Nishorgo Support Project

MANAGEMENT PLANS FOR TEKNAF GAME RESERVE

2006

LIST OF ABBREVIATIONS

ACF - Assistant Conservator of Forests
ACR - Annual Confidential Report
ADB - Asian Development Bank
AIG - Alternative Income Generation
BDR - Bangladesh Rifles
BFRI - Bangladesh Forest Research Institute
BGD - Bangladesh
cc - cubic centimeter
CCF - Chief Conservator of Forest
CEGIS - Centre for Environmental and Geographic Information Services
CF - Conservator of Forest
CIFOR - Centre for International Forestry Research
cm - centimeter
dbh - diameter at breast height
DCF - Deputy Conservator of Forest
DCCF - Deputy Chief Conservator of Forest
DFID - Department for International Development
DFO - Divisional Forest Officer
DR - Deputy Ranger
e.g. - for example
EIA - Environmental Impact Assessment
et al. - and others
etc. - etcetera
FAO - Food and Agriculture Organization
FD - Forest Department
FG - Forest Guard
Fr - Forester
FR - Forest Ranger
FRMP - Forest Resource Management Project
FSP - Forestry Sector Project
GIS - Geographic Information System
GoB - Government of Bangladesh
ha - hectare
HEED - Health Education and Economic Development
HSI - Habitat Suitability Index
i.e. - that is
IEC - Information, Education and Communication
IRG - International Resources Group
IUCN - International Union for Conservation of Nature and Natural Resources
km - kilometer
km2 - square kilometer
LDF - Landscape Development Fund
m - meter
m2 - square meter
MSc - Master of Science
NACOM - Nature and Conservation Movement
NGO - Non-Governmental Organisation
NIC - Nature Interpretation Centre
No. - Number
nos - numbers
NP - National Park
NSP - Nishorgo Support Project
NTFP - Non-Timber Forest Product
OIC - Officer in Charge
PA - Protected Area
PBSA - Participatory Benefit Sharing Agreement
PhD - Doctor of Philosophy
PP - Project Proforma
pp. - pages
PRA - Participatory Rural Appraisal
RF - Reserved Forest
RIMS - Resource Information Management System
RoW - Right of Way
RRA - Rapid Rural Appraisal
spp. - species (plural)
TA - Technical Assistance
Tk - Taka
TV - Television
UNDP - United Nations Development Programme
USAID - United States Agency for International Development
US$ - United States dollars
WC - Working Circle
WMNC - Wildlife Management and Nature Conservation
WNCC - Wildlife and Nature Conservation Circle
WS - Wildlife Sanctuary
WTO - World Tourism Organization

EXECUTIVE SUMMARY

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Teknaf Game Reserve (GR) is an intimate interspersion of human habitations and cultivation with traditional dependency on neighbouring forests for the livelihood. The Nishorgo Program of FD aims to protect and conserve the forests and biodiversity of the country's PAs by building gainful partnerships between the Forest Department (FD) and key stakeholders based on shared roles and responsibilities for biodiversity conservation and sustainable use. A basic principal of PA management is that every PA should have a management plan that guides the management of its resources, the uses of the area, and the development of facilities needed to support that management and use. This Plan is a five year management plan for the GR and will be implemented mainly by FD and the project staff of Nishorgo Support Project (NSP).

The present situation (description of the GR, biodiversity protection and management, human use and biotic interactions, natural resources use patterns, interface landscape, etc.) with a documentation of main findings and issues is assessed in Part I of the Plan. Based on the findings of Part I, the Part II of the Plan recommends strategic programs and priorities for future development and management of the Teknaf GR. The stakeholders consultations on the draft Plan were held with public representatives (e.g. chairman and members of Union Parishads), FD field staff, potential members of user groups and co-management councils/committees, village elites, leaders, journalists, NGOs, tribal leaders and forest villagers, saw mill owners, timber traders and mahaldars (forest contractors).
The Management Plan is based on a sustainable planning approach comprising, i) protection and conservation of all remaining natural forests and constituent biodiversity in the Game Reserve, ii) conversion of monocultures of exotic tree species into natural and man made regeneration of indigenous plant species by gradually opening the canopy, iii) development of co-management agreements (and linking Game Reserve conservation with benefit sharing arrangements) with key stakeholders to reduce ongoing habitat damage by helping them achieve sustainable livelihoods through participatory forest use and alternative income generation activities, and iv) provision of support to better administration and management of the Game Reserve including capacity development, infrastructure, training, and wider extension and communication.

Main objectives of the Plan are:

- To develop and implement a co-management approach that will ensure long-term protection and conservation of biodiversity within the GR, while permitting sustainable use in designated areas by local people as key stakeholders;
- To conserve the biodiversity of the GR by following a co-management approach based on building partnerships with key stakeholders and sharing benefits with local communities and key stakeholders;
- To develop existing elephant movement corridors;
- To maintain connectivity and implement elephant conservation programs
- To refine and strengthen the policy, operational, infrastructural and institutional capacity framework for PA management;
- To conserve and maintain viable wildlife population including endangered, threatened, endemic and rare species of plants and animals;
- To implement income generation activities for sustainable livelihood development of local stakeholders and enhance thier skills of local stakeholders;
- To restore, protect and develop degraded forest eco-systems; and
- To encourage eco-tourism in suitable areas and develop visitor facilities/amenities

Teknaf Game Reserve, as a part of Teknaf peninsula, is located in the country's far south-eastern corner, near to Myanmar border. It was established in 1983 over a reserved forest (RF) area of 11,610 ha covering 10 forest blocks in three Forest Ranges (Whykong, Silkhali and Teknaf) of Cox's Bazar (South) Forest Division. It is situated in Ukhia and Teknaf Upzilas of Cox's Bazar District, and lies in between the Naf river on eastern side and Bay of Bengal on western side. The GR is part of a linear hill range (reaching an altitude of 700m), gently slopping to rugged hills and cliffs running down the central part of the peninsula, with a north-south length of nearly 28 km and an east-west width of 3-5 km. A number of deep gullies and narrow valleys are crossed by numerous streams flowing down to Naf river in east and Bay of Bengal in west. Most of the streams are seasonal and dry up during off-monsoon season. The northern boundary of the GR starts near Whykong town (which is nearly 50 km from Cox's Bazar), extending in south up to Teknaf town. A metalled road connecting Cox's Bazar with Teknaf town runs in between the Naf river and eastern boundary of the GR, and is a major transport corridor for forest products. Although a four wheel drive can reach Teknaf on western side through an unbroken stretch of beach from Cox's Bazar during low

tide, no metalled road exist presently. Many earthen and brick soled roads traverse the GR from east to west including one on the north most boundary.

The forests of Teknaf are located in the high rainfall bio-geographic zone and so comprise wet evergreen and semi-evergreen plant species. Although rapidly being degraded, the GR still contains important floral and faunal biodiversity. Eight broad types of habitats in Teknaf GR and the surrounding landscape are identified as below:

i) high forests represented by the remaining natural forests,
ii) plantations including the monoculture of exotics,
iii) grasslands and bamboos,
iv) wetlands,
v) tidal mudflats and mangrove vegetation along the Naf River to the east,
vi) sandy beaches along the Bay of Bengal bordering the GR to the west,
vii) Cliffs and steep hills, and
viii) cultivated fields

These habitats support what is considered to be the highest biodiversity in Bangladesh (a documented total of 290 species of plants, 55 species of mammals, 286 species of birds, 56 species of reptiles and 13 species of amphibians). The water bodies and wetlands harbour important fish species, water birds and amphibians. The cultivated fields (mainly of paddies) and grasslands (these get inundated during monsoon rains) harbour mammals, ground birds and reptiles. Presently the GR has natural forests, and the plantations raised earlier by converting high forests of great biodiversity value. The top canopy includes *Artocarpus chaplasha*, *Dipterocarpus turbinatus*, *Elaeocarpus floribundaas*, *Dillenia pentagyna*, *Swintonia floribunda*, etc. The proportion of semi-evergreen scrub forests and wet tropical grassland are increasing in those areas where the forests have become heavily degraded due to high biotic pressure. However, few patches of wet evergreen and semi-evergreen forests have developed in some degraded areas due to less biotic pressure and favourable moisture conditions. Various NTFPs being currently obtained from the forests of the GR include medicinal plants, bamboo, canes, sungrass, fish, prawn' leaves and seeds, wild animals, etc.

The Reserve has long been known for its elephants and was indeed established for their protection. Elephants are still widely distributed in the area, and although numbers very likely have declined , the Reserve and adjacent parts of the Teknaf Peninsula still support an important population. These elephants are part of a larger population scattered over the Chittagong Hill Tracts and down through the Teknaf Peninsula, and contiguous with populations in adjacent parts of India and Mynmar. Elephants are of high conservation importance as they are considered to be endangered within both their total range in Asia and in Bangladesh. A number of animal species (mammals, birds, reptiles and amphibians), both forest-dwelling and wetland-associated species, of different genera and families are found in the GR. It is home to avifauna of many species (representing a substantial portion of the country's known bird species) dependent on good undergrowth and forest cover. Some of the forest-dwelling and wetland-associated species are at high risk of extinction. The Reserve supports herpetofauna, including frogs, toads, turtles, lizards, snakes and a rich diversity of other faunal groups such as invertebrates and fishes.

The easy accessibility of Teknaf from Cox's Bazar and Dhaka through road networks make the GR very attractive for eco-tourism, particularly to urban dwellers. After the development of minimum visitor facilities a large number of tourists are expected to visit, particularly easily accessible Teknaf to have a feel of luxuriant vegetation of wet evergreen forests and good landscape with rolling hills and rivers and sea beaches.

Interface landscape provides a framework to manage Teknaf GR for multiple uses by addressing interactions between local economy, stakeholders and natural resource base. It exercises influence around the boundaries of the GR. A large number of villages/paras, cultivated fields including betel leaf areas, khas lands, brick fields, prawn farms and water bodies fall within the zone of influence of Teknaf Game Reserve. It is bordered along most of its northern boundaries by RF, along southern boundary by Teknaf town including BDR establishments, along its western boundary by Bay of Bengal and along eastern boundary by Naf river bordering Myanmar. In view of natural features both on eastern (Naf river with varying distance upto 5 km from the GR's boundary) and western (Bay of Bengal with varying distance up to 5 km from the GR's boundary) sides, the boundaries of a landscape zones are naturally fixed on these two sides. Because of GR's long, narrow shape, its most parts are easily accessible either by vehicle along existing roads, or by foot from the nearest vehicle access points. Keeping in view of both relevant human system and biophysical system a zone of 5 km around the boundaries of the GR is taken as an interface landscape zone.

The rich coastal and forest resource base of this region has attracted migration from other parts of the country, resulting in a large landless population migration from other parts of the country, resulting in a

large landless population who find seasonal employment in agriculture and illegal utilization of forest resources. As a result of refugee influx from Myanmar, a number of Rohinga camps and settlements have come up in between the Naf river and the eastern boundary of GR. A large number of betel leaf cultivation areas are noticed, particularly in and around the western boundary facing the Bay of Bengal. Local people cultivate betel leaf as a cash crop for which they collect forest materials such as bamboo, leaves, grass and small trees from the GR for erecting fences around their betel leaf fields, providing support to betel vines and also for roof construction for shade. On encroached forest lands they burn forest floor for the preparation of betel vine beds and also weed eradication. A part of land adjacent to the eastern boundary of the GR along the Bay of Bengal has been converted to prawn farms. Little or no natural forest borders the GR on the west, although some scrub vegetation remains. Bangladesh Rifles (BDR) is responsible for maintaining security along the Bangladesh-Mynmar Border. The presence of BDR staff brings additional biotic pressure on one hand but on the other hand may help check illicit felling from the forests.

The human population is concentrated in a narrow strip of agricultural/settled land along the Bay of Bengal, and in more extensive flat topography bordering the GR on the east. Based on a RRA/PRA study conducted by NACOM during May-July 2004, a total of 115 settlements locally called *paras* or villages (spread over 6 unions : Zaliapalong, Whykong, Baharachara, Hnilla, Sabrang and Teknaf) have been identified having stakes of different levels in the GR. A total of 53 settlements are located inside the GR boundaries whereas the remainder 62 paras are situated (adjacent or outside the GR) in the interface landscape zone. Nearly two-third of total paras (the villages inside and on the periphery of WS) have major stakes in the WS as local villagers depend on the GR for meeting their basic consumption needs. In addition to fuelwood, timber, bamboo and other NTFPs, they collect vegetables, fruits, fodder and sungrass from the GR. The remaining one-third paras (lying mainly outside the GR) have minor stakes mainly in terms of associated with fuelwood collection. There are a number of tribal settlements (Tonchonga mainly in Shilkhali, Monkhali and Roikhong; and Rakhain-also known as Mogh- mainly in Hnilla and Whykong, etc.). Most of them are poor and get engaged as agricultural labourers, fuelwood collectors, fisherman, jhum cultivators, weavers, etc.

The arrival Rohingya refugees from adjacent Mynmar during the later part of 1991 and the early part of 1992 resulted in an immediate population increase on the Teknaf Peninsula, creating a resource to population imbalance in a region where forest resources were already heavily exploited. They are located mainly at Jahajpura, Shamlapur and Teknaf, and harvest large quantities of ploes, , bamboos and fueldwood from the nearby forests to meet their shelter and cooking needs. Only two settlements (Noyapara Camp 1 and 2) of Rohingas are legally recognized by the Government.

There are 22 primary stakeholders (feulwood/timber collectos, betel leaf growers, forest produce collectors, hunters, fishermen, etc.), who are directly involved in forest resources extraction activities with major/moderate stakes whereas 7 secondary stakeholders (brick field owners, timber/fuelwood merchant, saw mill owner, Boat owner/maker, Zeep owner, tea stall owner and outside visitors) have indirect influence on forests. The institutional/organizational stakeholders include the government organizations (FD, BDR, Police, Local Government, etc.), NGOs and CBOs. Major NGOs operating in the area include Gonosastha, BRAC, ASA, SHED, SDVR, Grameen Bank and Kisholaya focusing on income generation activities through micro-credit, health, education, nutrition, etc. A number of CBOs (e.g. youth clubs, sammittees, etc.) currently operating in the interface landscape would be useful in NSP implementation. Forest Protection Committee at Jhazpura is actively protecting shilkhali garzan forests.

