory processes.

APPENDIX 19
CRITERIA FOR SUSTAINABLE MANAGEMENT OF TROPICAL FORESTS

ENVIRONMENT AND LANDUSE

APPENDIX 19
CRITERIA FOR SUSTAINABLE MANAGEMENT OF TROPICAL FORESTS

INTRODUCTION

The list of Criteria and Examples of Indicators below is neither exhaustive nor exclusive. Moreover, all of the Examples of Indicators do not need to be measured to establish sustainability or the degree to which it has been achieved.

It must be emphasized that determinations of sustainability and, therefore, use of the following list must be specific to each nation or each management unit.

Sustainability at the National Level

Criteria	Examples of Indicators
The Forest Resource Base	- Comprehensive land use planning and provision for the Permanent Forest Estate (PFE)
	- Present area of the PFE in relation to national goals and targets.
	- Plantation establishment targets, present age class distributions, and annual planting regimes.
	- Areas of Protection Forests and Production Forests within the PFE.
	- The representativeness of the protected areas network and the current or planned reservation programme.
The Continuity of Flow	- National production statistics of Forest Products over time.
	- Documentation of logging (area) histories over time.
	- Proposed cutting cycle lengths for major forest types, and standard concession lengths.
	- Regulation of initial harvesting rates in relation to defined cutting cycles and net area of production forest.
	- Regulation of subsequent harvesting in relation to increment data and the net area of production forest.
	- Steps taken to harmonize the first and subsequent cutting cycles and manage the transition from the first to the second cutting cycle.
	- Wood production targets over time from various sources.
	- The availability of silvicultural prescriptions for the major forest types.
The Level of Environmental Control	- Management prescriptions for other non-production components of the PFE.
	- The availability of engineering, watershed protection and other environmental management prescriptions for production forests.
	- Availability of environmental assessment procedures.
Socio-Economic Effects	- Employment patterns and trends
	- Income generation and distribution patterns
	- National revenue and expenditure budgets for forest management.
	- Availability of environmental assessment procedures.

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APPENDIX 20
ECOLOGICAL GUIDELINES FOR THE MANAGEMENT OF TROPICAL MOIST FORESTS

GUIDELINES

Policy Review and Formulation

1. Policies must encourage the sustainable development of tropical forest as a national asset. The review and formulation of all policies which have a bearing, direct or indirect, upon tropical forest must therefore take into account:

   - o an evaluation of all the benefits which tropical forest can produce;
   - o the need to treat tropical forest as a capital resource and to invest accordingly in preventing its depletion;
   - o the need to ensure that the objectives of sustainable development are met;
   - o the need to maintain essential ecological processes, especially where these influence hydrological systems and local climate;
   - o the need to maintain overall biological diversity;
   - o the need to ensure that harvests do not exceed sustainable levels; and
   - o the necessity to maintain the basic spiritual needs of people living in and around the area in question.

2. The review and formulation of all policies which have a bearing on tropical forest should be carried out by representatives from the whole range of sectors who use or otherwise affect the state of tropical forest lands.

3. Policies must be backed up by effective tools and procedures for implementation. It is essential to have a capability for practical land-use planning and to be able to control and supervise operations effectively. The ecological and social implications of any proposal affecting tropical forest must be considered at the earliest stages to the proposal and throughout project development.

4. The National Constitution should reflect the nation's determination to ensure the sustainable use of the whole range of tropical forest benefits.

National Conservation Strategies

5. The process of developing a National Conservation Strategy or comparable policy review is an excellent way of beginning and maintaining the kind of multi-sectoral dialogue required for the formulation, and implementation of effective sustainable development policies. It also plays an important educative role.

6. A national land-use policy is an essential requirement. It must encourage the optimal use of each land resource; but it should balance this with the requirement to retain flexibility and ensure sustainability. Special care should therefore be taken to minimise irreversible land-use changes. An effective land-use policy would include a provision for controlling and monitoring the effects of changes in land-use.

Economic, Financial and Fiscal Policies

7. Economic policies should aim to balance short-term production from tropical forest lands with the need to ensure the long-term flexibility of tropical forest use.

8. Special attention should be given to valuing non-market forest benefits in economic terms, but more especially to using such valuation in making economic decisions affecting tropical forest. Where this valuation cannot be made realistically, other methods such as Environmental Impact Assessment, should be used to ensure that ecological considerations are included in decision-making.

9. The sustainable levels of production of forest benefits should be determined and, where possible, demand controlled so as to fall within these limits. This should be assisted by setting appropriate prices for forest products.

10. In economic development generally, the intention should be to add value to forest products; experience has shown that industries in tropical forest countries can only add value if efficiency in processing, and competition between forest industries, are encouraged.

11. An analysis should be made of incentives for any activity which affects tropical forest lands e.g. tax concessions, credit, grants or indirect incentives such as provision of infrastructure. Future incentives should be very carefully designed to ensure optimum, sustained production of a range of benefits and their equitable distribution.

12. Where concessions are given for forest use, governments must ensure that they capture a significant proportion of forest rents and that a sufficient proportion of this rent is reinvested in the maintenance of the forest. Realistic stumpage fees should be charged, land rents set by competitive bidding, taxes on timber exports levied and longer-term leases given where these would encourage more sustainable utilisation.

Trade and International Relations

13. Industrialised countries should formally recognise their dependence upon tropical forests by ensuring that trade and foreign relations policies help tropical forest countries to develop and manage tropical forest lands in a sustainable way.

Specifically, they should apply tariffs and quotas to discriminate in favour of timber and other products harvested sustainably and timber products processed within the country of origin.

The International Tropical Timber Agreement provides a mechanism for developing and applying such practices.

14. Commodity agreements should be formulated with the participation of producer and consumer nations on equal terms. They should help sustained-yield practices to be economically viable for producer nations in both the short - and long-term.

15. Tropical forest should not be exploited for short-term gains to repay foreign debts. Rather, it is important, in all negotiations between debtor countries and financial institutions, to balance debt repayment with the sustainable income-generating capacity of tropical forest. And, if it is true that the debt burden leads to environmental costs, then these should be reflected in lower interest rates or debt cancellation.

16. Aid-assisted projects in tropical forest land should only go ahead after thorough economic, social and environmental analysis, preferably as part of a national strategy formulated by the recipient government, and with the assurance that their implementation will be sustainable. In general, aid for securing the long-term viability of tropical forest ecosystems (protected areas, sustainable forest management, rehabilitation of degraded land, watershed management etc.) should be increased. Aid agencies should support organisations working on the ground with local peoples. While such action must have government encouragement, these will not always be government institutions.

Sectoral Policies

17. Forestry policy should cover the whole range of forest values, and not merely timber. There may be merit in designing two-fold forest policies, one concerned with wood production (including both state forests and private lands, including wood from agricultural land) and the other concerned with the environmentally sound management of the country's forests for all their values. Greater coordination with other sectors will be essential in order to maintain careful balances between:

- o land retained as forest and land to be transferred to agricultural use;
- o production of different products and protection for different purposes;
- o natural forest and plantations; and
- o short-and long-term returns on investment.

The major aim of state forest policy should be to maintain the forest resource base. This will necessitate the establishment of a state-owned forest estate, for the total protection of critical forest lands as watersheds and reserves for biological diversity. Powers of protection must be vested in a government forestry authority and/ or wildlife conservation authority, as appropriate. The objectives of forest management, and timber utilisation and processing should be clearly expressed, realistic and achievable, and be consistent with these Guidelines.

18. Agricultural policy should reflect the role of forests as the source of environmental services essential for maintaining food security, and as the living environment for certain communities of people. Agricultural development should not interfere with these services; and, in particular, it should not unnecessarily involve clearing forest land unless such land is of high fertility and the change in land-use produces an overall increase in sustainable benefits. No clearance should ever take place in critical watersheds, on critical soils or in areas of exceptional biological diversity. Agricultural development should incorporate agroforestry/ forestry/ gardening systems wherever possible. Permissible population densities of shifting cultivators should be defined for major forest types and action taken to intensify and stabilise agriculture if higher densities are likely to be reached.

19. As the industrial sector grows in tropical forest-dependent nations, policies of the control of pollution should be developed in order to avert possible disastrous ecological and economic effects on tropical forest such as those caused by acid rain and other pollutants in some European and North American forests.

20. Energy policies should recognise the often considerable dependence on fuelwood; policies for the sustainable development of wood fuel supplies should be formulated in conjunction with forestry authorities. Fuel efficiency and alternative energy sources should be promoted.

21. Major infrastructure development represents a considerable commitment of resources in tropical forest-dependent nations; policies should be based upon a careful analysis of environment issues, beginning when ideas are first being formulated.

Social and Settlement Policies

22. All tropical forest development should be planned with the full participation of communities already living in the area, and be responsive to their needs. Particular attention should be paid to the interests and values of indigenous communities long established in the forest. As a general principle, these communities should retain the maximum autonomy in the use of their traditional lands, except in rare instances of land of exceptional national importance or where an already diminished forest area can no longer support their requirements.

23. Land title should not generally be given in areas which have critical value for catchment management, biological diversity, or where unique or distinctive ecosystems occur. But security of tenure and management agreements are desirable for farmers living around a protected area, in order to discourage encroachment on the area. The common requirement that land be cleared to obtain title often encourages land speculation and should be avoided.

24. General education on natural resource values should be incorporated in the school syllabus. Training in sustainable development of tropical forest resources should form a distinct part of professional and technical training for all disciplines involved in tropical forest development.

25. Unplanned and uncontrolled settlement by new colonists in tropical forest should be discouraged. Demands for such settlement should be anticipated and viable alternatives sought. Incentives and infrastructure should be provided to encourage colonisation only of areas demonstrated to have the necessary potential for sustainable agriculture. Investments in creating industrial employment may be used to relieve pressure on forest lands.

26. Planned resettlement or the development of new centres of population should take into account the present social, cultural, economic and health conditions of those to be settled and their future needs. Settlement plans should be developed with the full participation of the persons to be resettled.

Land Evaluation and Survey

27. When they are not already available, national and regional surveys should be undertaken as soon as possible to provide the information on social structure, climate, topography and land form, soils, flora and fauna, mineral resources and hydrology. Special attention should be paid to fragile or sensitive areas and those where there is intense pressure of people on resources.

28. Until detailed surveys are available, the greatest use should be made of the results of remote sensing, and of vegetation survey, as a measure of climatic and soil characteristics.

29. Capability should be assessed separately for each possible use, or value, of the land. Land-uses or values include: potential for mineral extraction, agriculture and timber production; suitability for settlements, roads, dams and tourism; intrinsic value for conservation as examples of ecosystems, to preserve genetic resources of plants and animals; as beautiful landscapes, or as sites of historical or archaeological value.

30. Existing surveys may need to be supplemented or reinterpreted in the light of new knowledge, improved technology or changing social priorities.

31. A total catchment area is recommended as an appropriate unit for planning; and plans should include all elements of the infrastructure needed - settlements, roads, dams, water supply, siting of sawmills, processing plants for agricultural produce, and other industry.

32. Measures for conservation of the national heritage (natural protected areas and cultural sites) should be planned nationally and all local decisions should take account of this national plan.

33. Before felling, or major harvesting of forest produce, an assessment of the possible final use of the land should be made in order to enable a proper phasing and planning for development.

34. The environmental effects of alternative courses of action and legislative proposals should be assessed in advance in order to ensure that long-term costs do not outweigh short-term benefits.

35. National interests must be balanced against the interests of any special groups in the community.

36. Once forest lands have been transformed or extensively modified the change is for practical purposes irreversible. Modifications which cause least disruption to soils and the physical structure of the vegetation are likely to be the most stable and sustainable.

37. The effects of alternative courses of action on the region in question, its surroundings and, in particular, on the whole catchment area of any affected river system, must be evaluated through an "Environmental Impact Assessment" or other appropriate means.

38. Local peoples' participation should be encouraged at each stage of planning in order to find out local wishes and preferences and evaluate the full social costs and benefits of alternatives.

39. In the course of land-use planning, it may be decided to leave forest untouched in order to have a reserve of unallocated land. But in the case of protected forest, national parks and nature reserves, land should be allocated specifically for these purposes and not looked upon as a reserve which is available for future conversion.

40. Before deciding to modify or transform untouched areas, every consideration should be given to alternatives. This may include adapting areas that have already been changed to more productive uses, for example using grasslands for pine plantations. Alternatively, it may involve the intensification of existing uses or using areas for more than one compatible purpose.

41. The effects of any major development should be monitored and evaluated; the results of this evaluation may be used, if necessary, to modify the course of development and will provide experience to guide future development schemes.

Ecological Constraints to Development

42. Serious constraints are imposed on tropical land use by soils poor in nutrients. The long-term stability and productivity of natural ecosystems results from their highly evolved adaptation to deal with local nutrient constraints. The possibility of gradual decline in productivity of plantations, agricultural crops, pastures and managed forests through soil nutrient depletion must be recognised.

43. Because of the low prices commanded by products, and because of remoteness and transport problems, it is rarely economically or logistically possible to use inorganic fertilisers on a large scale on lands cleared from moist tropical forest. The use of crops or trees with nitrogen fixing symbiotic bacteria and various other agroforestry systems can enhance the availability of nutrients and the efficiency of their use.

44. The interactions between species are much more complex in tropical than temperate ecosystems. The impact of relatively minor disturbance to the ecosystem may be far reaching and hard to predict. Loss of one species may lead to the extinction of many others which depend upon it at some stage of their life cycle.

45. Local variations in soils and climates, and in the ecological history of sites, results in a large number of distinct ecosystems in tropical moist forests. As much as possible of this variation must be conserved if the full potential of tropical lands is to be realised.

46. The higher the total rainfall and the longer the rainy season, the more difficult it is to grow plantation or agricultural crops in the tropics.

