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GOVERNMENT OF BANGLADESH  
MINISTRY OF ENVIRONMENT AND FORESTS

LANDUSE

# FORESTRY MASTER PLAN

ASIAN DEVELOPMENT BANK (TA NO. 1355-BAN)

UNDP/FAO BGD 88/025

1992

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LANDUSE

TABLE OF CONTENTS

	<u>Page</u>
	iv
SUMMARY	1
INTRODUCTION	1
General	2
Sustainable Development	3
PRESENT LANDUSE	3
Land Utilization	4
Pattern of Land Distribution in Rural Bangladesh	6
Implications for Forestry	6
Need for Institutional Changes	6
Maximizing Wood Resources	7
Opportunities for Strip Plantations	8
Khas Lands	8
Classified and Unclassified State Forests	9
NATIONAL LAND POLICY FOR BANGLADESH	9
Land Policy Constraints in Bangladesh	10
Overall Land Constraint	10
Variation for Land Resources and Problems	10
Institutional Constraints to Effective Land Reforms	10
Absence of a Centralized Information System	11
General Recommendations for Landuse Policy	11
Specific Issues and Recommendations in Relation to Women	11
Other Forest Policy Issues and Recommendations	12
LAND RESOURCES APPRAISAL OF BANGLADESH	12
Biogeographical Resources of Bangladesh	13
Landforms	13
Physiographic Regions	14
Physiographic Units	14
Soils	14
General Soil Types	16
Physiographic Soil Groups	18
Inundation Land Types	19
Climate	19
General Description	20
Climatic Data and Agroclimatic Zones	21
Agroecological Regions	21
Land Suitability Assessment	23
Land Capability For Tree Species	24
Water Availability	24
Oxygen Availability	24
Availability of Root Hold	24
Nutrient Availability	25

<b>Importance for Forestry</b>	26
<b>Prospects for the Natural Forests under Present Management</b>	26
<b>FOREST LANDS</b>	27
<b>Forest Categories</b>	27
<b>Forest Department Controlled Land</b>	27
<b>Land Ministry Controlled Land</b>	27
<b>Private Lands</b>	27
<b>Protecting and Managing the Forests of Bangladesh</b>	27
<b>Multiple Use Management Area Approach</b>	28
<b>Opportunities for Multiple Use Management</b>	28
<b>Priority Areas</b>	29
<b>SUNDARBANS</b>	30
<b>General</b>	30
<b>Setting Priorities in Landuse Conflicts</b>	33
<b>Industrial Raw Material</b>	33
<b>Khulna Newsprint Mill</b>	34
<b>Khulna Hardwood Mill</b>	36
<b>Local Sawmills</b>	37
<b>Other Wood and Non Wood Products</b>	37
<b>Fuelwood</b>	37
<b>Non Wood Products</b>	38
<b>Fisheries</b>	38
<b>Wildlife</b>	39
<b>Ecological Diversity</b>	39
<b>Preferences and Priorities</b>	40
<b>Recommended Sustainable Landuse Strategy</b>	41
<b>Core Zone</b>	42
<b>Buffer Zone</b>	44
<b>Multiple Use Zone</b>	45
<b>Designation and Management</b>	46
<b>Impact on National Landuse</b>	48
<b>Integrating the Sundarbans into a National Coastal Management Plan</b>	48
<b>NEWLY ACCRETING COASTAL LANDS</b>	49
<b>General</b>	49
<b>Landuse on Islands Adjacent to Coastal Afforestation Plantations</b>	51
<b>People's Participation in Management of Resources</b>	51
<b>CHITTAGONG FOREST DIVISION</b>	53
<b>General</b>	53
<b>Recommended Sustainable Landuse Strategy</b>	54
<b>Plantation Productivity</b>	56
<b>Past Practices and Results</b>	56
<b>Present Situation</b>	56
<b>Species and Site Selection</b>	57
<b>Growth and Yield of Plantations</b>	59
<b>Land Allocation for Sustainable Plantations</b>	60
<b>Participatory Forestry Areas</b>	60
<b>Landuse Options</b>	61
<b>Involvement of NGOs</b>	62
<b>Designation and Management</b>	62
<b>Impact on National Landuse</b>	62

<b>COX'S BAZAAR FOREST DIVISION</b>	63
General	63
Sustainable Landuse Strategy Recommendations	63
Core Zone	64
Buffer Zone	65
Multiple Use Zone	65
Designation and Management	65
Impact on National Landuse	66
Chokoria and Naf River Mangrove Forests	66
Changing Landuse in the Chokoria Sundarbans	66
<b>CHITTAGONG HILL TRACTS</b>	67
General	67
Kassalong Reserved Forest	68
Rankhiang Reserved Forest	69
Sitapahar Reserved Forest	71
Sangu and Matamuhuri Reserved Forests	73
Reserved Forest Summary	74
Forest Department Plantations	75
<b>SYLHET</b>	76
General	76
Sylhet Pulp and Paper Mill	77
Background	77
Raw Material Supply	78
Recommended Reed Lands Strategies	81
Recommended Landuse Strategy	81
Core-Buffer-Multiple Use	81
Reserved and Acquired Forests	81
Sylhet/ Eastern Mymensingh Haor Basin	84
<b>SAL FORESTS AREA</b>	86
General	86
Past Practices and Results	88
Recent Experience	89
Recommended Landuse Strategy	90
Allocate Land to Achieve Sustainable Development	90
Retaining Forest Plantations and Sustainable Landuse	92
Established Rubber Plantations	92
<b>APPENDICES</b>	
1. Abbreviations, Terms and Conversion Factors	
2. Terms of Reference	
3. References	

## LANDUSE

### SUMMARY

Bangladesh, more than any other country, cries out for rational landuse planning to obtain optimum productivity from its limited land resources. Many studies and analysis over the years support this need. Despite this great need, the country has not adopted one. Forests are a legitimate, and in many parts of the country, the only possible rational use for land. Nevertheless, forestry use is not a strong social or economic priority. Forestry planning is therefore forced to base development on a number of technically and socially accepted principles suited to local conditions. This report outlines the principles involved in Bangladesh's case.

**Social Equity** - At present, the forestry sector is focused on providing goods and services for commercial and industrial uses which primarily benefit the middle and upper class members of society. Maintaining such a focus is not consistent with a commitment to poverty alleviation and social justice. It also does not contribute to sustainable development, where priority must be given to meeting the basic needs of the poor.

Forest lands will continue to be used for the production of economically valuable products. However, what is required is a change in the production system, whereby the private sector, cooperatives and smallholders are provided with incentives to increase production. The type of economically valuable product may however have to change, since smallholders require a quick and ongoing source of income and cannot afford to wait for long term future benefits.

The focus should be shifted from traditional forestry towards participatory forestry. In all activities priority should be given to the poor, with preference going to the rural poor who already occupy or utilize the forest lands being developed.

Non government development organizations (NGOs) can play an important role in the social preparation necessary to make participatory forestry effective. Also, by linking participatory forestry with programmes for literacy and health, NGOs can assist the overall human development of the rural poor.

**Fair and Equitable Involvement of Women** - Approximately 43% of the timber, fuelwood and bamboo utilized in Bangladesh presently come from homesteads and village woodlots. Women play a dominant role in the establishment and maintenance of these. Despite this fact, women are given little recognition and are not given fair and equal access to land, the most important productive resource in Bangladesh.

When designing forestry programmes and projects, mechanisms must be built in to ensure that women are involved equally, and that women have equal access to any land distributed, and any leases or permits issued. Affirmative action is needed, whereby women are actually given preference in the granting of land, leases or permits. Affirmative action programmes in favour of women are also affirmative action programmes in favour of children.

Within the Forest Department, there are negligible professional women staff. This has resulted in the Forest Department being unable to service the needs of rural women involved in participatory forestry programmes. Women have different perceptions of needs than the Forest

Department and they will have to be actively recruited for decision-making positions, as well as for positions as extension workers and trainers.

**Multiple Use Management Approach** - The need for conservation of biodiversity has only recently been recognized, and will require multisectoral collaboration, coordination and integrated action. This will have to take place at the highest policy making level. Since much of the natural biodiversity of Bangladesh is presently located on forest lands under the control of the Forest Department, it is important that the Forest Department takes up a greater role in the conservation of biodiversity than it has to date. Existing classified forest areas should be designated as Multiple Use Management Areas (MUMA) under the classification system of the World Conservation Union (IUCN). A master plan should be prepared for each of these Multiple Use Management Areas, based on the "core-buffer-multiple use zone" strategy for natural resource management. Under this system,

- protected core areas would be designated for the preservation of biodiversity through the preservation of the natural ecosystems;
- buffer zones would be designed to protect the core areas from outside interference, and provide wood and non wood products for the local people;
- multiple use zones would be designated for Forest Department Plantations and Participatory Forestry areas, which would be intensively managed for socioeconomic benefits.

**Depletion of Homestead and Village Woodlots** - Approximately 43% 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 forested area under homesteads and village woodlots is 270,000 ha, which is a relatively small area. The lands outside the homesteads are heavily utilized for food crops and grazing, and are not available for expansion of homestead and village woodlot lands.

Based on the predicted population for 1992, it is estimated that 92.5 million people presently live in rural areas. This is an average population density of almost 14 persons per hectare of net cropped area for the whole of Bangladesh. By the year 2013 the population will reach 124 million people, likely resulting in further fragmentation of homestead and village woodlot lands, as well as cultivated lands. With more houses, and less space for trees, the productivity of homesteads and village woodlots would be difficult to maintain. There are already indications of depletion. 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.

**Need for Increased Forest Department Productivity** - The Forest Department presently controls about 8 times the area presently under homesteads and village woodlots, yet only contributes 57% of the timber, fuelwood, and bamboo used in Bangladesh. This would suggest that the homestead and village woodlots under the ownership and management of independent smallholders are significantly more productive per unit area than forest lands managed by the Forest Department.

Models should be sought whereby people can be given the opportunity to make these lands productive using the same strategy which has made the homesteads and village woodlots so



productive. The strategy is smallholders enterprises focused on mixed species, multiple purpose woodlots, where the most appropriate species is planted to each microsite. This should provide the basis for participatory forestry activities on government-owned forest lands.

This can be done using the Multiple Use Management Area model described briefly above.

**Ethnic Problems and Environmental Degradation** - A considerable area of classified and unclassified state forest land exists in the Chittagong Hill Tracts. At present, the forests are being depleted and the environment is deteriorating due to uncontrolled logging and inappropriate landuse practices such as: (i) illegal logging of natural forests, often using inappropriate extraction methods which cause excessive environmental damage; (ii) shifting cultivation; (iii) planting inappropriate tree species in plantations e.g., teak plantations often have little ground cover and are subject to intense erosion; (iv) security methods used by the military include the denudation of hilltops and protective corridors. Soil erosion is heavy in this important watershed area, and contributes to the silting up of rivers and reservoirs.

An integrated strategy is required which should include: (a) a negotiated political settlement of the ethnic problems based on principles of human rights as defined in the United Nations' Universal Declaration of Human Rights; (b) participatory forestry activities through smallholders' enterprises involving tribal people on the unclassified state forest lands; and (c) integrated management of classified forest lands as Multiple Use Management Areas.

**Policy Changes and Participatory Forestry** - A new forest policy is required to facilitate new approaches to conservation and participatory forestry, and should appropriately be developed within the context of a national landuse policy for Bangladesh.

Forest laws/acts should be amended to allow the Government to enter into contracts or lease agreements with individual families or cooperatives to manage forest lands under participatory forestry systems. These agreements would have to be long term agreements (possibly in excess of 30 years) to allow participants to reap the benefits of participatory forestry activities. In some cases where people have occupied the land for a long period of time and have brought areas under a productive agriculture system, the land should be given over to the occupants as freehold ownership.

Efforts should be made to facilitate the distribution of 'khas' lands to landless families. This should be done in a way which will promote equal benefits for women. Once the land has been distributed, participatory forestry programmes and extension services should be provided to make this land productive, through matching of the most suitable tree species or crop to the site.

The overall Land Policy should address areas of intersectoral conflicts. For example, in densely populated countries such as Bangladesh, livestock should be pen fed. This would improve the health of the animal, and also its work capability in the case of draught animals. It would also provide work for the poor, since they could be employed to grow and/or gather fodder. This would free roadsides, railway right of ways, embankments, and 'khas' land for more productive and economic multiple purpose tree crops. The establishment and maintenance of these multiple purpose trees could be done by landless families, especially female-headed families, under a long term lease agreement. Support could be provided by government participatory forestry programmes. NGOs could assist in the social preparation necessary to make such programmes effective.

**Conserving the Sundarbans** - The stocking of major economic trees in the Sundarbans is declining, as is the availability of non wood products, and populations of most wildlife species, including fish, crustaceans and microorganisms. Sustainable development principles are not being applied to the management of this valuable national resource. If the present management system

continues, the Sundarbans is likely to be severely depleted, and irreparably damaged. The Sundarbans should be managed on a sustained yield basis for the conservation of the overall resources, with limited harvesting of wood and non wood products.

This can be best done by making the Sundarbans into a National Park, with protective core zones for conservation and buffer zones for providing wood and non wood products for the people in the surrounding area.

**Coastal Shelterbelt Plantations for Cyclone Protection** - The coastal areas of Bangladesh are prone to disastrous cyclones and tidal surges. In order to protect lowlying coastal areas the Forest Department has carried out a successful programme for coastal afforestation on newly accreted lands in the coastal zone.

The Forest Department only has control of these areas for 20 years, after which they are scheduled to be handed over to the Ministry of Lands. If handed over, the lands are likely to be cleared for agriculture or grazing. This would destroy their protective value, and once again open the coastal areas to significant damage from disastrous cyclones and tidal surges. Thus, plantations established on newly accreted lands in coastal areas should be classified as Reserved Forests, and all newly accreted lands should automatically be classified as Reserved Forest lands for plantation establishment.

## LANDUSE

### INTRODUCTION

#### General

The Asian Development (ADB<sup>1</sup>), 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 to decide on priorities for the development and protection of the country's forest land resources. The Landuse Report<sup>2</sup> presents the results of a four month consultancy by the Landuse Specialist, and is part of the overall planning process for the Forestry Master Plan for Bangladesh. The report provides background material for the Environmental and Landuse Subteam Report.

The function of landuse planning is to guide decisions on landuse in such a way that the resources of the environment are put to the most beneficial present use for humanity, whilst at the same time conserving those resources for the future. This planning must be based on an understanding both of the natural environment and of the kinds of landuse envisaged. It is the function of land evaluation to bring about such understanding and to present planners with a range of options for optimizing landuse.

Land evaluation is concerned with the assessment of land performance when used for specific purposes. It involves the execution and interpretation of basic surveys of climate, soil, vegetation and other aspects of land in terms of the requirements of alternative forms of landuse. To be of value in planning, the range of landuses considered has to be limited to those which are relevant within the physical, economic and social context of the area considered, and the comparisons must incorporate economic considerations. Land evaluation is only part of the landuse planning process.

In the forestry sector in Bangladesh, there is a recognized need for change. Two key elements of the recognized need for change within the sector are the need to give conservation priority in forestry sector planning and the need to focus on participatory forestry for poverty alleviation and social justice. The landuse planning process should play a key role in determining how to translate the recognized need for change into concrete programmes and projects for specific land areas. To be effective in terms of participatory forestry, the landuse planning process must itself be made participatory. This will mean involving the target group and potential participants in each stage of the process. This can be best achieved through the involvement of NGOs.

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<sup>1</sup> For this and other abbreviations, terms and conversion factors see Appendix 1.

<sup>2</sup> Terms of Reference for this Report are given in Appendix 2.

## Sustainable Development

Landuse planning in this context implies landuse planning for sustainable development. The United Nations' World Commission on Environment and Development (WCED, 1987<sup>3</sup>) defines sustainable development as follows:

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:

- a. the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and
- b. the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs."

A rationale is given for focusing on the needs of the poor and the same report also supports the principles of participatory forestry. Democracy and people's participation in decision-making are prerequisites for sustainable development.