Of the total 8 brickfields in and around the GR, 6 are located inside the boundaries; a clear violation of the Brick Act, 1989 and the Wildlife Act, 1974. On an average each brickfield consumes about 300 monds of fuelwood every day during their operation period of 7-8 months in a year and most of this demand is met illegally from the forests thereby degrading the GR. Betel leaf cultivation is quite a popular activity in and around the GR and a large number of people depend on it for their livelihood. Most of the betel leaf cultivation areas are located on the western side of the GR, particularly in Shaplapur, Shilkhali and Jhazpura. Many times forest land is encroached for establishing a betel leaf vein that is vacated after harvesting the betel leaves. Forest land encroachment, particularly near the flat and gently sloping boundaries around the GR, for agriculture, brickfields, refugee camps and settlements is a serious problem in the GR. Many times the village elites are directly or indirectly associated with forest land grabbing.

The proposed activities will be undertaken under the following 7 strategic programs :

1. Habitat Protection Programs

Main objective of this program is to provide adequate protection to the GR for the conservation of its constituent biodiversity. Main activities to be carried out to achieve this objective will include i) updating forest cover and interface landscape maps, ii) demarcating the GR boundary, iii) controlling illegal removals from the GR, and iv) checking encroachment of forest lands.

Detailed forest cover/landscape mapping for Teknaf is available with FD based on 1996 satellite imagery and relevant FD records. This mapping will be updated and used in management zoning by identifying core zones and interface landscape zones. Reconnaissance surveys, followed by detailed surveys of identified areas, will be helpful in verifying actual ground situation. New mapping will be carried out during the Plan implementation and will include relevant landscapes within a 5 km-wide interface landscape zone outside of existing/proposed GR boundaries (to provide a spatial context for coordination of regional landscape elements and neighbouring forests). All the peripheral boundaries of the GR will be identified, surveyed and marked on the ground. The advantage of natural features (i.e. rivers, streams/*cheras*, ridge, roads, etc.) will be taken, wherever possible, while carrying out demarcation. Posts or other markers (wooden or iron pillers, trenches, mounds, etc.) will be put in place at all important and/or turning points and will be labeled.

Effective protection against illicit felling, poaching, forest fires and grazing for the conservation of biodiversity of the GR will be provided by gainfully associating local stakeholders. An effective checking of organized smuggling of timber and fuelwood will require concerted efforts from FD by using modern equipments and transport facilities. Survey and demarcation of the peripheral boundary of the GR will be done during the first year of Plan implementation when encroachment areas will also be identified and evicted, if possible after obtaining the voluntary consent of encroachers.

2. Management Programs

It is recommended to declare Teknaf GR as Wildlife Sanctuary where main objectives of the management program will be to : i) maintain ecological succession in constituent forests by providing effective protection against biotic interference, ii) develop and maintain natural forests as good habitat, favouring wildlife, iii) conserve the forest resources including the constituent biodiversity, iv) identify and conserve elephant movement corridors, and
v) establish co-management practices through stakeholders' consultations and active participation.

The GR and surrounding land-use is divided into two zones (core zone and interface landscape zone) based on existing forests, land-use, settlements, relevant landscape elements and management objectives. The entire forest area gazetted by the Government of Bangladesh as GR is designated as core zone due to its high conservation value and its proximity to riverine, marine, intertidal or beach areas. Main management objectives in the core zone are i) to protect and maintain remaining vegetation in good stocking and encourage natural regeneration to gradually bring back natural forests, ii) to maintain connectivity of elephant movement corridors within the GR, and iii) to improve forest habitat for elephants through selective management interventions while preserving and increasing the diversity and interspersion of habitat.

Forest management in this zone will focus on conserving remaining natural forests and bringing back natural vegetation (composition and structure), wherever possible. This will be achieved by providing protection (against illicit removals of forest produce, poaching, encroachment, grazing and fire) and encouraging natural processes for regeneration and rehabilitation of degraded forests. Monoculture of teak and other exotic species will need gradual canopy manipulation in order to create more favorable habitat for wildlife including elephants by encouraging natural regeneration and enrichment planting of indigenous trees, shrubs, herbs and palatable grasses. Subsidiary silvicultural operations will be carried out whenever necessary to encourage natural vegetation. Effective protection against biotic pressure (illicit felling, forest fires and grazing) will allow natural processes of regeneration in degraded forest areas.

Co-management practices will be implemented (through associated user groups and co-management councils/committees to be formed at different levels) in strengthening protection efforts against illicit felling, poaching, forest fires and grazing. In *lieu* of reduced removals (due to control of illicit felling) by the local communities from the core zone, they will be provided alternative means from interface landscape zones, and resources for alternative income generation activities for sustainable livelihoods. The visitor use of the core zone will be regulated to allow low impact tourist activities in terms of hiking and wildlife watching; high impact visitor activities such as motorized transport and group pick nicks will not be allowed.

The protection efforts will be facilitated through communication outreach activities, public awareness, stakeholders' access to interface landscape zones in meeting their subsistence requirements. Subsidiary silvicultural operations will be carried out for encouraging natural regeneration of indigenous species. Inside the core zone there are patches of pure teak and other short rotation tree species that are not favoured by wildlife (they inhibit bushy undergrowth and middle storey to provide food and shelter for wild animals). Based on the following guidelines, the areas of monoculture will be identified for gradual (say 10 ha each year) canopy opening in teak and other exotic plantations :

- Dense teak and exotic plantations will be taken up for marking the trees, whose removal will open the canopy for natural regeneration to come up.

- Canopy opening will be done in small but irregular plots of say 2-4 ha, staggered to minimize disturbance to wildlife and its habitat (mosaic pattern of opening will provide better ground light penetration for natural regeneration).
- No canopy opening will be undertaken near waterbodies including *cheras* in order to avoid erosion.
- At least 50-150 trees/ha will be retained along with all the existing natural regeneration and advance growth.
- Marking of trees will be done after monsoon rains are over, and felling operations completed by February.
- After the felling the first year will be devoted for obtaining natural regeneration. During the second year suitable gaps will be identified for raising enrichment plantations (see below) of indigenous fruit bearing shrubs/trees (suitable for wildlife) and palatable grasses.

Enrichment and buffer plantations of indigenous species will be taken up in those areas where natural regeneration does not come up well due to lack of existing rootstock and mother trees. Fruit bearing species for wildlife and palatable grasses will be planted up in those areas where adequate regenerative rootstock may not exist. Existing grasslands will be maintained and will be further developed by taking up the plantations of palatable grass along with other tree species as a part of enrichment plantations. A number of natural waterbodies are present in the GR and they will be maintained for use of wildlife including elephants and also local people. An inventory of existing water bodies and a list of wildlife using different water bodies will be developed. Desiltation, cleaning and repairing may be necessary in those waterbodies where soil erosion has taken place. Degraded habitats within the core zone will be restored naturally by carrying out low capital but labour intensive land-based habitat restoration activities in identified micro-watersheds. The protection against biotic factors will be taken up before low-input oriented land husbandry practices can be implemented for facilitating eco-restoration process.

Main management objectives applicable for elephants movement corridors are to : i) ensure a continuous elephant movement corridor by checking any further fragmentation of elephant habitat, ii) provide community protection to both habitats and wildlife including elephants, and iii) provide diversified food, water and adequate shelter to elephants by restoring forests, water bodies and the habitat. Elephants as large hervibore mammal require huge amount of forage, and water bodies for drinking and bathing. They prefer a mosaic of habitat types including patches of forests, scrub forests, bananas, forest clearings and intermittent open spaces, succulent grasslands and savanna. Teknaf habitat meet these requirements in terms of good amount of palatable grasses, scrub forests with open spaces, bamboo and herbs/shrubs, and a number of streams flowing through the GR. The available fodder species for elephants in Teknaf include bamboo, jackfruit, blackberry, mango, coconut, banana, fig, potato, grasses, etc..

Interface landscape zonsub-zones will focus on the surrounding landscape that is helpful in protecting and conserving the core zone, and creating congenial habitat for wildlife including protecting and maintaining elephant movement corridors. As opportunities for receiving tangible benefits from the conservation-oriented management of core zone are less, adequate provisions will be made for off-forest livelihood opportunities provided to the local stakeholders in the interface landscape. Subsistence consumption needs of local people for fuelwood, NTFPs and timber will be met through co-management practices. Interface landscape zone is further categorized into four sub-zones (buffer reserve sub-zone, intensive use sub-zone, transport corridor sub-zone and elephant movement corridors sub-zone) depending upon the uses to which different areas are managed.

Proposed Extension Sub-Zone comprises the remainder natural vegetation/plantations and degraded forests (an extension to the north of the GR incorporating the remaining portion of Whykheong Range and parts of Ukhia and Inani Range), which can over the period be gazetted (10,985 ha of RF land) by FD as part of core zone. Expansion to include adjacent forests would nearly double the size of GR where main long-term aim will be to maintain the maximum possible area under forest cover with significant potential for biodiversity conservation, nature-based recreation and eco-tourism.

Buffer Reserve Sub-Zone comprises the remainder open forests/plantations (nearly 4,100 ha of RF in Ukhia and Inani Ranges) that can be put under sustainable use to reduce biotic pressure in the re-gazetted GR. Management of this area will focus on intensive production of replacement resources, particularly fuelwood, poles and timber, and on maintaining stability as elephant habitat. Existing short and long rotation plantations will be brought under PBSAs as applicable under FSP. However, the participants will, in addition to the protection of plantations, be responsible for providing biodiversity protection in the GR areas. These plantations will not be clearfelled but instead be managed under selection felling (mainly of exotic species) so that the area can be naturally regenerated to be ultimately included in core zone as a mixed forest. In such a case the existing participants will be well compensated through off-PA alternative income generation activities to be carried out for sustainable livelihoods.

It is important to ensure good connectivity between the re-gazetted GR, buffer reserve sub-zone and, the existing FD lands/elephant habitat (nearly 600 ha) that lies to the east (of proposed buffer reserve sub-zone, between the Cox's Bazar-Teknaf Road and the boundary with Lama Forest Division) in order to maintain seasonal elephants movement corridors. The management focus in this sub-zone will be on ensuring that existing or traditional elephant movement corridors through this area, linking elephant habitat in the GR with more extensive habitat in Lama Forest Division, the Chittagong Hill Tracts and Myanmar, are maintained.

Intensive Use Sub-Zone incorporates the relatively small areas required for administrative buildings and staff quarters, visitor accommodations and other facilities. The GR HQ will be developed at Teknaf with administrative buildings (GR Hqs, Beat Office, etc.), staff quarters, visitor facilities (e.g. Environmental Education Centre) and other infrastructure facilities.

3. Livelihood Programs

Main objective of livelihood program is to develop appropriate linkages with relevant livelihood opportunities and other projects/initiatives that will reduce biotic pressure on the GR by providing alternative livelihood opportunities to local stakeholders. Up-scaling of skills will be taken up for generating value additions through capacity building of local people. Landscape Development Fund (LDF) will be used to provide grants to the co-management councils/committees, and the members of user groups, and their federations will be encouraged to set up micro-enterprises to generate value additions locally. The benefits from eco-tourism will be ploughed back for the development of local communities and the GR. Networking with relevant NGOs active in the area will be established for rendering other rural development services to local stakeholders. Appropriate production technologies, which may be implemented as a part of off-PA development interventions, were identified based on field investigations done by the partner NGO (CODEC).

4. Facilities Development Programs

Main objective of this program is to develop necessary facilities including accommodation and field equipments for FD field staff responsible for the management of GR. Existing FD facilities will be fully utilized and incorporated in GR management where these can be renovated on a cost-effective basis. Built facilities will be concentrated AT GR Headquarters (incorporating the existing Teknaf Range Office) and Range Offices at Whykheong and Silkhali.

Renovations, and a regular schedule of maintenance, will be initiated during the first year of the Plan. New constructions will be initiated during the second year of the Management Plan. The existing toilets will be removed and replaced with a new facility. New quarters will be constructed for the staff on priority basis. Forest Guard and Forester quarters will be renovated to provide electricity and piped water, and will be repainted and maintained on a regular basis. Restoration of existing trails would provide quick and easy access to the GR for management staff. Vehicles, field equipments and office equipments will be needed to support the management and administration programs. Double-cab pickups will be provided for the ACF/OIC. In addition, two 100 cc motorcycles will be provided for use at GR Headquarters, and one at Beat Offices. Two walkie-talkies will be provided for use at GR Headquarters, and one each at Beat Offices. These will be suitable for communication among these sites. Compasses, binoculars, GPS and other field equipment will be provided as required for support of the GR management programs. Office equipments (telephone, computer, etc.), furniture (desks, filing cabinets *etc.*) and supplies will be provided as required for use at GR Headquarters and Beat Offices.

5. Visitor Use and Visitor Management Programs

Regulated eco-tourism in the form of nature education and interpretation tours will be a main objective of visitor use and management programs. This will help promote biodiversity conservation and educate the visitors as enlightened nature tourists. Socio-economic benefits of eco-tourism will be ensured to local people through forward and backward linkages. An initial tourism region encompassing the three hiking trails has been identified. However, during the first year of Plan implementation a broad eco-tourism region will be identified around the GR by linking with other local and regional attractions including Guest Houses, tribal villages, rolling landscapes, Naf river banks, sea beaches, wetlands, existing forest roads and trails. Adequate care will be taken to preserve the local traditions and culture of tribals by avoiding intrusive, exploitative and commercial behavior activities while implementing visitor program. Existing roads and trails will be renovated for easy movement in eco-tourism zone. Elephant ride may also be considered by FD as many tourists may be interested to have a close look of nature from elephant back. Existing Forest Rest Houses (FRH) will be made available to eco-tourists for night halts on payment. Longer-term visitors can get accommodation outside the GR area in reasonable hotel accommodation. The tourists can travel to Teknaf on a day trip and return back to Cox's Bazar where a number of hotels are available for night halt.