Forests for Nature Conservation and Environmental Protection

47. For each conservation or protection area, a primary objective of management should be determined and other uses should be permitted only if they do not conflict with this primary use.

48. Those forests which are of critical importance for the conservation of biological diversity or which fulfil critical environmental functions should be legally gazetted by the highest competent authority of the country and should in no circumstances be modified or cleared.

49. It must however be recognized that many kinds of careful extractive use can be compatible with species protection and the maintenance of hydrological functions. In these circumstances management regimes which permit controlled exploitation by, and under a degree of control of, local communities may be more viable than attempts to impose total protection in the face of possible resentment and hostility on the part of traditional users of the area. The extractive reserves in Amazona and certain forests managed for the controlled extraction of small volumes of timber for local use, fall into this category.

Protection Forests

50. Catchment protection in the tropics is so important for ensuring food security and protecting water supplies that the designation of catchment protection areas must have very high priority.

51. The conditions under which it is necessary to maintain intact forest cover vary according to slope, soil erodability and climate. General specifications for protection forest cannot therefore be laid down, but should be determined individually for each country or region.

52. If they have not already done so, governments should draw up specifications (covering soil type, erodability, climatic conditions etc) for areas that must be scheduled as protection forest and should ensure that these are respected.

53. Specifications should also be drawn up, based on the necessary research, to determine what kinds of exploitation may be permitted in protection forests. Permissible exploitation may include: the harvesting of medicinal herbs, extraction of carefully selected trees, the collection of genetic material, and so on. The specifications should ensure that such activities are carefully licensed and controlled and do not interfere in any way with the forests' protective function.

54. Governments should identify all deforested catchment areas which are contributing to soil erosion and irregular river flow. As a matter of urgency, every effort should be made to restore a stable cover of trees or other vegetation which will protect the soil and regulate water flow to the same extent as the original forest.

55. Critical catchment areas of this kind should only be used for food production when there is no other acceptable alternative. Where this is the case, agroforestry systems should be adopted which copy as closely as possible the protective structure of the natural vegetation, and which will continue to protect the soil even if they are abandoned or neglected.

Nature Conservation Forests

56. A survey and assessment should be made (at an early stage in planning) of the intrinsic value of land for the conservation of flora, fauna and natural ecosystems; and legal and administrative action should be taken to permanently secure large, typical samples of all the country's ecosystems together with any areas of exceptional interest.

57. In specific situations, where there are areas of outstanding and possibly of unique value, high priority should be given to their protection. This should be given preference over other forms of land-use and is particularly urgent in lowland rain forest.

58. Safeguarded areas should be as large and as varied as possible. It is impossible to make universally valid recommendations about these matters, for often, in practice, there is very little choice. However, the size and characteristics of the protected areas should be related to the needs of the plant and animal communities that they are intended to protect; and, wherever possible, the areas chosen should be large and should include examples of different ecosystems, representing, for example, the different attitudinal zones on a mountain or gradations of wetness. (This will provide some insurance against climatic change).

When the land surrounding protected areas becomes intensively used, these are left as "islands". Their edges become altered for some hundreds of metres and the areas become very vulnerable to such external factors as climatic extremes. The danger of losing species can be lessened by making reserves larger and more varied, or by regulating land-use in the areas between them so that migration is possible.

59. The larger and more varied the area, and the more sympathetic the land-use surrounding it, the less active management is likely to be required to maintain its value.

60. In planning the overall development of any area, provision should be made for the migration of animals and dispersal of plants between protected areas, for example by leaving corridors between reserves.

61. Wherever possible, areas set aside to safeguard samples of natural ecosystems should be surrounded by buffer zones, taking advantage of physiographic and other natural protective features. These should be maintained under natural vegetation or, if this is impossible, under protective tree cover; but they can be used for any form of economic land-use that does not interfere with the integrity of the protected area.

When a protected area is established in an inhabited region, various supporting measures may be necessary to withdraw pressure from the protected area and to make it acceptable to local people. Unless there is local sympathy and understanding for a protected area among the people who live around it, it is unlikely to survive.

62. Protected areas should only be established after close consultation with the people living in or near them.

63. Measures should be taken to ensure that the people benefit economically from the protected area.

64. Where these measures are not enough to prevent continuing damage to the protected area, steps should be taken to attract the population to new and less harmful forms of economic activities: more intensive agriculture, the managing of community forest, agroforestry systems or small-scale industry. Pressure may be reduced still further if these are sited at some distance from the protected area.

65. The objectives of management for such a protected area should be carefully defined and adhered to. They should include maintaining part of the area completely undisturbed, as a standard for comparison; but in the remainder, uses for scientific study, for education and for recreation should be encouraged, provided that these uses do not conflict with the primary purpose of protection.

66. There should be a management plan for each protected area, and the course of management should be monitored to assess whether the original objectives were reasonable and the management has been successful.

67. By the careful manipulation of controls and financial incentives it may be possible to maintain "protected landscapes" which combine the function of nature conservation with those of a thriving and developing local community.

68. Management of land outside protected areas should be carried out in such a way that reasonable populations of wild plants and animals can survive in them. By maintaining variety, this may often prevent any of these species from becoming pests. Sometimes also, wild species play an important part in the life cycle of cultivated plants. Their disappearance may prove to be serious.

Genetic Resource Forests

69. National surveys and conservation programmes for genetic resources should be undertaken to:

- identify species of actual or potential economic importance;
- determine the extent to which the varieties of each species are preserved in existing protected areas;
- establish additional protected areas as necessary;
- apply additional management, both in protected areas and in production forest, to preserve genetic resources and make them available for use.

Forests for Wood

70. Natural forests which are managed for a sustainable production of timber will also provide numerous other benefits to society (watershed protection, biological diversity conservation, a variety of minor forest products). Although timber needs could often be met from plantations for similar levels of investment, the multiple benefits of the forest would not then be safeguarded against competing land uses. Where options still exist countries should attempt to derive the maximum of their timber needs from a managed "natural forest estate".

71. Such forests should be managed according to the best available principles of silviculture, and in such a way that the natural composition and structure are altered no further than is necessary.

72. Management should be directed at getting the best total return from all forest products, consistent with ensuring that the forest resource base is not depleted.

73. Efforts should be made to widen the range of products that can be used or marketed. The relative values of the various products may change from time to time and new uses may be discovered. A forest which still retains its varied potential can best respond to changes in demand.

74. Good management depends upon a knowledge of the ecology of the principal economic species in any particular forest; this should be given priority in research.

75. Incentives should be provided to those harvesting the forest, whether concessionaires or others, to encourage them to maintain the potential productivity of the forest.

76. Management plans should be prepared for each area of production forest. It should be the responsibility of the Forest Authority to ensure that these are followed.

77. Timber extraction and road building should be carried out in ways that least damage soil, vegetation and watercourses.

78. Predicted timber requirements should take account of local needs for fuelwood. When the viability of the forest is threatened by fuelwood collection, special plantations should be established near the site of demand - but outside the forest - to reduce pressure and preserve areas of forest for future allocation. Alternative sources of fuel (e.g. biogas) should also be developed.

79. When tree plantations are needed to meet demands for wood, they should be placed in non-forested areas wherever there are suitable sites. Such are often provided by waste and degraded lands or abandoned agriculture. Plantations need not be in blocks; they may be more appropriate in and around villages, along roads and canals or in association with agricultural crops. Multi-purpose trees (for fuel, fodder, timber for local construction) can often best serve the needs of local communities, and much can be accomplished by encouraging the recovery of natural vegetation. In densely populated regions, plantation forests can provide effective buffer zones around nature conservation forests.

Transformation of Natural Forest into Field and Plantation Crops

80. Land should only be used for cultivation or plantation crops when sufficient survey of the ecological conditions has shown that the area is suitable for such crops and when field trials or observations have confirmed this assessment.

81. Farming systems must be selected which are suited to local conditions and which can be managed effectively by the people expected to use them.

82. Any modification or transformation of existing vegetation must be carried out in such a way that the least possible harm is done to the soil by radiation and rainfall, in order to retain organic matter, fertility and adequate soil structure. Hand methods are often preferable to using heavy machinery, which can cause serious damage to the soil if used under the wrong conditions.

83. Careful studies should be made of traditional and indigenous systems of agriculture which have produced a sustained yield under these conditions. Every attempt should be made to extend such stable and productive indigenous systems, or suitable aspects of them.

84. Particular attention should be paid to the public health problems that may arise from forest clearing.

85. Special attention is drawn to the danger of introducing species of animals for domestic purposes, under range conditions, where there is any opportunity for escape into the wild. Animals such as buffalo and goat, for example, have caused considerable ecological and economic damage after escape from domestic control.

86. Careful studies should be made before the transformation of mangrove swamp forest to agriculture or fisheries so as to avoid long-term and irreversible side effects from the loss of these ecosystems.

87. New agroforestry and livestock management systems should be developed, both to improve animal production and to prevent unnecessary forest destruction.

88. Improvements in ruminant livestock production can most suitably be obtained by:

- developing new and suitable breeds;
- increasing the productivity (and hence the carrying capacity) of existing pastures by the use of multi-species forage and improvements in management;
- integration with field and tree crop production; and
- utilising all available by-product feeds.

89. The improvement of non-ruminant livestock can probably best be accomplished by ensuring the continuous and economic supply of suitable feeds, which should include as many locally-produced by-product feeds as possible. There are also possibilities for integrating pig, chicken and duck production with fish production.

90. Wherever possible, tree crops should be integrated into systems that include the raising of animals and production of food crops.

91. Every effort should be made to improve the productivity of existing grasslands by the introduction and testing of new forage species, the solution of dry season feeding problems and overall improvements in management.

92. Further efforts should be made to domesticate, or bring under extensive management, indigenous animals, such as deer, banteng and crocodile.

Indigenous Communities and Shifting Agriculture

93. When the present practice of shifting agriculture by indigenous peoples is in harmony with the environment and is not leading to slow degradation, there is no ecological reason to change it.

94. There should be regular monitoring to detect when shifting cultivation is beginning to surpass the capacity of the local environment to support it. Measures should then be taken to render local systems more productive or facilitate the introduction of more intensive forms of sustainable agriculture, such as new agroforestry systems. If alternative employment can be provided this may divert pressure from the land.

95. Careful note should be taken of the techniques used by local peoples, the plant species and varieties that they use and the systems of agriculture they practise. Much of value may be learned which may be incorporated in new and more intensive systems.

96. Every effort should be made to discourage the unplanned and uncontrolled movement of new colonists into the forest, and the destructive forms of migratory agriculture that they practice. This can be done through well-planned and sustainable land settlement or by the provision of other opportunities for employment.

Settlements, Engineering Works and Industries

97. As far as possible, infrastructure developments should be sited in areas where (a) environmental conditions are most favourable for them; and (b) their local effects can be successfully absorbed.

98. As well as the socio-economic effects, probable ecological impacts should be assessed in advance, and subsequently monitored and evaluated.

99. It must be recognised that the population in new settlements is certain to grow. The infrastructure and allocation of suitable of land for agriculture must be planned accordingly.

100. The planning, design, construction and operation of industries should take into account the possible adverse effects of industrial pollution (Physical, thermal, chemical, biological) and other harmful ecological consequences. Standards of quality for water, soil and air should be based on proper ecological criteria.

Means of Transport and Communications

101. Careful consideration should be given to a choice of mode of transport which will minimise damage to the environment and best enable the course of development to be regulated.

102. Allocation of land and land management along new axes of communication should be in accordance with land capability and a regional development plan.

103. All land clearing and other activities which are not consistent with these should be strictly prevented.

104. If possible, no roads should be routed through sensitive areas, especially those designated as parks or reserves; but, if other considerations make this unavoidable, plans to mitigate any potentially harmful impacts should be drawn up before the roads are built; no activity should be permitted which is not in accordance with these.

Exploitation of Mineral and Hydrocarbons

105. Every exploration, development or production initiative should be preceded by an Environmental Impact Assessment (EIA) covering the ecological and social conditions at the site, the likely course of the industry and its effects, recommendations to mitigate any damage and a scheme of monitoring.

106. If a decision is taken to go ahead, any adverse effects must be minimised by good design and environmental management at all stages.

Water Catchment Areas

107. The catchment should be managed in such a way as to ensure water delivery of the required, and preferably high, quality.

108. The utilisation of the water resource should be based on the needs of the people, first consideration being given to domestic needs and food production.

109. As far as possible, natural vegetation cover should be maintained on upland catchments. The cost of water development projects should include the cost of actively protecting catchment forests.

110. If the land pressures are so great that it is not possible to retain natural forest cover, then systems maximising tree crops and agroforestry should be used which approximate of the multi-layered structure of the natural forest.

111. National parks and strict nature reserves often provide the best possible protection for upland catchments.

112. Catchment forest could be exploited for timber, but this would require much more careful logging practices than are presently found in most of the tropics. Selective logging with sawing in the forest and the use of animal traction to transport timber to roads or waterways has worked well in the past and should be retained as a management technique in sensitive catchment areas.

113. Natural vegetation should be used wherever possible to rehabilitate degraded catchments. If this is not possible, then agricultural or forestry uses which maximise woody vegetation should be used. Stabilisation of steep slopes with irrigated terraces is only worthwhile on relatively fertile soils such as those found in parts of Java.

114. Multiple use of catchments can be consistent with the above objectives and should include provision for sustainable use of wildlife and the greatest possible variety of other forest products.

Waterway, Dams and Weirs

115. When planning and executing improvements to existing waterways, canals, etc, special attention should be paid to the total effect of these works on water and living conditions of the people living nearby. Public health and environmental problems that might be solved by any such improvement should be given special attention.