The WCED (1987) also maintains that it is possible to integrate conservation of resources for future generations into present development programmes:

"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 importance of political will is also stressed:

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

The common theme throughout the WCED strategy for sustainable development is the need to integrate economic and ecological considerations in decision making. They are, after all, institutions arrangements at every level.

The approach to landuse planning recommended in this Landuse Report is consistent with principles of sustainable development.

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<sup>3</sup> References are given in Appendix 3.

## PRESENT LANDUSE

The total area of Bangladesh is approximately 14.40 million hectares of which <sup>13</sup>13.46 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 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 area under medium farms decreased from 37.68% in 1960 to 24.72% in 1983/84. 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 land use 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	<u>5,608.71 km</u>
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 made on the most appropriate land use. 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 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<sup>3</sup> 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 managed 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 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 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<sup>2</sup> (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 land use 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.

As noted in FAO (1988), the objectives of the Land Resources Appraisal of Bangladesh were as follows:

- to compile a national computerized land resources data base from available reconnaissance soil survey reports and published climatic data;
- to develop and establish a computerized land and climatic resources appraisal system appropriate for Bangladesh's environment, agricultural system and development needs;
- to differentiate, delineate and describe agroecological regions of significance for the planning of agricultural and forestry research, extension and development;
- to assess the crop production potential of the land and climatic resources under rainfed and irrigated conditions at national, district and upazila levels, and within agroecological regions; and
- to make the land resources data base and crop suitability assessments available to agricultural and forestry research, extension and development planners at national, regional and district levels in the form of a computerized reference base and as agroecological maps and reports.

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 material 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.

## 2. Physiographic Units

Each of the physiographic regions can be further subdivided into physiographic units. FAO (1988) recognized 34 physiographic units and subunits. These are mapped in Figure 1.

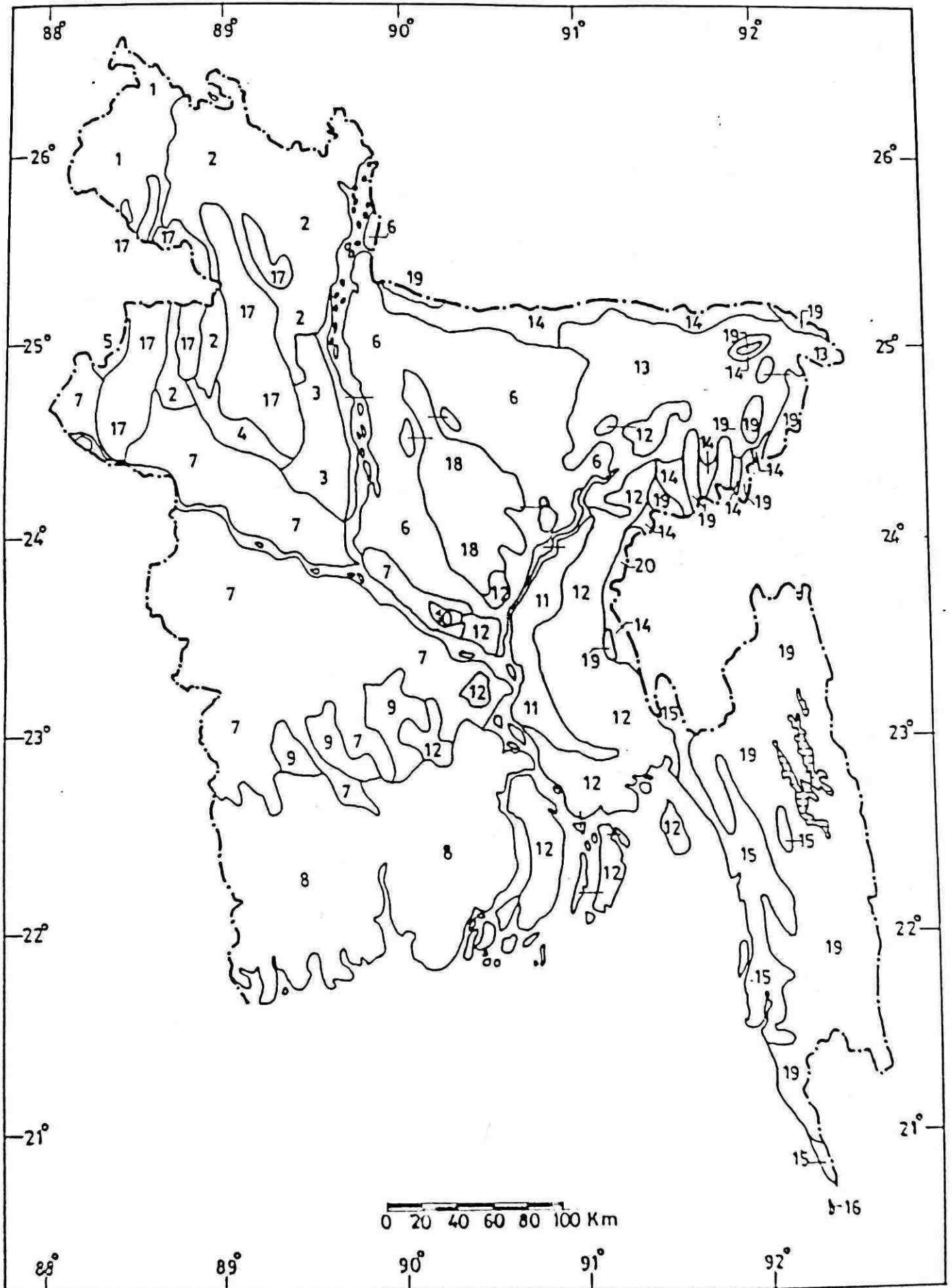
### Soils

#### 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. Figure 2 maps the General Soil Types. Only the principal General Soil Type of the unit is indicated on the map. The following is a legend for the map.

- 1a Calcareous Alluvium (non saline)
- 1b Calcareous Alluvium (seasonally saline)
- 2 Noncalcareous Alluvium
- 3 Calcareous Grey Floodplain Soils
- 4 Calcareous Dark Grey Floodplain Soils
- 5a Noncalcareous Grey Floodplain Soils (non saline)
- 5b Noncalcareous Grey Floodplain Soils (seasonally saline)
- 6 Noncalcareous Brown Floodplain Soils
- 7 Noncalcareous Dark Grey Floodplain Soils
- 8 Noncalcareous Dark Grey Floodplain Soils and Peat
- 9 Black Terai Soils
- 10 Acid Basin Clays
- 11 Acid Sulphate Soils
- 12 Grey Piedmont Soils
- 13 Brown Hill Soils
- 14 Shallow and Deep Grey Terrace Soils
- 15 Deep Red-Brown Terrace Soils





Source : FAO (1988 )

Figure 1 - Physiographic Units

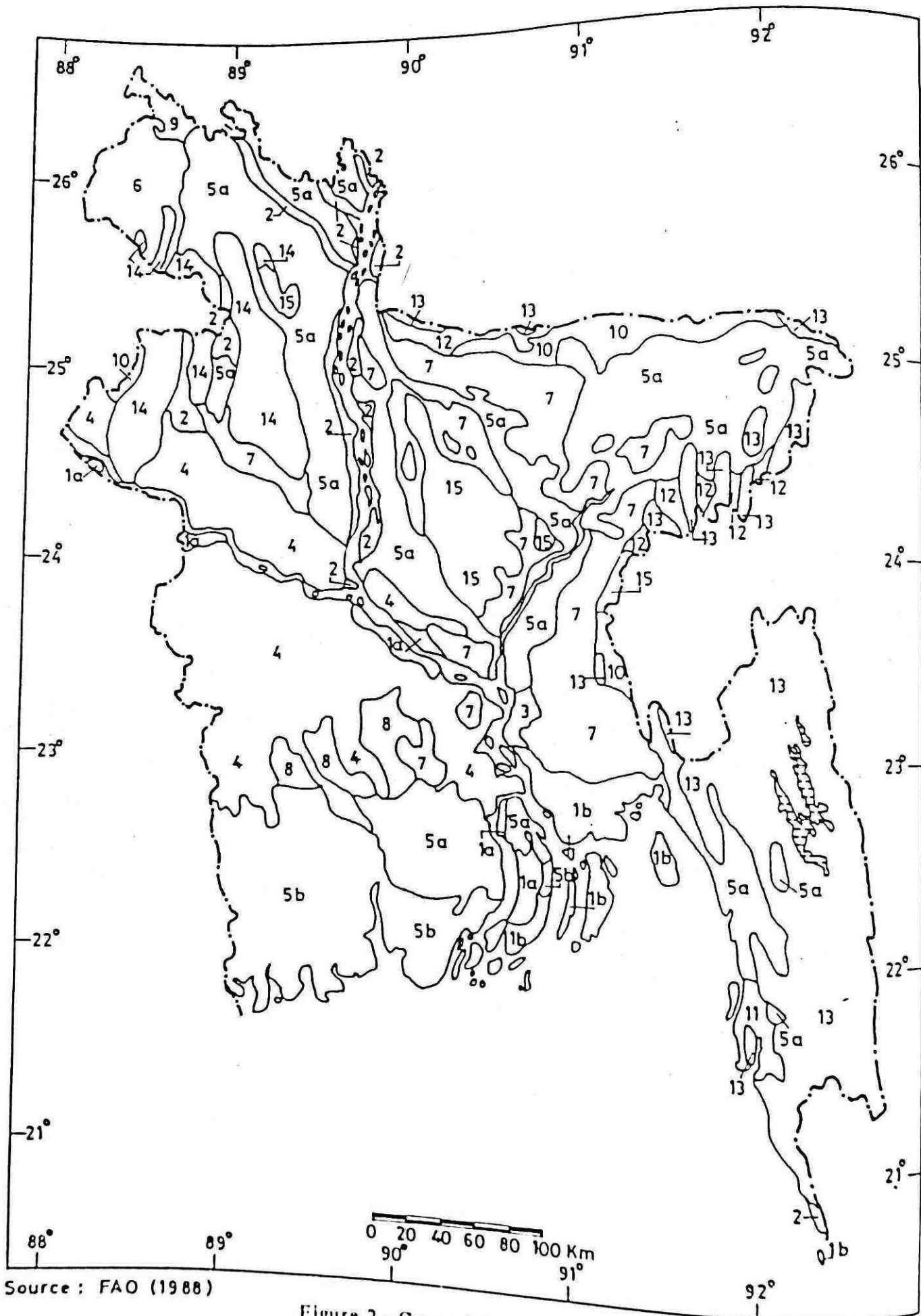


Figure 2 - General Soil Types

## 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%

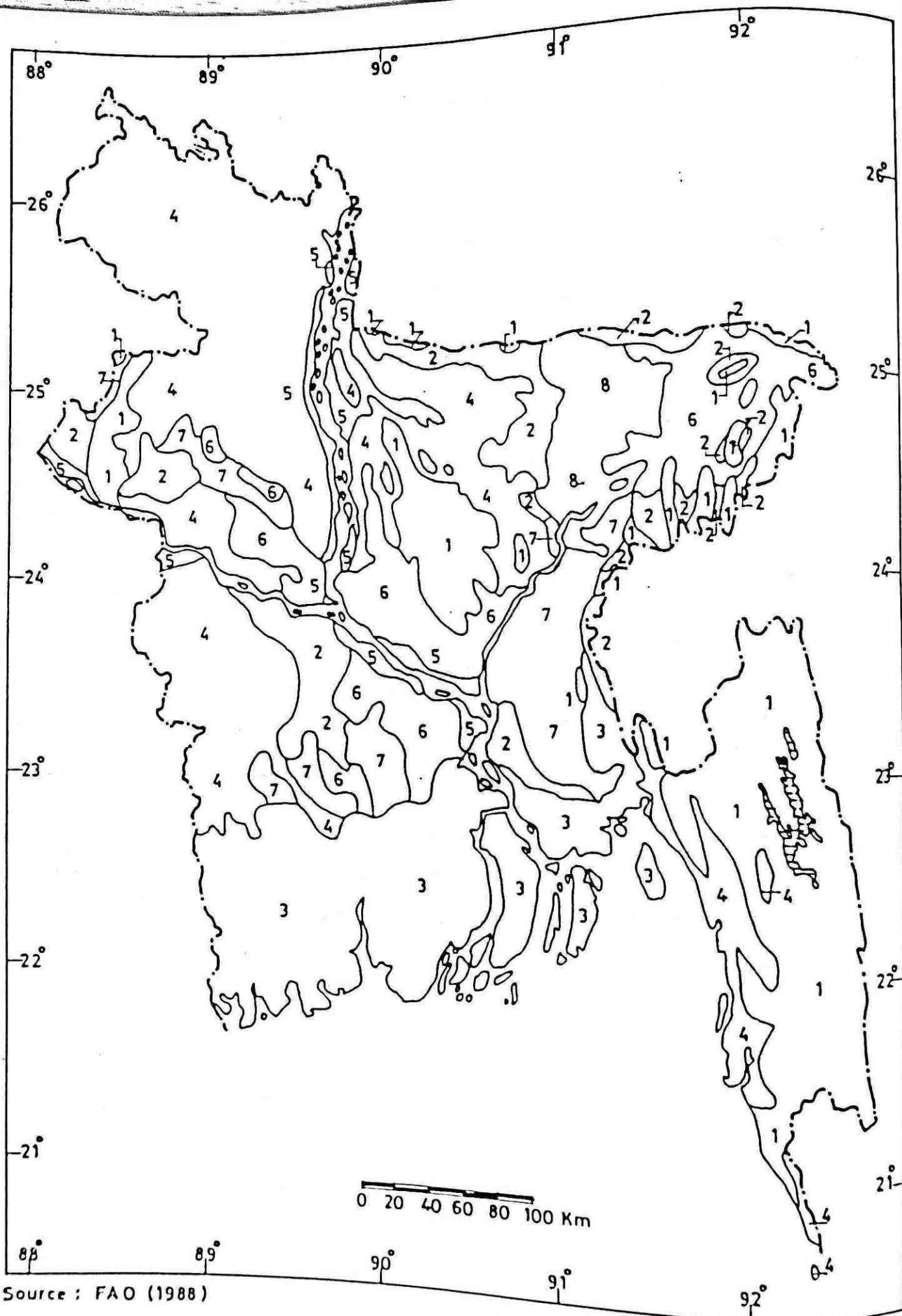
Figure 3 maps the Inundation Land Types. A legend for the map is given below.

1. Mainly Highland
2. Highland to Medium Lowland
3. Mainly Medium Highland
4. Medium Highland and Highland
5. Medium Highland and Medium Lowland
6. Medium Highland to Lowland
7. Medium Lowland and Lowland
8. Lowland and Very Lowland

## 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.



Source : FAO (1988)

Figure 3 - Inundation Land Types

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. This map was created by adding successive layers of information on the physical environment which are relevant for land use and for assessing agricultural potential. As already noted, the layers are:

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

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. The description of each agroecological region in Report 2 of FAO (1988) includes a section on agricultural development possibilities under rainfed conditions and with small scale irrigation and/or drainage. Opportunities to increase crop yields and production exist in all regions through improved crop, soil and water management; increased and more efficient use of fertilizers/manure; provision of irrigation of improved crop varieties, etc. This applies equally for field crops and tree crops.

### Land Suitability Assessment

FAO (1988), Report 6, describes the methodology for assessing land suitability. The procedure for assessing land suitability for individual crops is summarized as follows:



- define the ecological requirements and limitations of crops under specified production systems (e.g. rainfed or irrigated; traditional or modern management);
- assess the agroclimatic suitability for each crop on the basis of estimated losses of yield potential imposed by climatic conditions defined for the thermal and length of growing period (i.e. moisture) zones;
- assess the suitability of individual soils for each crop in each growing period zone on the basis of an analysis of 11 soil, inundation and landform factors;
- combine the agroclimatic and soil suitability classifications to provide land suitability classes for each crop;
- match the ecological suitability classification for each crop against the data included in the computerized land resources inventory so as to obtain the area of land of each land suitability class by Upazila, District, country, agroclimatic zone or agroecological region/subregion.