Publicity and information materials having basic information about the GR will be provided to visitors by means of fixed signs, brochures, leaflets, printed guides, etc. at key road access points. An Environmental Education Centre to be established at the GR's office will serve as Nature Interpretation Centre (NIC) with update information. A network of nature trails will be developed for visitors movement on foot and bicycle, traversing key natural and cultural features of interest (e.g. patches of dense forests, caves, cliffs, cultural remnants, natural streams/*cheras*, religious places, tribal areas, etc.). The existing FRHs will be connected with existing and new nature trails. Priority will be given to develop existing foot paths and vehicle tracks as far as possible in order to minimize creation of new paths and consequent vegetation clearances and soil erosion. The Environmental Education Centre will be connected by one such trail for visitor access.

6. Conservation Research, Monitoring and Capacity Building Programs

A research, monitoring and capacity building program will be developed with main objectives i) to better understand the biodiversity resources, ecosystem and landscape environment, ii) to establish a baseline listing of all flora and fauna species for assessing their current abundance, distribution, and functional relationship among biotic communities iii) to develop quantitative population estimates for elephants, and develop detailed information on their current distribution and habitat use, iv) identify and map key patches of remnant forests and other critical habitats, v) to identify priority research and monitoring topics to help guide the development of GR's management program, and vi) to gradually reduce the extent and degree of uncertainty while taking management decisions.

A detailed methodology for establishing benchmark data and measuring the volume of timber loss (cubic meter/ha) during the Project period will be used. A survey of natural regeneration (density of seedlings and saplings per ha) in the forests of GR will be taken. This will be complemented by photo monitoring technique, focusing on changes in plant height as a visual evidence of success of NSP interventions. Forest dwelling bird species will be used for assessing biodiversity status. A simple procedure of sighting and counting (either population or nests) the indicator bird species using the forests as their habitat will be employed by associating local stakeholders in identified transect walks. Benchmark measurements will be taken to establish initial set of values, which will act as reference for future comparison with subsequent measurements taken periodically for assessing impacts of project interventions.

There is great necessity of imparting conservation training to the FD field staff responsible for managing the GR. Other stakeholders including the beneficiaries and NGO staff also need conservation training. An exhaustive conservation training plan, covering both in-country and overseas training, will be developed under NSP and implemented over the project period. A training strategy dealing with both quality and quantity of training including refresher and orientation training courses will form part of the training plan.

7. Administration and Budget Programs

Main objective of administration and budget programs is to ensure that technical and administrative staff required to manage the GR effectively are approved, developed and posted. Improvements in financial organizational systems will aim for the financial sustainability for the GR. It is recommended to operationalize the approved organogram and adequate administrative and management structure be put in place.

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ASSESSING THE PRESENT SITUATION-FINDING AND ISSUES

1. BACKGROUND

Participatory forestry projects, supported by donors, have been implemented in Bangladesh on a large scale since 1981 when a community forestry project was taken up by Forest Department (FD) with the financial support from Asian Development Bank (ADB). Sectoral forestry projects such as Forestry Sector Project (FSP) have been implemented with a major policy shift in favor of a participatory management of forests (Figure 1) and protected areas (PAs). Local people and communities participated in developing, protecting and managing forests/plantations *in lieu* of usufructury rights granted as per participatory benefit sharing agreements (PBSAs) signed between user groups (of participants) and land owning agencies (such as FD in case of forest land). The Nishorgo Program of FD aims to protect and conserve the forests and biodiversity of the country's PAs by building gainful partnerships between the Forest Department (FD) and main stakeholders based on shared roles and responsibilities for biodiversity conservation and sustainable use.

The country's PAs (Figure 2) and natural forests have been an intimate interspersion of human habitations and cultivation through them with traditional dependency on neighboring forests for the livelihood of local people in a largely agrarian economy. In addition to development pressures on forest land, the traditional dependence of local communities on forests has historically been an important aspect of forests management in Bangladesh. As a result, the biodiversity conservation priorities cannot be set in isolation from local forest resource use and development imperatives. Anthropogenic pressures including increased commercial extraction of forest produce, and forest land encroachment for habitations and agriculture, brought by manifold increase in human and cattle population, have led to widespread shrinkage and degradation of PAs in Bangladesh. Illegal removals from the forests have increased off late, thereby jeopardizing the very existence of biodiversity in some of the PAs. This has adversely affected the local people and communities as well as the conservation status of wildlife habitat.

A basic principal of PA management is that every PA should have a management plan that guides the management of its resources, the uses of the area, and the development of facilities needed to support that management and use; it facilitates all development activities in an area (MacKinnon *et al*. 1986). A summary Action Plan prepared for Teknaf Game Reserve covered under the FSP was to be fully developed into a full fledged management plan based on a co-management approach being adopted under the Nishorgo Support Project (NSP) supporting a broad Nishorgo Program of FD, which is a comprehensive effort to improve the management of country's PAs being managed by FD. The Nishorgo Program, which focuses on PAs, aims to protect and conserve country's forests and biodiversity for future generations.

This Plan is a five year management plan for Teknaf Game Reserve (GR) and will be implemented mainly by FD and the project staff but would also be useful to key stakeholders including local participants, NGOs, planners, policy-makers and researchers. The Plan is developed by following a process-oriented and participatory approach based on consultative discussions with main stakeholders including co-management councils and committees. The contents and structure of the Plan were agreed to in a meeting attended by senior FD officials. The first draft developed by following the agreed format was circulated among the FD staff for their written comments. A revised version prepared by including the written suggestions made by FD staff was presented and discussed in a planning workshop held at Ban Bhaban. An updated version of the draft Plan that incorporated the comments made in the workshop was again circulated among FD staff for their written comments. The draft Plan was finally presented and discussed in a meeting held at Ban Bhaban for final review of senior FD officials prior to submission for Government approval. This Plan incorporates all the suggestions made in this meeting.

2. INTRODUCTION

Nishorgo Program focuses on building gainful partnerships between the FD and key stakeholders, who can assist in the conservation efforts for a PA. It will help conserve forest and constituent biodiversity through facility development, capacity building, and gainful partnerships with key stakeholders. USAID through NSP is providing targeted technical support to main aspects of the Nishorgo Program under its partnership with the Government of Bangladesh (GOB). The NSP works closely with the FD and key conservation stakeholders to develop and implement a co-management strategy to help conserve the country's 5 pilot PAs.

The Plan provides for an overall five year framework for developing and managing the Teknaf Game Reserve (GR) that is home to Asian elephants (occurring in Bangladesh primarily along the northern and eastern borders, both as year-round residents and moving seasonally between the adjacent hill tracts of India and Myanmar and similar habitats in the Garo Hills, Chittagong Hill Tracts, and Teknaf Peninsula). Planned development interventions under FSP, NSP and other GOB funded schemes are included in the Plan along with other relevant activities, necessary for the development of the Game Reserve. The stakeholders consultations on the draft Plan were held with the members of user groups, villagers and local tribals, FD field staff, sawmill owners, timber traders, mahaldars, NGOs, local journalists, and public representatives (UP chairman and members). Main focus of forest management under this Plan is on conservation of forests and constituent biodiversity, sustainable use of specified areas where this can help to achieve conservation on a broader scale, and involvement of local people and other key stakeholders in the management of GR.

The present situation (providing a description, an assessment of biodiversity, resources protection and management, human interactions, forest resources use patterns, interface landscape situation, past management and practices, etc) of the Game Reserve is assessed in Part I of the Plan with main findings and issues. Additional information on the regional/national biophysical and socio-economic scenario can be found in the documents listed under References. The strategic programs and priorities (comprising prescriptions for future development and management of the GR with detailed guidelines) are recommended in Part II of the Plan. The Plan, as a guide to development interventions, will be useful for PA managers, planners, decision-makers, researchers, donors and other stakeholders including local forests dependent communities.

The scope, timing and relative emphasis on specific activities may be modified by the PA managers on the basis of experience, success and progress as the Plan is implemented. The overall levels of inputs indicated under each activity will be maintained to the extent possible in order to ensure reasonable success in Plan implementation. However, it is important to have sufficient flexibility needed for making required modifications and adjustments to management activities within the limits set by overall goals and objectives. Hence, although five year schedules of activities and inputs are presented, it is recommended that needed changes in timing, inputs and outputs will be reflected in annual work plans to be prepared by PA managers every year.

The Management Plan is based on a sustainable planning approach comprising, i) protection and conservation of all remaining natural forests and constituent biodiversity in the Game Reserve, ii) conversion of monocultures of exotic tree species into natural and man made regeneration of indigenous plant species by gradually opening top canopy, iii) development of co-management agreements (and linking Game Reserve conservation with benefit sharing arrangements) with key stakeholders to reduce ongoing habitat damage by helping them achieve sustainable livelihoods through participatory forest use and alternative income generation activities, and iv) provision of support to better administration and management of the GR including capacity development, infrastructure, training, and wider extension and communication.

2.1 Constitution and Location

The Teknaf Game Reserve as currently gazetted ($21^0$00'N latitude and $92^0$20'E longitude) occupies the middle part of the Teknaf peninsula (Figure 3) from Ukhia south to the town of Teknaf. It is located in the country's far south-eastern corner, near to Myanmar border. It was established in 1983 (vide Notification No. XIII/For-65/83/770 dated 17th November, 1983) over a Reserved Forest (RF) area of 28,688 acres (11,610 ha) covering 10 RF blocks (Raikhong-4376 acre, Saplapur-2071 acre, Shilkhali-1852 acre, Maddyanilla-4250 acre, Dakhin-Nilla-2066 acre, Matabhanga-2110 acre, Rajachara-3340 acre, Ledha-3101 acre, Dumdumia-2548 acre and Teknaf-2974 acre) in three Forest Ranges (Whykong, Silkhali and Teknaf) of Cox's Bazar (South) Forest Division. The locations of Beat Offices covered under Teknaf Game Reserve is shown in Figure 4. The current designation as a Game Reserve (Elephant) does not provide adequate

protection for either wildlife including elephants or habitat and so its re-designation as a Wildlife Sanctuary is recommended in this Plan to provide more scope for protection.

It is situated in Ukhia and Teknaf Upzilas of Cox's Bazar District, and lies in between the Naf river on eastern side and Bay of Bengal on western side (Figure 5). The GR is part of a linear hill range (reaching an altitude of 700m), gently slopping to rugged hills and cliffs running down the central part of the peninsula, with a north-south length of nearly 28 km and an east-west width of 3-5 km. A number of deep gullies and narrow valleys are crossed by numerous streams flowing down to Naf river in east and Bay of Bengal in west. Most of the streams are seasonal and so dry up during off-monsoon season. The northern boundary of the GR starts near Whykong town (which is nearly 50 km from Cox's Bazar), extending in south up to Teknaf town. A metalled road connecting Cox's Bazar with Teknaf town runs in between the Naf river and eastern boundary of the GR, and is a major transport corridor for forest products. Although a four wheel drive can reach Teknaf on western side through an unbroken stretch of beach from Cox's Bazar during low tide, no metalled road exist presently. Many earthen and brick soled roads traverse the GR from east to west including one on the north most boundary.

3. BIODIVERSITY CONSERVATION ATTRIBUTES

3.1 Statement of Biodiversity Significance

The forests of Teknaf Game Reserve are located in the high rainfall bio-geographic zone, comprising wet evergreen and semi-evergreen forests that are rich biologically. They are home to tribes with their traditional lifestyle dependent on existing natural resources. It is one of Bangladesh's largest PAs, surpassed in size only by the Sundarbans Wildlife Sanctuaries and Pablakhali Wildlife Sanctuary. The forests-water interactions are very prominent in Teknaf, where the forests play an important role in regulating water flows, checking soil erosion and protecting coasts. They are part of watersheds with intense forests-water interactions that have regional and transnational implications. In addition to providing a sanctuary to wildlife, these forests also may in future form water sanctuaries required for the conservation of water and soil, and also for carbon sequestration. The protection and conservation of these forests is particularly important in view of significant loss of the country's hill forests in the country.

3.2 Biodiversity Conservation Values

Although rapidly being degraded, the GR still has very high level of biodiversity containing important flora and fauna. The gazetted GR area, neighbouring RFs and immediately adjacent coastal areas comprise a broad variety of habitats within a relatively compact area, including representative but increasingly fragmented and degraded examples of evergreen and semi-evergreen hill forests, tidal mudflats and mangrove vegetation along the Naf river to the east, and broad sandy and rocky beaches along the Bay of Bengal bordering the GR to the west. These habitats support high biodiversity. The GR has long been known for its elephants, and was established as Game Reserve (Elephant) specifically for their protection. Elephants are still widely distributed in the area, and although numbers have declined, the GR and adjacent parts of the Teknaf Peninsula still support an important population, with total numbers estimated as 15 to 100 or more. These elephants are part of a larger population scattered over the Chittagong Hill Tracts and down through the Teknaf Peninsula, and contiguous with populations in adjacent parts of India and Myanmar. However, elephant movement routes into and out of the GR may now have been cut off due to habitat degradation and fragmentation.

Socio-economic values of the GR are important because a number of communities including ethnic minorities reside within and around the forests on which they depend for their livelihood opportunities. Biological values include providing shelter to biodiversity comprising important flora and fauna, elephant habitat connectivity, presence of threatened and endemic species, and improvement of degrading habitat. Main ecological functions are catchment conservation of rivers/streams and water bodies, coast conservation, control of soil erosion, ecological security, irrigation and agricultural production, carbon sink and environmental amelioration. The GR provides significant scope for wildlife education and research, nature interpretation and conservation awareness. It represents a fragile landscape with a very rich biodiversity, which if not conserved, may be lost for future generations. The GR is also a potential source of eco-tourism, nature-based recreation, aesthetic values, dense high forests, historical and cultural values, and scenic beauty. Finally many conservation values of the GR are regional and transnational but also with local implications.