116. When planning any dam or significant change of river regime, special attention should be paid to its effect (or the effect of alternatives) on flow and on physical, chemical and biological characteristics of the water at and below the intended work. this is necessary to assess possible consequences for human health, fisheries and wildlife. It is also necessary to assess the risk of infestation by water weeds. These should include advance studies, of at least one year, on:

- o stream flow, sediment load and bed load;
- o water chemistry, precipitation and the chemical content of rainfall;
- o aquatic vegetation and its dynamics;
- o aquatic fauna, especially fish of economic importance, their life histories, food and feeding habits, reproductive patterns, spawning and migration;
- o groundwater in the neighbourhood of the proposed reservoir; and
- o the sedimentation patterns and water regime of flood plains, estuaries and deltas downstream.

117. Arrangements should be made to monitor these variables and the cost of doing so should be included in the project.

118. The cost of protecting the catchments of new dams, usually by maintaining natural forest cover on slopes, must be included in the overall investment programme. Enormously expensive catchment rehabilitation projects are now becoming necessary where settlers, displaced by or attracted to new impoundments, have damaged catchment forests.

119. Public health problems that may be caused by, or associated with, an impoundment must be anticipated, and their management needs and costs included in the cost-benefit analysis and future management plan. The problems of mosquito and snail-borne human diseases require special attention. If resettlement schemes or spontaneous population movements near any proposed reservoir are likely to bring new populations in contact with disease, this risk must be assessed in order to design appropriate public heath programmes.

120. Preparations should be made in advance to manage the fisheries in the period following impoundment and to provide for the resettlement displaced animal populations.

The Management of Fisheries

121. The introduction of exotic species into water systems should only be considered after all other possibilities of increasing production, such as the encouragement of selected native species, have been exhausted. Even then it should only be carried out after careful trials and with stringent precautions.

122. In large river systems, regulations for fisheries management must take into account the riverine spawning migrations of many species. Protective legislation designed to maintain a breeding population of such species may need to apply to large portions of a river system and its estuaries.

123. In flood plains (which have high seasonal potential for fish production and are also farmed at low water) farming methods should be avoided which may damage aquatic life. Special care should be taken in the use of pesticides, and persistent chemicals toxic to aquatic life should not be employed. Artificial breeding of important species should be developed for the deliberate stocking of suitable waters.

Source: Poore, D. and Sayer, J. 1991

APPENDIX 21
GUIDELINES FOR INITIAL ENVIRONMENTAL EXAMINATION FOR PROJECTS IN FORESTRY DEVELOPMENT

ENVIRONMENT AND LANDUSE

APPENDIX 21
GUIDELINES FOR INITIAL ENVIRONMENTAL EXAMINATION FOR PROJECTS IN FORESTRY DEVELOPMENT

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1. CHECKLIST OF ENVIRONMENTAL EFFECTS COMMONLY ASSOCIATED WITH PROJECTS IN FORESTRY

I. Commercial Logging

A. Project Siting

1. Watershed areas: Is the proposed project area located in a critical watershed serving reservoirs, large population centres or industries? If so, what will be the likely effects on hydrology, siltation and water quality and how will the affect the various users?

2. Relation to other dedicated land uses: Will the proposed project area infringe on other dedicated land uses such as parks and wildlife preservation zones, mining operations, etc.? Has the project duly considered including forestry as an integral part of development taking place in other sectors? How?

3. Traditional forest uses: Have the different kinds and levels of traditional forest uses by local populations and the expected effects of the project on these uses been adequately considered in the selection of project location?

4. Resettlement: Will the proposed project entail resettlement of indigenous populations? If so, how will this be handled?

5. Relation to regional/national forestry plans: Has project siting taken into account the regional and/or national master plans for forest utilization/conservation? Does it contravene plans for conservation of minimum forest area/type that should be maintained for long-term regional welfare?

6. Critical environmental areas: Is the project to be located in environmentally critical areas such as land with steep slopes and fragile soils? If so, what will be the effects on soil stability?

7. Precious ecology: Does the selected site contain rare or useful species of wildlife, fish and plants? Will the project lead to serious depletion or loss of these resources as concerns their regional or national status? Are project "with project" (compared to "without project") depletion/loss of these and other precious ecological resources sufficiently high to warrant selection of an alternative site in order to preserve these resources? If not, will appropriate mitigation measures be provided?

B. Planning and Design

1. Benefit/cost analysis: Has a benefit/cost analysis been done that clearly addresses costs due to erosion/sedimentation; increased peak flows and flood flows; loss of recreational or tourism opportunities?

2. Operations and maintenance: Does the fiscal setup ensure availability of necessary O&M funds, especially for erosion and sedimentation control and forest rehabilitation? Has training for the local labour force and/or foresters been included as an integral part of O&M plans as concerns technologies both at the logging site and at the processing site?

3. Data base for decision making: Have the impacts of previous regional logging operations due to proper/improper planning and design been accounted for and modifications been made to the project based on this information? Will sufficient information be collected on timber stand density, species composition, terrain, logging conditions and the environmental effects of logging operations to provide the basis for long-term logging and road development plans? Has provision been made to store the above information in a data base of indicators that the Bank, government and others can use for planning and decision making for this and future projects? Is the data base defined/costed and how will be financing for monitoring be ensured?

4. Road network design: Has planning and design of roads adequately considered soil conditions, grades and curves, water drainage, proximity to waterways, and adequate drainage? Will adequate monitoring be provided to ensure minimal erosion from road construction/operation? Has the road system been planned in advance, taking into roads can be determined, thus reducing the area of soil disturbance and lowering construction/maintenance costs?

5. Design of logging activities: Does planning and design allow for minimal damage to the residual stand?

6. Critical environmental areas: Has due consideration been given to critical areas (i.e., those with extreme soil erodability, rainfall erosivity and slope gradient/length) for erosion control measures?

7. Previous ecology: Has planning and design taken into account the mitigation/protection/enhancement measures for rare or useful wildlife, fish and plant species, such as provision of buffer strips, of standing food trees, of newly created protected areas around the logging site? Selective logging can enhance habitat for several species of large mammals, including elephant, deer and others.

C. Project Operations

1. Road construction:

   a. Will road construction be limited to the dry season and, if not, will there be added environmental dangers from wet season construction?

   b. Are drains spaced properly and has wise use been made of bridges, culverts and paved fords?

   c. Have up-and-down spur roads been avoided to the maximum extent possible?

   d. Have areas adjacent to logging roads been provided with vegetative cover, and have cut-and-fill areas been reseeded to minimize erosion?

2. Felling:

   a. Is the felling system employed optimal for minimizing loss of seed trees and residual stands?

   b. If wide-scale clear-cutting (as opposed to selecting cutting and shelterwood systems), can the following effects be expected significantly accelerated erosion; increases in height of flood peaks; serious loss of wildlife habitat; promotion of landslides? Clear-cutting should be avoided, particularly in unstable areas. If clear-cutting is being done, have adequate measures been taken to minimize the above impacts?

   c. Is the felling system being monitored to check compliance with the concession contract as regards size and types of trees allowed to be logged and permissible area of operations?

   d. Have precautions been taken not to disturb vegetation near waterways and to avoid blocking streams with logging debris?

3. Log conveyance and allocation:

   a. Will the log conveyance system cause undue erosion and compaction? Erosion can be minimized by employing a suitable log conveyance system. Cable yarding in hilly regions will cause minimal damage compared to ground skidding, for example.

   b. Is rational and profitable use being made of residues and will the logs be allocated to their most appropriate use so optimal benefits are gained from the logged area?

4. Riparian zones

   a. Have the following values of riparian zones been recognized and measures taken to conserve these values: enhance the quality of habitat for aquatic resources; provide a "filtering" buffer zone, inhibit rises in stream temperature and provide bank/ floodplain stability; provide important habitats for wildlife; and provide a focal point for many recreational activities? Defining riparian zones can be difficult and professional judgment must usually be employed, but immediate control over these areas will significantly reduce non-point pollution and provide sufficient time to later resolve competing use demands.

   b. Have the following general rules for logging vis-a-vis riparian zones been adhered to: keep wheeled and tracked vehicles out of these zones; keep roads and trails as far away as possible; carry out all silvicultural and logging operations by hand or from the outside edge of the riparian zones; avoid burning that would leave the riparian zone exposed during periods of high-intensity rainfall; keep tracers for firebreaks as far uphill as possible?

5. Socioeconomic:

   a. Does the project include close involvement of local leaders to avoid future problems from disgruntled villagers due to loss of traditional forest uses?

   b. Is manual labour involved to the maximum extent possible and are local people given special employment considerations to provide maximum benefits to locals?

   c. Will the project provide compensation to local people for loss of forest use, such as provision of planting stock and adequate training to enable production of multipurpose species?

D. Post-Project

1. Rehabilitation and conservation: Does the project provide for silvicultural treatment of logged-over stands ad protection against encroachment and fire after the operation has ceased? If so, has adequate monitoring of such activities been provided? For selectively-logged areas, has consideration been given to incorporating the logged-over area as a multiple-use zone within a larger conservation unit, including nature reserves?

2. Road shutdown: Has provision been made to "put to bed" temporary roads such as spur roads after completion of the operation?

II. Reforestation

A. Project Siting

1. History of forest abuse: Does the proposed project site have a history of forest degradation and, if so, has an O&M plan been prepared which can realistically ensure protection of the new forest? If not, can the new forest be expected to survive or should alternative sites be considered"?

2. Relation to other dedicated land uses: Will the project interfere with other established land uses? Has the project duly considered potentials for reclaiming for forest those areas dedicated to other uses that have not been sustainable or profitable, such as unsustainable agriculture? Does it fit in with regional/ national plans for forest utilization/ conservation? Are there opportunities for enhancing existing conservation areas?

3. Resettlement: Will the proposed project entail resettlement of local populations and, if so, how will this be handled?

4. Sitting in degraded forest: If reforestation is to be done by clearing existing degraded forest, has due consideration been given to alternative siting in adjacent areas, thereby taking pressure off the existing forest and promoting its

conservation?

B. Planning and Design

1. Benefit/ cost analysis: Has a benefit/ cost analysis been done that clearly delineates specific benefits to result from the project, for example erosion control; savings in downstream flooding hazard; decreases in sedimentation and turbidity in steams/ estuaries/ near shore marine waters, including protection of fisheries and beaches; enhanced opportunities for recreation and tourism; increased fuel sources; enhanced employment opportunities?

2. Selection of tree species: Is the selection of tree species optimal to meet project objectives, and are sufficient seed supplies available? The use of monoculture planting in extensive areas should be avoided; mixed crops provide greater safety against damage from pests and diseases. Have the physical and environmental site characteristics been adequately studied to help determine which tree species will best adapt to the site? In some cases attempting to reforest extremely steep and shallow soils may result in less environmental gains than leaving the area in grass/ shrub cover.

3. Precious ecology: Have opportunities been recognized for enhancing environmental parameters such as wildlife habitat, species diversity and soil/ water conservation through selection of multipurpose species and appropriate harvesting schedules? Has the project been planned so that it complements existing forests in providing critical ecological benefits?

4. Allocation of benefits to locals: Has it been identified who is to benefit from the project and how? Does the overall plan include provisions for local job employment and other incentives for local people (such as intercropping) so they will protect the new forest? Has appropriate training of locals and/ or foresters been included in the O&M plans? If the new forest has potential to attract recreation/ tourism activities, will villagers be supported to meet this demand through training as guides, establishment of handicraft centres and the like? Have local needs and traditional forest uses been considered in project planning/ design especially the use of forests as sources of protein, edible and medicinal plants, and recreation?

5. Operations and maintenance: Does the fiscal setup ensure regular availability of necessary O&M funds, especially for weeding, fire protection, watering and protection from encroachment?

6. Data base for decision making: Does the cited literature contain all salient, pertinent references? Have the impacts (both beneficial and adverse) of previous reforestation efforts due to proper/ improper planning and design been accounted for and modifications made to the proposed project based on this information? Does the project include a data base system. Has provision been made for systematic data gathering on such parameters as before and after effects on groundwater supplies, stream flow, wildlife use, soil building and socioeconomic to provide a basis for future decision making?

7. Project financing and reservoirs: If a major reservoir project is to be developed in the region, has the potential been explored to finance the reforestation project as a component of the reservoir project?

8. Appropriate technology: Is the technology to be used appropriate for developing countries in tropical monsoon areas or is it copied from possibly inappropriate western models?

9. Relation to other dedicated land uses: Have efforts been made to incorporate the project into existing land use practices and has significant modification of land use been minimized to he extent possible? If not, what are the expected social effects?

10. Road network design: Has sufficient consideration been given to the effects of road siting to minimize erosion?

11. Use of grasslands: Has the use of grass cover instead of trees been considered in areas where sufficient downstream water supply is a critical concern?

C. Project Operations

1. Commercial logging: If the plantation is to be harvested, guidelines as presented in Section I, Commercial Logging, will need to be followed to minimize increased erosion and sedimentation rates. Will there be proper replanting to maintain a sustainable yield?

2. Reduced water supplies: Have project impacts on downstream water supplies been identified? Large reforestation projects may reduce supplies of water to downstream users and reservoirs as the trees mature due to increased evapotranspiration rates. Mitigation measures such as shorter harvesting rotations or retaining grassland areas may be needed where sufficient water supply is a critical consideration.

3. Chemicals and fertilizers: Will suitable controls be used when applying chemicals and pesticides to protect young plants; burning slash; and applying fertilizers near waterways to avoid or minimize detrimental effects on fish and other aquatic life?

4. First year operations: Has due consideration been given to erosion mitigation measures during the plantation's initial year, such as leaving unploughed strips or bunding? A combination of vegetative (reforestation) and mechanical (engineering) control of erosion and overland flow can provide the most effective technique for erosion and water problems in depleted watersheds.