Five suitability classes are employed, each linked to attainable yields, as follows:

Very Suitable (VS)	- 80% or more of maximum attainable yield (MAT)
Suitable (S)	- 60-80% of MAT
Moderately Suitable (MS)	- 40-60% of MAT
Marginally Suitable (mS)	- 20-40% of MAT
Not Suitable (NS)	- less than 20% of MAT

Attainable yields are the average yields to be expected over a 5-10 year period taking into account year-to-year variations resulting from differences in weather, flooding, etc., within the ranges defined for a particular soil series, soil phase, inundation land type and agroclimatic zone.

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 land use surveys, agricultural and forestry research, and field experience with individual crops and management practices.

#### Land Capability For Tree Species

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 dendroecological 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:

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

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.

### 5. Importance for Forestry

In Report 6 of FAO (1988), 48 crops have been rated for Agroecological Zone Land Suitability Assessment. Several important tree crops are included, i.e., Mango, Jackfruit, Rubber, Tea, Coconut, Oil palm. In addition, many of the other crops rated are important species to be considered for agroforestry systems promoted for participatory forestry. This could also provide the basis for farm systems research and development for forest lands, both classified and unclassified.

The success of tree crop plantations largely depends on the selection of the most appropriate species, variety, cultivar, and/or provenance for the particular site available for planting. Agroecological Zone Land Suitability Assessment could play an important role in the selection process.

It is therefore important that the Bangladesh Agroecological Zones Programme set up in the BARC Computer Centre be utilized to carry out dendroecological zone land suitability assessment for other important tree crops, including plantation species. The methodology may have to be modified to refine it to the specific needs of tree crops; however, the basic data and system should be invaluable if properly utilized.

### Prospects for the Natural Forests under Present Management

The ecological diversity outlined above has been greatly reduced by land clearing for human settlement and agriculture. At present, the remnants of natural vegetation types only occupy a small percentage of the land area of Bangladesh. The remnants are constantly being reduced by overexploitation, conversion to forest plantations, conversion to permanent agriculture, and encroachment for shifting cultivation or bushfallow farming. If the present trends continue, the remnants of the natural vegetation of Bangladesh will be completely lost in the next twenty years.

In the following section, a strategy is presented which is aimed at the conservation of the remaining biodiversity and ecological diversity of Bangladesh, while still providing wood and non wood products for the benefit of the people.

## FOREST LANDS

### Forest Categories

The forest land of Bangladesh can be classified under three broad categories. These are summarized in Table 6.

Table 6 - 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 10% of the area of Bangladesh under a protection system.

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.

Under the IUCN Classification system for protected areas, a Category VIII approach would seem most appropriate for use in Bangladesh. This category is described below.

### 1. Multiple Use Management Area Approach

The following description is extracted from a paper by IUCN's Commission on National Parks and Protected Areas.

"Some terrestrial and marine areas can both provide protection to natural resource 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 of 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 or 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 marine products.

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), conservation may be a primary objective in its own right and given equal importance to 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.

A category VIII area is large, containing considerable territory suitable for wood products, water, pasture, wildlife, marine products and outdoor recreation. Part of the area may be settled and may have been altered by man. The area may possess nationally unique or exceptional 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 the overall productivity of the areas in perpetuity."

### 2. 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 the Multiple Use Management Areas. 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 7 summarizes the area available for inclusion in Multiple Use Management Areas. The rationale for allocating areas to the three zones is discussed under the following section on Priority Areas. Using the Multiple Use Management Area approach, 1,377,704 ha would be brought under a National protection system. This represents 9.6% of the area of Bangladesh.

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.
- buffer zones would be designated to protect the core areas from outside interference, and provide wood and non wood products for the local people.
- multiple use zones would be designated for Forest Department Plantations and Participatory Forestry areas, which would be intensively managed for socioeconomic benefits.

The case studies given in the following section under Priority Areas illustrates the concept, as applied to a range of forest and wetland areas in Bangladesh.

### Priority Areas

Landuse priorities are best dealt with on the following regional basis as discussed and presented in the following report sections:

- Sundarbans
- Newly Accreting Coastal Lands
- Chittagong
- Cox's Bazaar
- Chittagong Hill Tracts
- Sylhet
- Sal Forest

Table 7 - Summary for Proposed Multiple Use Management Areas

Name of Area	Core Zone (ha)	Buffer Zone (ha)	Multiple Use Zone (ha)	Total
Sundarbans (surrounding area)	203,000	377,000	(1,499,100)(-)	580,000 (2,079,100)
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				
Sal Forest in North Region	32,496	15,000	56,320	103,816
				15,000
<b>Total</b>	<b>400,478 +</b>	<b>502,377 +</b>	<b>327,310 + (1,499,100)(-)</b>	<b>1,377,704 (2,876,807)</b>

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

(-) indicates the area surrounding the Sundarbans which would be part of integrated management, but not within the existing Reserved Forest

## SUNDARBANS

### General

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 (see Figure 4).

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.



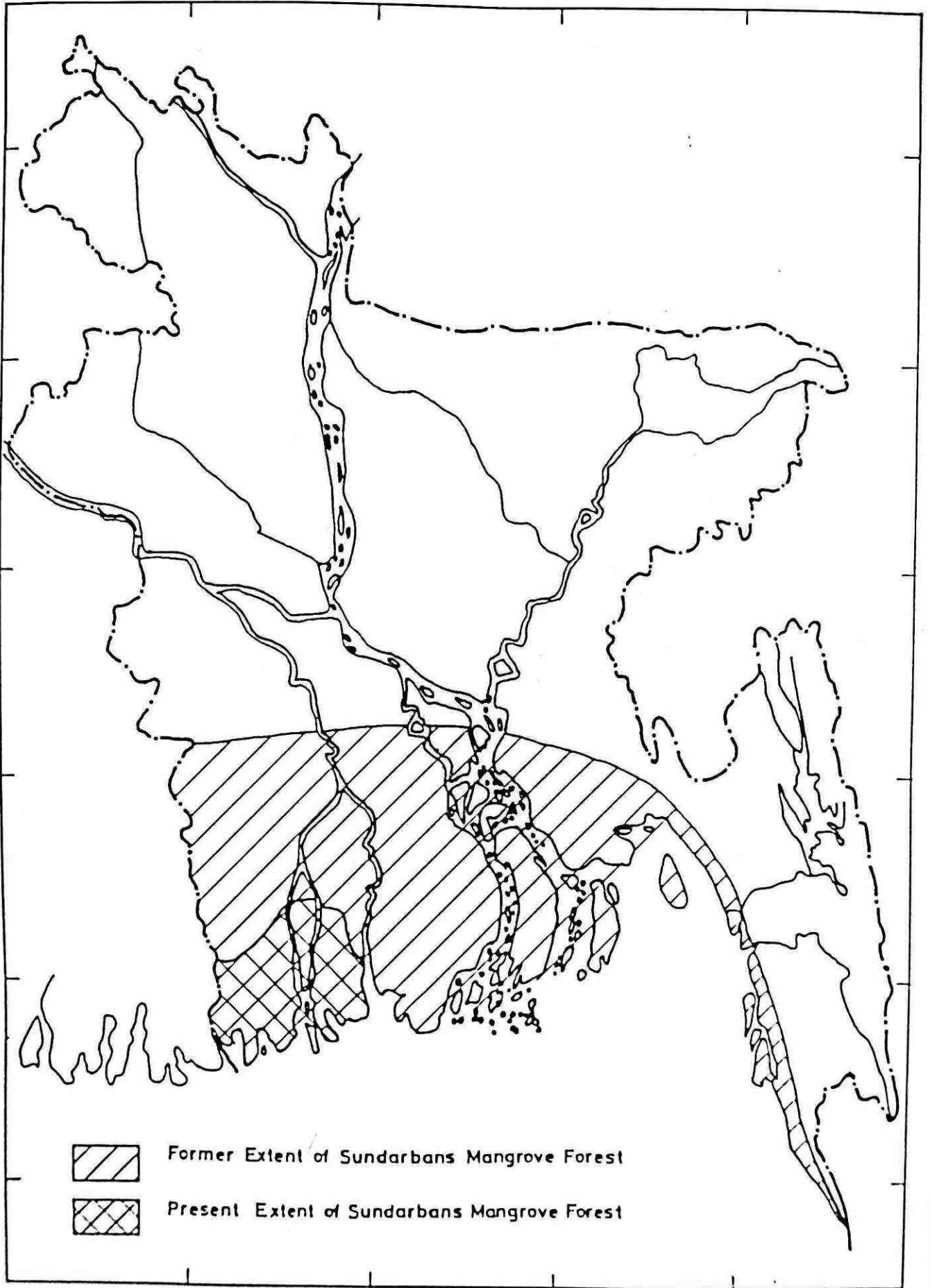


Figure 4 - Extent of Sundarbans Mangrove Forest: Past and Present

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.

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.

Wood and non wood products from the Sundarbans Reserved Forest has 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 8.

Table 8 - Sundarbans Forest Products

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

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.

### **Setting Priorities in Landuse Conflicts**

Thus, it is imperative that the remnants of Sundarbans Mangrove Forest be preserved, and managed in a way which will ensure the preservation of the natural and human environment and the conservation of biodiversity.

ESCAP (1987, Coastal Environmental Management Plan for Bangladesh) has noted:

"Because of population pressure on land, the ecology of the Sundarbans may already be in a dynamic disequilibrium where the successive vortices spiral downwards to the vanishing of the largest forest land in the country".

However, 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."

It would be irresponsible to let this happen because of political expediency, which should not take precedence over the sound socioeconomic and environmental planning of the forest resources of the country.

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.

### **Industrial Raw Material**

The Sundarbans Reserved Forest has been the main source of raw materials for two large industries: the Khulna Newsprint Mill and the Khulna Hardwood Mill. It also provides round wood for sawmills in the adjoining districts of Khulna, Barisal, and Patuakhali.

## 1. 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.

To provide raw materials for the mill, KNM was given a lease for 273,304 ha of forest in the Sundarbans. In 1969, the match wood felling Block I of 59,729 ha was added to the KNM lease. This was done to ensure better utilization of the Gewa wood. In 1977, the Forest Department created a game sanctuary and deleted 23,713 ha from the leased area leaving KNM a total of 309,320 ha of leased land. In 1990, Blocks 7 and 8 were added to the lease.

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.

Under the circumstances, a decision has to be made as to the future of the Khulna Newsprint 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 may 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. This is totally undesirable.

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.

At present low yields (9.2 m<sup>3</sup>/ha/A) in the Kaptai-Bandarban plantation, 14,472 ha of plantations would be necessary to provide for the total requirements of KNM (133,140 m<sup>3</sup>/A) on an 11 year rotation. However, with proper maintenance, these plantations should be able to produce at least 15 m<sup>3</sup>/ha/A. The mill would then require only 8,876 ha on an 11 year rotation.

Under Forestry Project II, approximately 23,000 ha of industrial plantations were established, and under the Forest Resources Management Project (Forestry III) an additional 27,000 ha will be planted. The estimated mean annual increment would be 25 m<sup>3</sup>/ha, 18 m<sup>3</sup>/ha, and 9 m<sup>3</sup>/ha for industrial plantations managed under 12, 18 and 40 years rotation, respectively. If these yields can be standardized, then only 3,330 ha of short rotation plantations would be needed to provide the wood necessary for a mill with the capacity of the Khulna Newsprint Mill. Since industrial plantations are already being established under Forestry Project II and Forest Resources Management Project, it may be possible to use 3,330 ha of these plantations for supplying pulpwood for newsprint production.

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.

However, 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 need 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.

One positive environmental benefit of closing the mill would be to free the Sundarbans for sustainable management, with the major emphasis on the conservation of biodiversity. The Government is already committed to the preservation and conservation of ecological diversity and biodiversity. The Sundarbans has been designated a special site under the RAMSAR convention.

Under such a system of management, buffer zones could be scientifically managed for the production of fuelwood, poles, and non wood products needed by residents of the Khulna District. This may be more socially beneficial than providing pulpwood for a sick public sector industry.

The closing of the mill in Khulna would help reduce the industrial pollution in waterways which flow through the Sundarbans Reserved Forest, by reducing motorized traffic on the waterways and tanker traffic on the main rivers. This would help preserve the natural environment in the Sundarbans Reserved Forest.

There are already reports of increased heavy metal concentrations in the water of the Sundarbans, and these can be traced to Mongla Port and Khulna industries (probably not KNM). These heavy metals may enter the food chain, and accumulate in fish and shrimp which are eaten by people, causing serious health problems. If the levels increase past a safe limit, the Government may be forced to ban the catching and consumption of fish from these waters. This would create considerable social and economic hardship for fishermen and their families, and to fish consumers in Bangladesh.

Energy studies of Bangladesh show that the West Zone of Bangladesh is energy deficit. It is therefore unwise to locate industries which are heavy users of energy in the form of fuel and

biomass raw materials in this zone. The Khulna Newsprint Mill requires imported oil for fuel and huge quantities of pulpwood (biomass) for its raw materials, and should not be located in this energy deficit zone. Instead, such industries should be located in the East Zone of the country where domestic natural gas is available for fuel and pulpwood plantations can be developed for the biomass raw material. This is good landuse planning for industries. The wood from the Sundarbans Reserved Forest could then be used as fuelwood, and other wood products, to help alleviate the energy and wood supply deficiency in the area.

## 2. 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 m<sup>3</sup> (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. According to the Harvesting Report, KHBM is receiving a lot of rotten wood, which is severely affecting quality and yield. The extraction operations are managed by the Forest Department with no quality control allowed by KHBM personnel. Consequently, the contractors take full advantage of the situation by including anything which will hold together. Royalty payments and contractor payments are based on a gross end area measurement of stacked wood with no allowances made for voids or rot. Thus, in this type of wood, the mill is paying about 40-50% too much. 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. The Harvesting Report goes on to recommend that the Forest Department should not be in charge of harvesting operations, and such operations should be left to the companies so that they can exercise some quality control over the contractors.

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 reduction of stocks of sundri is mainly due to:

- Rates of removal exceeding the allowable rates.
- High level of removal of immature stems in the 5-15 cm dbh classes, resulting in decline of standing volume.
- The incidence of top-dying appears to be increasing throughout the forest area, perhaps related to increasing salinity.

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.

### 3. 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.

#### Other Wood and Non Wood Products

The Sundarbans Reserved Forest is an important source of wood and non wood products for domestic use, cottage industries, and small rural industries.

##### 1. 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 demand for fuelwood far exceeds the supply. Thus, the demand for fuelwood from the Sundarbans will increase in the future as the population expands. However, the management of the Sundarbans Reserved Forest based on principles of sustained yield management will require a reduction in the annual extraction rate of wood products for all types of uses, including fuelwood.

Any decrease in supplies of fuelwood from the Sundarbans will put added pressure on the homestead forests for providing fuelwood, and also on agriculture lands for agricultural residues and dung which could be put to use as fertilizer and fodder. This will have a negative impact on the energy balance of this already deficit region.

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.

The closing of the Khulna Newsprint Mill and the Khulna Hard Board Mill would increase the land base within the Sundarbans available for fuelwood and timber species.

The Khulna Newsprint Mill is losing money and is therefore a sick public sector industry. In contrast, the fuelwood operations are highly profitable. As noted in the table in section 1. above, far more revenue comes from fuelwood and timber than from pulpwood (gewa).

## 2. 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 benefit from having some breeding areas set aside within core areas of nature reserves.

## 3. 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, suggesting that overfishing is occurring either within the Sundarbans or in the adjacent waters of the Bay of Bengal. 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.



The Task Force for Environment and Development (1991) recognized this critical situation, and went so far as to recommend Fish Parks to ensure protection for fisheries resources. This could be done in each of the blocks making up the Sundarbans Reserved Forest, and combined with the system for conserving ecological diversity and biodiversity of other flora and fauna.

#### 4. 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.

#### 5. Ecological Diversity

The best way to protect the biodiversity of wildlife in the Sundarbans Reserved Forest is to preserve the ecological diversity of the area. This means preserving the various habitats where the flora and fauna occur.

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.