3.3 Wildlife Conservation

Special protection measures were contemplated for the preservation of elephants under Bengal Elephant Preservation Act, 1879. The Wildlife Birds & Animal Protection Act, 1912 provided for the preservation of wildlife in Bengal through protection of many species of birds and animals, particularly during breeding season. The promulgation of Bangladesh Wildlife (Preservation) Order in 1973 was followed next year by the enactment of Bangladesh Wildlife (Preservation) (Amendment) Act, 1974. A Wildlife Advisory Board was set up for performing such functions as the Government may assign to it. The Act provided a sound legal basis for the preservation of wildlife in Bangladesh. Both *in-situ* and *ex-situ* conservation of wildlife were to be achieved by designating and managing PAs in representative zones. A new circle (Wildlife and Nature Conservation Circle) was created in 2001, exclusively for looking after the affairs related to wildlife and nature conservation.

3.4 Forest Boundaries

Teknaf Game Reserve is one of the country's largest PAs, covering 10 RF blocks, which were covered under regular Working Plans that contained recommendations for the maintenance of legal boundaries of forest

blocks and compartments. The boundaries of forests could not, however, be maintained, as a result of which some forest areas have been brought under encroachment for cultivation and settlements. No efforts have been made to physically demarcate the boundaries in the field and the situation got exacerbated with heavy biotic pressure on forests and encroachment of forest land. This has adversely affected the ecological boundaries of GR with limited elephant movement corridors and breeding space for wildlife.

3.5 Forest Geology, Rock and Soil

The hills of the GR are composed of upper tertiary rocks (Pliocense and Miocene epoch) with 3 representative geological series : Surma, Tipam and Dhupitila. The soils vary from clay to clayey loam on level ground, and from sandy loam to coarse sand on hilly land; the soils developed on unconsolidated sandstone of low hills are brown, loamy and acidic. Unless hindered by the presence of lateritic, plinthitic or placic layer at shallow depths, these soils permit penetration of tree roots. The high soils are developed usually on stratified shale or semi-consolidated sandstone. Steep slopes and presence of semi consolidated rocks at shallow depth hinder deeper penetration of tree roots in these soils. Low mountains are separated by broad valleys, making the land form irregular and slopes precipitous.

3.6 Biophysical Situation

The GR in past supported mixed tropical evergreen and semi-evergreen forests, which over the period have been substantially altered due to heavy biotic pressure. Forest land encroachments has resulted in conversion of many foothills and low areas into paddy cultivation and settlements. As a result, the habitat has degraded and fragmented, adversely affecting the elephants by restricting their movements through a barrier effect. However, at places good natural re-growth, particularly of ground flora and middle storey, has come up due to favorable climatic and edaphic conditions, thereby enhancing the GR's *in-situ* conservation value. At few places old plantations have grown up in shape of multi-storied structure with re-growth of ground flora and a middle storey of naturally occurring species. Consequently the vegetation at some places in the GR has approached towards natural structure and species. The biophysical conditions of the GR are further described in detail in Chapter 4.

3.7 Micro-Climate

The climate of the GR (in general warm and humid) is characterized by 3 seasons – winter, summer and monsoon rains. The temperature varies on an average from 15.4 degrees in January to 25.4 degrees in May. The humidity is high in the GR throughout the year, with monthly average humidity varying from 27.6% in April to 98.6% in August. There is heavy dew during winter when rainfall is low. The water condensation is thus distributed throughout the year in different forms and greatly influences plants and wildlife. The area covered under the GR is wet as a result of good rainfall with an annual average of 3,314 mm (with average no. of rainy days as 127.4), with maximum rainfall falling during June to August from South-West monsoon. Pre-monsoon Nor'westerly and cyclonic storms are accompanied by high speed winds and rains, which do considerable damage to property and trees.

3.8 Water Bodies

Teknaf GR is characterized by good rainfall and so a large amount of water is drained from the surrounding hills to the Bay of Bengal and Naf River. The area is traversed by numerous creeks that are clear with gravely and stony beds that flow down to the Naf river on the eastern side and to the Bay of Bengal on the western side. There are a number of other small streams and shallow depressions, which are wetlands providing marshy sanctuaries to migratory birds and livelihood to local fishermen. They provide good habitat, drainage and drinking water source for the wild animals and local people. So aquatic habitats associated with forest cover and riparian (streamside) vegetation and animal species are important part of overall habitat composition.

4. BIODIVERSITY AND HABITAT

The conservation of biodiversity in each of the representative bio-geographic zone of Bangladesh is a main objective of establishing and managing the PAs in Bangladesh. Tropical wet evergreen and semi-evergreen plant species including Dipterocarpus sp., characterized by high rainfall and at places a multi-tier vegetational assemblage of rich biodiversity, comprise the remainder forests of Teknaf Game Reserve. The Game Reserve is, therefore, categorized under the tropical evergreen and semi-evergreen bio-geographic zone.

The following 8 broad types of habitats are identified in Teknaf GR and the surrounding landscape :

ix) high forests represented by the remaining natural forests,
x) plantations including the monoculture of exotics,
xi) grasslands and bamboos,
xii) wetlands,
xiii) tidal mudflats and mangrove vegetation along the Naf River to the east,
xiv) sandy beaches along the Bay of Bengal bordering the GR to the west,
xv) cliffs and steep slopes, and
xvi) cultivated fields and settlements

These habitats support what is considered to be the highest biodiversity in Bangladesh (a documented total of 290 species of plants, 55 species of mammals, 286 species of birds, 56 species of reptiles and 13 species of amphibians). The first three of the above-mentioned 8 habitats are very important from PA management point of view. The water bodies and wetlands harbour important fish species, water birds and amphibians. The cultivated fields (mainly of paddies) and grasslands (these get inundated during monsoon rains) harbour mammals, ground birds and reptiles.

The following main components (flora, fauna and NTFPs) of biodiversity are described in order to have a better understanding of the habitat of Teknaf GR.

4.1 Forests

The forests (mainly tropical wet evergreen and semi-evergreen forests with predominance of Dipterocarpus sp.) of Teknaf were reserved in early nineteenth century. Before reservation many forests were cleared for *jhum* (shifting cultivation), after which secondary vegetation developed over the period. Presently the GR has natural forests, the plantations raised earlier by converting high forests of great biodiversity value, scrub forests, bamboo and grassland. The tropical evergreen forests are found in deep valleys where wet conditions exist with shade. The tropical semi-evergreen predominates on the hills and flat lands. Evergreen species are more frequent in the lower stories; main upper storey has a high proportion of species that are decidupus during dry season. The top canopy includes *Artocarpus chaplasha*, *Dipterocarpus turbinatus*, *Elaeocarpus floribundaas*, *Albizzia procera, Dillenia pentagyna*, *Swintonia floribunda*, etc. The shrub, cane and bamboos species, and a number of fodder and fruit bearing plants occur naturally (see Volume 2 for a list of plant species). Savannah areas of sun grass occur in large areas. Forest fires in summer have adversely affected the natural forest regeneration in the GR. The proportion of semi-evergreen scrub forests and wet tropical grassland are increasing in those areas where the forests have become heavily degraded due to high biotic pressure. Intensive human use has resulted in the degradation or conversion of much of the original wet forest cover. However, few patches of wet evergreen and semi-evergreen forests have developed in few degraded forest areas due to less biotic pressure and favourable moisture conditions as a result of high rainfall. Long and short rotation plantations have been raised under different projects including FSP.

Parts of natural forests of Teknaf GR were converted by raising long rotation plantations (teak, garjan, jarul, dhakijam, chatian, etc.) . As a result, the original forests have been removed and its conservation value currently stems from the remaining natural forests and the plantations, which at places have developed a tall, multi-storied structure. Its biodiversity conservation and eco-tourism values are high due mainly to adjoining long sea beach that is visited by a large number of tourists. The conversion of high biodiversity value natural forests to plantations was not justified in view of traumatic disturbances to the forest ecosystem, brought by clearfelling of natural forests and followed by plantation activities. Many of the plantations suffered heavily from cyclones during the last three decades. Pilferage in the recent past has also been responsible for the loss of much stocking. Although rapidly being degraded, the GR still

contains important floral and faunal biodiversity resources, and there is a good possibility of effective conservation of these resources if specific and timely actions are taken as per this Plan.

4.2 Wildlife

The estimates of both the Reserve population and the total country population of elephants are very crude, the Teknaf population probably represents 20-30% or more of the total number of elephants currently remaining in Bangladesh (most recently estimated as 75-205 animals by Islam, 1998). Elephants are of high conservation importance as they are considered to be endangered within both their total range in Asia and in Bangladesh. A number of animal species (mammals, birds, reptiles and amphibians), both forest-dwelling and wetland-associated species, of different genera and families are found in the GR (see Volume 2 of a list of fauna). It is home to avifauna of many species (representing a substantial portion of the country's known bird species) dependent on good undergrowth and forest cover. Some of the forest-dwelling and wetland-associated species are at high risk of extinction. The Reserve supports herpetofauna, including frogs, toads, turtles, lizards, snakes and a rich diversity of other faunal groups such as invertebrates and fishes.

Large mammals such as tigers, leopards, bears, wild dogs and sambar have disappeared from the Reserve due to habitat degradation and fragmentation. However, viable populations of many small and medium-sized mammal species that can survive in limited forest areas and/or disturbed or secondary habitats (e.g., jackals, small cats, barking deer, wild pigs, etc.) are found in the remaining disturbed and fragmented habitat. A rich diversity of other faunal groups such as reptiles, vertebrates, fishes and amphibians is present.

4.3 Non-Timber Forest Products (NTFPs)

Various NTFPs being currently obtained from the forests of the GR include medicinal plants, bamboo, canes, sungrass, fish, prawn' leaves and seeds, wild animals, etc. Rural population depends on medicinal plants as traditional medicine, oftenly prescribed by indigeneous medical doctors (*Kabiraj*). Usufructury rights in terms of both timber and non-timber products are granted to local communities through participatory benefit sharing agreements (PBSAs) under FSP. A regular flow of benefits from NTFPs can be a good source of livelihood, employment and income to local people. However, sustainable management of forests and the GR are necessary for managing NTFPs sustainably.

As commercial harvesting is not practiced in the GR, one of the multiple objectives of forest management should be the production of NTFPs and consequent employment and income generation to rural surplus labour through the collection stage to processing and sale. Many NTFPs such as roots, seeds, leaves and barks of medicinal trees can be harvested sustainably without adversely affecting forest regeneration (as cutting down a tree is not required). *In-situ* and *ex-situ* conservation of biodiversity of medicinal value is appropriate within the GR in view of heavy dependence of rural poor on medicinal plants for their primary health care. Some NTFPs collected by local people (e.g. sungrass) offer opportunities for self-employment if NTFPs based cottage and small-scale industries are promoted locally through co-management councils/committees and user groups. They may be assisted (e.g. grants from LDF and skill development training through partner NGOs) in establishing value addition units locally.

5. ASSESSMENT OF BIODIVERSITY MANAGEMENT PRACTICES

5.1 Forest and Wildlife Management Systems

The forests, now covered under Teknaf GR, were declared as RFs during early nineteenth century; Cox's Bazar was originally constituted as a Forest Division in 1920 following the gazetment of RFs in 1903 and 1907. In 1933 it was a sub-division of the Chittagong Forest Division and remained so until 1950. By and large the catchment area of each existing stream (*chera*) was designated as a forest block. These forests were historically subjected to unrestricted biotic interference; shifting cultivation, grazing and forest fires being the most prominent. During initial management period, individual trees used to be sold based on permits issued by FD. The purchase contract system based on a minimum guaranteed royalty was introduced under which the purchaser was allowed to fell any tree over and above 6 feet girth. The system of marking trees (by a responsible officer of FD) before felling also was introduced. As the traders objected, the marking system had to be replaced next year by coupe (*mahal*) system of timber harvesting based on fee-cum-royalty.

Natural forests since 1923 have been managed on cleafelling system followed by artificial regeneration of plantations of teak, garjan, jam, dhakijam, jarul, gamar, etc. The management system followed since 1950 has been the separation of forests in to working circles and periodic bloacks within ranges and beats. The high forests were categorized into timber working circles that were managed under cleafelling system. Bamboo areas constituted an overlapping working circle and were worked on 2-3 year cutting cycle. Bamboo working in the RFs was regulated in order to avoid excessive extraction of immature bamboo clumps/culms in designated blocks and compartments (that were opened for bamboo harvesting over a four year felling cycle).

In 1963, 11610 ha of RFs of Teknaf Range were gazetted as Elephant Reserves for the protection of elephants. During 1971 war period considerable areas of RFs were encroached and large areas of plantations were damaged through illicit felling. M. U Chowdhury in his working plan (1968/69 – 1977/78) recommended for setting up Whykheong Game Sanctuary whereas J. H Chowdhury in his working plan (1991/92 – 2000/01) prescribed Preservation Working Circle to manage Teknaf Game Reserve. Unfortunately the plan prescribed, "the management of the areas for timber production will not be excluded but will be carried out only where forestry operations, under special prescriptionsenhance or satisfy the conditions for which these areas were constituted; plantations already established within the Sanctuary areas will continue to be managed for timber production".

5.2 Eco-Tourism

The easy accessibility of Teknaf from Cox's Bazar and Dhaka through road networks make the GR very attractive for eco-tourism, particularly to urban dwellers. Once minimum visitor facilities are developed, a large number of tourists are expected to visit, particularly to easily accessible areas of Teknaf to have a feel of luxuriant vegetation of wet evergreen forests and good landscape with rolling hills, creeks and rivers and sea beaches. However, chartered eco-tours on the pattern of Sundarbans have not been yet popular for Teknaf.