5. Soil conservation benefits: Soil conservation is perhaps the most profound environmental result of reforestation. Have the following beneficial impacts been identified/ maximized: erosion protection; decreased sedimentation that can affect reservoir life, alter quality and aquatic/ marine/ estuarine systems; promotion of improved soil capacity,

soil surface moisture and soil nutrients?

6. Socioeconomic benefits: Have the following beneficial impacts been identified/ maximized: provision of alternative employment opportunities; increased fuelwood supplies; increased fisheries (particularly in the case of mangrove plantations); and enhancement of recreational and tourism potentials?

7. Water resources benefits: Have the project's beneficial effects on reducing overland flows and flood peaks been identified/ maximized? Reforestation's beneficial/ adverse effects on groundwater and periodicity of stream flow remains a topic of much debate, thus the need for a usable data base system as part of Bank-supported projects.

III. Community Forestry

6. Considerations for siting planning/ design and project operations as presented in the section on reforestation are, by and large, applicable to community forestry projects. Presented below are additional considerations as well as some parameters already discussed in previous sections but deserve emphasis when dealing with community forestry projects. It is assumed that the main goals of most community forestry projects are timber and fuel production and that most projects involve afforestation not the use of existing forests.

A. Project Siting

1. Siting in well-defined areas: Will the project be located in a well-defined area such as a watershed or a group of villages?

2. Historical patterns of illegal land use: Has special emphasis been placed on understanding historical patterns of illegal land use? Can these problems be realistically overcome? For instance, lands that have a history of prior illegal use for grazing may need to be ruled out because of the hazard that these users would try to maintain their "rights" by eliminating the new forest through fire and grazing. Conversely, well-sited and designed projects can serve as an intervention to illegal use of nearby forest by offering similar products without the risk of arrest.

3. Critical environmental area: What effects will project harvesting rates have on soil and water? Highly unstable lands may need to be avoided because of "working" community forest can require frequent soil-disturbing harvests. Such areas may also significantly affect expected benefit/ cost ratios due to sub-optimal tree production,

4. Essential surveys: Have the following been surveyed prior to site selection: climate, soil and land use characteristics; past/ present types and uses of existing forests, including gathering of nonwood products; wood use and needs; market prospects; community social systems; land tenure and other legalities; population characteristics?

5. Relation to other dedicated land uses: See II(a)(ii)

6. Resettlement: See II(a)(iii)

7. Siting in degraded forest: See II(a)(iv).

B. Planning and Design

1. Relation to overall development: Has the project been included as an integral part of intersectoral development?

2. Operations and maintenance: Effective handling of threats to the new forest is a requisite for success. Does the O&M plan provide realistic and adequately funded mechanisms to prevent encroachment and fire? Does it provide for sufficient weeding watering and other essential maintenance?

3. Selection of tree species: Will single-species or multispecies planting be done? Single-species forestry over large areas should be avoided as it can be particularly susceptible to pests and diseases with potential for loss of the entire crop. For similar reasons, indigenous species should be used whenever possible. Multispecies planting can provide greater yields due to more efficient site utilization. In selection of tree species, have conditions been considered such as limited wildlife habitat, soil conservation, water conservation and nutrient enhancement, particularly through use of nitrogen fixers?

4. Precious ecology : See II(b)(iii).

5. Data base for decision making: See II(b)(iv).

6. Appropriate technology: See II(b)(viii).

7. Relation to other dedicated land uses : See II(b)(ix)

C. Project Operations : See II(c)

D. Socioeconomic Factors

Past projects have shown socioeconomic considerations to be of paramount importance in achieving full benefits from community forestry. Major considerations are presented below.

1. Including villagers in decision making: Have community members, particularly village leaders, been included in decision making at all project stages?

2. Accelerated benefit flow: The time scale of most community forestry projects is bound to conflict with priorities of poor rural people. Because may villagers are hard pressed to meet everyday needs, have mechanisms been

included to accelerate the flow of tangible benefits to the villagers? This could include growing multiple-use species, intercropping and introducing additional sources of income as an adjunct to the forestry project.

3. Operations and maintenance: Have provisions been made for training villagers and forestry officers responsible for community forestry projects? Forestry officers should be trained in social as well as technical skills. Will new local institutions such as forest cooperatives be required in order to ensure project success?

4. Key social factors: Have the following key social factors been considered; cultural knowledge and values regarding forestry; availability of resources - land, capital, materials and labour; social constraints on resource management; social competition and conflict over resource use?

5. Economic inequalities: Will the project increase the gap between rich and poor members of the community? Would changes in project design or operation help bridge existing economic differences among villagers?

6. Nutrition and health: What likely effects will the change in land use patterns caused by the project have on nutrition and health? For example, malnutrition has been found in many Malaysian rubber plantations because, although income has soared, local markets have few fruits and vegetables as all efforts stress industrial crops.

7. Reliance on markets: Will the project result in heavy reliance on markets? Community forestry projects that emphasize cash crops may suffer from significant price instability and thus increase local dependency on national/ international markets.

Source: ADB, 1991, Annex I-D, Attachment 2(a).

2. CRITERIA TO IDENTIFY SIGNIFICANT ADVERSE EFFECTS OF PROJECTS IN FORESTRY DEVELOPMENT

I. All Types of Forestry Development

A. Physical Resources

1. Steep slopes and fragile soils, in conjunction with heavy rainfall patterns that will lead to significant increases in erosion and land instability.

B. Ecological Resources

1. Conversion of a high diversity forest to a species-poor forest or monoculture

2. Serious depletion or loss of rare/ useful fish and wildlife species especially in terms of their regional or national status. This can apply to reforestation and community forestry as well as commercial logging where these are done in degraded forest areas.

C. Human Use Values

1. Any measurable damage to established conservation areas or areas identified for probable inclusion as a conservation area.

2. Any significant infringement on existing mining agriculture, aquaculture or other profitable economic ventures.

3. Any social conflicts due to modification of existing land use practices.

4. Downstream decreases in flows, especially low flows that interfere with domestic, industrial or agricultural withdrawals of water.

D. Quality of Life Values

1. Increased conflicts due to loss of traditional income sources or beneficial uses in a segment(s) of the local communities

2. Likelihood of increasing the gap between rich and poor members of local communities because of probable inequities in distribution of project benefits.

3. Employment arrangement that disrupt traditional folkways but make it impossible to return to these folkways once the forestry operations re over.

4. Any likelihood of significant conflict between forestry workers and local residents.

5. Any required resettlement of local people or indigenous forest dwellers.

II. Commercial Logging

A. Physical Resources

1. Forest removal in a semi-arid region that is likely to cause the advance of desert conditions.

2. Loss of soil nutrients and organic matter, soil compaction, laterization and/ or induced poor drainage that will prevent forest regeneration.

B. Ecological Resources.

1. Creation of access that is likely to increase encroachment pressures on rare/ useful species in the logged-over area or adjacent forest.

2. Likelihood that forest will not regenerate itself on land set aside for forest growth or that seed trees of prime forest species will not survive.

3. Induced turbidity, eutrophication or other alteration of water quality likely to eliminate one or more key species in the aquatic food chain.

C. Human Use Values

1. Displacement of wild animals in such numbers as to cause crop losses in adjacent agricultural lands.

2. Accelerated sedimentation likely to shorten the lifespan of reservoirs by years, to require dredging of navigable waterways, or to destroy spawning grounds or benthos that support subsistence of commercial fisheries.

3. Denudation of forested watersheds likely to cause downstream flood losses that are measured in human lives and in monetary terms.

4. Log conveyance that is likely to impede traditional navigation routes.

5. Any destruction of traditional habitats and supplies of food, fuel and other forest products.

D. Quality-of-Life Values

1. Damage to a well-recognized public recreation area, even it if lacks legal status as such.

2. Likelihood that an influx of newcomers will require increased intervention of public safety or public health authorities.

III. Reforestation and Community Forestry

A. Ecological Resources

1. Use of fertilizers or pesticides likely to eliminate one or more key species in the aquatic food chain.

B. Human Use Values

1. Emphasis on cash crops that suffer from significant price instability and will likely increase local dependency on national/ international markets.

2. Any increase in or introduction of diseases and malnutrition that requires the intervention of public health officials.

Source: ADB, 1991, Annex I-D, Attachment 2(b)

APPENDIX 22
ENVIRONMENTAL EXAMINATION - SCENARIO 1

PROJECT 372001/30
FORESTRY MASTER PLAN,
BANGLADESH (TA NO.1355-BAN)

ASIAN DEVELOPMENT BANK
MANILA PHILIPPINES
DATE: JANUARY 1993

ENVIRONMENT AND LANDUSE

APPENDIX 22
ENVIRONMENTAL EXAMINATION - SCENARIO 1

1. This lists all significant environmental impacts known to have occurred in past forestry development projects in developing countries
2. It is arranged to permit screening of insignificant impacts (by checking the column "No Significant Impact" and grading of significant environmental impacts by degree "Significant Impact" column - small, moderate or major)
3. The process furnishes the information needed for preparing the IEE

Checklist of Environmental Parameters for Forestry Development Projects

For _____ (Name of Project)

I. Commercial Logging

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
A Environmental Considerations Regarding Project Siting				A*	B*	A	B	A	B	A	B
1 Watershed areas			1 Appropriate watershed management techniques								
a erosion	a down stream economic losses		a "			●					
b siltation	b "		b "			●					
c hydrology	c increased peak and flood flows		c "			●					
d water quality	d loss of downstream beneficial uses		d "			●					

* A - Adverse
B - Beneficial

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
				A	B	A	B	A	B	A	B
A Environmental Considerations Regarding Project Siting											
2 Relation to other dedicated land uses											
a conservation areas	a impaired ecological and recreational opportunities		a Proper siting/planning					●			
b economic ventures	b possible economic loss		b "			●					
3 Traditional forest uses	3 Impaired beneficial uses		3 Proper siting/management techniques				●				
4 Resettlement	4 Social problems		4 Appropriate resettlement program with "hard" budget					●			
5 Relation to regional/national forestry plans	5 Possible conflicts with established management policies		5 Proper siting/management techniques		●						
6 Critical environmental areas	6 Downstream economic losses		6 Appropriate watershed management techniques; alternative site				●				
a erosion	a "		a "			●					
b siltation	b "		b "			●					
c hydrology	c increased peak and flood flows		c "			●					

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
				A	B	A	B	A	B	A	B
A Environmental Considerations Regarding Project Siting											
d water quality	d loss of downstream beneficial uses		c			●					
7 Precious ecology	7 Loss of ecological values		7 Proper siting/management techniques							●	
B Considerations Regarding Planning and Design											
1 Cost/benefit analysis								●			
2 Operations and maintenance	2 Diminished project efficiency and objectives if lack of funds		2 Realistic O&M planning and budget		●						
3 Data base for decision making		3 Enhanced decision making for present and future projects				●					
4 Road network design			4 Careful planning/design/location								
a erosion	a downstream economic losses		a					●			
b siltation	b		b					●			
c hydrology	c increased peak and flood flows		c					●			
d water quality	d loss of downstream beneficial uses		d					●			

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
B Considerations Regarding Planning and Design				A	B	A	B	A	B	A	B
5 Design of logging activities	5 Unnecessary damage to residual stand		5 Careful planning/design					●			
6 Critical environmental areas			6 Appropriate watershed management techniques			●					
a erosion	a downstream economic losses		a "			●					
b siltation	b "		b "			●					
c hydrology	c increased peak and flood flows		c "			●					
d water quality	d loss of downstream beneficial uses		d "			●					
7 Precious ecology	7 Loss of ecological values	7 Possible habitat enhancement for certain large mammal species	7 Avoid highly destructive logging techniques; preserve ecological "pockets"					●			
C Consideration Regarding Project Operations											
1 Road construction			1 Limit construction to dry season; adequate drainage			●					

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
C Consideration Regarding Project Operations				A	B	A	B	A	B	A	B
a erosion	a downstream economic losses		a limit construction to dry season adequate drainage			●					
b siltation	b "		b "			●					
c hydrology	c increased peak and flood flows		c "			●					
d water quality	d loss of downstream beneficial uses		d "			●					
2 Felling			2 Select suitable logging/ system; avoid clear cutting								
a erosion	a downstream economic losses		a "					●			
b siltation	b "		b "					●			
c hydrology	c increased peak and flood flows		c "					●			
d water quality	d loss of downstream beneficial uses		d "					●			
3 Log conveyance and allocation											
a erosion	a downstream economic losses		a appropriate conveyance system					●			

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
C Consideration Regarding Project Operations				A	B	A	B	A	B	A	B
b soil compaction	b increased runoff		b					●			
c log floatation	c impeded navigation		c use of terrestrial conveyance					●			
d allocation	d less than optimum economic benefits		d efficient processing at mills			●					
4 Logging in riparian zones	4 Degradation of waterways/ fisheries		4 Use of buffer zones			●					
5 Socioeconomics											
a employment opportunities		a increased income	a provision of compensation to locate				●				
b loss of traditional forest use	b economic and cultural losses					●					
D Considerations Regarding Post-Project Activities											
1 Rehabilitation and conservation		1 Gradual reclamation of traditional forest uses						●			
2 Road shutdown		2 Decreased erosion						●			

II. Reforestation

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
A Considerations Regarding Project Siting				A	B	A	B	A	B	A	B
1 History of forest abuse	1 Negation of project goals if not effectively controlled		1 Select alternative site; effective protective measures					●			
2 Relation to other dedicated land uses											
a conservation areas		a enhancement of ecological values in conservation areas						●			
b economic ventures	b Interference with more profitable ventures	b improved economic opportunities			●						
c regional/national forestry plans		c further forestry goals						●			
3 Resettlement	3 Social problems		3 Appropriate resettlement program with "hard" budget							●	
4 Siting in degraded forest	4 Possible unnecessary loss of ecological values	4 Optimum economic gains of tree resources that would otherwise be lost to encroachment	4 Select alternative site				●				
B Considerations Regarding Planning and Design											
1 Cost/benefit analysis							●				
2 Selection of tree species	2 Diminished project objectives	2 Soil and water conservation; economic/ ecological gains	2 Select multiple use species					●			
3 Precious ecology		a enhanced habit; increased diversity					●				