Experiments are being carried out to determine which non mangrove species are best suited for these sites. Once the results of these experiments are known, it may be desirable to plant mixed plantations of some of the more suitable species. Preference should be given to native species, whenever feasible. If species are carefully selected, it may be possible to develop some of these mixed plantations into relatively natural dryland forests, into which associated native plant and animals can be introduced. This would contribute to the biodiversity of the Forest Reserve, and may be useful for protecting dryland species as well as mangrove species. The selective logging of selected timber trees could contribute to a sustainable supply of timber from the Sundarbans.

At present, overexploitation is adversely affecting the natural ecology of the Sundarbans Mangrove Forest. A 20-year cutting cycle causes changes in age class distribution within the forest, by changing mature forests into immature forest, which are never allowed to mature. This in turn causes changes in forest structure and species composition, by disrupting natural ecological processes and plant successions. This may have a long term impact on the flora and fauna of the reserve. Under such circumstances, it is difficult to carry out landuse planning and forest management for preservation and conservation.

Thus, more protected core areas are needed which will allow selected associations and forest types to reach maturity and overmaturity, in order to restore ecological balance to the ecosystem. This would provide habitats and breeding areas for a wider range of flora and fauna. In the managed buffer zones, silvicultural activities will be designed in such a way as to extend the habitats and breeding grounds of some of the more important species.

Thus, the integrated management of the Sundarbans under core zones and buffer zones would provide facilitate the conservation of populations and stocks of important species by protecting their breeding and reproduction areas, and would also allow for the continued production of wood and non wood products under sustained yield management.

### 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.

In the past, it was difficult for matchwood industries to get raw materials from the Sundarbans because preference was given to the Khulna Newsprint Mill. Thus, potential jobs were lost.

The Sundarbans Reserved Forest would continue to produce valuable timber, but at lower and more sustainable yields. This timber could be used by efficient sawmills to produce a range of wood products. Present sawmills are highly inefficient, and wastage is very high. Efficient sawmilling could nearly double the amount of wood recovered per unit volume of round wood.

### Recommended Sustainable Landuse Strategy

As noted in previous sections, every aspect of the Sundarbans ecosystem is in decline. The stocking of major economic trees is declining, the availability of non wood products is declining, and the populations of most wildlife species, including mammals, birds, reptiles, amphibians, crustaceans, fish, microorganisms, etc. are declining. It is abundantly clear from this that principles of sustainable development are not being applied to the management of this valuable national resource.

If the present management system continues, the Sundarbans is likely to be completely depleted, and irreparably damaged. This was predicted by Chaffey et. al. (1985) and ESCAP (1987). The solution seems to be the management of the whole Sundarbans for the conservation of resources, with limited harvesting of wood and non wood products based on principles of sustained yields.

It is recommended that landuse planning for the Sundarbans Mangrove Forest be based on the "Core-Buffer-Multiple Use Zone" strategy, widely adopted in many countries for nature and wildlife conservation. This strategy has been used with success in India, a country with development problems and constraints not unlike Bangladesh. In India, this concept was found to be the only promising approach to alleviate pressure on core areas, while ensuring local people a continued supply of essential resources.

The Bangladesh Task Force for Environment and Development (1991) also recommended this "Core-Buffer-Multiple Use Zone Strategy" for conservation in Bangladesh.

In this strategy, a number of inviolate core areas are identified for the conservation and preservation of biodiversity through the protection of the natural ecosystem. The core areas are surrounded by protective buffers. The core and buffer areas are in turn surrounded by a multiple use zone.

In the case of the Sundarbans, the multiple use zone is the area outside of the Sundarbans Reserved Forest, which was formerly part of the Sundarbans Mangrove Forest before being cleared for agriculture and shrimp cultivation. To facilitate the integrated management of the three zones, it is recommended that the three zones be designated as a single Multiple Use Management Area.

The Multiple Use Management Area would include the Sundarbans Reserved Forest and the five Districts which surround it.

Table 9 - Summary of Zones in the Sundarbans Multiple Use Management Area

Zone	Area in ha	% of Total
Core Zone	203,000 ha	13.5%
Buffer Zone	377,000 ha	25.2%
Multiple Use Zone	919,100 ha	61.3%
Total	1,499,100 ha	100.0%

Figure 5 shows the relationship between the multiple use zone and the other zones.

### Core Zone

As noted above, the Sundarbans is not a homogeneous area, but a complex and dynamic ecosystem which is constantly changing over space and time along a number of environmental gradients. Thus, in order to maintain the integrity of this complex ecosystem, it is necessary to locate core areas along the main environmental gradients.

Since some of the environmental gradients have more or less east-west and north-south orientation, it is proposed that core areas be located in all three ecological zones (based on salinity). Within each ecological zone, it is important to protect area representing mangroves of the inner fringe, the middle mangroves, and the seaward mangroves.

In order to give the spatial distribution necessary to include representatives of all the forest/vegetation types in core areas of a Nature Reserve for the Sundarbans, it is recommended that a core area be located in each of the nine blocks identified by Forestal (1960) and Chaffey et. al. (1985). This appears appropriate since the demarcation of the blocks was intended to reflect broad differences in forest type.

To be effective, core areas should represent a minimum of 30%-40% of each block. The rest of the block would be managed as a buffer with exploitation of wood and non wood products being carried out under licence or permit, as it is under the present system.

The continued use of forest blocks as the main management unit would facilitate the management of buffer zones around core areas for the production of wood and non products. It would also allow for continuity in management, and the use of existing staff and infrastructure for the management of these buffer zones.

A large core is necessary to protect representative samples of a range of ecosystems. It is also necessary to protect breeding populations of mammals, birds, reptiles, amphibians, crustaceans, fish, molluscs, etc.

The protected core areas would provide a protected breeding ground and nursery area for a range of important animal species, including fish and shrimp. Thus, the core areas would be an important part of an integrated strategy aimed at replenishing depleted fish and shrimp stocks, and this would provide the basis for sustainable management of the important fishery which depends on breeding and nursery grounds in the Sundarbans. Critical habitats for these species must be protected.

Some sections of the western part of the Sundarbans adjacent to the Indian border would benefit from being designated as a large core area within the National Park. Consideration should be given to including the present Wildlife Sanctuaries in Sundarbans South and Sundarbans East in this core area. This could be done by putting all of Block 8 in the core area, as well as compartments 43 and 44 from Block 6. Also, in order to make the core area more easily accessible to tourists, both local and international, compartments 48 and 49 of Block 7 could also be included. This would make easy access possible through Koikhali, once the road has been extended and upgraded to this point. An information centre at this access point would do much to educate the public and promote the aims of the National Park and the Sundarbans as a whole.

It is estimated that the core area would include 203,000 ha or 13.5% of the overall Multiple Use Management area.

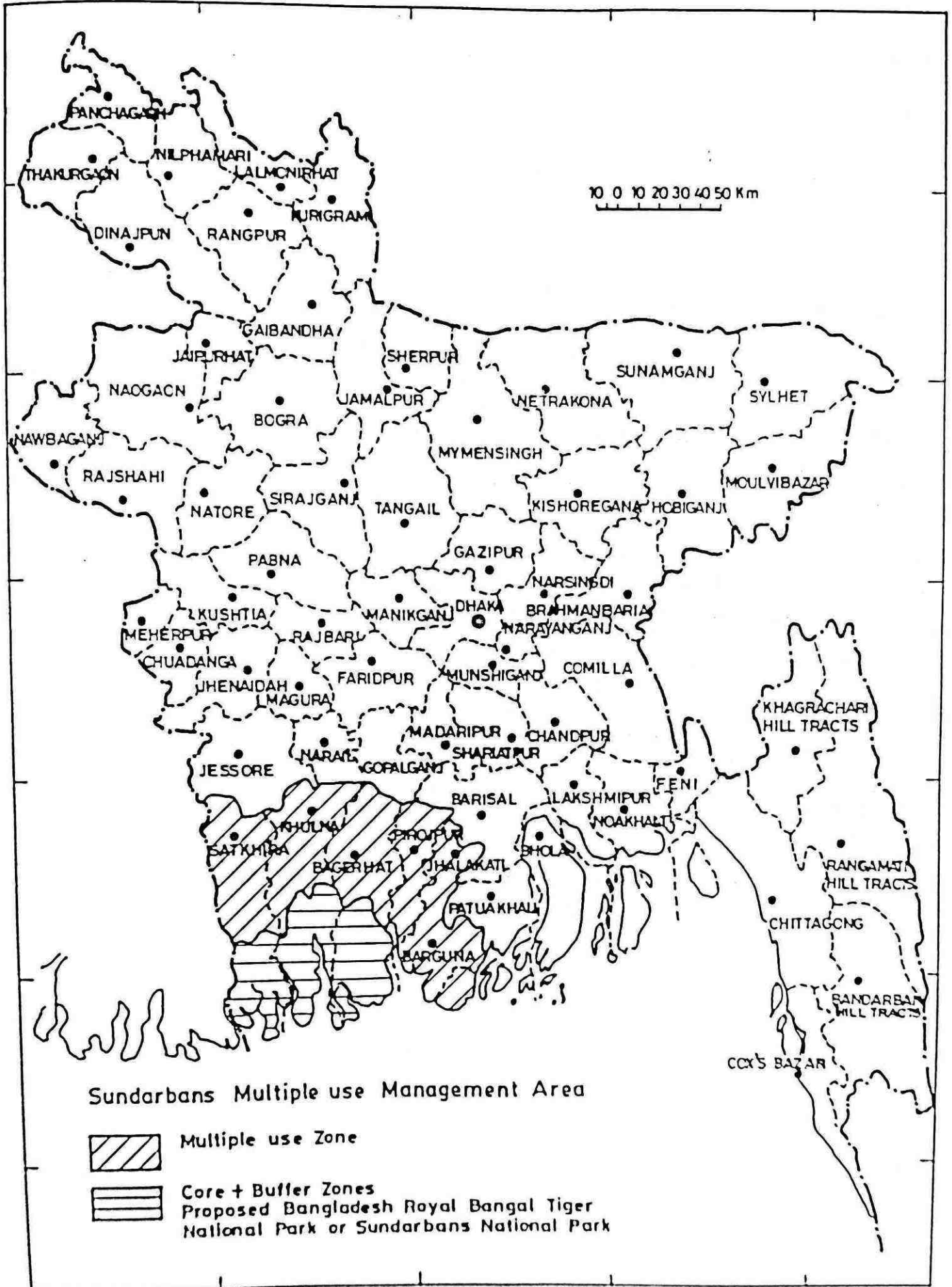


Figure 5 - Sundarbans Multiple Use Management Areas

## Buffer Zone

The areas designated as buffer zone would represent 60-70% of each forestry block. These buffer zones would be managed in such a way as to insure the integrity of the protected cores.

The buffer zone would also be managed for sustained production of wood and non wood products. This would be done by applying principles of sustained yield management. In this way, the buffers would not be depleted through over extraction. Extraction would be controlled by a permit system, not unlike the system presently being used by the Forest Department.

As noted previously, there are limits on the various products which can be produced in the Sundarbans Reserved Forest on a sustained basis. Thus, choices will have to be made as to the allocation of resources. In order to maximize social and environmental benefits from the Sundarbans Reserved Forest, it is recommended that priority be given to products (domestic fuelwood, small house poles, thatching materials, etc.) which benefit poor people more directly. The use of Sundarbans for supplying raw materials for large industries should be discontinued. This is already in line with present Forest Department instructions, that KNM will not receive gewa pulpwood from the Sundarbans Reserved Forest after 1993.

However, at present, the harvesting of these other wood and non wood products is dominated by a number of wealthy people, who use poor labourers to do the collection and extraction of the products, or who rent their equipment for a large share of the benefits. Thus, the main benefits of the present management system goes to these relatively wealthy individuals, and not to the mass of labourers. In order to maximize social benefits, there may be advantages in supporting individual labourers or groups of labourers with credit for purchase of their own boats and equipment and with appropriate training. NGOs could be encouraged to take part in this activity, since they have considerable experience in this type of activity. Some of the larger national NGOs also have enough power and influence to support these labourers to resist potential pressure from the business people who presently control activities in the area.

It should be noted that past management has failed to recognize the important role of women in the gathering and processing of products from the Sundarbans, and the issue of permits has been biased in favour of men and has discriminated against women. It is therefore important that this be rectified, and that women are given at least equal recognition in the issue of permits. Since families tend to work as economic units, the policy should be to give permits in the name of the women. This would give her and her children a measure of financial security in case of divorce or widowhood. Groups should be composed of both men and women (mainly families and single mothers), and group permits should also be biased towards women members. This may also have economic advantages since women are often interested in the processing of products into secondary goods. This would result in value added. This could be encouraged through training and credit.

In order to better service these women participants, it is important that the NGOs and Government Agencies involved in programmes associated with buffer zone management and utilization have significant numbers of women staff. These women staff should be in key decision-making positions, as well as being extension staff.

The aim should be to encourage permanent groups. The advantage of permanent groups is that the group members have a long term interest in the resource, and should support activities aimed at preserving the resource, or even increasing the resource. The renewal of permits or licences could be made dependent on the permit holder carrying out specified activities aimed at preserving or increasing the resource base. For example:

- Golpatta collectors could be required to plant golpatta in suitable area where they are absent or understocked.
- Fuelwood collectors could be required to leave some branches and stems on the forest floor to encourage regeneration by trapping seeds.
- Timber extractors could be required to plant and maintain seedlings of valuable timber species in their designated area.
- Honey collectors could be required to maintain the habitats of bees, and be involved in the planting of some of the better fodder species at selected locations to increase fodder.

These long term permit holders would be involved in the management of their permit areas, and would work together with the professionals managing the overall Reserve for the sustainable management of the resources within the buffer zones.

It is important to base the selection of individuals and groups on sound information. It is therefore recommended that a detailed socioeconomic survey be carried out of the present users of the Sundarbans Reserved Forest. This should include an inventory of present users (labourers as well as permit holders). NGOs could be involved in this major piece of work. Some funds are scheduled under the 'Integrated Development of the Sundarbans Forest' Project for socioeconomic studies. Perhaps these funds could be used for this survey.

As noted by Berkmuller and Mukherjee (1989), people's participation in the management of parks and sanctuaries is not new, and has been successful in a number of countries.

A number of lessons have emerged from these participatory efforts. For example, participation by the local people requires absolute transparency of project organization and a maximum of democratic participation at the grass root level so that project aims cannot be easily subverted and benefits actually reach those who are most dependent on protected area resources. For participation to work, people need to organize themselves and accept responsibility as well as benefits. This takes time and much patience on the part of the protected area manager who may fear the complications arising from increased awareness.

Managers are needed who believe that cooperation with the local people can work and who, either themselves or through extension agents, encourage local articulation of needs and ideas as basis for projects. Local people should eventually be trusted with the responsibility of joint buffer zone management. Agreements between the local people and the park authority may prove more effective if participation is painstakingly nurtured in the beginning until a broad consensus has been reached about the terms of an agreement and people's role in it. Common to these successful approaches are the sharing of responsibility, power and revenue. These are indicators of true participation which should become a more regular feature in protected area management.

It is estimated that the buffer zones would include 377,000 ha, or 25.2%, of the overall Multiple Use Management Area.

### **Multiple Use Zone**

The mangrove forest within the Sundarbans Reserved Forest are strongly influenced by processes which have their origin outside the boundary of the reserved forest. This is especially the case in terms of freshwater flows.

The Sundarbans receive large volumes of fresh water from inland rivers from the north, and saline water from tidal incursions from the sea. The relative contribution from the two sources of water are not constant throughout the year. The bulk of the fresh water reaches the forest in the monsoon season from June to September. During the dry season, freshwater flow decreases

progressively, resulting in a prolonged saline influence which persists until the freshwater flow increases again. The stability of the mangrove forest ecosystem is dependent on these seasonal changes.

Freshwater flows of the main river were apparently much higher in the past. The decline in freshwater flows can be attributed to a number of reasons, including changes in landuse upstream. More and more water is being diverted for irrigated agriculture and for landuse activities such as fish and shrimp culture.

At present, only the Baleshwari and Passur rivers and their distributaries have direct connections to the Ganges and thus to an uninterrupted source of fresh water. The Sibsra River and all the other rivers to the west receive fresh water only from localized catchments lying between the Ganges and the northern edge of the forest. These rivers are therefore more susceptible to dry season reduction in stream flow and tidal intrusion of salt water.