5.3 Management Practices for Non-Timber Forest Products

Forest management practices in Teknaf have in past focused mainly on timber management due mainly to its commercial value. The approach of forest management laid more emphasis on the development of major forest products such as timber whereas NTFPs received relatively low priority by treating them as bye-products. NTFPs available in Teknaf will cover a broad spectrum of biomass obtained from leaves, flowers, fruits, seeds, stems, roots and barks from different tree species, shrubs, herbs and wild animals for meeting human needs for food shelter, clothing and other items for local use and income generation. Many of these NTFPs are collected locally by primary collectors for their subsistence consumption but also for cash sale. Food and medicinal value of the products for which they are used as raw material largely determined the degree of commercialization of NTFPs. The extent and use-patterns of many NTFPs have remained inadequately known in the absence of any scientific survey.

5.4 Conservation Research, Monitoring and Training

There is neither any wildlife research staff nor research facility (e.g. laboratory) for the GR. Similarly there is no established monitoring mechanism presently for assessing the health status of wildlife and biodiversity.

The assessment of regeneration or degeneration of forests is necessary for which a suitable monitoring mechanism need to be put in place for better management. Although no special wildlife in-country training of FD staff has been organized, some officers have been trained overseas in wildlife and PA management. Wildlife management is one of the several subjects being taught during the regular forestry training imparted to cadre officers at Forest Academy, Chittagong. There is a need for organizing special training (in-country and overseas) courses on protected area management, conservation of biology, habitat restoration, co-management of PAs, legal aspects of PA management, capture of wildlife, census operations, captive breeding, etc.

5.5 Administrative Set Up

Under the overall charge of the CCF, a wildlife and nature conservation circle (with CF as head and assisted by a staff officer of DCF rank) operates with six field level DFOs. Of the six DFOs, four are incharge of Wildlife Management & Nature Conservation (WMNC) Divisions with HQs at Chittagong, Sylhet, Khulna and Dhaka. However, of the four designated DFOs, only three (at Chittagong, Sylhet and Khulna) are in position presently. There is a need of immediately posting a DFO for the WMNC Division at Dhaka as per the approved organogram. They should be well assisted with adequate staff including trained ACFs posted at each PA level within a Wildlife Division.

6. INTERFACE LANDSCAPE SITUATION

The present situation of the surrounding landscape (both biophysical and stakeholders landscape) of Teknaf Game Reserve is described as below.

6.1 Landscape Approach

The Plan has adopted a landscape approach of PA management by focusing on an appropriate spatial scale to integrate relevant habitat/forest system, ecosystem and social/institutional system (Figure 5). It is an holistic approach that takes into account relevant factors impinging on the management of Teknaf GR in the context of a broader spatial scale. So surrounding landscape is taken as a planning and development unit for integrated GR management. It addresses the needs of households and co-management activities in the context of a broader economic, natural resource and socio-institutional environment of the Game Reserve. It provides a framework to manage a PA for multiple uses by addressing interactions between local economy, stakeholders and natural resource base.

Landscape management of Teknaf GR would entail PA entails biodiversity conservation by linking surrounding ecosystems and human systems. It helps restore ecological processes both within the GR and in surrounding landscapes by accounting presence and needs of local inhabitants. It promotes active involvement of main stakeholders in PA management and biodiversity conservation. However, the boundaries of an identified integrated system (the spatial scale) need to be kept within manageable limits after assessing field specific situation. The structure and conditions of surrounding landscape must be accounted for in the management of the GR.

6.2 Interface Landscape of Teknaf Game Reserve

The identified interface landscape exercises influence in and around the boundaries of the GR. A large number of villages/paras, cultivated fields including betel leaf areas, khas lands, brick fields, prawn farms and water bodies fall within the zone of influence of Teknaf Game Reserve. It is bordered along most of its northern boundaries by RF, along southern boundary by Teknaf town including BDR establishments, along its western boundary by Bay of Bengal and along eastern boundary by Naf river bordering Myanmar. In view of natural features both on eastern (Naf river with varying distance upto 5 km from the GR's boundary) and western (Bay of Bengal with varying distance up to 5 km from the GR's boundary) sides, the boundaries of a landscape zones are naturally fixed on these two sides. Because of GR's long, narrow shape, its most parts are easily accessible either by vehicle along existing roads, or by foot from the nearest vehicle access points. This is positive in the sense that it provides easy access for managers, researchers and visitors, but also negative in the sense that it facilitates unregulated harvesting and marketing of forest produce. Keeping in view of both relevant human system and biophysical system a zone of 5 km around the boundaries of the GR is taken as an interface landscape zone (Figure 6).

The rich coastal and natural resource base of this region has attracted migration from other parts of the country, resulting in a large landless population migrating from other parts of the country, resulting in a large landless population, who find seasonal employment in agriculture and illegal utilization of forest resources. As a result of refugee influx from Myanmar, a number of Rohinga camps and settlements have come up in between the Naf river and the eastern boundary of GR. A large number of betel leaf cultivation areas are noticed, particularly in and around the western boundary facing the Bay of Bengal. Local people cultivate betel leaf as a cash crop for which they collect forest materials such as bamboo, leaves, grass and small trees from the GR for erecting fences around their betel leaf fields, providing support to betel vines and also for roof construction for shade. On encroached forest lands they burn forest floor for the preparation of betel vine beds and also weed eradication. A part of land adjacent to the eastern boundary of the GR along the Bay of Bengal has been converted to prawn farms. Little or no natural forest borders the GR on the west, although some scrub vegetation remains. The personnel of Bangladesh Rifles (BDR), responsible for maintaining security along the Bangladesh-Mynmar Border, bring additional biotic pressure on one hand but on the other hand may help check illicit felling from the forests, if motivated.

6.2.1 Interface Villages

The human population is concentrated in a narrow strip of agricultural/settled land along the Bay of Bengal, and in more extensive flat topography bordering the GR on the east. This means that the GR is surrounded by dense populations, who are heavily reliant on fuelwood and other forest produce collected from the nearby forests.

Based on a RRA/PRA study conducted by NACOM during May-July 2004, a total of 115 settlements locally called *paras* or villages (spread over 6 unions : Zaliapalong, Whykong, Baharachara, Hnilla, Sabrang and Teknaf) have been identified having stakes of different levels in the GR. A total of 53 settlements are located inside the GR boundaries, whereas the remainder 62 paras are situated (adjacent or outside the GR) in the interface landscape zone. Nearly two-third of total paras (the villages inside and on the periphery of the GR) have major stakes in the WS as local villagers depend on the GR for meeting their basic consumption needs. In addition to fuelwood, timber, bamboo and other NTFPs, they collect vegetables, fruits, fodder and sungrass from the GR and also hunt wild birds. The remaining one-third paras (lying mainly outside the GR) have minor stakes, being associated with fuelwood collection. There are a number of tribal settlements (Tonchonga mainly in Shilkhali, Monkhali and Roikhong; and Rakhain-also known as Mogh- mainly in Hnilla and Whykong, etc.). Most of them are poor and get engaged as agricultural labourers, fuelwood collectors, fisherman, jhum cultivators, weavers, etc.

The arrival of Rohingya refugees from adjacent Mynmar during the later part of 1991 and the early part of 1992 resulted in an immediate population increase on the Teknaf Peninsula, creating a resource to population imbalance in a region where forest resources were already heavily exploited. They are located mainly at Jahajpura, Shamlapur and Teknaf, and harvest large quantities of ploes, , bamboos and fueldwood from the nearby forests to meet their shelter and cooking needs. So far only two settlements (Noyapara Camp 1 and 2) of Rohingas are legally recognized by the Government.

As per the PRA report, nearly 70% of local people are very poor followed by poor as 19% and the remainder as middle class. Nearly 80% of local people are landless but have homestead land on which they cultivate a variety of fruit and timber trees. Some practice cultivation of paddy on rainfed fields (Figure 7) and betel leaf cultivation on encroached land. They depend heavily on nearby forests for meeting their subsistence consumption needs; per the PRA report about 90% of total households depend on forests for meeting their fuelwood needs. Local people are involved in paddy farming, small scale trading and as daily laborers. Agriculture is the main income source of 53% of households, followed by fishing and shrimp collection (30%), day labourers (10%) and others (7%). On the western side of the GR facing Bay of Bengal most of the local people dpend on fish collection and betel leaf cultivation, whereas on the eastern side facing the Naf river most of the people depend on agriculture and forests. They also use nearby forests for fuelwood, timber and cultivation on encroached forest lands. An exploitative relationship of this large population with nearby forests has contributed to habitat degradation including lack of natural regeneration (due mainly to forest land encroachment, wide spread unemployment and rural poverty, weak law enforcement, illegal felling for timber and fuelwood, refugee settlements, betel leaf cultivation, brickfields, jhum, etc).

Table 6.2 Villages/Paras having stakes in Teknaf Game Reserve

Sl No	Village	Situation	Beat	Location	Level of Stake
1	Puranpara	Baharchara Union	Shamlapur	Inside	Major
2	Notunpara	Baharchara Union	Shamlapur	inside	Major
3	Guschha gram	Baharchara Union	Shamlapur	Adjacent	Major
4	Montoliapara	Baharchara Union	Shamlapur	Adjacent	Major
5	Jhumpara	Baharchara Union	Shamlapur	inside	Major
6	Rohingapara	Baharchara Union	Shamlapur	Adjacent	Major
7	Kerontoli	Whykong union	Whykong	inside	Major
8	Chammapara	Zaliapalong Union	Monkhali	inside	Major
9	Gilatoli	Whykong union	Whykong	Inside	Major
10	Chakmapara	Whykong union	Whykong	Inside	Major
11	Katakhali	Whykong union	Whykong	Adjacent	Moderate
12	Balukhali	Whykong union	Whykong	Adjacent	Moderate
13	horikhola	Whykong union	Whykong	Adjacent	Moderate
14	Ulubonia	Whykong union	Whykong	Inside	Major
15	Tulatoli	Whykong union	Whykong	Adjacent	Moderate
16	Whykong	Whykong union	Whykong	Near to Adjacent	Moderate
17	Chakmapara	Whykong union	Whykong	Inside	Major
18	Dhaingakata	Whykong union	Whykong	Inside	Major

Sl No	Village	Situation	Beat	Location	Level of Stake
19	Tanghaingapara	Whykong union	Whykong	Inside	Major
20	Lombagonal	Whykong union	Roikhong	Inside	Major
21	Laturikola	Whykong union	Roikhong	Inside	Major
23	Amtoli	Whykong union	Roikhong	Inside	Major
24	Lombabeel	Whykong union	Roikhong	Inside	Major
25	Unchiprang	Whykong union	Roikhong	Adjacent	Moderate
26	Roikhong	Whykong union	Roikhong	Inside	Major
27	Keruntoli	TK union	Teknaf	Inside	Moderate
28	Puran Pollan Para	2 no Ward, TK Pou	Teknaf	adjacent	Moderate
29	Kaikkhalipara	TK Pou	Teknaf	adjacent	Moderate
30	Islamabad & natun Pallan para	4 no Ward, TK Pou	Teknaf	adjacent	Moderate
31	Damdamia	TK union	Teknaf	Inside	Major
32	Teknaf Bazar	TK Pou	Teknaf	Adjacent	Major
33	Naitongpara	TK Pou, 1 no ward	Teknaf	Adjacent	Major
34	Kharak Khali	TK pou	Teknaf	adjacent	Minor
35	Uttar jaliapara	TK Pou	Teknaf	adjacent	Negligible
36	daksin jaliapara	TK pou	Teknaf	adjacent	Negligible
37	hangar para	TK pou	Teknaf	adjacent	Minor
38	daispara	TK pou	Teknaf	adjacent	minor
39	oliabad	TK pou	Teknaf	adjacent	minor
40	Teknaf reserve forest	TK uni	Teknaf	Inside to adjacent	major
41	hatir ghona	TK union	TK uni	adjacent	moderate
42	natun para	TK union	TK uni	adjacent	moderate
43	Baroitoli	TK union	Teknaf	Inside	Major
44	Nithongpara	TK union	Teknaf	Inside	Major
45	Lengurbeel	TK union	Teknaf	Inside	Major
46	katabunia	Subrang union	Teknaf	Near to adjacent	
47	Jahaliapara	TK union	Teknaf	Inside	Major
48	Hechapara	TK union	Teknaf	Inside	Major
49	Dumdamiapara	Hnilla union	Mosuni	Inside	Major
50	Jhadimurapara	Hnilla union	Mosuni	Inside	Major
51	Noyapara	Hnilla union	Mosuni	Inside	Major
52	Chakmapara	Hnilla union	Mosuni	Inside	Major
53	MoChunipara	Hnilla union	Mosuni	Adjacent	Moderate
54	Noyapara Rohinga Camp	Hnilla union	Mosuni	Inside	Major
55	Dhakhin Ledha	Hnilla union	Mosuni	Inside	Major
56	Moidho Ledha	Hnilla union	Mosuni	Inside	Major
57	Lesha Lamarpara	Hnilla union	Mosuni	Inside	Major
58	Ledha Puchingapara	Hnilla union	Mosuni	Inside	Major
59	Purba Rongikhali	Hnilla union	Mosuni	Inside	Major
60	Paschim Rongikhali	Hnilla union	Mosuni	Inside	Major
61	Uttar Ledha	Hnilla union	Mosuni	Adjacent + Inside	Moderate
62	Dakhin Alikhali	Hnilla union	Mosuni	Adjacent	Moderate
63	Moidho Alikhali	Hnilla union	Mosuni	Inside	Major
64	Ali Akborpara	Hnilla union	Hnilla	Inside	Major
65	Rojergona	Hnilla union	Hnilla	Inside	Major
66	Marichagona	Hnilla union	Hnilla	Adjacent	Major
67	Ali khali	Hnilla union	Hnilla	Adjacent	Moderate
68	Villagerpara	Hnilla union	Hnilla	Inside	Major
69	Shikderpara	Hnilla union	Hnilla	Adjacent	Moderate
70	Uttarpara	Hnilla union	Hnilla	Adjacent	Moderate
71	Dakhinpara	Hnilla union	Hnilla	Adjacent	Moderate