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for	Initial Environmental Examination							
	Adverse	Beneficial	Mitigating Adverse Impacts	No Significant		Significant Impacts					
				Impact D1		Small D2		Moderate D3		Major D4	
B Considerations Regarding Planning and Design				A	B	A	B	A	B	A	B
a wildlife		b					●				
b fisheries		c					●				
c plants		d economic gains					●				
d soil and water						●					
4 Allocation of benefits to locals											
a employment opportunities	a social conflict if local people not significantly involved	a economic gains	a special employment considerations for local people					●			
b training		b enhanced project efficiency		●							
c non-wood products		c economic, cultural gains					●				
5 Operations and maintenance	5 Diminished project efficiency and objectives if lack of funds						●				
6 Database for decision making		6 Enhanced decision making for present and future projects						●			
7 Project financing and reservoirs								●			
8 Appropriate technology	8 Diminished project objectives if inappropriate		8 Adapt foreign technology to local conditions				●				

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
B Considerations Regarding Planning and Design				A	B	A	B	A	B	A	B
9 Relation to other dedicated land uses	9 Potential social and economic conflicts		9 Appropriate planning to integrate with existing land use					●			
a extensive land use modification		a	a				●				
10 Road network design	10 Increased erosion		10 Appropriate planning/design			●					
11 Use of grasslands		11 Superior erosion control on some lands					●				
C Considerations Regarding Project Operations											
1 Commercial logging	1 Same as I.B and C		1 Same as I.B and C			●					
2 Reduced water supplies	2 Socioeconomic losses		2 Shorten harvest cycles; leave some grasslands			●					
3 Chemicals and fertilizers	3 Impaired fisheries and aquatic systems		3 Proper control over use			●					
4 First-year operations	4 Increased erosion due to soil disturbance		4 Use engineering structures (e.g. bunds)			●					
5 Soil conservation benefits							●				
a erosion		a economic and ecological gains					●				

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
C Considerations Regarding Project Operations				A	B	A	B	A	B	A	B
b sedimentation		b					●				
c soil capacity		c					●				
d soil surface moisture		d					●				
e soil nutrients		e					●				
6 Socioeconomic benefits							●				
a employment opportunities		a economic gains					●				
b fuelwood		b					●				
c enhanced fisheries		c					●				
d enhanced recreation/ tourism		d					●				
7 Water resource benefits						●					
a minimized overland flows		a economic gains				●					

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
				A	B	A	B	A	B	A	B
C Considerations Regarding Project Operations											
b reduced flood peaks		b			●						
c water quality		c economic and ecological gains				●					

III. Community Forestry

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
				A	B	A	B	A	B	A	B
A Considerations Regarding Project Siting											
1 Siting in well-defined areas	1 Social problems if boundary not well-defined		1 Proper surveys to determine best site	●							
2 Historical patterns of illegal land use	2 Diminished or complete loss of project objectives		2 Select alternative site; effective protection measures					●			
3 Critical environmental areas								●			
a siting on highly unstable lands	a diminished project benefits		a select alternative site; longer harvesting cycles					●			
4 Essential surveys	4 Diminished project objectives if not carried out properly		4 Devise and fund essential surveys					●			
5 Relation to other dedicated land uses											

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
				A	B	A	B	A	B	A	B
A Considerations Regarding Project Siting											
a conservation areas		a enhancement of ecological value in conservation areas					●				
b economic ventures	b interference with more profitable ventures	b improved economic opportunities	b proper siting/planning				●				
c regional/national forestry plan		c further forestry goals			●						
6 Resettlement	6 Social problems		6 Appropriate resettlement program with "hard" budget					●			
7 Siting in degraded forest	7 Possible unnecessary loss of ecological values	7 Optimum economic gains of tree resources that would otherwise be lost to encroachment	7 Select alternative site				●				
B Considerations Regarding Planning Design											
1 Relation to overall development		1 Enhanced, synergistic benefits					●				
2 Operations and maintenance	2 Diminishment of project efficiency and objectives		2 Realistic O&M planning and budget				●				
3 Selection of tree species	3 Possible loss of tree crop if monoculture	3 Enhanced economic and social benefits	3 Plant mulitispecies forests				●				
4 Precious ecology											
a wildlife		a enhanced habitat; increased diversity				●					
b fisheries		b				●					

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for	Initial Environmental Examination							
	Adverse	Beneficial	Mitigating Adverse Impacts	No Significant		Significant Impacts					
				Impact D1		Small D2		Moderate D3		Major D4	
B Considerations Regarding Planning Design				A	B	A	B	A	B	A	B
c plants		c				●					
d soil and water		d economic gains				●					
5 Database for decision making		5 Enhanced decision making for present and future projects				●					
6 Appropriate technology	6 Diminished project objectives inappropriate		6 Adapt foreign technology to conditions				●				
7 Relation to other dedicated land uses	7 Potential social and economic conflicts		7 Appropriate planning to integrate with existing land use					●			
C Considerations Regarding Project Operations											
1 Commercial logging	1 Same as I.B and C		1 Same as I.B and C			●					
2 Reduced water supplies	2 Socioeconomic losses		2 Shorten harvest cycles; leave some grasslands				●				
3 Chemicals and fertilizers	3 Impaired fisheries and aquatic systems		3 Proper control over use			●					
4 First year operations	4 Increased erosion due to soil disturbance		4 Use engineering structures (e.g. bunds)				●				
5 Soil conservation benefits											
a erosion		a Economic and ecological gains					●				

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
C Considerations Regarding Project Operations				A	B	A	B	A	B	A	B
b sedimentation		b					●				
c soil capacity		c					●				
d soil surface moisture		d					●				
e soil nutrients		e					●				
6 Socioeconomic benefits							●				
7 Water resources benefits					●						
a minimized overland flows		a Economic gains			●						
b reduced flood peaks		b			●						
c water quality		c Economic and ecological gains			●						
D Socioeconomic Factors											
1 Including villagers in decision making	1 Diminished project objectives if not included		1 Include villagers in all phases				●				
2 Accelerated benefit flow		2 Protection of tree crop: economic gains					●				

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for	Initial Environmental Examination							
	Adverse	Beneficial	Mitigating Adverse Impacts	No Significant		Significant Impacts					
				Impact D1		Small D2		Moderate D3		Major D4	
D Socioeconomic Factors				A	B	A	B	A	B	A	B
3 Operations and maintenance	3 Diminished project benefits		3 Realistic O&M planning and budget				●				
4 Key social factors	4 Diminished or complete loss of project objective		4 Proper planning and O&M procedures				●				
a cultural values regarding forestry	a "		a "			●					
b resource availability	b "		b "			●					
c social constraints	c "		c "			●					
d conflicts over resource use	d "		d "			●					
5 Economic inequities	e Wider gap between rich and poor	e Improved economic status of poor	e Administrate project so bulk of economic benefits go to poor villagers					●			
6 Nutrition and health	f Impaired nutrition and health		f Plant multispecies forests				●				
7 Reliance on markets	g Reduced economic gains		g Plant multispecies forests and tends of use in the village				●				

APPENDIX 23
ENVIRONMENTAL EXAMINATION - SCENARIO 2

PROJECT 372001/30
FORESTRY MASTER PLAN,
BANGLADESH (TA NO.1355-BAN)

ASIAN DEVELOPMENT BANK
MANILA PHILIPPINES
DATE: JANUARY 1993

ENVIRONMENT AND LANDUSE

APPENDIX 23
ENVIRONMENTAL EXAMINATION - SCENARIO 2

1. This lists all significant environmental impacts known to have occurred in past forestry development projects in developing countries
2. It is arranged to permit screening of insignificant impacts (by checking the column "No Significant Impact" and grading of significant environmental impacts by degree "Significant Impact" column - small, moderate or major)
3. The process furnishes the information needed for preparing the IEE

Checklist of Environmental Parameters for Forestry Development Projects

For _____ (Name of Project)

I. Commercial Logging

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
A Environmental Considerations Regarding Project Siting				A*	B*	A	B	A	B	A	B
1 Watershed areas			1 Appropriate watershed management techniques						●		
a erosion	a down stream economic losses		a "						●		
b siltation	b "		b "						●		
c hydrology	c increased peak and flood flows		c "						●		
d water quality	d loss of downstream beneficial uses		d "								

* A - Adverse
B - Beneficial

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
				A	B	A	B	A	B	A	B
A Environmental Considerations Regarding Project Siting											
2 Relation to other dedicated land uses											
a conservation areas	a impaired ecological and recreational opportunities		a Proper siting/ planning						●		
b economic ventures	b possible economic loss		b				●				
3 Traditional forest uses	3 Impaired beneficial uses		3 Proper siting/ management techniques						●		
4 Resettlement	4 Social problems		4 Appropriate resettlement program with "hard" budget		●						
5 Relation to regional/ national forestry plans	5 Possible conflicts with established management policies		5 Proper siting/ management techniques				●				
6 Critical environmental areas	6 Downstream economic losses		6 Appropriate watershed management techniques; alternative site						●		
a erosion	a		a						●		
b siltation	b		b				●				
c hydrology	c increased peak and flood flows		c				●				

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for	Initial Environmental Examination							
	Adverse	Beneficial	Mitigating Adverse Impacts	No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
A Environmental Considerations Regarding Project Siting				A	B	A	B	A	B	A	B
d water quality	d loss of downstream beneficial uses		c				●				
7 Precious ecology	7 Loss of ecological values		7 Proper siting/management techniques						●		
B Considerations Regarding Planning and Design											
1 Cost/benefit analysis									●		
2 Operations and maintenance	2 Diminished project efficiency and objectives if lack of funds		2 Realistic O&M planning and budget				●				
3 Data base for decision making		3 Enhanced decision making for present and future projects							●		
4 Road network design			4 Careful planning/design/location								
a erosion	a downstream economic losses		a						●		
b siltation	b		b						●		
c hydrology	c increased peak and flood flows		c						●		
d water quality	d loss of downstream beneficial uses		d						●		

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
				A	B	A	B	A	B	A	B
B Considerations Regarding Planning and Design											
5 Design of logging activities	5 Unnecessary damage to residual stand		5 Careful planning/design						●		
6 Critical environmental areas			6 Appropriate watershed management techniques				●				
a erosion	a downstream economic losses		a "				●				
b siltation	b "		b "				●				
c hydrology	c increased peak and flood flows		c "				●				
d water quality	d loss of downstream beneficial uses		d "				●				
7 Precious ecology	7 Loss of ecological values	7 Possible habitat enhancement for certain large mammal species	7 Avoid highly destructive logging techniques; preserve ecological "pockets"						●		
C Consideration Regarding Project Operations											
1 Road construction			1 Limit construction to dry season; adequate drainage				●				

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for	Initial Environmental Examination							
	Adverse	Beneficial	Mitigating Adverse Impacts	No Significant		Significant Impacts					
				Impact D1		Small D2		Moderate D3		Major D4	
C Consideration Regarding Project Operations				A	B	A	B	A	B	A	B
a erosion	a downstream economic losses		a limit construction to dry season adequate drainage				●				
b siltation	b "		b "				●				
c hydrology	c increased peak and flood flows		c "				●				
d water quality	d loss of downstream beneficial uses		d "				●				
2 Felling			2 Select suitable logging/system; avoid clear cutting								
a erosion	a downstream economic losses		a "					●			
b siltation	b "		b "					●			
c hydrology	c increased peak and flood flows		c "					●			
d water quality	d loss of downstream beneficial uses		d "					●			
3 Log conveyance and allocation											
a erosion	a downstream economic losses		a appropriate conveyance system					●			

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
				A	B	A	B	A	B	A	B
C Consideration Regarding Project Operations											
b soil compaction	b increased runoff		b					●			
c log floatation	c impeded navigation		c use of terrestrial conveyance					●			
d allocation	d less than optimum economic benefits		d efficient processing at mills						●		
4 Logging in riparian zones	4 Degradation of waterways/ fisheries		4 Use of buffer zones						●		
5 Socioeconomics											
a employment opportunities		a increased income	a provision of compensation to locate						●		
b loss of traditional forest use	b economic and cultural losses										
D Considerations Regarding Post-Project Activities											
1 Rehabilitation and conservation		1 Gradual reclamation of traditional forest uses					●				
2 Road shutdown		2 Decreased erosion					●				

II. Reforestation

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
A Considerations Regarding Project Siting				A	B	A	B	A	B	A	B
1 History of forest abuse	1 Negation of project goals if not effectively controlled		1 Select alternative site; effective protective measures		●						
2 Relation to other dedicated land uses											
a conservation areas		a enhancement of ecological values in conservation areas							●		
b economic ventures	b Interference with more profitable ventures	b improved economic opportunities							●		
c regional/national forestry plans		c further forestry goals							●		
3 Resettlement	3 Social problems		3 Appropriate resettlement program with "hard" budget			●					
4 Siting in degraded forest	4 Possible unnecessary loss of ecological values	4 Optimum economic gains of tree resources that would otherwise be lost to encroachment	4 Select alternative site						●		
B Considerations Regarding Planning and Design											
1 Cost/benefit analysis									●		
2 Selection of tree species	2 Diminished project objectives	2 Soil and water conservation; economic/ ecological gains	2 Select multiple-use species						●		
3 Precious ecology		a enhanced habit; increased diversity							●		