This is impacting negatively on the Sundarbans where there has been a decrease in freshwater inflows, and consequent increased salinity. The top-dying of sundri is often attributed to these changes in salinity.

If the Sundarbans is to be maintained as a relatively stable ecosystem, some balance must be maintained in terms of freshwater inflows. This can only be achieved with the cooperation of upstream water users. This requires integrating the long term management of the Sundarbans with the long term management of the area as a whole.

For this reason, the "core-buffer-multiple use zone strategy" for the Sundarbans has been extended to include the surrounding area, as a multiple use zone. It is recommended that the multiple use area surrounding the Sundarbans Reserved Forest or National Park be identified as a special area for ecodevelopment (SAED), and that an integrated development programme be developed for the area based on sound environmental management practices. This integrated development programme could be taken on as a pilot project to be funded by some donor agency. In India, such a project was submitted to UNDP/FAO.

There are many important landuse issues, and environmental problems which need to be addressed in the multiple use zone. Many of these landuse issues are related to increasing salinity, and its management through appropriate patterns of landuse. This shared concern for increased salinity and freshwater inflows should provide the basis for the integrated management of the multiple use zone outside the Sundarbans with the core and buffer zones within the Sundarbans. The zones are already socially and economically integrated. For example, the shrimp fingerlings used for stocking the shrimp ponds in the multiple use zone come from the Sundarbans. Building materials and fuelwood for the multiple use zone also come from the Sundarbans. Many people living in the multiple use zone find employment from the Sundarbans, through the harvesting of wood and non wood products, and through fishing. Thus, an integrated approach to the management of the Sundarbans and the surrounding area is necessary for environmental, social and economic reasons.

It is estimated that the multiple use zone would include 919,000 ha, or 61.3%, of the overall Multiple Use Management Area.

#### **Designation and Management**

As noted above, it is recommended that the Sundarbans Reserved Forest and the five Districts Use Management Area would be one planning subunit within an overall Coastal Management Plan



for Bangladesh. It more or less corresponds to the Western Region in the Coastal Environmental Management Plan for Bangladesh prepared by ESCAP (1987).

The remnants of the great Sundarbans Mangrove Forest should be viewed as an international, as well as a national heritage site, and be protected accordingly. It is recommended that the Sundarbans be proposed as a World Heritage Site. It is also recommended that the present Sundarbans Reserved Forest be designated as a National Park (perhaps the Bangladesh Royal Bengal Tiger National Park).

It is important that the whole Reserved Forest be designated as a single unit in order to facilitate its management. It would also make future management of the reserve as a business enterprise feasible, since revenues from the management of the buffer zones could finance the conservation aspects of the National Park. These conservation aspects would be focus on the core areas.

In order to provide continuity in management, it is important that some of the best and most experienced Forest Department staff who are familiar with the present permit system be transferred to the National Park management system.

It would be necessary to supplement these staff with trained specialist in National Park Management for overall park management, specialist in ecology and wildlife management to manage conservation activities in the core and buffer zones, and specialists in extension and participatory forestry to manage participatory forestry activities in the buffer zones.

Some funding and staff support for conservation activities in the Sundarbans will be provided under the Forest Resources Management Project. This could be used to support the development the National Park and its staff.

However, it is important for the sustainable management of the National Park to have an ongoing source of revenues. It is therefore recommended that funds which result from the issuing of permits and royalties be used for the scientific management of the overall reserve (core areas and buffers).

The management of the National Park should aim at the sustainable supply of wood and non wood products from the buffer zones for social benefits, and the conservation of the reserve for ecological diversity and biodiversity, and should not been seen as an area for generating revenues for the government.

Since the Sundarbans are an internationally important area, efforts should be made to have international conservation organizations support some of the conservation activities, by providing expertise and funds.

The government would benefit from reduced expenditures on projects for meeting the shortfall in biomass fuels and alternate building materials for people in the West Zone. There is also likely to be benefits from increased tourism and value added to products produced from materials coming from the Reserve.

Socioeconomic benefits resulting from giving the poor people involved in the extraction process a greater share of the profits would benefit the government's overall development efforts directed at equity and poverty alleviation.

Research and inventories to be funded under the 'Integrated Development of the Sundarbans Forest' and 'Forest Resource Management Project' should help provide information which will assist the development of a sustainable landuse plan for the Sundarbans Forest Reserve. It is recommended that the focus of these two Projects be on the sustainable use of the buffer zones in the Sundarbans for wood and non wood products for domestic use and cottage industries, and

the sustainable management of core areas for the preservation of ecological diversity and biodiversity.

However, as noted above, it is imperative that this management plan includes the multiple use zone which is located outside the Reserve, as well as the core and buffer zones within the Managed Nature Reserve and National Park.

The development and implementation of this management would involve the Agriculture Department, Fisheries Department, Livestock Department, Port Authority, and the tourist agency Parjatan, as well as the new institutions for participatory forestry and conservation which will be active within the Managed Nature Reserve and National Park.

### **Impact on National Landuse**

For the conservation of ecological diversity and biodiversity, it has been recommended that all countries should have at least 12% of its land area in protected areas for conservation. Since this percentage is hard to achieve in Bangladesh, the government presently has a target of 5%.

The Sundarbans Reserved Forest represents one of the few opportunities which Bangladesh has to contribute to national and global environmental protection. Using the 'Core-Buffer-Multiple Use' as outline above, this can be done without disadvantaging the poor of the country. In the long run, under sustainable management, they are even likely to benefit through increased stocks of harvestable fish, shrimps, mollusc, etc. and increase resources for fuelwood and inexpensive building materials. The present proposal would designate the whole of the Sundarbans Forest Reserve as a National Park. Since the total area of Bangladesh is approximately 14.4 million ha of which 12.46 million ha are land surface and 0.94 million ha are rivers and other inland water bodies, the Sundarbans Reserved Forest represents 4% of the total area of Bangladesh. Thus, designating the Sundarbans Reserved Forest as National Park would put 4% of the area of Bangladesh under a protection classification. This is a meaningful first step to having at least 5% of the country in protected areas for conservation.

The area available for industrial forestry would decrease, but because of the low annual increments in mangrove forest, the shortfall can easily be made up for by the intensive management of industrial plantations in the Chittagong area. As noted previously, 3325 ha of intensively managed short rotation plantations would probably provide the present fuelwood requirements of the Khulna Newsprint Mill.

The area available for participatory forest management would greatly increase with all the buffer zones in the Nature Reserve under sustained yield management for wood and non wood products. Since priority would be given to low income people, the socioeconomic benefits would increase.

### **Integrating the Sundarbans into a National Coastal Management Plan**

As noted above, the Sundarbans Mangrove Forest is an open ecosystem which cannot be managed in isolation from the surrounding area. For this reason, the core-buffer-multiple use zone strategy recommended for the landuse planning of the Sundarbans includes the surrounding area as the multiple use zone. Only the core and buffer zones are within the boundaries of the National Park.

This is an important step towards developing an integrated approach to coastal management, as recommended by ESCAP (1987) in their Coastal Environmental Management Plan for Bangladesh. Such an approach is necessary for social and economic reasons, as well as environmental reasons, and the sustainable development of the coastal areas is dependent on an integrated approach.

ESCAP (1987) stresses the need for sustainable development in the coastal zone:

"Over and over again it is emphasized that development which destroys the resource base, whether that base be mangrove forests, fisheries, drainage channels or newly accreted lands, is not development at all. The future of the people of Bangladesh demands planning with a view to sustainability, not rapacious maximization of short term gains enjoyed by only a few."

In order to facilitate sustainable development in the coastal zone, an environmentally sound and integrated approach for landuse planning and resource management has been recommended for the Sundarbans, which is a key breeding area and nursery grounds for many marine animals, including fish and shrimp. This integrated approach is extended to other coastal areas in following sections on Coastal Afforestation, the Chokoria Sundarbans, and Other Coastal Areas.

## NEWLY ACCRETING COASTAL LANDS

### General

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.

The objectives of coastal afforestation have since been expanded to include:

- creation of a shelter belt to protect human life and property in low-lying coastal areas from cyclones and tidal surge;
- 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; and
- create an environment for wildlife, fishes and other estuarine and marine fauna.

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.

All newly accreted lands or char lands are the property of the Government. At present, their allocation and disposition are the responsibility of the Ministry of Land Administration and Land Reform (MLALR).

In April 1976, the Government, recognizing the role of mangroves in stabilizing newly formed lands, decided to transfer management of 497,975 ha of newly formed chars in the four Coastal Divisions to the Forest Department for afforestation purposes. The land was to be managed by the Forest Department for 10 years after which they will be returned to the Ministry of Lands. This decision was contained in the memorandum of the MLALR dated 10-8-1976 and published in the Bangladesh Gazette.

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.

This recommendation is partially supported in the project preparation report for the Environmental Component of Bangladesh Forestry III Project. Their recommendations included:

- a. "All coastal areas, both existing lands and future accreted lands should be classified into one of the following categories:
  - protected areas (for coastal protection, fisheries protection, threatened species, etc.)
  - intensive use zone, for sustainable yield of natural resources;
  - traditional resource utilization zone;
  - eco-tourism zone."
- b. "Land tenure of the important afforested areas should be secured by the Forest Department, and the leasing out of newly accreted land and afforested land should be terminated."
- c. "Restrictions should be imposed on livestock grazing and the collection of fodder on the low-lying chars which are causing rapid habitat degradation."

The Landuse Consultant strongly supports these recommendations.

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*, *Albizia procera*, *Acacia nilotica*, *Samanea saman*, and *Leucaena* spp. (Ipil ipil).

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

- a. a shelter belt to protect human life and property in low-lying coastal areas from cyclones and tidal surge;
- b. a cover to accelerate the process of siltation and the stabilization of newly accreted soils;
- c. production of wood for fuel, timber, and other uses;
- d. generation of employment in coastal areas; and
- e. an environment for wildlife, fishes and other estuarine and marine fauna.

### **Landuse on Islands Adjacent to Coastal Afforestation Plantations**

There are many areas of new accretions which have already been settled for agriculture. In spite of the shelter belt provided by mangrove plantations, the people living in these open agricultural areas are exposed to the risks associated with cyclones and tidal bores. It is only a matter of time before many thousands of these poor farmers will be killed by such natural disasters.

The situation is made even more tragic by the fact that many of these poor people are not land-owners but only sharecroppers for better off landlords who live on the mainland in comfort and relative safety.

Cyclone shelters will help in some cases, but are not a final solution. Alternate patterns of landuse must be given careful consideration. Wherever possible, people should be discouraged from living permanently in these open disaster-prone areas. Putting newly accreted lands in reserved forests would be one way of achieving this, and reducing future disasters and loss of life and property.

In areas which have already been handed over for agriculture, other options should be explored.

For example, 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. It was noted that many economic tree species were growing in homestead on some of the island. Some of these could be more extensively planted, and managed as plantations. Some of the commonly occurring species are coconut, betelnut, date palm, guava, lemon, mango, *Acacia nilotica*, *Albizia procera*, *Dalbergia sissoo*, *Samanea saman*, etc.

If properly managed, these tree crops would probably be more profitable than the present combination of rice and fallow used for pasture.

### **People's Participation in Management of Resources**

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. This system condemns the poor local people and their children to a life of poverty, by institutionalizing poverty. Local resources which could be used locally for poverty alleviation are taken by better-off outsiders.

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 hogla areas on Char Zahiruddin in the Bhola Division can be used to illustrate the concept. A good stand of hogla occurs on this char. Near the stand, poor landless families were given .1 ha of land by the Government. These poor families have built their small hut out of hogla, and the women weave hogla into mats, baskets, and other handicraft. In order to get hogla for their needs, the people must travel a considerable distance to the local market and buy hogla at a relatively high price from merchants. The merchants in turn buy their supplies from the contractor who have won the bid for harvesting the hogla on Char Zahiruddin. Thus, poor local families are forced to buy a local resource at a high price from middlemen and merchants. As a result, the handicrafts made from the hogla and sold to other poor local people are also relatively expensive because of profits made by contractors and middlemen.

From a poverty alleviation focus (the Government's stated priority), it would be beneficial to have long term permits granted to groups of poor local families for the management and utilization of this local resource. The same groups could use the hogla for making handicrafts. This would benefit group members through value added. The groups could also get involved in the marketing of their products at local markets. In this way, the local poor would gain more income, and the poor customers would benefit from a lower priced product, since profits associated with contractors and middlemen would be eliminated.

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. They could encourage the development of groups for the extraction of raw materials under permit, and also the processing of some of these raw materials into secondary products, resulting in value added.

NGOs have credit programmes which could be used by groups to finance their activities. They also have training packages 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.

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. Poor families tend to work as an economic unit, and there would be advantages in issuing the permits in the name of the woman. This would give the woman and her children a measure of financial security in case of divorce or widowhood. As noted above, this may also have economic benefits, since women are often involved in the processing of products into secondary goods, resulting in value added.

Again, in order to better service these women participants, it is important that the NGOs and Government Agencies involved in programmes associated with the group programmes have significant numbers of women staff. Women staff should be in decision-making positions, as well as being extension workers and trainers.

The aim would be to encourage permanent groups. It is more likely that permanent groups would support activities aimed at preserving the resource, or even increasing the resource. Also, the renewal of the permit could be made dependent on the permit holder carrying out specified activities aimed at preserving or increasing the resource base. For example, permit holders

involved in the extraction of hogla may be required to assist with the establishment of hogla in blanks within the plantation area.

These long term permit holders would be involved in the management of their permit area, and would work together with the professional resource managers for the sustainable management of the resources.

## 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 10 - 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
<b>Total</b>	<b>83,365 ha</b>	<b>15,717 ha</b>	<b>99,084</b>	<b>100.0</b>

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 11 summarizes present landuse within these Wildlife Sanctuaries, based on 1985 inventory.

Table 11 - 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 12 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 12 - 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
<b>Total</b>	<b>83,365</b>	<b>100.0</b>	<b>83,365</b>	<b>100.0</b>

**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), *Albizia procera* (koroï) 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 caribaea*, 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* 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 be 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 caribaea*, *Samanea saman*, *Albizia procera* and *Eucalyptus camaldulensis* will be the species to be used. *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., *Albizia 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 suggest 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 13 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 m<sup>3</sup>/ha/A, which is much less than 30-40 m<sup>3</sup>/ha/A given in the table. Also, actual yield from *Tectona grandis* plantations in the Chittagong Hill Tracts was calculated at about 2 m<sup>3</sup>/ha/A rather than the 4.8 m<sup>3</sup>/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 13 - Potential Yield of Some Plantation Species

Production	Species	MAI m <sup>3</sup> /ha/A	Rotation in Years	Number of Thinnings
High MAI greater than 20 m <sup>3</sup> /ha/A	<del>Lalbagia</del> <i>Paraserianthes falcateria</i> (Melocanna)	30-40	12-15	2
Good MAI 7-10 m <sup>3</sup> /ha/A	<i>Dipterocarpus</i> spp. (Garjan)	10.5	45	4
	<i>Gmelina arborea</i> (Gamar)	9.0	15	2
	<i>Sonneratia apetala</i> (Keora)	7.0	15	2
	<i>Avicennia</i> spp. (Baen)	7.5	15	2
Moderate MAI 5-7 m <sup>3</sup> /ha/A	<i>Artocarpus chaplasha</i> (Chapalish)	6.1	45	4
	<i>Alstonia scholaris</i> (Chatian)	5.5	50	4
	<i>Syzygium grande</i> (Dhakijam)	5.4	45	4
Poor mai less than 5 m <sup>3</sup> /ha/A	<i>Tectona grandis</i> (Teak)	4.8	45	4
	Teak/dhakijam/garjan mixed	4.9	45	4
	<i>Shorea robusta</i> (Sal)	4.8	45	3
	<i>Lagerstroemia speciosa</i> (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 and 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.