Sl No	Village	Situation	Beat	Location	Level of Stake
72	Konapara	Hnilla union	Hnilla	Adjacent	Moderate
73	Majherpara	Hnilla union	Hnilla	Adjacent	Moderate
74	Muslimpara(Maughpara)	Hnilla union	Hnilla	Outside	Moderate
75	Nikhang khali	Hnilla union	Hnilla	Adjacent + Inside	Major
76	Chowdhurypara	Hnilla union	Hnilla	Outside	Moderate
77	Fulerdail	Hnilla union	Hnilla	Outside	Moderate
78	Pankhali	Hnilla union	Hnilla	Adjacent + Inside	Major
79	Kutubdiapara	Whykong union	Moidho Hnilla	Adjacent	Moderate
80	Khanjorpara	Whykong union	Moidho Hnilla	Adjacent	Moderate
81	Karachipra	Whykong union	Moidho Hnilla	Adjacent	Moderate
82	Rajargona	Whykong union	Moidho Hnilla	Adjacent	Moderate
83	Noyapara	Whykong union	Moidho Hnilla	Adjacent	Moderate
84	Jimongkhali	Whykong union	Moidho Hnilla	Adjacent	Moderate
85	Purbo Satghariapara	Whykong union	Moidho Hnilla	outside	Moderate
86	Paschim Satghariapara	Whykong union	Moidho Hnilla	Inside	Major
87	Purbo Moheshkhaliapara	Whykong union	Moidho Hnilla	Adjacent	Moderate
88	Moheshkhalipara	Whykong union	Moidho Hnilla	Adjacent	Major
89	Komboniapara	Whykong union	Moidho Hnilla	Inside	Major
90	Nachorpara	Whykong union	Moidho Hnilla	Outside	Moderate
91	Maughpara	Hnilla union	Moidho Hnilla	Outside	Major
92	Dakhin Dailpara	Baharchara Union	Shilkhali	Inside	Major
93	Jahajpura Mathpara	Baharchara Union	Shilkhali	Inside	Major
94	Miarpara	Baharchara Union	Shilkhali	Inside	Major
95	Holbunia	Baharchara Union	Shilkhali	Adjacent	Moderate
96	Kaderpara	Baharchara Union	Shilkhali	Adjacent	Moderate
97	Uttaar Chakmapara	Baharchara Union	Shilkhali	Inside	Major
98	Dakhin Chakmapara	Baharchara Union	Shilkhali	Inside ,Adjacent	Major
99	Uttar Shilkhali	Baharchara Union	Shilkhali	Inside	Major
100	Chokiderpara	Baharchara Union	Shilkhali	Outside	Moderate
102	Rajar Chhara	TK Union	Rajar Chhara	Inside	Major
103	Habib Chhara	TK Union	Rajar Chhara	Inside	Major
104	Mithapanir Chhara	TK Union	Rajar Chhara	Inside	Major
105	Darga Chhara	TK Union	Rajar Chhara	Inside	Major
106	Tulatoli	TK Union	Rajar Chhara	Inside	Major
107	Hatirgona	TK Union	Rajar Chhara	Inside	Major
108	Lambari	TK Union	Rajar Chhara	Inside	Major
109	Kachchhapiapara	Baharchara Union	Mathabanga	Inside ,Adjacent	Major
110	Karachipara	Baharchara Union	Mathabanga	Inside ,Adjacent	Major
111	Noakhali	Baharchara Union	Mathabanga	Inside ,Adjacent	Major
112	Bordail	Baharchara Union	Mathabanga	Inside ,Adjacent	Major
113	Morisbunia	Baharchara Union	Mathabanga	Inside ,Adjacent	Major
114	Mathabanga	Baharchara Union	Mathabanga	Inside ,Adjacent	Major
115	Hajompara	Baharchara Union	Mathabanga	Inside ,Adjacent	Major

There are also a number of ethnic settlements (i.e. Chamma Para of Monkhali under Zaliapalong Union of Ukhia Thana, Chowdhuri Para, Nila Para and Kharang Khali of Hnilla, Chakma Para in Whykong) located in and around the GR.

6.2.2 Stakeholders Assessment

Primary and secondary stakeholder groups have been identified during the RRA/PRA exercise based on their involvement in the extraction of forest resources directly or indirectly from the GR. There are 22 primary stakeholders (fuelwood/timber collectos, betel leaf growers, forest produce collectors, hunters, fishermen, etc.), who are directly involved in forest resources extraction activities with major/moderate stakes, whereas 7 secondary stakeholders (brick field owners, timber/fuelwood merchant, saw mill owner, Boat owner/maker, Zeep owner, tea stall owner and outside visitors) have indirect influence on forests. Timber and fuelwood trading takes place in the Bazars of Teknaf (Teknaf Beat), Ledha (Mosumi Beat), Kalur (Mosumi Beat), Gum Gachhiola (Mosumi Beat), Whykong, Unchiprang (Roikhang Beat), Khanjorpara (Moidho Hnilla Beat), Noyapara (Moidho Hnilla Beat), Mina (Moidho Hnilla Beat), Bangla (Mathabanga), Morishbunja (Mathabanga), Shamlapur, Palong Khali, etc. Different institutional/organizational stakeholders include the government organizations (FD, BDR, Police, Local Government, etc.), NGOs and CBOs. Major NGOs operating in the area include Gonosastha, BRAC, ASA, SHED, SDVR, Grameen Bank and Kisholaya focusing on income generation activities through micro-credit, health, education, nutrition, etc. A number of CBOs (e.g. youth clubs, sammittees, etc.) currently operating in the interface landscape would be useful in NSP implementation. An informal forest protection committee at Jhazpura is actively protecting shilkhali garzan forests, and can be strengthened through support from FD.

6.2.3 Brickfields

Of the total 8 brickfields in and around the GR, 6 are located inside the boundaries; a clear violation of the Brick Act, 1989 and the Wildlife Act, 1974. On an average each brickfield consumes about 300 monds of fuelwood every day during their operation period of 7-8 months in a year; most of this demand is met illegally from the forests thereby degrading the GR.

6.2.4 Betel Leaf Cultivation

Betel leaf cultivation is quite a popular activity in and around the GR and a large number of people depend on it for their livelihood. Most of the betel leaf cultivation areas are located on the western side of the GR, particularly in Shaplapur, Shilkhali and Jhazpura. Many times forest land is encroached for establishing a betel leaf vein that is vacated after harvesting the betel leaves. In view of its popularity it seems that betel leaf cultivation is found more profitable than paddy cultivation by local cultivators. Main inputs in betel leaf cultivation include land, sapling vine, forest material for fences and roofs, irrigation, fertilizer, etc. Family labour is used in harvesting, processing and marketing of the betel leaves.

6.2.5 Forest Land Encroachment

Forest land encroachment, (particularly near the flat and gently sloping boundaries around the GR, for agriculture, brickfields, refugee camps and settlements is a serious problem in the GR. Many times the village elites are directly or indirectly associated with forest land grabbing. As per the official records of FD, 795.54 acres of forest land has been encroached in Whykhong (86.50 acres encroached by 258 persons), Shilkhali (496.96 acres encroached by 1100 persons) and Teknaf (212.08 acres encroached by 848 persons) Ranges. However, the extent of encroachment may be more than the officially recorded figures.

PART II

RECOMMENDING STRATEGIC PROGRAMS FOR A SUSTAINABLE PROTECTED AREA SYSTEM

1. PLAN OBJECTIVES AND CHALLENGES

1.1 Objectives of Management

The Plan focuses on protecting and conserving the rich biodiversity of Teknaf GR in accordance with sound principles of sustainable environmental and socio-economic development and the Forest Policy of 1994. Main long-term management aim is to maintain the maximum possible area under forest cover, and to maintain this forest and its constituent biodiversity in the best possible condition. Main objectives of the Plan are as follows :

- To develop and implement a co-management approach that will ensure long-term protection and conservation of biodiversity within the GR, while permitting sustainable use in designated areas by local people as key stakeholders;
- To conserve the biodiversity of the GR by following a co-management approach based on building partnerships with key stakeholders and sharing benefits with local communities and key stakeholders;
- To develop existing elephant movement corridors;
- To maintain connectivity and implement elephant conservation programs
- To refine and strengthen the policy, operational, infrastructural and institutional capacity framework for PA management;
- To conserve and maintain viable wildlife population including endangered, threatened, endemic and rare species of plants and animals;
- To implement income generation activities for sustainable livelihood development of local stakeholders and enhance thier skills of local stakeholders;
- To restore, protect and develop degraded forest eco-systems; and
- To encourage eco-tourism in suitable areas and develop visitor facilities/amenities

1.2 Framework Activities

Main framework activities to be undertaken for achieving the above-stated objectives include amongst others :

- Survey, demarcate and mark the Game Reserve boundaries;
- Develop a co-management model and relevant policy guidelines, and establish co-management agreements linking GR conservation with benefits sharing arrangements with key stakeholders;
- Restore, protect and develop degraded forest ecosystems;
- Survey biodiversity resources;
- Strengthen FD institutional capacity for the GR management;
- Build conservation awareness, constituencies and extension activities on conservation issues;
- Train local stakeholders including participants and FD field staff in conservation management, and raise awareness among stakeholders;
- Develop conservation and visitor facilities within the GR;
- Create tree resources in adjacent landscape on participatory conservation and benefits sharing basis and implement alternative income generation activities for sustainable livelihoods;
- Convert existing short-rotation plantations of exotic species to naturally regenerated areas by gradually opening the top canopy, and enrichment plantations of indigenous species in identified gaps; and
- Provide alternative income generation opportunities for key stakeholders.

1.3 Challenges in Achieving Management Objectives

Encroachment of forest lands and illegal removal of forest produce (mainly timber and fuelwood) are two main challenges facing the GR. Other important challenges include hunting and poaching, cyclone and erosion, land degradation, demarcation of GR boundaries, lack of funds, lack of trained professionals, brick kilns, Rohinga settlements, inadequate staffing and infrastructure, monoculture, man-animal conflicts, etc.

2. SUSTAINABLE PROTECTED AREA MANAGEMENT SYSTEM

2.1 Protected Area Management : Emerging Priorities

In earlier stages of forests management in the country, main objective of FD was production of wood, mainly timber. The value of other forest functions and services such as regulation of stream flow, source of biological diversity and sink for carbon content was neither adequately appreciated nor accounted for in forest management decisions. Consequently, the management of forests was based on partial valuation of forest functions and services. With the promulgation of Forest Policy of 1994, the forest management emphasis in Bangladesh shifted from timber production to ecological requirements, conservation of biological diversity, meeting bonafide consumption needs of local people and other services from forests.

A forest ecosystem creates its own micro-climate that is an integrated result of meteorological processes and the conditions within the space occupied by the forest ecosystem. Success of natural forest management depends upon adequate site information, understanding of plant communities and local people, nutrient availability, regeneration, etc. Management of natural forests for generating products and services while maintaining their environmental roles and multiple functions is possible, but silviculturally complex. An important process responsible for the sustainability of forest ecosystems is the biogeochemical cycling of nutrients. The leaves, twigs, small branches and fruits make the litter falling on forest floor. The litter is decomposed by micro-organisms (e.g. bacteria and fungi), adding nutrients to forest soils for plant growth. Forest management should thus be part of biodiversity and land management strategy so that perennial vegetative cover is maintained. The management system should be perceived as husbandary of renewable forest resource with attention to the protection of conservation, recreational and other values.

2.2 Management Strategies

Consistent with the definition of Game Reserve and Wildlife Sanctuary under the Wildlife (Preservation) (Amendment) Act, 1974 and the need to establish gainful partnerships with key stakeholders based on sustainable use, the following management strategies have guided the development of this Management Plan, and of the management and development programs outlined in Part-II. The overall focus of management planning in the GR is to manage it as natural and undisturbed condition as possible, and to provide protection to their constituent biodiversity including wildlife population. However, such a management of Teknaf would by necessity require gainful partnerships with key stakeholders in view of their intimate interspersion with human habitations and cultivation in a largely agrarian area with traditional dependency on neighbouring forests for livelihoods. Co-management approach within the parameters set by the NSP has, therefore, been adopted.

The maintenance and development of good quality forest cover with natural structure and composition, and the conservation of its constituent plant and animal biodiversity will guide the management of the GR. The management of Teknaf will focus on maintaining, and wherever necessary developing, natural forests with its constituent biodiversity. Hunting of wildlife and commercial felling from forests will not be allowed in keeping with the provisions of the Wildlife (Preservation) (Amendment) Act, 1974. However, subsidiary silvicultural operations required for natural forests regeneration will be carried out keeping in view of specific requirements of habitat management. Similarly sustainable use practices will be allowed by local people/stakeholders particularly in surrounding landscape based on co-management agreements, specifying roles and responsibilities for stakeholders partnerships. As far as possible subsistence use will be shifted gradually to interface landscape zones and no new settlement or in-migration will be permitted within the core zone. Visitor use for outdoor recreation, research and educational purposes will be encouraged in designated areas.

Boundaries of the GR will be surveyed, demarcated and maintained regularly. Specific zones/sub-zones will be designated for achieving different management objectives. Within the Game Reserve a management zone is an area of specific management category, distinguishable on account of its management objectives. Zonation will help achieve different management objectives by applying suitable management strategies and operations in each identified zone/sub-zone. The programs, prepared for each identified zone/sub-zone with specific management objectives and strategies, will be implemented over the plan period of five years. Some management strategies may be common to two or more zones/sub-zones and so will be detailed in the relevant zones. Such strategies may be related to habitat improvement, restoration and protection. Detailed strategies along with management practices are described described in detail in each zone plans in subsequent chapters.

2.3. Co-management Approach

Rural development efforts in Bangladesh have so far either been inadequate or failed to take into account relevant linkages between conservation of PAs and welfare of local people. Not only they are getting less production and employment opportunities due to decreasing land fertility and reduced underground water tables but also degraded forests are not able to meet their bonafide consumption needs for forest produce. The consequent degradation of both public and private land-based resources has resulted in widespread deprivation and rural poverty among local people. A gainful association of such rural mass, achieved by establishing appropriate partnership mechanisms, is essential for sustainable management of the GR. Co-management agreements are formal mechanisms for soliciting community interventions for the protection and conservation of the GR in lieu of identified benefits.