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
				A	B	A	B	A	B	A	B
B Considerations Regarding Planning and Design											
a wildlife		b							●		
b fisheries		c							●		
c plants		d economic gains							●		
d soil and water									●		
4 Allocation of benefits to locals											
a employment opportunities	a social conflict if local people not significantly involved	a economic gains	a special employment considerations for local people						●		
b training		b enhanced project efficiency							●		
c non-wood products		c economic, cultural gains									
5 Operations and maintenance	5 Diminished project efficiency and objectives if lack of funds								●		
6 Database for decision making		6 Enhanced decision making for present and future projects							●		
7 Project financing and reservoirs							●				
8 Appropriate technology	8 Diminished project objectives if inappropriate		8 Adapt foreign technology to local conditions						●		

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
B Considerations Regarding Planning and Design				A	B	A	B	A	B	A	B
9 Relation to other dedicated land uses	9 Potential social and economic conflicts		9 Appropriate planning to integrate with existing land use						●		
a extensive land use modification		a	a					●			
10 Road network design	10 Increased erosion		10 Appropriate planning/design					●			
11 Use of grasslands		11 Superior erosion control on some lands					●				
C Considerations Regarding Project Operations											
1 Commercial logging	1 Same as I.B and C		1 Same as I.B and C						●		
2 Reduced water supplies	2 Socioeconomic losses		2 Shorten harvest cycles; leave some grasslands						●		
3 Chemicals and fertilizers	3 Impaired fisheries and aquatic systems		3 Proper control over use						●		
4 First-year operations	4 Increased erosion due to soil disturbance		4 Use engineering structures (e.g. bunds)						●		
5 Soil conservation benefits							●				
a erosion		a economic and ecological gains					●				

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
C Considerations Regarding Project Operations				A	B	A	B	A	B	A	B
b sedimentation		b "					●				
c soil capacity		c "					●				
d soil surface moisture		d "					●				
e soil nutrients		e "					●				
6 Socioeconomic benefits											
a employment opportunities		a economic gains							●		
b fuelwood		b "							●		
c enhanced fisheries		c "							●		
d enhanced recreation/tourism		d "							●		
7 Water resource benefits											
a minimized overland flows		a economic gains					●				

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
				A	B	A	B	A	B	A	B
C Considerations Regarding Project Operations											
b reduced flood peaks		b			●						
c water quality		c economic and ecological gains					●				

III. Community Forestry

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
				A	B	A	B	A	B	A	B
A Considerations Regarding Project Siting											
1 Siting in well-defined areas	1 Social problems if boundary not well-defined		1 Proper surveys to determine best site				●				
2 Historical patterns of illegal land use	2 Diminished or complete loss of project objectives		2 Select alternative site; effective protection measures				●				
3 Critical environmental areas											
a siting on highly unstable lands	a diminished project benefits		a select alternative site; longer harvesting cycles				●				
4 Essential surveys	4 Diminished project objectives if not carried out properly		4 Devise and fund essential surveys						●		
5 Relation to other dedicated land uses											

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for	Initial Environmental Examination							
	Adverse	Beneficial	Mitigating Adverse Impacts	No Significant		Significant Impacts					
				Impact D1		Small D2		Moderate D3		Major D4	
				A	B	A	B	A	B	A	B
A Considerations Regarding Project Siting											
a conservation areas		a enhancement of ecological value in conservation areas							●		
b economic ventures	b interference with more profitable ventures	b improved economic opportunities	b proper siting/planning						●		
c regional/national forestry plan		c further forestry goals							●		
6 Resettlement	6 Social problems		6 Appropriate resettlement program with "hard" budget		●						
7 Siting in degraded forest	7 Possible unnecessary loss of ecological values	7 Optimum economic gains of tree resources that would otherwise be lost to encroachment	7 Select alternative site						●		
B Considerations Regarding Planning Design											
1 Relation to overall development		1 Enhanced, synergistic benefits							●		
2 Operations and maintenance	2 Diminishment of project efficiency and objectives		2 Realistic O&M planning and budget						●		
3 Selection of tree species	3 Possible loss of tree crop if monoculture	3 Enhanced economic and social benefits	3 Plant mulitispecies forests						●		
4 Precious ecology											
a wildlife		a enhanced habitat; increased diversity							●		
b fisheries		b							●		

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
B Considerations Regarding Planning Design				A	B	A	B	A	B	A	B
c plants		c							●		
d soil and water		d economic gains							●		
5 Database for decision making		5 Enhanced decision making for present and future projects							●		
6 Appropriate technology	6 Dimished project objectives inappropriate		6 Adapt foreign technology to conditions						●		
7 Relation to other dedicated land uses	7 Potential social and economic conflicts		7 Appropriate planning to integrate with existing land use						●		
C Considerations Regarding Project Operations											
1 Commercial logging	1 Same as I.B and C		1 Same as I.B and C			●					
2 Reduced water supplies	2 Socioeconomic losses		2 Shorten harvest cycles; leave some grasslands						●		
3 Chemicals and fertilizers	3 Impaired fisheries and aquatic systems		3 Proper control over use						●		
4 First year operations	4 Increased erosion due to soil disturbance		4 Use engineering structures (e.g. bunds)				●				
5 Soil conservation benefits											
a erosion		a Economic and ecological gains							●		

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
C Considerations Regarding Project Operations				A	B	A	B	A	B	A	B
b sedimentation		b							●		
c soil capacity		c							●		
d soil surface moisture		d							●		
e soil nutrients		c							●		
6 Socioeconomic benefits									●		
7 Water resources benefits							●				
a minimized overland flows		a Economic gains				●					
b reduced flood peaks		b				●					
c water quality		c Economic and ecological gains					●				
D Socioeconomic Factors											
1 Including villagers in decision making	1 Diminished project objectives if not included		1 Include villagers in all phases								●
2 Accelerated benefit flow		2 Protection of tree crop: economic gains							●		

Considerations Affecting Environmental Resources and Values	Environmental Impacts		Potential Measures for Mitigating Adverse Impacts	Initial Environmental Examination							
	Adverse	Beneficial		No Significant Impact D1		Significant Impacts					
						Small D2		Moderate D3		Major D4	
D Socioeconomic Factors				A	B	A	B	A	B	A	B
3 Operations and maintenance	3 Diminished project benefits		3 Realistic O&M planning and budget						●		
4 Key social factors	4 Diminished or complete loss of project objective		4 Proper planning and O&M procedures						●		
a cultural values regarding forestry	a "		a "						●		
b resource availability	b "		b "						●		
c social constraints	c "		c "						●		
d conflicts over resource use	d "		d "						●		
5 Economic inequities	e Wider gap between rich and poor	e Improved economic status of poor	e Administrate project so bulk of economic benefits go to poor villagers				●				
6 Nutrition and health	f Impaired nutrition and health		f Plant multispecies forests				●				
7 Reliance on markets	g Reduced economic gains		g Plant multispecies forests and tends of use in the village						●		

APPENDIX 24
REFERENCES

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APPENDIX 24
REFERENCES

Abedin, M. Zainal et al. 1991. Preliminary Studies Of Social Forestry in Bangladesh. Prepared by BCAS, Dhaka.

ADAB. 1992a. Directory of Environmental NGOs in Bangladesh. Sponsored by ADAB/ UNDP/ NGO Affairs Bureau.

ADAB, 1992b. Environment and Development: Bangladesh NGO's Perspective on Policy and Action. Position Paper for UNCED. Association of Development Agencies in Bangladesh.

ADAB and UNIFOM. 1991. The Report of the National Workshop on Women and Environment. Policies for Sustainable management of Natural Resources. Proceedings of a Workshop held at BARD, November, 1991.

ADAB, 1990. Environmental problems in Bangladesh: An NGO Perspective for Policies and Action. Prepared by the ADAB Environment Advisory Group.

Ahmad, Y.S. 1938. Working Plan for the Dacca-Mymensingh, Forest Division, 1937-38 to 1956-57.

Akonda, A.W. 1989. Capped Langurs (Presbytis pileanta) in Madhupur National Park. In Karim, G.M.M.E., A.W. Akonda and P. Sewitz. 1989. Conservation of Wildlife in Bangladesh. Proceedings of the First International Symposium Cum Workshop for conservation of Wildlife in Bangladesh, Dhaka, Dec 1-4, 1986. Organized by the German Cultural Institute.

Akonda, A.W., S.M.A. Rashid and R. Ahmed and S.A. Kalam. 1989. Bangladesh. In Scott, D.A. (ed.) 1989. A Directory of Asian Wetlands. IUCN, Gland and Cambridge.

Alam, M.K., M. Mohiuddin and M.K. Guha. 1991. Trees for Lowlying Area of Bangladesh. Bangladesh Forest Research Institute, Chittagong.

Alam, S.S. et al. 1990. Tree Plantation Pattern in Tidal Agroforestry. A Case Study of Five Villages in Greater Barisal District. Prepared by BCAS, Dhaka.

Alcorn, A. and N. Johson. 1989. Conservation of Biological Diversity in Bangladesh: Status, Trends and Recommended Responses prepared for WRI/ USAID.

Ali, S.I. 1991. " Haor Basin Eco-System". In Environmental Aspects of Surface Water Systems of Bangladesh.

Ali, Syed I., M. Waliuzzaman and A. Mohammed. 1990. South Asia Partnership. Environmental Study Programme (ESP) Report.

Anon. NGO Statement to UNCED. 1991. In Reflexion, Volume 1, No. 4, October 1991.

Asian Development Bank. 1991a. Environmental Guidelines for Selected Agricultural and Natural Resources Development Projects. Revised Edition, 1991a, Manila, Philippines.

Asian Development Bank. 1991b. Minimum Quality Criteria for Ecologically Sensitive Areas, ADB Environment Paper No. 4.

Asian Development Bank. 1990. Bangladesh Environmental and Natural Resources Assessment. A Sector review Prepared during the Environment Consultation-cum-Sector Mission 28 December 1989-4 January 1990.

Asian Development Bank. Sector Paper on Forestry, July 1989 (Revised).

Asian Wetland Bureau et. al. 1991. Project Preparation Report- Bangladesh Forestry III Project, Environment Component. Draft version June 27, 1991. Prepared with assistance of Bangladesh Centre for Advanced Studies and Nature Conservation Movement.

Bakwell, D.N. and J.R. Howes. 1989. Further Observations on the Shorebirds in the Lower Gangetic Delta, Bangladesh The Stilt, No 14, April, 1989.

Bangladesh Bureau of Statistics. 1986. The Bangladesh Census of Agriculture and Livestock: 1993-84. Dhaka.

Bangladesh Geographical Society. 1992. Proceedings of a Seminar on Women & Environment, September 1991.

BARC, 1990. Proceedings of the Seminar on Top Dying of Sundri (Heritiera Fomes) Trees, 1988. Bangladesh Agricultural Research Council, Dhaka.

BCEOM, Compagnie Nationale Du Rhone Euroconsult, et al. 1992a. FAP 3, North Central regional Study, Draft Preliminary Supporting Report V Ecological Assessment, April, 1992. Prepared for GOB, MIWDC, FPCO.

BCEOM et al. 1992b. FAP 3 North Central Regional Study, Draft Regional Water Resources Plan, March, 1992. Prepared for GOB, MIWDFC, FPCO.

Belal, Khaled (ed.). 1992. The Chittagong Hill Tracts Falconry In The Hills. Published by Codec, Chittagong.

Berkmuller K. and S. Mukherjee. 1989. Buffer Zones in the Service of Ecodevelopment. Tigerpaper, Vol. XVI No 3.

Bertocci, P.R. 1984. "Resource Development and Ethnic Conflict: The Case of Chittagong Hill Tracts of Bangladesh" in Tribal Cultures in Bangladesh, M.S. Qureshi (ed.), Rajshahi.

Berttilsson, P. 1991. SIDA's Environmental Profile for Bangladesh

BIDS. 1991. Pre-Election Survey.

Blower, J,H. 1985 Wildlife Conservation in the Sundarbans: Sundarban Forest Inventory Project. Report 151, ODA, Surbiton, UK.

CARDMA. 1989. The Greenhouse Effect and Coastal Area of Bangladesh. Proceedings of an International Conference Held In Dhaka, 5th March, 1989.

CARDMA. 1988. Executive Summary and Recommendations of the National Workshop on Bangladesh Coastal Area Resource Development and Management. Report 1, October 3-4, 1988, Dhaka.

Castro, C. (ed.), 1991 Upland Conservation in Asia and the Pacific FAO, RAPA Publication 1991, Bangkok.

Centre for Science & Environment, 1992. The Imperative of Equity. The Missing Dimension of UNCED Statement of the South Asia NGO Summit, New Delhi, February, 1992.

Chaffey, D.R., F.R. Miller and J.H. Sandom. 1985. A Forest Inventory of the Sundarbans, Bangladesh: Main Report, Project Report 140, Overseas Development Administration, London.

Champion M.G., S.K. Seth and G.M. Khattak. 1965. Forest Types of Pakistan. Sukkur, India.

Choudhury, A. M. Quadir, D. A., and Islam, J. 1990. Study of Chokoria Sundarbans Using Remote Sensing Techniques. Bangladesh Space Research and Remote Sensing Organization (SPARRSO), Dhaka, Bangladesh.

Choudhury, J.H. 1991a. Draft Revised Forest Management Plan for Cox's Bazar Forest Division for 1991-2 to 2000-2001, Vloume 1, November 1991. Working Plans Division, Chittagong.

Choudhury, J.H. 1991b. Draft Revised Forest Management Plan for Chittagong Division 1991-92 to 2000-2001, Volume, 1 October, 1991.

Choudhury, J. H. 1991c. Draft Working Scheme of Chittagong Hill Tracts South Forest Division for 1989-90 to 1993-94, Volume 1, September 1991. Working Plans Division, Chittagong. Department.