## COX'S BAZAAR FOREST DIVISION

### General

The forests of the Cox's Bazar Forest Division are uniquely located at the very southern tip of Bangladesh. As a result, they have their own special characteristics. This makes them very important for the preservation of biodiversity through preservation of the unique ecosystems found in the area. The forests also have considerable potential for tourism, especially when the unique forest ecosystems are integrated with the world's longest beach, wildlife habitats, and the coral island of St. Martin's. The demand for pristine areas for recreation and relaxation will increase in the future with increasing populations. Thus, the potential for tourism, both domestic and international, will increase in the future. This could become an important industry in the Cox's Bazar district. The process is already underway, and many domestic and international tourists already visit the area each year. In anticipation of the future demands of tourists and the tourism industry, it is very important that the remaining areas of natural forest in the Cox's Bazar Forest Division be preserve. This would also have benefits in terms of biodiversity of both flora and fauna. Though proper landuse planning and integrated forest management, the preservation of natural forests can be accomplished, while still producing a sustainable supply of wood and non wood products to help meet present and future needs.

Choudhury (1991b) gave the following summary of landuse.

Table 14 - Summary of Forest Landuse Cox's Bazar Forest Division

Landuse Type	Area in ha	% of Total
Natural Forests (Types 1,2,3)	24,438 ha	32.2%
Brush with Scattered Trees (Type 4)	2,754 ha	3.6%
Plantations	24,210 ha	31.9%
Denuded	6,501 ha	8.6%
Encroached	17,910 ha	23.7%
Total	75,813 ha	100.0%

Approximately, 12,602 ha of natural forest is in protected areas such as game sanctuaries. In addition, there are 60 ha in the unofficial Dulahazara Deer Breeding Centre. Approximately, 5,000 of land in the Chokoria Sundarbans is under shrimp cultivation or encroachment.

### Sustainable Landuse Strategy Recommendations

The basis for a sustainable landuse strategy for the forest lands of the Cox's Bazar Forest Division is the management of the forest lands as Multiple Use Management Areas under the IUCN classification system as described earlier for Chittagong Division.

Table 15 presents a sustainable landuse scenario for the forests of the Cox's Bazar Forest Division, based on the "core-buffer-multiple use zone strategy" for the management of natural resources within Multiple Use Management Areas.

Table 15 - Cox's Bazaar Sustainable Landuse Scenario Bazar Forest Division

Zone and Landuse Type	Area by Zone (ha)	% of Area	Area by Type (ha)	% of Area
<b>Core Zones</b>	<b>31,438</b>	<b>41.4</b>		
Natural forest			24,438	32.2
Natural vegetation with scattered trees			1,000	1.3
Old Plantations			6,000	7.9
<b>Buffer Zones</b>	<b>5,964</b>	<b>7.9</b>		
Natural Vegetation with scattered trees			1,754	2.3
Old plantations				
Multiple Use Zone			4,210	5.6
<b>F.D. Plantations</b>	<b>38,411</b>	<b>50.7</b>		
Participatory forestry areas			16,000	21.1
Others			20,911	27.6
			1,500	2.0
<b>Total</b>	<b>75,813</b>	<b>100.0</b>	<b>75,813</b>	<b>100.0</b>

### 1. 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 41.4% of the forest land, or 31,438 ha, would be designated as core zones.

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 Cox's Bazaar Forest 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 area designated as core area may presently be disturbed, or under old plantations. 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 forests designated as core areas 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 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 into plantations. They should instead be managed through enrichment planting and limited selection management system.

## 2. 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 7.9% of the forest land, or 5,964 ha, would be designated as buffer zone. The extraction of wood and non wood products could be controlled by a permit system.

## 3. 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 crops, in order to provide a relatively short term income for the participants. About 50.7% of the forest land, or 38,411 ha, would be designated as multiple use zone.

The landuse options, designation and management would be outlined for Chittagong Forest Division except for the size of area involved. 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. Participatory forestry activities would usefully include NGOs. Through their credit programmes and target group approach the rural poor (with necessary attention to the needs of women) would benefit

## 4. Designation and Management

To facilitate the management of the forest land using the "core-buffer-multiple use strategy", it is recommended that the present forest lands be designated as Multiple Use Management Areas under 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.

## 5. Impact on National Landuse

Using this strategy, approximately 75,813 ha would be brought into the national protection system. This represents 0.5% 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.

### Chokoria and Naf River Mangrove Forests

The Chokoria Sundarbans, which lies in the delta of the Matamuhuri River in the Cox's Bazar Division, was once part of a continuous mangrove forest which extended from West Bengal in India to the Chokoria area of southeast Bangladesh. The Sundarbans Mangrove Forest and the Chokoria Sundarbans were subsequently separated by the destruction of intervening mangrove forests, primarily due to land clearing for agriculture, grazing, salt production, and shrimp and fish ponds.

The Chokoria Sundarbans consists of tidal forests intersected by a system of channels and streams. In this forest, there are a large number of low lying islands which are mostly submerged at high tide, and the water remains brackish throughout the year. Salinity increases during the dry season.

Other mangrove forests are located along the Naf River. In the south, this river forms the international boundary between Bangladesh and Burma. The bank of the River Naf is muddy and contains a small strip of mangrove vegetation consisting of dispersed stems of *Excoecaria agallocha* and *Ceriops roxburghiana*. Jhaliardwip Island, near Teknaf, was previously covered by a beautiful keora (*Sonneratia apetala*) forest of over 300 ha, and was a habitat of the crab-eating monkeys. The mangrove forest has subsequently been cleared for the development of shrimp ponds. This development failed, and the island is now a wasteland.

#### 1. Changing Landuse in the Chokoria Sundarbans

The forest of the Chokoria Sundarbans was reserved in 1903 to provide protection to human settlements following damage caused by a cyclone in 1882. Of a total of 8500 ha, 7489.8 ha was declared as Reserved Forest and 1012.2 ha was declared as Protected Forest.

Suggestions made in the Working Plan of Cox's Bazaar Forest Division in 1968, including:

- closing the forest for 10 years to allow it to recover from over-exploitation.
- restrict grazing to reduce damage to regeneration.
- enrichment of the forest through artificially regenerated plantations.

It also recommended that no more permits be issued for converting more land to shrimp ponds, since 43.1% of the forest had already been converted to shrimp enclosure.

Management practices involve restricted exploitation based on minimum diameter limits of trees of different species and limited grazing. However, the quality of the forest deteriorated due to the illicit removal of timbers and other forest produces. Insufficient Forest Department staff, lack of cooperation from the local population, and the greed of the forest produce traders contributed to this process.

The depletion of the Chokoria Sundarbans mangroves accelerated in the late 1970's as a result of their conversion into shrimp cultivation ponds. In 1978, 2024.3 ha of forest land was handed over for shrimp ponds. In 1982, another 694 ha of reserved forest was given to the Directorate of Fisheries to implement the Asian Development Bank funded project for the development of

shrimp aquaculture. Thus, prior to 1986, 3,061 hectares had been allotted to private individuals for shrimp cultivation.

ESCAP (1987) also advised against the further development of shrimp ponds in the Chokoria Sundarbans as well as on Jhaliardwip Island in the Naf River.

In spite of these warnings and recommendations, the clearing of land for shrimp ponds continued unabated. This was confirmed by SPARRSO (1990). As observed in the Landsat TM data of 1988, the mangrove forest has been completely removed except for some patches on the banks. These remaining patches were measured as only 973 ha out of a total of 7500 ha of the original Reserved Forest. Thus, almost all the forest area is now under shrimp ponds.

Also, as noted above, Jhaliardwip Island was cleared for shrimp ponds, but the conversion was not successful. The island is now a wasteland.

In the cyclone of 1991, the tidal surge flooded the shrimp ponds and caused extensive damage and loss of production. Efforts are now underway to rehabilitate the shrimp ponds. However, it will some time before this area becomes fully productive.

The Chokoria Sundarbans was large enough to accommodate both shrimp farming and mangrove forests. A properly developed landuse plan would have preserved significant areas of mangrove forests in strategic locations for protecting the areas from the worst effects of cyclones and tidal surges. Under sustained management practices, the remaining mangrove forest could have provided a range of wood and non wood products for the local people. Intensive management of fewer enclosures using modern techniques would produce more shrimp as well.

There is little that can be done to remedy the present sad situation in the Chokoria Sundarbans. The area has been altered to such a point that it would be difficult, if not impossible, to convert the area back to mangrove forest. However, mangrove afforestation should continue on suitable areas on waterways adjacent to the Chokoria Sundarbans, and trials could be carried out to determine suitable species for planting on embankments and waste areas within the Chokoria Sundarbans. Care must be taken to avoid a repeat of this type of development in the future.

## 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<sup>2</sup>, 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* (chupalish).

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.

The main reserved forests in the Chittagong Hill Tracts are:

- Kassalong Reserved Forest
- Rankhiang Reserved Forest, including Thega Reserved Forest and Subalong Headwater Reserved Forest
- Sitapahar Reserved Forest, including Rampahar Reserved Forest
- Sangu Reserved Forest
- Matamuhuri Reserved Forest

### **Kassalong Reserved Forest**

The basis for a sustainable landuse strategy for the Kassalong Reserved Forest is the management of the reserved forest as a Multiple Use Management Area under the IUCN classification system described earlier for both Chittagong Forest Division and Cox's Bazaar.

For this to be effective, the ethnic problem in the Chittagong Hill Tracts must be resolved. Such a solution must be based on established principles of sustainable development and human rights. As noted in WCED (1987),

"Tribal and indigenous peoples will need special attention...Their traditional rights should be recognized and they should be given a decisive voice in formulating

policies about resource development in their areas...The starting point for a just and humane policy for such groups is the recognition and protection of their traditional rights to land and the other resources that sustain their way of life."

It is quite obvious that no fair and lasting solution can take place without local autonomy for the tribal people within their own area. Within this autonomous area, they must control local government and the allocation of resources, mainly land.

It is assumed that the present democratically elected government will have the courage and political will to seek a fair and just solution to the ethnic problems based on established principles of human rights. A military solution is not possible, and too expensive, both economically and socially. The funds now being spend on unproductive military and policing operations could be better spent elsewhere on development programmes for poverty alleviation and social justice.

Once the ethnic problem has been solved, the presently unproductive lands can be put to productive use through a programme of both traditional forestry and participatory forestry involving the tribal peoples.

Table 16 presents a sustainable landuse scenario for the Kassalong Reserved Forest, based on the "Core-Buffer-Multiple Use Strategy" for the management of natural resources.

Table 16 - Sustainable Landuse Scenario for Kassalong Reserved Forest

Zone and Landuse Type	Area by Zone	% of Area	Area by Type	% of Area
Core Zones	55,000	33.4		
Timber types			45,000	27.4
Mixed timber - bamboo			5,000	3.0
Mixed bamboo -timber			5,000	3.0
Buffer Zones	30,000	18.2		
Mixed timber-bamboo			5,000	3.0
Mixed bamboo-timber			15,000	9.1
Bamboo types			10,000	6.1
Multiple Use Zones	79,448	48.4		
F.D. plantation areas			20,000	12.2
Participatory forestry areas			53,571	32.6
Non productive areas			500	0.3
Water and swamps			5,377	3.3
Total	164,448	100.0	164,448	100.0

### Rankhiang Reserved Forest

In Table 17, the Forestal figure for plantations refers to established plantations plus the area of proposed plantations scheduled to be established up to 1965. The BGD/79/017 figure for

plantations represents the situation in 1981, while the clearings and logged areas of 1982-84 have been classified as recent clearings and logging areas under "Non forested areas".

The non forested areas include: brush and reeds (=NCC or non commercial cover), jhum, all clearings, logged and selectively logged areas, agriculture and settlements, natural regeneration or protection strips in between the plantation blocks.

De Milde et. al. (1985) made the following conclusions based on their inventory.

a. Since 1963, the productive forest land has decreased by approximately 35,700 ha. The following changes have occurred:

Timber types	- less	13,200 ha
Mixed timber-bamboo	- less	3,700 ha
Mixed bamboo-timber	- less	11,300 ha
Bamboo types	- less	<u>14,300 ha</u>
Total	- less	42,500 ha

The plantation areas have increased by about 6,800 ha. This is an average of 1,800 ha/year when considering the period 1963-83, but it is obvious that the average rates during the last 10 and 5 years must have been much higher than during the previous periods and we can safely estimate that the present one must be around 2,500 ha per year and, at that rate, the reserved forests of Rankhiang will have ceased to exist within another 10 years.

Various instances, including FAO, have predicted that by 1990-2000, many presently well-known areas of tropical forest will have disappeared. The reserved forest of Rankhiang can undoubtedly be included in the list.

The large-crowned high forest, a subtype of the timber types, now only covers an area of about 4,800 ha.

Table 17 - Changes in Landuse in Rankhiang Reserved Forest 1963 to 1983

Landuse	FORESTAL 1963		BGD/79/017 - 1983	
	Area (ha)	% of total	Area (ha)	% of total
Timber types	20,325 ha	26.3 %	7,116 ha	9.2 %
Mixed timber - bamboo	6,933 ha	9.0 %	3,228 ha	4.2 %
Mixed bamboo - timber	17,519 ha	22.7 %	6,194 ha	8.0 %
Bamboo types	27,907 ha	36.2 %	13,606 ha	17.7 %
Plantations	2,011 ha	2.6 %	8,873 ha	11.5 %
Non forested areas	372 ha	0.5 %	36,624 ha	47.5 %
Non productive areas	1,060 ha	1.4 %	486 ha	0.6 %
Water and swamps	977 ha	1.3 %	977 ha	1.3 %
Total	77,104 ha	100.0 %	77,104 ha	100.0

b. Shifting cultivation (Jhuming) is also here the main cause of the continuous regression of the high forest and bamboo types. Where, in 1963, Forestal classified only 4 ha as jhum, nearly



30,000 ha were affected somehow by jhuming in 1983 (jhum land, abandoned jhum land covered by brush, weeds, young bamboo, etc.). Hopefully, some of the abandoned jhum land, especially the future.

- c. In 1981, the official Forest Department figure for the total area of plantations in the Hill Tracts South Division was 16,200 ha. Besides Rankhiang, also the Reserved Forest of Sitapahar, is also part of that Division. 1,800 ha are assumed to have been planted in 82-83, bringing the total to 18,000 ha of which approximately 3,430 belong to Sitapahar. The plantations in Rankhiang should therefore have covered an area of approximately 14,570 ha. In reality, it was 8,870 or, assuming the 900 ha of cleared land have been planted, 9770 ha. This is still a discrepancy of 4,800 ha or 33% which is the average (deficit) figure for the whole of the plantation area in the Chittagong District and Chittagong Hill Tracts.

Table 18 presents a sustainable landuse scenario for the Rankhiang Reserved Forest, based on the "Core-Buffer-Multiple Use Strategy" for the management of natural resources.

Table 18 - Sustainable Landuse Scenario for Rankhiang Reserved Forest

Zone and Landuse Type	Area by Zone (ha)	% of Area	Area by Type (ha)	% of Area
Core Zones	12,000	15.6		
Timber types			7,000	9.1
Mixed timber - bamboo			3,000	3.9
Mixed bamboo -timber			2,000	2.6
Buffer Zones	17,000	22.0		
Mixed timber-bamboo			-	0.0
Mixed bamboo-timber			4,000	5.2
Bamboo types			13,000	16.7
Multiple Use Zones	48,104	62.4		
F.D. plantation areas			15,000	19.5
Participatory forestry areas			31,627	41.1
Non productive areas			500	0.6
Water and swamps			977	1.3
Total	77,104	100.0	77,104	100.0

### Sitapahar Reserved Forest

Table 19 gives the landuse for the reserve based on photo interpretation of 1984 aerial photographs (Choudhury, 1989).

Choudhury (1989) recommended that the block of natural forest overlooking the Karnafuli River should be preserved as soon as possible, since it is a good example of the forest which previously existed in the Chittagong Hill Tracts.