Collaborative management – or co-management - is defined as a situation in which two or more social actors negotiate, define and guarantee amongst themselves a fair sharing of the management functions, entitlements and responsibilities for a given territory, area or set of natural resources. An equitable sharing of benefits and costs of the GR' protection and management among the stakeholders is, therefore, an important part of co-management approach. An effective linking of socio-economic and ecological incentives and biodiversity conservation will be instrumental in eliciting stakeholders' participation in this approach. For Bangladesh's PAs, relevant co-management actors will include the FD, as legal custodian of PAs, and the stakeholders that play important role in the conservation management. Co-management agreements are important for linking participatory benefit sharing arrangements to the GR conservation and will help formalize symbiotic linkages. A 2-tier institutional structure comprising co-management council and co-management committee will be adopted. In addition to their important roles and responsibilities these co-management bodies will have an oversight role in Plan implementation and monitoring.

The NSP is designed to assist in achievement of the primary objective of conservation of biodiversity within 5 pilot of Bangladesh. This overall objective is to be achieved through support to the FD and key stakeholders in protecting, rehabilitating, conserving and sustainably managing biodiversity of the PAs by building gainful partnerships based on shared rights and responsibilities. Nishorgo Support Project is working in 5 pilot PAs to achieve the following six separate but closely related objectives in support of the above-stated co-management objective :

- Develop a functional model for formalized co-management of PAs;
- Create alternative income generation opportunities for key local stakeholders associated with pilot co-managed PAs;
- Develop policies conducive to improved PA management and build constituencies to further these policy goals;
- Strengthen the institutional system and capacity of the FD and key stakeholders so that improvements co-management under the Project can be made permanent;
- Build or reinforce the infrastructure within PAs that will enable better management and provision of visitor services at co-managed sites; and
- Design and implement a program of habitat management and restoration of pilot PAs.

Local communities are generally put to hardships after notification of a forest area as PA due mainly to curtailment of the flow of forest usufructs through strict regulation, and threats from wildlife to their life and property. Fragmentation of wildlife habitat due to loss of forest land has given rise to man-wildlife conflicts and a tenuous interface situation. Conservation-oriented management of PAs with strict restrictions on forest harvesting and enhanced patrolling have further excerbated their problems. Local people incur high opportunity costs in terms of foregone benefits, which they were deriving from the forests before the implementation of strict enforcement practices within a designated PA.

The local people, who were hitherto using forests for meeting their livelihood consumption needs, get deprived from forest-based benefits and so need to be compensated adequately for the loss of economic opportunities and wildlife damage to their life and property. This can be achieved by launching co-management projects such as Nishorgo Support Project and sharing the benefits with local people. So there is a strong case for compensating them by sharing benefit streams flowing through PAs and/or off-PAs alternative income generating (AIG) activities.

A sustainable partnership will require an equitable sharing of both benefits and costs. Due to widespread impoverishment of local people it is not expected that they will come forward in investing cash money in the conservation efforts of a PA. However, due to widespread unemployment and under-employment it is plausible to solicit their voluntary labour contribution in an effective protection and management of the PAs

and also create self-employment opportunities through alternative income generation activities. This will not only help in instilling ownership feeling among the partners but will also help utilize surplus labour productively for efficient allocation of human and land resources for effective wildlife and habitat conservation.

The stakeholders' rights (e.g. sharing of usufructs and revenue) and responsibilities (e.g. protection and conservation of biodiversity) need to be defined in co-management agreements. Easy access of stakeholders to PAs and protection measures against anthropogenic factors including illegal removals, encroachment, poaching and man-made fires should also be clarified. These agreements will play an important role in the protection and conservation of PAs.

Main focus of co-management in the GR is on equitably sharing roles and responsibilities by main stakeholders for biodiversity conservation. Benefits sharing from the harvests of plantations is a main mechanism for eliciting peoples' participation in social forestry and so the focus is on plantations as a part of community forestry. For instance, the harvests from plantations raised under FSP form seed money for Tree Farming Fund (10% of total proceeds from the harvests of plantations are earmarked as seed money for TFF). With focus on biodiversity conservation the flow of benefits to local people is much less in co-management of PAs when compared to participatory forestry. This means that benefit stream need to be strengthened for which LDF is being designed for funding alternative income generating activities. An initial amount of USD 300,000/- is earmarked to be used as seed money for granting small sums to user groups and co-management councils/committees.

2.4. Elements of a Sustainable Protected Area Management System

A study on assessment of the FD's institutional organization and capacity to manage the PA system of Bangladesh was completed under NSP with main objectives as, i) identifying main elements of a sustainable PA system, ii) assessment of current status of PA management elements and finally iii) making recommendations along with delivery mechanisms. Two broad elements identified were on institutional organization (management support systems), and training and capacity building. These two broad elements were further sub-divided into specific elements as below :

Institutional Organization : Management Support Systems :

- Organizational management
- Information management technology
- Spatial data management
- Financial organizational systems
- Institutional orientation to co-management
- Legal support
- Law inforcement
- Wildlife insurance
- Information, education and communication
- Research
- Monitoring and Evaluation
- Inter-sectoral conservation planning
- Public-private partnerships
- Sustainable financing

Training and Capacity Building :

- Staffing pattern
- Training facilities and capacity
- Training for professional specialist skills
- Integrated training for on-site PA field staff
- Integrated training for local community and other stakeholders

Some of the relevant aspects from the above-mentioned list are covered in this Plan.

3. HABITAT PROTECTION PROGRAMS

3.1 Program Objectives

Habitat degradation and loss of wildlife has occurred in the GR due mainly to heavy biotic pressure brought by manifold increase in population and agricultural demands. Main objective of this program is to provide adequate protection to the GR for the conservation of its constituent biodiversity. Main activities to be carried out to achieve this objective will include i) updating forest cover and interface landscape maps, ii) demarcating the GR boundary, iii) controlling illegal removals from the GR, and iv) checking encroachment of forest lands.

3.2 Updating of Existing Forest Cover and Landscape Maps

Detailed forest cover/landscape mapping for Teknaf is available with FD based on 1996 satellite imagery and relevant FD records. This mapping will be updated and used in management zoning by identifying core zones and interface landscape zones. It is recommended to complete this zoning during the Management Plan implementation based on field visits and stakeholders assessments. A map (Figure 7) prepared by FD is used in identifying the core area covering the entire gazetted area, and the surrounding landscape.

Reconnaissance surveys, followed by detailed surveys of identified areas, will be helpful in verifying actual ground situation. New mapping will be carried out during the Plan implementation and will include relevant landscapes within a 5 km-wide interface landscape zone outside of existing/proposed GR boundaries (to provide a spatial context for coordination of regional landscape elements and neighbouring forests). Mapping will be extended to include the forests and khas land portions of the landscape and will particularly focus on identifying remnant patches of natural vegetation. Land-use and base maps will be prepared by acquiring latest satellite imageries for the GR. These maps may be standardized after comparing with the previous RIMS maps. Actual maps may be produced based on ground truthing by making use of differential GPS.

3.3 Boundary Demarcation

All the peripheral boundaries of the GR will be identified, surveyed and marked on the ground. The boundaries of core and interface landscape zones will be defined, mapped and also be identified on the ground during the Plan implementation. The advantage of natural features (i.e. rivers, streams/*cheras*, ridge, roads, etc.) will be taken, wherever possible, while carrying out demarcation. Posts or other markers (wooden or iron pillers, trenches, mounds, etc.) will be put in place at all important and/or turning points and will be labeled. Sometimes boundary and markers are vulnerable to alteration due to human-interference or natural calamities such as floods. So a regular annual maintenance program will be necessary for boundary and pillar renovation and maintenance.

All the locations where primary access routes cross the GR's outer boundaries will be clearly marked with signs indicating the name and summarizing key regulations in written text and symbols. Signboards will be of the following types : i) attractively designed, large wooden signboards, and ii) concrete slab signboards (of the type currently used to mark plantations).

The traditional traversing method is generally used for boundary demarcation based on Gazette Notification. This method does not employ Aerial Photographs for re-validation. The boundaries of the GR have not been delineated keeping in view permanent natural features such as streams/rivers, roads and ridges. As a result, some inconsistencies creep in, particularly with respect to boundaries and areas of the GR. Some human errors during plotting the traverses and mapping are also not ruled out. The field maps have been used by RIMS to generate GIS databases (administrative boundary layers) through digitization. These problems can be solved either through traditional survey and mapping or else through DGPS guided survey using satellite technology. However, the traditional survey method may not produce desired accuracy and will indeed be costly in terms of time and manpower. So the DGPS survey, which may be accurate to sub-meter and would require limited manpower, may be employed for field work.

3.4 Control of Illicit Felling, Poaching, Fires and Grazing

Effective protection against illicit felling, poaching, forest fires and grazing are necessary for the conservation of biodiversity and management of the GR.

3.4.1 Control of Illicit Felling

Illicit felling inside the GR will be checked through extensive joint patrolling (FD staff and local stakeholders) inside the forests, particularly the core areas and proposed extensions. User groups and co-management councils/committees comprising local stakeholders will assist FD in joint patrolling forests. Stakeholders' participation in controlling petty theft will be very helpful, as being local people they are better informed about biotic pressure points and routes. Patrolling on foot by participants and FD field staff will regularly be done. In addition to controlling illicit felling they will also check the boundaries of GR and encroachment of forest land. It will be essential to regulate illegal running of sawmills and furniture shops located nearby the GR. Guidelines may include that no sawmill should function, say within 5 km boundary (interface landscape) of the GR.

An effective checking of organized smuggling of timber and fuelwood will require concerted efforts from FD by using modern equipments and transport facilities. In case of organized smuggling by outsiders there will be need for sophisticated fire arms and ammunition and training to combat organized poachers and smugglers. In such cases it may be necessary to give one Revolver and/or Rifle to each ACF/RO and DBBL guns to Beat Officer and FGs. This also may require setting up special protection force by augmenting the presence of FD field staff, if necessary backed up by local police and BDR officials. In such cases, an inter-agency coordination will be necessary for successful protection efforts and control measures. Similarly international coordination with Mynmar may be sought. Communication network particularly needs strengthening by installing a radio communication network and by mobilizing more walkies talkies, mobile telephones and vehicles. At least one four wheel jeep along with sufficient nos. of motor cycles will be provided for the use of FD field staff; each Beat would have at least one motor cycle.

Existing motorable roads will be maintained for easy movement of patrolling duties. But construction of new roads is not proposed as patrolling on foot will be more effective due to limited areas under the GR. Redeployment of FD field staff may be necessary depending upon the intensity of illicit felling in certain areas. Special incentives and amenities may be provided to the FD field staff posted in difficult areas. Adequate rewards will be provided to those field staff who perform exemplary protection duties. Similarly a group of local informers may be engaged based on payment of rewards to those local people whose information may lead to catching of smugglers. This may prove most effective against poaching of wild animals and theft of forest produce.

3.4.2 Control of Poaching

Poaching of wildlife inside the GR will be checked by FD field staff. Local stakeholders' participation in controlling poaching will be very helpful; joint patrolling on foot by participants and FD field staff will regularly be done. Special care will be taken during moon nights when incidences of poaching of elephants may increase due to better visibility. However, an effective checking of poaching by organized gangs will require concerted efforts from FD by using modern equipments and transport facilities. This also may require setting up special protection force, if necessary by involving local police and BDR officials. A public awareness program will be mounted through TV, Radio, Video film, newspaper, magazines, brochures, etc. for generating awareness among local people for propagating the cause of elephants and thier habitat.

3.4.3 Regulations of Non-Timber Forest Products (NTFPs)

NTFPs such as bamboo, cane and sungrass are presently collected from the GR by whosoever gets access. This collection process may be streamlined and entrusted to co-management councils/committees and user groups, who will be responsible for the collection of NTFPs (particularly medicinal forest products, sun grass, bamboo and canes) under overall guidance of FD field staff. An assessment of availability of selected NTFPs will be done before allowing NTFPs collection by the members of user groups and co-management committees/councils). This assessment will cover the regeneration status of NTFPs, time and methods of collection and limits of sustainable harvest. The collection of bark and roots will not be allowed. Similarly felling and lopping of trees will also not be allowed. Fruits, seeds, leaves used by wildlife will not be collected. If possible, the processing of NTFPs will be done locally in order to get value addition and generate employment opportunities.

3.4.4 Control of Forest Fires

Control of forest fires will be done by involving local stakeholders. Existing paths/tracks will be used as fire lines as well and will be maintained so by cutting and control burning of grasses and debris twice a year (say in December and March/April). Existing patrolling paths will be cleaned every year before fire season. Additional fire lines will be created at strategic places including regeneration areas. Local people engaged in grazing and NTFPs collection will particularly be targeted for making them aware about forest fire control. Publicity and awareness material will be developed and put up at convenient places for making local people aware about the necessity of forest fire control. The watch towers, to be developed for tourists, will also be

used for monitoring and control of forest fires. Similarly patrolling squads in association with local stakeholders will guard against forest fires as well. Communication network including walkie talkies will be used in forest fire control. Handy fire extinguishers and other fire fighting tools (e.g. fire beater, fire rake, fire shovel, brush hook) will be kept at HQs and other convenient places. A register of forest fire occurrences will be maintained for monitoring of forest fire incidences and assessing their adverse impacts.

3.4.5 Control of Forest Grazing

Villagers in and around the GR maintain cattle, who invariably let loose to graze in forests. No grazing will be allowed in the GR except allowed by the concerned DFOs, particularly rotational grazing in plantation areas. Stakeholders will be convinced not let loose their cattle in forests and also control the cattle of other villagers while patrolling for illicit felling and poaching. However, cutting and carrying of grasses from some specified areas such as plantations may be allowed for stall feeding of cattle maintained by local stakeholders. In the surrounding landscape silvi-pastoral models may be implemented and villagers may be provided such technologies (including seeds/slips) so that they can raise fodder plantations on their private lands and other unutilized khas lands. A public campaign will be undertaken by holding public meetings and distributing leaflets to make the local people aware about adverse effects of grazing.