Choudhury, J.H. 1990a. Draft Working Scheme of Matamuhuri Reserved Forests for 1990-91 to 1994-9 5. Working Plans Division, Chittagong.

Choudhury, J.H. 1990b. Draft Revised Forest Management Plan for Sylhet ForestDivision for 1990-1 to 1999-2000, Volume 1, April 1991, Working Plans Division, Chittagong.

Choudhury, G.Q. 1982. Problems of Madhupur National Park. pp 515-516. In Proceedings of Second Bangladesh National Conference on Forestry., Dacca, January 21-26, 1982.

Clerk, J. et.al. 1991. Project Formulation Mission. Phase I Project Report. November, 1991.

Cort, C. 1986. The Role of NGOs in the Sustainable Development of Natural Resources in Bangladesh.

Dalmacio, M., Rahman, Z. and Ahmad, I. U. 1991. Coastal Afforestation Management Manual. Draft Working Paper No. 43. Forest Department, FAO/UNDP Project BGD/85/085.

DANIDA, 1989. Environmental Profile: Bangladesh

Das S. and N.A. Siddiqi. 1985. The Mangroves and Mangrove Forests of Bangladesh. Mangrove Silviculture Bulletin No 2 Bangladesh Forest Research Institute.

Das, D.K. 1990. Forest Types of Bangladesh. Bulletin No. 6, Plant Taxonomy Series. Bangladesh Forest Research Institute.

De Milde, R., and Ahmad, I. U. 1985. The Mixed Hardwood/Teak Plantations in the Chittagong(District. Assistance to the Forestry Sector, FAO/UNDP Project BGD/79/017.

De Milde, R., M. Shaheduzzaman and J.A. Chowdhury. 1985. The Kassalong and Rankhiang Reserved Forests in the Chittagong Hill Tracts. Field Document No. 10, FAO/UNDP Project BGD/79/017, FAO Rome.

De Milde, R., Shadeduzzaman, M. and Drigo, R. 1985. The High Forest in the Chittagong District. Assistance to the Forestry Sector, FAO/UNDP Project BGD/79/017.

Drigo, R., Shaheduzzaman, and M. Lorensiri. 1991. Utilization of Sport Satellite Imagery for the Inventory of Forest Resources of Sylhet District, Bangladesh. Prepared under FAO/UNDP Project BGD/85/085, Phase II, Rome.

Drigo, R., Shaheduzzaman, M., and Chowdhury, J. A. 1988. Inventory of Forest Resources of Southern Sylhet Forest Division. FAO/UNDP Project BGD/85/085.

Drilling, M. E. 1992. Miscellaneous Back-to-Office Reports. Unpublished. UNDP/FAO BGD/84/054.

ESCAP. 1988. Tourism. Chapter 5 In Coastal Environmental Management Plan for Bangladesh. Volume 2 Final Report. UN Economic and Social Commission for Asia and the Pacific, Bangkok, Thailand.

ESCAP. 1987. Coastal Environmental Management Plan for Bangladesh. Economic and Social Commission for Asia and the Pacific (ESCAP), Bangkok, Thailand.

Faizuddin, M. 1985. Distribution, Abundance and Conservation of Gharials in Bangladesh. Tigerpaper Vol XII No 3.

FAO. 1992. Bangladesh Second Forestry Project. Project Completion Report 132/92 CP-BGD. 79 PCR.

FAO. 1990. Shrimp Seed Collectors of Bangladesh. Bay of Bengal Programme Small Scale Fisher Folk Communities, BoBP/WP/63. Based on a study by UBINIG (Policy Research for Development Alternatives).

FAO. 1988a. Land Resources Appraisal of Bangladesh for Agricultural Development. BGD/81/035, 7 Reports. Rome.

FAO. 1988b. Assistance to the Forestry Sector. Project Findings and Recommendations. FO:DP/BGD/79/017.

FAO. UNDP. 1992c. ADB Community Forest Project. Project Findings and Recommendations.

FAO. 1976. A Framework for Land Evaluation. Rome.

Fattah, Q.A. 1979. Protection of the Marine Environment and Related Ecosystems of St. Martins's Island. Proceedings of the National Seminar on Protection of Marine Environment and Related Ecosystems, Dhaka, 27-29 November, 1979. (Reported in UNEP, 1986).

Forest Department, 1990. Statement Showing the Population and Land Area of Madhupur Forest Area. Prepared by Range Officer, Madhupur National Park Range.

Forestal. 1966a. Soil and Land Use Survey Chittagong Hill Tracts 1964-1966. Volume 3, Agronomy-Agricultural Engineering Animal Husbandry.

Forestal. 1966b. Soil and Land Use Survey Chittagong Hill Tracts, Volume 5, Part 1 -Forestry.

Forestal. 1966c. Soil and Land Use Survey Chittagong Hill Tracts, Volume 5, Part 2 -Land Use.

Forestal. 1961. Chittagong Hill Tracts Forest Inventory, 1961-63 Kassalong and Rankhiang Reserved Forests. CIDA.

Gain, P. 1989a. Madhupur: From Hostility to Confrontation over Rubber Plantation. In Dhaka Courier March 31-April 6, 1989.

Ghani, C.Q., A. Alim and P.R. Stevens. 1990. Rehabilitation and Land Use Planning of Sal Forests, Parts I, II and III. Working Paper 39, FAO/UNDP Project BGD/085/85.

Gain, P. 1989b. "Gavos get Pushed again by Rubber Planters". In Dhaka courier, July 21-29, 1989.

GOB, BFRI. 1992. Forest Statistics of Bangladesh. Bulletin 3.

GOB, updated. Country Report on the Study on Greenhouse Effect and its Impact on the SAARC Region.

GOB. Department of Environment. 1991. Environmental Quality Standards (EQS) for Bangladesh.

GOB. MOEF. 1991. Environmental Issues and Management Plan Pertinent to the Cyclone and Strom Surge of April, 1991. Report by NEMAP Team, May, 1991, Dhaka.

GOB. Ministry of Environment and Forest and IUCN. 1991a. Towards Sustainable Development The National Conservation Strategy of Bangladesh. Second Draft, December, 1991. Prepared in association with Bangladesh Agricultural Research Council (BARC and IUCN).

GOB. MOEF and UNDP. 1991b. National Environmental Management Action Plan: An Action Plan for Bangladesh. Dhaka, November, 1991b.

GOB. MOEF. 1991c. Bangladesh Country Report For United Nations Conference on Environment and Development (UNCED) Brazil, 1992.

GOB. Bangladesh Forest Research Institute. 1990. Rattans of Bangladesh, Bulletin 7, Plant taxonomy Series.

Green, M.J.B. 1990. IUCN Directory of South Asian Protected Areas. Compiled by IUCN-The World Conservation Union, Gland Switzerland and Cambridge UK. 294.

Haider, R (ed.). 1992. Cyclone' 91 Revisited. Prepared by BCAS.

Haider, R. , Rahman, A.A. and S. Huq (eds.). 1991. Cyclone '91 An Environmental and Perceptional Study. Prepared for BCAS, Dhaka.

Halcrow et al. 1992. Brahamaputra Right Embankment Strengthening. Draft River Training Studies of the Brahmaputra River, Chapter 4, Environmental Impact Assessment: Priority Works. Prepared for FAP 1, GOB, Ministry of Irrigation, Water Development and Flood Control. Flood Plan Coordination Organization.

Halcrow, Danish Hydraulic Institute, Engineering and Planning Consultants Ltd., and Sthapati Sangshad Ltd. 1992b. Except from draft report of South-west and Regional Water Resources Management Project (FAP-4). Prepared for GOB, MIWDFC, FPCO. October, 1992.

Haque, M.N. 1975. The Avifauna of the Madhupur Forest (with notes on ecology, status, distribution and food). M.Sc. thesis, Dept of Zoology, University of Dhaka.

Harvey, W.G. 1989. Birds in Bangladesh. University Press Ltd. Dhaka.

Harvey, W.G. 1992. Birds of Bangladesh (Updated by D. Johnson, P. Thompson and J. Woolner, March 1992.) Mimeo.

Hassal & Associates et. al. 1989. Second Rubber Development Project. Volume I, Main Report. June 1989.

Hassan, M.M. 1991. Soil Erosion, Conservation and Watershed Management in Bangladesh. Monograph for BARC.

Hassan, M.M. 1984. Status of General and Forest Hydrology Research in Bangladesh. BFRI, Chittagong, Bangladesh. Prepared for Status of Watershed Forest Influence Research in Asia and the Pacific.

Hassan, M.M. and A.H. Mazumdar. 1991. Suitable tree Species for Villages and National Forests in Relation to the Inundation Regimes of Bangladesh.In Grassroots, Volume 1, Issue 2, Published by ADAB.

Heywood, V.H., 1990. Proposal for the Establishment of a National Botanical Garden, Bangladesh. Submitted by IUCN, 1990.

Hossain, A. M. Chowdhury, A. M., Islam, M., Mahbubullah, D., Siddiqui, K. U., and Rahman, H. Z. 1991. Land Administration In: Report of the Task Forces on Bangladesh Strategies for the 1990s. Volume 2. University Press Limited, Dhaka.

Hossain, M. 1991. Agriculture in Bangladesh: Performance, Problems and Prospects. University Press Limited, Dhaka.

Huq, S. and S.I. Ali. 1990. International Sea Level Rise: A National Assessment of Effects and Possible Responses for Bangladesh. Prepared for the Centre for Global Change, University of Maryland, USA.

Husain K.Z. and M.N Haque, 1981. The Whitewinged Wood Duck Project (Study of the ecology and breeding biology of the white winged wood duck, Cairina scutulata, in Pablakhali, the Chittagong Hill Tracts, 1976-1978. Report prepared for the University Grants Commission, Government of Bangladesh.

Husain, K.Z. and M.N. Haque. 1977a. Birds of the Madhupur Forest. Miscellaneous Publication # 1. Wildlife Society of Bangladesh, Zoology Department, Dhaka University.

Husain, K.Z. and N.M. Haque. 1977b. The Avifauna of the Madhupur Forest. pp 381-391. In Proceedings of First Bangladesh National Conference on Forestry. Dacca, January 21-26, 1977.

Husain, K.Z. 1990a. Wildlife Preservation in Bangladesh (present status). Paper presented to Seminar, 31-10-91 of Wildlife Society of Bangladesh and Bangladesh National Museum.

Husain, K.Z. 1990b. The Fauna of Chunati Wildlife Sanctuary. A Preliminary Survey Report. Prepared by MARC, supported by IUCN and NORAD.

Islam, A.K.M.Nazrul. 1991. "Ecological Characteristics of The Coastal Zone, Sundarbans, Coastal Islands and Saline belt". In Environmental Aspects of Surface Water Systems of Bangladesh. BCAS, Dhaka.

Islam, A.K.M.N. 1976. Contribution to the study of the marine algae of Bangladesh. Bibilotheca Phycologica. Band 19J. Cramer, Vaduz, Germany. (Reported in MOEF and IUCN, 1990).

Islam, Mahmuda - 1990. Women's Role in Resource Management for Development. Case of Bangladesh.

ITTO. 1992. Criteria for the Measurement of Sustainable Tropical Forest Management. ITTO Policy Development Series No. 3, Yokohama, Japan.

ITTO. 1991. Report on Working Group on Guidelines For the Conservation of Biological Diversity in Tropical production Forests. Third Draft Proposal ITTC (XI)/7 Rev.2, December 1991, Yokohama.

IUCN. 1991. Caring For the Earth . A Strategy for Sustainable Living. Published in partnership by IUCN, UNEP, WWF, Gland, Switzerland.

IUCN. 1990a. Towards Sustainable Development: Energy and Mineral Resources of Bangladesh. A Background Paper Prepared for NCS. BARC and MOEF, Dhaka.

IUCN. 1990b. Towards Sustainable Development: Conservation of Genetic Resources of Bangladesh. A Background Paper Prepared for NCS. BARC and MOEF, Dhaka.

IUCN 1990c. Towards Sustainable Development: Land Resources in Bangladesh. A Background Paper Prepared for the National Conservation Strategy. BARC and MOEF, Dhaka.

IUCN. 1986. Review of the Protected Areas System in the Indo-Malayan Realm. Switzerland.

IUCN. 1985. The Corbett Action Plan for Protected Areas of the Indo-Malayan Realm.

IUCN. 1984. Conservation of Ecological Processes. Commission on Ecology Papers No. 8.

Kampsax, et. al 1992b. FAP 7 Draft Project Preparation Report, Volume 2, Annexes I-XI. Prepared for GOB, MIWDFC, BWDB, February 1992, Dhaka.

Kampsax, BCEOM, Danish Hydraulic Institute et al. 1992a. FAP 7 Cyclone Protection Project Feasibility and Design Studies, Final Project Preparation Report, Appendix H-Afforestation. Prepared for GOB, MIWDFC, BWDB, May 1992, Dhaka.

Khan, M.A.R. 1982. Wildlife of Bangladesh. A checklist. University of Dhaka.

Khan, S., Choudhury, N., Majumdar, P., Kamal, S., Begum, M., Hamid, S., Thakurata, M. G., and Mahboob, G. 1991. Women in Development. In: Report of the Task Forces on Bangladesh Development Strategies for the 1990s. Volume 1. University Press Limited, Dhaka.

Khan, L. R., 1991. Watershed Management Prepared for UNDP/FAO/BGD/85/011. Field Document No. 44.

Khan, M.A.R. 1985a. Mammals of Bangladesh. A Field Guide.

Khan, M.A.R. 1985b. St. Martins - A Vanishing Coral Island of Bangladesh. Tigerpaper Vol XII No. 4.

Khan, F. H. 1991. Geology of Bangladesh. The University Press Limited, Dhaka.