Table 19 - Landuse in Sitapahar Reserved Forest

Landuse	Area in ha	% of total
Natural Forest, large-crowned	283.5 ha	5.2 %
Natural Forest, small-crowned	373.0 ha	6.9 %
Brush with scattered high trees	309.0 ha	5.7 %
Plantations	3,726.5 ha	68.4 %
Agriculture, settlements, lake, clearings	750.5 ha	13.8 %
Total	5,444.5 ha	100 %

About 68.4%, or 3,726.5 ha, of this Reserved Forest has already been converted to plantation. Another, 13.8%, or 750.5 ha, is under agriculture, settlements, lake, and clearing. Only, 17.8%, or 965.5 ha, is under natural forest and brush. This limits the options available for alternate landuses. A recommendation landuse scenario is given in the following table for this reserved forest on the same basis described for other areas.

Table 20 gives a sustainable Landuse Scenario for Sitapahar Reserved Forest.

Table 20 - Sustainable Landuse Scenario for Sitapahar Reserved Forest

Zone and Landuse Type	Area by Zone (ha)	% of Area	Area by Type (ha)	% of Area
Protected Core Zone	656.5	12.1		
Natural Forest, large-crowned			283.5	5.2
Natural Forest, small-crowned			373.0	6.9
Buffer Zone	309.0	5.7		
Brush with scattered high trees			309.0	5.7
Multiple Use Zone	4,477.0	82.2		
Plantations			3,726.5	68.4
Agriculture, settlements, lake, clearings			750.5	13.8
Total	5,444.5	100.0	5,444.5	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 areas, and access would be restricted. About 12.1%, or 656.5 ha, of the reserved forest would be designed as protected core zone.

The core area should be as large as possible in order to protect the existing flora and fauna. The natural forests in the Sitapahar Reserved Forest are no longer connected with the other natural

forests in the other Reserved Forests. The forests now have a disjunct distribution. Therefore, the survival of the forest in the Sitapahar Reserved Forest depends on the maintenance of local seed sources, and breeding populations.

The multiple use zone would be intensively managed for the production of wood and non wood products. It is envisaged that the Forest Department plantations would be long rotation plantation managed on a 40+ year rotation for quality timber. About 82.2%, or 4,477.0 ha, of the reserved forest would be designated as multiple use zone.

### Sangu and Matamuhuri Reserved Forests

The Sangu and Matamuhuri Reserved Forests are situated in the southern part of the Bandarban District adjacent to the Burma border.

Table 21 gives a summary of landuse in the two reserved forests.

Table 21 - Landuse in the Sangu and Matamuhuri Reserved Forests

Landuse	1961		BGD/79/017 - 1984	
	Area in ha	% of Total	Area in ha	% of Total
High forest, medium-good density	7,100	9.5	8,700	11.7
High forest, poor density	18,450	24.8		
Low immature forest, poor density	14,530	22.7	47,840	64.2
Low forest medium-good density	2,380			
Bamboo	31,260	42.0		
Shifting cultivation	30	0.5	17,100	23.0
Grass land, agriculture, settlement	270	0.4	380	0.5
Water	480	0.6	480	0.6
<b>Total</b>	<b>74,500</b>	<b>100.0</b>	<b>74,500</b>	<b>100.0</b>

Table 22 presents a sustainable landuse scenario for the Sangu and Matamuhuri Reserved Forests, based on the "Core-Buffer-Multiple Use Strategy" for the management of natural resources.

Table 22 - Sustainable Landuse Scenario for Sangu and Matamuhuri Reserved Forests

Zone and Landuse Type	Area by Zone (ha)	% of Area	Area by Type (ha)	% of Area
Core Zones	16,000	20.8	16,000	20.8
High Forest + Disturbed High Forest				
Buffer Zones	25,104	32.6	25,104	32.6
Disturbed Forest + Bamboo				
Multiple Use Zones	36,000	46.6	15,000	19.5
F.D. plantation areas			20,000	25.9
Participatory forestry areas			500	0.6
Non productive areas			500	0.6
Water				
Total	77,104	100.0	77,104	100.0

### Reserved Forest Summary

Table 23 summarizes the land area of the main reserved forests in the Chittagong Hill Tracts by zone in "Core-Buffer-Multiple Use Strategy".

Table 23 - Summary For Main Reserved Forests in the Chittagong Hill Tracts Based on Zone in Core-Buffer-Multiple Use Strategy

Reserved Forest	Core Zone	Buffer Zone	Multiple Use Zone
Kassalong Reserved Forest	55,000.0 ha	30,000.0 ha	79,448.0 ha
Rankhiang Reserved Forest	12,000.0 ha	17,000.0 ha	48,104.0 ha
Sitapahar Reserved Forest	656.5 ha	309.0 ha	4,477.0 ha
Sangu and Matamuhuri Reserved Forest	26,000.0 ha	25,104.0 ha	36,000.0 ha
Total	93,656.5 ha	62,413.0 ha	168,029.0 ha
% of Reserved Forest Area	28.9%	19.3%	51.8%
% of Chittagong Hill Tracts	7.2%	4.8%	12.8%

Thus, a total of 93,656.8 ha (28.9%) of reserved forests would be designed as protected core, and would be preserved for protecting biodiversity. A further 63,412 ha (19.3%) would be designed as buffer zone, and be managed for biodiversity and the production of wood and non wood products on a sustained yield basis through a selection system, or rotating harvest. The remaining 168,029 ha (51.8%) would be designed as multiple use zone, and used for the intensive production of wood and non wood products, through F.D. plantations and participatory forestry.

At this point in time, it is not possible to accurately map the various zones. This will have to wait for a new detailed inventory and mapping of the reserved forest areas, accompanied by field checks. This will likely not happen until the ethnic problems have been settled by direct negotiations.

### Forest Department Plantations

These are plantations which are established and maintained by the Forest Department using contractors or paid labour.

Under the scenario for sustainable landuse of reserved forests in the Chittagong Hill Tracts, Forest Department plantations would be integrated into the multiple use zones. The area proposed for this purpose can be summarized as follows.

Kassalong Reserved Forest	20,000 ha
Rankhiang Reserved Forest	15,000 ha
Sitapahar Reserved Forest	3,726 ha
Sangu and Matamuhuri Reserved Forest	<u>15,000 ha</u>
Total	53,727 ha

The allocation is tentative, and is conditional on improvements being made in plantation establishment, maintenance, protection, harvesting, and utilization.

At present, Forest Department plantations are generally very poor, and as a result yields are very low. This can be attributed to a number of factors, including:

- failure to properly match species to site
- poor seed (not genetically selected or improved)
- poor nursery techniques
- poor establishment techniques
- inadequate weeding of young plantations
- inadequate thinning of plantations over time
- inadequate protection from fire and pilfering
- poor harvesting techniques
- poor and ineffective utilization

A poorly established and poorly maintained plantation with low yield may be much worse than no plantation at all, since it prevents the land from being used for a more productive use.

Various inventories and studies have provided estimates of yield from the present plantations. The estimates are generally in the order of 2-3 m<sup>3</sup>/ha/A for long rotation plantations. This may be lower than yields from the natural forests managed using selection logging and natural regeneration.

If this is true, the present rationale for converting natural forests to plantations is invalid. It would be more economic and productive over the long term to manage the forests by a system of selection logging and natural regeneration, perhaps with some enrichment planting in areas where the stocking of merchantable natural species is low.

Managing the natural forest by a selection system and natural regeneration would also be better for the maintenance of biodiversity of flora and fauna.

Thus, before any area is considered for plantation establishment, it is recommended that a regeneration survey be carried out on the site to determine stocking of natural forest species. If some natural regeneration of merchantable species is present, then enrichment planting with

native species should be considered. Plantations should only be considered on the more degraded and depleted sites away from seed sources for native species.

Plantations require considerable expertise and ongoing financial inputs. When such expertise is lacking or the funds cannot be guaranteed, plantations should not be planted. At present, the Forest Department lacks adequate staff and financial resources to maintain existing plantations. Thus, under present conditions, the planting of more Forest Department plantations in the Chittagong Hill Tracts cannot be justified.

If this continues to be the case, then the land allocated for Forest Department plantations could be included in either the buffer zone, or in the area set aside for participatory forestry.

Since it is presently impossible to carry out any effective forest management in the Chittagong Hill Tracts because of the ethnic conflicts in the area, it is recommended that the government make a concerted effort to solve the problems through direct negotiations with the tribal peoples.

It is recommended that no new Forest Department plantations be established in the unclassified state forests of the Chittagong Hill Tracts until the ethnic problem has been solved, and tribal land rights settled through negotiations. This does not preclude participatory forestry activities involving tribal people on land which they presently use for shifting cultivation. ✓

## SYLHET

### General

The Greater Sylhet District has a total area of about 13,674 km<sup>2</sup> or 1,367,400 ha. Within this area, the Forest Department administers 748.2 km<sup>2</sup>, or about 5.5%. The status of the forests are as follows.

Reserved Forest	46,965 ha
Proposed Reserved Forest	23,189 ha
Acquired Forest	<u>4,669 ha</u>
Total	74,823 ha

The Proposed Reserved Forest was previously Unclassified State Forest which is now under the process of reservation.

For forest management and administration, the forest areas have been divided into 48 beats under 9 Ranges. Within this area, there are 1,095 ha of the Rema-Kalenga Wildlife Sanctuary. It is also proposed to set aside approximately 442 ha of the older plantation area of Lawachara Beat as a National Park. For convenience, the division can be divided into Northern Sylhet and Southern Sylhet.

The forest areas in the northern part of the Sylhet Division have not been inventoried. In these areas, landuse has been summarized as follows:

Manageable Timber Area (Plantations)	1,169 ha (1990)
Available Denuded Area	3,516 ha
Manageable Murta Area	563 ha
Reed Area Leased Out to SPPM	10,239 ha
Encroached Area	14,062 ha
Reed and Marshy Area	<u>1,183 ha</u>
Total	30,732 ha

Most of the forest reserves with manageable forests occur in the southeast part of the Division. Drigo et. al. (1988) carried out a forest Inventory of Forest Resources of Southern Sylhet Forest Division. The area of the Reserved and Acquired Forests by landuse classes is summarized below.

Table 24 - Sylhet Landuse Summary

Code	Landuse Class	Hectares	%	Contents
P	Plantations	11,502	28.6	Includes all species and age classes
PSR	Short Rotation	2,538		
PLR	Long Rotation	8,963		
CNF	Closed Canopy forest	3,337	8.3	Both large and small crown forests
ONF	Open Canopy forest	2,832	7.1	Various combinations of scattered trees and brush
B	Bamboo	13,933	34.6	Pure bamboo area and bamboo with scattered trees
D	Denuded	3,407	8.5	Various combination of brush and grass, with/ without scattered trees. Also failed plantations.
O	Other	1,109	2.8	FRI research Station seed orchard, rubber nurseries, oil palm.
A	Agriculture	4,052	10.1	Agriculture, villages, forest villages, tea gardens.
		40,172	100.0	

Between the time this inventory was completed and 1990 when the Forest Management Plan for the Sylhet Forest Division was completed, there were some minor changes in landuse. The area of natural forest was reduced from 6169 ha to 5,378 ha, while the area under plantations increased from 11,502 ha to 12,634 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

### 1. Background

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.

## 2. Raw Material Supply

At present, the mill depends on a number of sources for meeting its raw material needs. For example, the projected raw material supply programme for 1991-92 was:

<u>Fibre Type</u>	<u>Source</u>	<u>Air Dry Tonnes (ADT)</u>
Bamboo	a) Reserve Forests	
	b) Tea Estate & Auctions	10,000
	c) Village Bamboo	10,000
	d) Station Purchases	7,000
	Subtotal	<u>7,000</u>
		34,000
Wood	a) Reserve Forest Plantations	
	b) Private	6,000
	Subtotal	<u>5,000</u>
		11,000
Reeds	a) Licenced Reed Lands	
Total		<u>1,000</u>
		46,000



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. 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 cannot maintain the present level of extraction, and stocks are rapidly declining. This threatens 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 both the local demands of the people and the demands of the industries. Since industries have alternative 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.

The Forest Department recognized this fact in the mid-1970s, and began planting *Melocanna* (*Paraserianthus falcataria*) in order to supply SPPM with pulpwood. According to the Harvesting Report, 2308 ha of *Melocanna* plantations have been planted to date, and there are plans to plant an additional 2972 ha in the future, for a total of 5280 ha of pulpwood plantations. According to the Forest Department, this area of pulpwood plantations should be able to provide the total requirements of the mill. For this to be true, the plantations would have to yield 30 m<sup>3</sup>/ha/A. However, existing plantations are poorly maintained and are infested by mistletoe (*Loranthus* spp.). This has resulted in poor growth, and low yield.

According to Drigo et. al. (1988), the mean annual increment (MAI) for *Melocanna* plantations is 11 m<sup>3</sup>/ha/A. They suggest that improved management could increase this to some 15 m<sup>3</sup>/ha/A. At the low MAI of 11 m<sup>3</sup>/ha/A, approximately 14,545 ha of *Melocanna* plantation would be required, while at the improved management rate, 10,666 ha would be required. This is much more than the 5280 ha planned by the Forest Department. Thus, there is likely to be a serious shortfall.

Since there are presently only 2308 ha of *Melocanna* plantations, an additional 12,237 ha of plantations would be needed at present low MAI. As noted in the Introduction above, this amount of vacant land is not available in Forest Reserves and Acquired Forests. Denuded areas in the southern part of the Sylhet Division only amount to 3,407 ha, while in the northern part there are 3,516 ha of denuded land.

The Harvesting Report suggested that shortfalls in raw materials might come from:

- Improved management of existing bamboo areas in Forest Reserves by FD and SPPM to increase exploitable volumes in a sustainable manner. Royalty would be adjusted to produce maximum revenue for the FD while providing an acceptable raw material cost for SPPM. Shared investment in infrastructure would increase the area accessible for extraction and thus increase available supplies of raw materials.

In the future, it is highly likely that there will be a large demand for bamboo from these forests for uses other than the production of pulp. The future priority should be to provide

bamboo for use by rural poor. Thus, extraction of bamboo from these forest reserve for pulp should only be considered a temporary activity. However, it is likely that considerable quantities of top end cutting and waste materials will continue to be available for the making of pulp, if they can be extracted in an economic manner.

- Inventory of lands held by tea estates which are not planted with tea to determine the availability of under-utilized lands which could be used for growing pulpwood for SPPM. Regulations could be introduced which would make it compulsory for tea estates to put such areas to productive use. To encourage this process, tea companies interested in growing bamboo or pulpwood plantations could make agreements with SPPM guaranteeing them a market for pulpwood produced, and the tea companies would get permission from the Government to retain their leased land. These plantations would serve as a future land bank for the expansion of the tea gardens.

Since the long term plan is to eventually bring this area under tea gardens, this source cannot be relied on as a sustainable long term source of pulpwood for the mill. It is only a temporary source of pulpwood.

According to reports from ODA and tea estate managers, unused lands represents less than 10% of the total tea lands. This land is usually part of the planned planting programme.

- Investigate the possibility of importing bamboo from Assam, India on a long term basis.

This may be economically viable, but supplies could not be assured from this source, because of potential changes in the political and economic situation.

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.

According to the Harvesting Report, surplus plantations already exist in the Kaptai area, and land is available for the expansion of plantations, if necessary for producing more pulpwood. Also, under Forestry II, 23,000 ha of industrial plantation were established, and another 26,880 ha are planned to be established under the Forest Resources Management Project. Most of the plantation are located in the southeast Bangladesh, between Feni and Teknaf.

Thus, it would appear appropriate to move pulp production to an area with excess supplies of raw materials. This would release local supplies for alternate uses. This would probably prove more economic over the long term. Priority in allocating local supplies should go to supplying the basic needs of the local people, especially the poor.

It is disturbing to note that there are plans to build a new paper mill in Bangladesh, based on pulp from SPPM and imported pulp. In light of inadequate supplies of raw materials from government forests in the Sylhet area and the depletion of homestead forests, planning a new mill based on pulp from SPPM appears ill-advised, and potentially damaging to the rural poor who depend on the homestead forests for their basic needs.

It is therefore strongly recommended that the Government look for sustainable supplies of raw materials from Government forests in the Sylhet and Chittagong area and eliminate the mills dependence on private homestead forests.

### **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.

### **Recommended Landuse Strategy**

#### **1. Core-Buffer-Multiple Use**

As with the management of the Sundarbans Mangrove Forest, it is recommended that a "Core-Buffer-Multiple Use Zone Strategy" be used when allocating landuse in this area.