Khan, F.A., A.M. Choudhury and M.D. Jinnahtul Islam, 1990. Timber Volume Inventory in the Sundarbans Using Aerial Photography and Other Remote Sensing Techniques. Mangrove Ecosystems Occasional Paper No. 9, UNDP/UNESCO Regional Mangrove Projects.

Khan, S. 1990. The Flora of Chunati Wildlife Sanctuary. A Preliminary Survey Report. Prepared by MARC, supported by IUCN and NORAD.

Labrousse, R. 1984. Preliminary Report on the Ecological Classification of Plantations in the Chittagong Hill Tracts Districts. FAO BGD/79/017.

Livingston, R. Wetland Ecology in the Northeast Region of Bangladesh. Draft Final proposal for the Northeast Regional Project: FAP-6, May, 1992.

Lovejoy, T, 1985. Rehabilitation of Degrated Tropical Forest Lands. IUCN Commision on Ecology Occasional Paper No. 5

MacKinnon, J. and K. MacKinnon. 1986. Review of the Protected Areas System of the Indo-Mayalan Realm. IUCN in collaboration with UNEP.

Mahtab, F. U., Mujeri, M. K., Huq, S., Basher, S.H.M.A. Ali, M. Y., Katebi, N. A., Rashid, H., Asaduzzaman, M., Karim, M. A., Karim, Z., Mahmud-ul-Ameen, Rahman, K., and Kamal, S. M. 1991. Environment and Development In: Report of the Task Forces on Bangladesh Development Strategies for the 1990s. Volume 4. University Press Limited, Dhaka.

Malhotra, K.C. and M. Poffenberger (ed.). 1989. "Forest Regeneration Through Community Protection: The West Bengal Experience. In Proceedings of the Working Group Meeting on Forest Protection Committees, Calcutta, June 21-22, 1989.

Mather, A. S. 1990. Global Forest Resources.

Mott MacDonald et al. 1992 FAP 5 South East Regional Study, Draft Regional Plan, Annex IV Environment. Prepared for GOB, MIWDFC, FPCO.
Mott MacDonald et al. 1991. FAP 2 North West Regional Study, Interim Report, October, 1991, Annex 9 Initial Environmental Evaluation.

Musgrave, P. 1990. Effective Social Forestry. A Fact Pack. Prepared for CBSP in Collaboration with PACI.

Muthoo, M.K and M.E. Chipeta (eds.), 1991. Tree and Forests in Rural Land Use. Prepared for FAO for Tenth World Forestry Congress, Paris, 1991.

National Forum of Environmental NGOs. 1991. A Preliminary Report on Environmental Impact Assessment of Cyclonic Storm and Tidal Surges in the Greater Chittagong and Noakhali Districts of Bangladesh, Dhaka.

Naripokkho. 1991. Naripokkho's Workshop " People & Environment. Proceedings from a Workshop.

Olivier, R.C.D. 1979. Wildlife Management and Conservation in Bangladesh. UNDP/FAO project BGD/72/005. FAO. Forest Research Institute Chittagong. 121 pp.

Oppenheimer, J.R., A.W. Akonda and K.Z. Husain. 1983. Rhesus Monkeys: Effect of Habitat Structure, Human Contact and Religious Beliefs on Population Size. In Seth, P.K. ed. Perspectives in Primate Biology, Today and Tomorrow Printers and Publishers, New Delhi, India, pp-193-199.

Pannell, Kerr and Forster, 1990. Bangladesh Tourism Action Plan. Prepared for Bangladesh Parjatan Corporation by Pannell, Kerr Forster, Hong Kong.

Parjatan Corporation, 1991. Technical Assistance Project Proforma on Feasibility Study on Tourism Development at Mongla and Sundarban Areas. Planning, Training and Statistics Division, Parjatan, December, 1991.

Phillipson, J. 1988. Wildlife and Tourism in Bangladesh. Annex to Section 4 In UNDP/WTO. 1988. Strategic Master Plan For Tourism : Bangladesh. Project Recommendations and Findings. Prepared by Pannell Kerr Forster, London for World Tourism Organization, Madrid Spain. Project BGD/85/119.

Poore, D. and Sayer, J. 1991. The Management of Tropical Moist Forest Lands Ecological Guideline. Prepared for the IUCN Forest Conservation Programme, Gland, Switzerland.

Pramanik, M.A.H. 1990. Zoning of the Water Systems of the Chittagong region". In Environmental Aspects of Surface Water Systems of Banagladesh.

Pramanik, A.H. 1984. "Government's Participation in the Development Activities of the tribal people in Bangladesh" in Tribal Cultures in Bangladesh, edited by M.S. Qureshi, Institute of bangladesh Studies, Rajshahi University, Bangladesh.

Proshika Manobik Unnayan Kendra. 1992. Micro Case Studies of Forestry in Bangladesh. Prepared for the South-North Project on Sustainable Development, Dhaka.

Proshika Manobik Unnayan Kendra. 1991. A Macro View of Forestry in Bangladesh. Prepared for the South-North Project on Sustainable Development, Dhaka.

Rahman, M. 1989. Preservation of Gharial in Bangladesh. In Karim, G.M.M.E., A.W. Akonda and P. Sewitz. 1989. Conservation of Wildlife in Bangladesh. Proceedings of the First International Symposium Cum Workshop for Conservation of Wildlife in Bangladesh, Dhaka, Dec 1-4, 1986. Organized by the German Cultural Institute.

Rahman, S.Y. and A.W. Akonda, 1987. Wildlife and Protected Areas. Report prepared for Bangladesh National Conservation Strategy.

Rahman, A. A., S. Huq and G. R. Conway (eds.) 1990. Environmental Aspects of Surface Water Systems of Bangladesh.

Rashid, S.M.A. 1989. Some Observations on the Shorebirds of Some Islands in the Lower Gangetic Delta, Greater Noakhali District, Bangladesh. The Stilt, No. 14, April 1989.

Rashid, S.M.A. and A.Z. Khan. 1987. Waterfowl of the Teknaf Peninsula, Bangladesh. Paper Presented at the Conference on Wetland and waterfowl Conservation in Asia. Malacca, Malaysia. 23-28 February, 1987.

Rashid, S.M.A. and A.Z. Khan. 1985. Preliminary survey of the Gharials, Gavialis gangeticus, in the Padma, Bangladesh. Paper presented at the 10th Annual Science Conference, Rajshahi University. (Reported in Akonda et.al., 1989).

Rashid, H. E. 1991. Geography of Bangladesh. University Press Limited, Dhaka, Bangladesh.

Richards, B. N. and M.M. Hassan. 1989. Dendroecological Regions of Bangladesh: A Land Capability Assessment for Tree Species. BFRI/FAO BGD/83/010 Working Paper No.7.

Ryan, John C. 1992. Life Support: Conserving Biological Diversity. Worldwatch Paper 108. Worldwatch Institute, April, 1992.

SIDA, 1991. SIDA's Environmental Profile for Bangladesh. Prepared by Bertilsson, Hifab Int. A.B.C. July, 1991.

SEATEC. 1992a. National Environmental Monitoring and Pollution Control Project. Final Report, Volume 1, July 1992. Submitted to Asian Development Bank for GOB, Department of Environment.

SEATEC. 1992b. National Environmental Monitoring and Pollution Control Project, Volume 2.

Sarker, S.U. and N.J. Sarker. 1986. Status and Distribution of Birds of the Sundarbans, Bangladesh. The Journal of Naomi, Vol 3. June 1986.

Sarker, S.U. and K.Z. Husain. 1991. Conservation of Wetland Wildlife of Bangladesh. In Environmental Aspects of Surface Water Systems of Bangladesh.

Sarker, N.M. and A.K.M. Fazlul Huq. 1985. Country Report on National Parks, Wildlife Sanctuaries and Game Reserves of Bangladesh. Prepared for 25th Working Session of IUCN's Commission on National Parks and Protected Areas. Corbett National Park, India, 4-8 February, 1985.

Sarker, S.U. and N.J. Sarker. 1988. Wildlife of Bangladesh - A systematic list. Ric Printers, Dhaka.

Sayer, J. 1991. Rainforest Buffer Zones: Guidelines for Protected Area Managers. IUCN, Forest Conservation Program. Cambridge, UK.

Scott, D.A. and S.M.A. Rashid. 1992. Wetland Assessment and Ornithology Main Surveys. Draft Final Report prepared for Northeast Regional Water Management Project (FAP6). Dhaka.

Scott, D.A. (ed). 1989. A Directory of Asian Wetlands. IUCN, Cambridge and Gland.

Scott, D.A. and C.M. Poole. 1989. A Status Overview of Asian Wetlands. Asian Wetland Bureau Publication 53, Kuala Lumpur.

Shawinigan Lavalin (1991) Inc., Northwest Hydraulic Consultants et al. 1992a. FAP 6 Northeast Regional Water Management Project, Regional Plan Considerations, Preliminary Draft for Discussion. Prepared for GOB, MIWDFC, FPCO.

Shawinigan Lavalin et al. 1992b. Northeast Regional Water Management Project, Environmental Field Studies, May-June, 1992.

Siddique, N.A. 1986. Impact of Forest Management Practices in Bangladesh on Wildlife and the Environment. Tigerpaper Vol XII,No 1.

Siddiqui, K. 1981. Political Economy of Land Reforms in Bangladesh. BIDS.

Sogreah, Halcrow, Lahmeyer et al. 1992b. FAP 3.1 Jamalpur Priority Project Study, Interim Feasibility Report, Annex 3, Environmental Impact Assessment, July 1992. Prepared for GOB, MIWDB, FPCO.

Sogreah, Halcrow, Lahmeyer et al. 1992a. Jamalpur Priority Project Study, FAP 3.1, Char Study Report, Volume 1, September 1992. Prepared for GOB, MIWDFC, FPCO.

Stanford, C.B. 1989. The Conservation of Capped Langur (Presbytis pileata) in Bangladesh. In Karim, G.M.M.E., A.W. Akonda and P. Sewitz. 1989. Conservation of Wildlife in Bangladesh. Proceedings of the First International Symposium Cum Workshop for Conservation of Wildlife in Bangladesh, Dhaka, Dec 1-4, 1986. Organized by the German Cultural Institute.

Stevens, P. R. 1986. Handbook for Site Classification and Site Suitability Assessment. FAO BGD/79/017.

Timm, R.W. 1992. ADB Assistance in Bangladesh. Unpublished Report distributed to FMP.

Timm, R.W. 1991. The Adivasis of Bangladesh. A Minority Rights Group International Report 92/1, London, UK.

Treygo, W. and P. B. Dean. 1989. The Environment and Development in Bangladesh An Overview and Strategy for the Future. Prepared for the Bangladesh program, Asia Branch, CIDA, October 1989.

Treygo, W. 1991. Rural Development, Credit, and NGOs in Bangladesh: A Green Strategy. Prpepared for the Bangladesh Program, CIDA, September 1991.

UNCED. 1992. The Global Partnership for Environment and Development. A Guide to Agenda 21, April 1992, Geneva.

UNDP and WTO. 1988. Strategic Master Plan For Tourism : Bangladesh. Project Recommendations and Findings. Prepared by Pannell Kerr Forster, London for World Tourism Organization, Madrid Spain. Project BGD/85/119.

UNDP. 1992b. Project Document. BGD/91/018. Unpublished Agreement between MOEF and UNDP.

UNDP. 1992c. Report of the Mid-Term Evaluation Mission. Project BGD/84/054/A/01/45, November, 1992

UNEP. 1992. Saving our Planet Challenges and Hopes. The State of the Environment (1972-1992), Nairobi.

UNEP. 1986. Environmental Problems of the Marine and Coastal Area of Bangladesh: National Report. UNEP Regional Seas Reports and Studies No. 75. UNEP, Nairobi, Kenya.

WCED. 1987. Our Common Future. United Nations' World Commission on Environment and Development. Oxford University Press.

Wells, M. et al. 1992. People and Parks. Linking Protected Area Management with Local Communities the World Bank, WWF, USAID, Washington, D.C.

Wildlife Task Force. 1986. Report of the Wildlife Task Force. Report submitted to Ministry of Agriculture, Government of Bangladesh. June 1986.

Winterbottom, R., H. Rashid and G. M. Kamal. 1989. Sustainable Development of Forest Resources in Bangladesh: Challenges and Opportunities. Annex of the Bangladesh Environment and Natural Resource Assessment. Report submitted to USAID by World Resources Institute,
Washington DC.

World Bank. 1992. Staff Appraisal REport Bangladesh Forest Resources Management Project. Report No. 10377 - BD.

World Bank. 1991a. Forestry The World Bank's Experience, Operations Evaluation Department, Washington, D.C.

World Bank. 1991b. The Forest Sector. A World Bank Policy Paper, Washington, D.C.

World Bank. 1991c. Bangladesh Environment Strategy Review. Report No. 9551-BD.
World Bank. 1991d. Environmental Assessment Sourceable Volume I, Policies, Procedures and Cross-Sectoral Terms Technical Paper No. 139, Washington, DC.

World Bank. 1991e. Volume II. Sectoral Guidelines. Technical Paper Number 140.

World Bank. 1991f. Volume III. Guidelines for Environmental Assessment of Energy and ..... Projects. Technical Paper No. 154.

World Resources Institute. 1990. Bangladesh Environment and Natural Resource Assessment (Draft Report). Submitted to USAID.

Zabala, N.Q. 1990. Forest Types of Bangladesh. Chapter XIII in Forest Ecology. Institute of Forestry, Chittagong Univ. and FAO, Rome. UNDP/FAO BGD/85/011 Field Document No 6.

Zuberi, M.I. 1992. List of Flora of the Barind. In Investigation and Monitoring of Environmental Degradation: Study of Natural Habitat and Vegetation in the Barind Tract of Rajshahi Division and Ways to Combat the Degradation. Project proposal for Science and Technology Division, Bangladesh Ministry of Education.