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: that is, field crops, tree crops, livestock raising, fisheries, forest plantations, and protected areas for biodiversity.

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 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. The land should not be given over to the public until such an integrated plan has been developed.

#### **2. Reserved and Acquired Forests**

**Increasing Yields** - The present management system for the Forest Reserves and Acquired Forests calls for the clearcutting of natural forests and their conversion to plantations. In this way, it is hoped that the annual yield of wood products can be increased from the forest lands.

This strategy or management system must be seriously questioned, especially in light of the Forest Department's past failures in properly managing existing plantations. For example, as noted above, short rotation plantations are presently yielding only 11 m<sup>3</sup>/ha/A, which is far below

potential. With intensive management (better planting and maintenance), these plantation should be able to yield greater annual increments. The same is true for long rotation plantations. Drigo et. al. (1988) give the increment of long rotation plantations as 3.1 m<sup>3</sup>/ha/A, which is also well below potential.

The Forest Resource Management Project is proposing to establish an additional 27,000 ha of industrial plantations. According to their estimates, the estimated mean annual increment would be 25 m<sup>3</sup>/ha, 18 m<sup>3</sup>/ha, and 9 m<sup>3</sup>/ha for industrial plantations managed under 12, 18 and 40 years rotation, respectively. This suggests that under better management existing short rotation plantation should be able to produce over twice the volume per unit area per annum, while long rotation plantations should be able to produce nearly 3 times as much volume per unit area. However, for these estimates to be realistic, there must be major improvements in plantation management.

The Forest Management Plan for the Sylhet Forest Division (1990) puts the figure for plantations at 12,634 ha. The fact that these plantations are giving very low yields, strongly indicates that the Forest Department does not have sufficient human and material resources to manage the existing plantations properly. Expanding the area under plantations would therefore likely only aggravate the existing poor situation, and result in even lower yields per unit area.

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. Under present low yields, the conversion of all the remaining natural forests to plantations could not even double the present total yields from the Forest Reserves and Acquired Forests.

The Forest Management Plan for the Sylhet Forest Division (1990) puts the figure for natural forests (closed canopy natural forest and open canopy natural forest) at 5378 ha, as compared to 12,634 ha of existing plantations. Thus, the conversion of all the remaining natural forest would only increase the area under plantations by 43%. Total yield would also only increase by 43%, which is less than the 100% to 150% increases possible with intensive management of the existing area of plantations.

There are also 3,219 ha 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. It was noted that the forest floor of many teak plantations were completely bare of vegetation and/or mulch, and soil erosion was a serious problem. This should not be allowed to continue, and new management practices are needed for teak, or the present areas of teak should be converted to other species which allow the development of ground cover and undergrowth, for soil conservation.

**Conserving Ecological and Biological Diversity** - The Natural Forests of the Sylhet Division are irreplaceable for preserving ecological diversity and biodiversity of natural forests in Bangladesh. These are remnants of the Tropical Wet Evergreen Forests and the Tropical Semi Evergreen Forests. If thy remnants are lost through conversion to plantations, they are lost forever, and their biodiversity will be lost along with them. These forest represents the natural heritage of Bangladesh, and are as priceless as any historical monument and cultural shrine. They should be viewed as such, and protected in the same manner from exploitative development and criminals (organized pilferers and poachers).

At present, the greatest threat comes from the Forest Department itself, and its management plan based on clearcutting and conversion of natural forests to plantations. Pilfering and poaching may reduce the economic value of the forest and disturbs the physical structure, but the forest retains much of the ecological diversity and the biodiversity. Clearcutting and conversion to plantations destroys much of the ecological diversity and the biodiversity, and its damage is much more permanent. According to the Forest Management Plan for the Sylhet Forest Division, 2802 ha of Natural Forest were converted to plantations in the period 1984-1990. The plan is to convert the remaining areas of natural forest to plantations, once the moratorium is lifted.

The clearcutting and conversion of natural forests is not the best way to increase the annual yield of wood from the Reserved Forest and Acquired Forest. Increasing yield through the intensive management of existing would probably give better results. This can be done without destroying the natural forest and its biodiversity. It is therefore strongly recommended that the remaining areas of natural forests 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.

**Recommendation Summary** - The following is a summary of the main recommendations for the forest lands of the Sylhet Forest Division. It serves to summarize the Multiple Use Management Area model referred to throughout the text. In the case of Sylhet Forest Division, the recommendations are that the:

- a. forest lands of the Sylhet Forest Division be designated as Multiple Use Management Areas under the IUCN classification system, and be managed according to the "core-buffer-multiple use zone strategy" for resource management.
- b. core zones be composed of natural vegetation types plus some of the more disturbed vegetation types which also contain a rich biodiversity.
- c. present management practice of clearcutting natural forest, burning and planting for plantations be stopped.
- d. buffer zones be established to protect these core areas. The buffer zones could be managed through enrichment planting and a limited selection system to maintain biodiversity within the buffer zones, and still produce products for the benefit of the local people.
- e. local people, both men and women, be involved in the management and utilization of these buffer zones.
- f. multiple use zones be used for intensively managed Forest Department plantations and participatory forestry areas. In some areas, this will be integrated with agriculture and fisheries activities.
- g. native species be used in Forest Department plantations whenever feasible.
- h. local people be given long term leases to land in the participatory forestry areas, in order to carry out participatory forestry activities. Priority should be given to those people who already occupy or utilize the land.

- i. women have fair and equal access to leases being provided for lands within the participatory forestry areas. Leases would go to family units, and should either be in the name of the woman or in the name of both the husband and wife.
- j. NGOs be involved in the participatory forestry programme for the participatory forestry areas.
- k. landuse in the participatory forestry areas be based on land suitability assessment, and the preference of the participants (lease holders).
- l. new plantations not be established on forest lands in the Sylhet Forest Division until integrated 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 landuse has been determined by a proper planning process.

### 3. Sylhet/Eastern Mymensingh Haor Basin

The Haor Basin of Sylhet and eastern Mymensingh comprises a vast alluvial plain with a mosaic of wetland habitats, including numerous rivers, streams and irrigation canals, large areas of seasonally flooded cultivated plains, and hundreds of shallow freshwater lakes and marshes (haors and beels). The basin is bounded to the north by the hill ranges of Meghalaya, to the south by the hills of Tripura and Mizoram, and to the east by the highlands of Manipur. The numerous rivers rising in these hills provide a abundant supply of water to the plains and cause extensive flooding during the monsoon season. The drainage is southwest via the Surma and Kalmi rivers into the Meghna River and the Bay of Bengal.

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.

**Present Landuse and Management** - 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. The following two examples illustrate this variability.

Aila Beel in Jamalganj Upazilla covers 160 ha. It is 60% privately owned, and 40% government owned. The surrounding areas are privately owned. Fishing takes place every third year. Rice is cultivated around the edges of the beel during the dry season. Trees, shrubs, herbs and grasses are collected for use as cattle fodder and fuel. The surrounding areas are under cultivation, mainly rice.

Hakaluki Haor, southeast of Sylhet town, covers an area of 20,400 ha, including 4,440 ha of beels. The wetland is owned by the government, and is under the control of the Additional Deputy Commissioner, Revenue. Fishing is the principal activity. Hakaluki Haor supports one of the largest inland fisheries in Bangladesh, and provides the government with considerable revenues. The large beels are fished once in every three years, while the smaller beels are fished once every year. Beels over 8 ha in extent are leased by the Additional Deputy Commissioner, while smaller beels up to 8 ha are leased by the Chairman of the Upazilla Parishad. During the dry season, the undulating fallow land between the beels are leased to local people for agriculture, and the margins of the beels are used for growing rice. Dry vegetation is collected for fuel. Each

winter, several herds of cattle are allowed to graze throughout the marshes. The surrounding area is under cultivation, with rice being the principal crop.

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 25 gives the area for the ten main wetland areas located in the Haor Basin of Sylhet and Eastern Mymensingh.

Table 25 - 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.

## SAL FORESTS AREA

### General

The Sal Forests in the Central Region of Bangladesh 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 land use 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 land use issues which are restricting the effective development of this important land resource. Most of these land use 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 26 summarizes the land controlled by the Forest Department in these districts.

Table 26 - 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 27.

Table 27 - 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	27,672
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* (chaplash), and *Lagerstroemia parviflora* (jarul).

Degraded land means young sal coppice, cut over repeatedly by local people, mostly of 1-2 years age. This area is divided into three categories:

- better stocked areas, with stocking of more than 2,000 stumps per ha. It is estimated that about 20% of the area shown as degraded will be better stocked areas.
- poorly stocked areas, containing 800-2,000 stumps per ha. It is estimated that about 30% of the area shown as degraded land will be under this category.
- blanks. Part of the blank area is under encroachment and the area is grazed freely.

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:

- 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.
- No comprehensive survey was ever carried out to determine the exact location of encroachment areas.
- 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.
- 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.
- 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.

- The local demand could not be met with the slow growing and degenerated sal species. This resulted in excessive and repeated short interval felling of coppice shoots. The increase in population aggravated the situation.
- Felling operations have been suspended in the sal forest since 1972, in order to protect the remaining sal forest and facilitate its natural regeneration. However, illegal felling has continued.
- The Government's campaign for the "grow more food" programme has led to the temporary cultivation of blanks in the forest, and encroachment has increased as a result.
- In the absence of firm legal status of forest land, proper map showing the legal boundary of the forest, and an over all deterioration of the law and order situation in the forest, Forest Department personnel have become despondent.
- The situation is such that conventional forest management practices are unable to protect the forest. Participatory forestry is required.

### 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.

The image of the Forest Department has also been tarnished by the failure to keep official obligations associated with peoples' participation in plantation establishment under the community forestry project, and follow-on activities. The general feeling at the community level is that the Forest Department, and its staff, cannot be trusted.

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.

Under the existing situation, it is impossible for the Forest Department to carry on a successful plantation programme, and protect the plantations which are being established.

As noted by Ghani et. al. (1990):

"protection of the forest tract is not possible through singlehanded activities of the Forest Department. Unless the active cooperation of the villagers surrounding the forest tracts is secured, it is a matter of time that the forest will disappear..."

We have shown that the only viable technique for managing the areas is participatory forestry with the cooperation of the villagers."

### Recommended Landuse Strategy

#### 1. Allocate Land to Achieve Sustainable Development

Table 28 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 28 - 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	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%
<b>Total</b>	<b>103,816</b>	<b>100.0%</b>	<b>103,816</b>	<b>100.0%</b>

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

## 2. 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 10,000 ha be set aside for Forest Department Plantations. 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.

## 4. Established Rubber Plantations

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. 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.

**APPENDIX 1**  
**ABBREVIATIONS, TERMS AND CONVERSION FACTORS**

LANDUSE

APPENDIX 1  
ABBREVIATIONS, TERMS AND CONVERSION FACTORS

ABBREVIATIONS

ACCF	- Assistant Chief Conservatpr
ADAB	- Association of Development Agencies Bangladesh
ADT	- Airdry Metric Tonne
AWB	- Asian Wetland Bureau
BARC	- Bangladesh Association of Research Councils
BCIC	- Bangladesh Chemical Industries Corporation
BFD	- Bangladesh Forest Department
BFIDC	- Bangladesh Forest Industries Development Corporation
CAI	- Current annual increment
CCF	- Chief Conservator Forests
CF	- Conservator Forests
cft (H)	- Cubic feet hoppus (.785 x true cubic foot)
cft (T)	- Cubic foot true volume (1.27 x Hoppus cubic foot)
CHT	- Chittagong Hill Tracts
cm	- Centimetre
crore	- Ten million
DCCF	- Deputy Chief Conservator
DCF	- Deputy Conservator Forests
DFO	- Divisional Forest Officer
FAO	- Food and Agriculture Organization of the United Nations
FDTC	- Forest Development and Training Centre
ESCAP	- Economic and Social Commission for Asia and the Pacific
gm	- Gram
GR	- Game Reserve
GS	- Game Sanctuary
ha	- Hectare
ha	- Hectare
hp	- Flywheel horse power
hr	- Hour
kg	- Kilogram
KHM	- Khulna Hardboard Mill
km	- Kilometre
km <sup>2</sup>	- Square kilometre
KNM	- Khulna Newsprint Mill
KPM	- Karnafuli Paper Mill
kw	- Kilowatt
lakh	- One hundred thousand
LPC	- Lumber Production Complex (Kaptai)
m	- Metre
m <sup>3</sup> /ha/A	- Cubic metre per hectare per annum
m <sup>3</sup> /ha	- Cubic metre per hectare
m <sup>3</sup>	- Cubic metre
MAI	- Mean annual increment
MAI	- Mean Annual Increment
max	- Maximum
md	- Man day
MOEF	- Ministry of Environment and Forest
min	- Minimum
mm	- Millimetre
MM	- Million
NACOM	- Nature Conservation Movement
NEMAP	- National Environmental Management Action Plan
NGO	- Nongovernment organization
No.	- Number



NRS	- Natural Regeneration Strip
ODA	- Overseas Development Agency
POTHIKRIT	- Nongovernment Organization
POUSH	- Nongovernment Organization
RF	- Reserved Forest
RF	- Reserve Forest
SIDA	- Swedish International Development Agency
SPPM	- Sylhet Pulp and Paper Mill
St	- Saint
T	- Metric tonne
TEX	- Timber Extraction (Kaptai)
Tk	- Taka
UNCED	- UN Conference on Environment and Development

## TERMS

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.
amenity forestry	- Forestry for the purpose of recreation, pleasure, or general beautification of an area or a settlement.
dao	- Large hand-held work knife
dumb barge	- Barge requiring towing or pushing, a high-sided vessel used for water transportation and without propulsion means on board
mahal	- Contract block, wood or bamboo
mahaldar	- Wood Contractor
yarding	- Moving logs from stump site to roadside
Water bar	- Earthen berm installed across road ways to control water flow to prevent road erosion.
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. A broader discussion of the term follows in the chapter section on case studies.
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).

## CONVERSION FACTORS

US \$ 1	- 38.8
Tk	- US 0.0258
1 m <sup>3</sup>	- 27.7 cft Hoppus
1 cft(H)	- 1.2732 cubic feet true - cft(t)
1 cft(t)	- one cubic foot true solid volume
maund	- 37.33 kg
1 km	- 0.621 miles
1 ha	- 2.471 acres
1 litre	- 0.220 imperial gallons
ton	- 2,000 lbs
tonne	- 1,000 kilograms
teak	- 1,080 kg/m <sup>3</sup> , green weight
gamar	- 650 kg/m <sup>3</sup> , green weight
moluccana	- 450 kg/m <sup>3</sup> , green weight
1000 culms muli bamboo	- 1.8 ADT
1000 culms other bamboo	- 1.6 ADT
Raw ton	- 0.67 ADT

**APPENDIX 2**  
**TERMS OF REFERENCE**

LANDUSE

APPENDIX 2  
TERMS OF REFERENCE

Land Use Planner Terms of Reference are:

- a. Review the present patterns of forest land use on a country-wide basis.
- b. Identify the major forest land use issues. Give particular attention to the situation of landlessness in the country and its impact on encroachment.
- c. Examine policies and programs for future land use. Focus on lands sought for a variety of uses. Land use conflicts are common problems in such areas (eg. coastal lands suitable for shrimp cultivation, salt production, some forms of agriculture and/or afforestation).
- d. Quantify the amount of lands available for forestry in the long term, given the circumstances of encroachment.
- e. Assess the role of forestry in watershed management. Identify critically important watersheds needing urgent reforestation for protective purposes.
- f. Review the appropriateness, sustainability and impact of alternative land use systems developed through various programs and projects in Bangladesh.
- g. Identify forestry development projects for watershed management in high priority areas. Propose alternative techniques. Evaluate and compare the net benefits of the different techniques.
- h. Recommend appropriate land uses for the different types of land in Bangladesh. Give particular attention to areas identified as environmental concerns (See Item d, Environmental Planner).

**APPENDIX 3  
REFERENCES**

LANDUSE

APPENDIX 3  
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