3.4.6 Control of Forest Land Encroachment

Survey and demarcation of the peripheral boundary of the GR will be done during the first year of Plan implementation when encroachment areas will also be identified and evicted, if possible after obtaining the voluntary consent of encroachers.

3.4.7 Resolution of Man-Animal Conflicts

Wild animal depredation (e.g. elephants, monkeys) may be a problem in fringe villages. Local stakeholders will be responsible for checking wildlife damage. They will be trained by FD staff and partner NGOs and the equipments will be provided under the project for driving away wild animals. A provision will be kept for making compensation in case of elephant depredation. Currently neither a Wildlife Insurance Schemes for human-elephant conflict (e.g. injury, death, property damage, crop damage, etc.) and nor provision for damage compensation exist in FD. In some south Asian countries (and also in the Sundarbans of Bangladesh) compensation schemes through wildlife insurance have been developed as a mechanism to compensate the loss caused by wildlife. Similarly the budget provisions need to be made to FD for compensating the damage to private property and life by wildlife. The Wildlife Insurance and compensation for damage should be implemented in Bangladesh and be incorporated in the revised Wildlife Act.

3.5 Co-Management Agreements

The existing traditional use of forests for bonafide consumption inside the GR needs to be formalized through co-management agreements to be signed with groups of forest users. Detailed discussions will be held with existing forest users about their roles and responsibilities, and the type and quantity of benefits to be accrued to them on long-term basis in *lieu* of their current exploitative forest use to be foregone. Under FSP buffer plantations have been raised in Teknaf; participants formed into user groups take responsibility for protecting and managing the plantations in *lieu* of usufructury benefits ensured through PBSAs signed between them and FD. These PBSAs will be valid (and so renamed as co-management agreements) under NSP as well. The participants will also have responsibility for the protection of neighbouring forests of core zone in addition to the plantations assigned to them under FSP. In order to compensate them for additional responsibility of the protection of core areas, they will be helped through LDF for taking alternative income generation activities. Another set of co-management agreements will be signed with user groups to whom grant money will be provided for taking up alternative income generation activities in the interface landscape.

As per the Wildlife (Preservation) (Amendment) Act, 1974 no commercial harvesting is allowed inside the core zone and hence other relevant mechanisms of benefits flows to local communities need to be explored. Moreover, in future no regular plantations are planned to be established in the core areas. This means that no benefits will flow from the harvests of either plantations or naturally occurring trees. Some enrichment plantations of indegenous tree species, shrubs, herbs and grass species will be taken up by gradually opening the top canopy through selectively felling of exotic trees that are not suitable for wildlife. It is envisaged that the enrichment plantations of indigenous species will over a period of time develop similar to natural stands of forests to be retained in future as a part of suitable habitat for wildlife.

An important source of benefits to local people could be from the sustainable harvesting of NTFPs from the forests of GR. Similarly some forest produce will be available as a bye-product of subsidiary silvicultural

operations (SSOs) to be carried out for the improvement of wildlife habitat. Enhanced water yield as a result of habitat conservation can be an additional incentive to local people for agricultural purposes.

The above-enumerated benefits may not be sufficient to motivate local people and so additional benefits need to be mobilized through off-PA activities including AIG activities. The upscaling of skills of local stakeholders will be helpful in generating value additions through capacity building of local people. LDF will help provide grants to organized groups of local stakeholders to initiate alternative income generation activities and set up micro-enterprises, thereby offering self-employment opportunities. Benefits from eco-tourism can also be ploughed back for the development of local communities and GR.

3.6 Conflict Resolution

Forest conflicts among local stakeholders of the GR may relate to forest produce extraction, forest land encroachment, land disputes, forest offences, grazing, money lending, children and family affairs and local politics. Unlike the traditional forestry practiced in RFs, the chances of conflicts are more in co-management approach due to a number of actors/factors involved. Some of these conflicts may be resolved by local elites and public representatives. Identification of forest conflicts and the underlying reasons for such conflicts in co-management need to be done through field visits and close interactions with disputing parties by adopting participatory methods such as RRA/PRA, focus group discussions, diagnostic visits and stakeholders analyses.

Face to face interactions between disputing parties and use of communication tools such as audio-visuals will help establish a participatory process of conflict resolution based on dialogue and mutual trust. Building appropriate local institutions (e.g. regular meetings of co-management committees, and forming federations or umbrella groups and networks) as a platform for airing dissent and creating situations where local stakeholders can learn together are necessary for resolving Park conflicts. Some of the following steps may help prevent and resolve forest conflicts :

- Self-sensitization of FD and NGO staff is important
- Learn from the GR dependent communities instead of telling them as to what to do
- Using co-management tools to involve local stakeholders in the process of learning about GR use and management
- Appreciating and nurturing grounds of common interest on GR issues
- Generating recognition between individuals/user groups and underlining similarities of their aims and objectives on GR issues
- Establishing reliable information base on GR resources on which conflicts may be based
- Organizing short workshops and developing manuals on training on GR conflict resolution
- Conducting focus group discussions with co-management councils/committees to build consensus on collective goals as against individual gaols
- Raising questions on real GR issues, seeking options/suggestions from local stakeholders for co-management of the GR
- Developing, implementing and monitoring a plan of co-management action for the GR
- Follow up, networking and process documentation for future learning

The forest conflicts that cannot be resolved over a short period, need to be managed and transformed so as to enable their ultimate resolution in long-term. A negotiated management of a forest conflict may involve i) acting as catalyst in making understanding among disputing parties, ii) focusing on a particular situation being faced by disputing parties, iii) informal efforts (Track II) by local leaders/elders that may complement/supplement formal efforts (Track I) of co-management committees, FD staff and NGOs, iv) collaborative approach to negotiations, v) taking adequate preparations before starting of formal negotiations, and vi) adopting appropriate negotiation skills/tools. In some cases the disputing parties locked in an endless tit-for-tat retribution cycle may need a third party to push or pull them into a conflict management process. Intervention efforts through a third party may in such cases involve negotiation, facilitation, mediation or arbitration.

In summary a typical GR conflict resolution/management process may involve :

- Develop and institutionalize a mechanism for interactions and discussions at a common platform (e.g. co-management council/committee or user groups meetings)
- Allow disputing parties to present their versions of facts at a forum conducted by a neutral third person
- Build trust and confidence among the members of local stakeholders through informal interactions, discussions and social gatherings

- Explore with each party main areas of common concern/understanding where a consensus could be reached and issues resolved through dialogue among disputing parties
- Leave out contentious issues initially; flag areas of severe dissent where bridges need to be built
- Hold meetings with the representatives of both disputing parties to explore GR issues and bring about agreements among them
- Create a win-win situation for disputing parties by establishing a regular dialogue, patience listening, consulting with co-management committees to deflate potential GR conflicts and crises as they emerge. Seek solutions to the identified GR issues with tangible benefits to be shared equitably among disputing parties
- Develop and install confidence building measures before solving contentious issues and provide sufficient time for their implementation
- Attempt to resolve contentious issues by making use of local leadership. If needed outside help may be taken in the form of mediation, etc.
- Establishing a forum for maintaining a regular dialogue among disputing parties to review performance and discuss relevant issues of co-management of the GR
- Maintain a list of selected persons (e.g. villager leaders/elders), who can be available as facilitators/mediators.

3.7 Summary of Main Prescriptions

Main prescriptions outlined under the above-developed protection programs are summarized (Table 3.1) with respect to indicative timing of each proposed activity and responsibility assigned.

Table 3.1 Summary of Main Prescriptions

Year	Main Activities	Main Outputs/Success Criteria	Responsibility
1	-Procuring modern equipments, vehicles, tools, imageries/digital data, etc.	Equipments, vehicles & remote sensing products procured	FD/NSP
	-Reviewing the existing forest cover and land-use maps and updating them by using latest imageries/digital data and socio-economic information collected under NSP	Updated maps prepared by RIMS/CEGIS	RIMS/FD/NSP
	-Identifying, surveying and marking peripheral boundaries of the GR	GR boundaries identified, surveyed and mapped	FD/NSP
	-Posting of boundary pillars	-Boundary pillars in place	FD
	-Establishing co-management councils/committees, and forming user groups and youth clubs for biodiversity protection	Co-management councils/committees and user groups/youth clubs are in place	NSP/FD/ Stakeholders
	-Signing co-management MOUs and participatory benefit sharing agreements	Co-management MOUs & participatory benefit sharing agreements signed	FD/NSP/ Stakholders
	- Controlling poaching, forest land encroachment and illicit removals from the GR and checking forest grazing and fires by associating local stakeholders	Reduced level of biotic interference in the GR	Stakeholders/ FD/NSP
	-Regulating the collection of NTFPs through user groups/councils	Exploitative NTFPs harvesting checked	FD/Stakeholders
	-Providing incentives for good protection efforts and disincentives for poor protection	Capable FD field staff and stakeholders rewarded	FD/NSP

Year	Main Activities	Main Outputs/Success Criteria	Responsibility
	-Establish conflict resolution mechanisms through co-management committees	Conflict resolution mechanism in place	Stakeholders/ FD/NSP
2	-Delineating the GR's boundaries and management zones and putting pillars and markers	GR's boundaries delineated in field	FD/NSP
	-Maintaining a register of the GR's boundaries and pillars, and conducting annual inspections by supervisory FD field staff	Register updated and inspections done	FD
	-Conducting regular meetings of co-management councils/committees and user groups for providing effective protection against illicit felling, encroachment, forest grazing and fires	Reduced level of biotic interference	Stakeholders/ FD/NSP
	-Regulating the collection of NTFPs through user groups/councils	Exploitative NTFPs harvesting checked	FD/Stakeholders
	-Controlling poaching, forest land encroachment and illicit removals from the Sanctuary and checking forest grazing and fires by associating local stakeholders	Reduced level of biotic interference	Stakeholders/ FD/NSP
	-Providing incentives for good protection efforts and disincentives for poor protection	Good FD field staff and stakeholders rewarded	FD/NSP
	-Resolving forest conflicts	Certain no. of conflicts resolved	Stakeholders/ FD/NSP
3	-Maintaining a register of the GR's boundaries and pillars, and conducting annual inspections by supervisory FD field staff	Register updated and inspections done	FD
	-Conducting regular meetings of co-management committees and user groups for providing effective protection against illicit felling, encroachment, forest grazing and fires	Reduced level of biotic interference	Stakeholders/ FD/NSP
	-Controlling poaching, forest land encroachment and illicit removals from the Park and checking forest grazing and fires by associating local stakeholders	Reduced level of biotic interference	Stakeholders/ FD/NSP
	-Regulating the collection of NTFPs through user groups/councils	Exploitative NTFPs harvesting checked	FD/Stakeholders
	-Providing incentives for good protection efforts and disincentives for poor protection	Good FD field staff and stakeholders rewarded	FD/NSP
	-Resolving forest conflicts	Certain no. of conflicts resolved	Stakeholders/ FD/NSP
4	-Maintaining a register of the GR's boundaries and pillars, and conducting annual inspections by supervisory FD field staff	Register updated and inspections done	FD

Year	Main Activities	Main Outputs/Success Criteria	Responsibility
	-Conducting regular meetings of co-management committees and user groups for providing effective protection against illicit felling, encroachment, forest grazing and fires	Reduced level of biotic interference	Stakeholders/ FD/NSP
	- Controlling poaching, forest land encroachment and illicit removals from the Sanctuary and checking forest grazing and fires by associating local stakeholders	Reduced level of biotic interference	Stakeholders/ FD/NSP
	-Providing incentives for good protection efforts and disincentives for poor protection	Good FD field staff and stakeholders rewarded	FD/NSP
	- Resolving forest conflicts	Certain no. of conflicts resolved	Stakeholders/ FD/NSP
5	-Maintaining a register of the boundaries and pillars, and conducting annual inspections by supervisory FD field staff	Register updated and inspections done	FD
	-Conducting regular meetings of co-management committees and user groups for providing effective protection against illicit felling, encroachment, forest grazing and fires	Reduced level of biotic interference	Stakeholders/ FD/NSP
	- Controlling poaching, forest land encroachment and illicit removals from the Park and checking forest grazing and fires by associating local stakeholders	Reduced level of biotic interference	Stakeholders/ FD/NSP
	-Providing incentives for good protection efforts and disincentives for poor protection	Good FD field staff and stakeholders rewarded	FD/NSP
	- Resolving forest conflicts	Certain no. of conflicts resolved	Stakeholders/ FD/NSP

4. MANAGEMENT PROGRAMS

4.1 Program Objectives

It is recommended to declare Teknaf GR as Wildlife Sanctuary where main objectives of the management program will be to :

i) maintain ecological succession in constituent forests by providing effective protection against biotic interference,
ii) develop and maintain natural forests as good habitat, favouring wildlife,
iii) conserve the forest resources including the constituent biodiversity,
iv) identify and conserve elephant movement corridors, and
v) establish co-management practices through stakeholders' consultations and active participation.

4.2 Management Zoning

Land-use within the GR and the surrounding landscape will be managed based on sound co-management principles and practices applicable for sustainable biodiversity conservation. The general approach is to permit existing levels of land-use where these are manageable by means of zoning, and/or where they do not result in major adverse or irreversible environmental impacts. This includes the majority of existing and expected land-uses with some controls on location and use intensity.

Management zoning in and around the GR will be useful in implementing relevant management practices in different areas based on management objectives to be achieved spatially. The GR and surrounding land-use is, therefore, divided into two zones (core zone and interface landscape zone) based on existing forests, land-use, settlements, relevant landscape elements and management objectives. The proposed management follows internationally accepted management zoning principles (MacKinnon and MacKinnon, 1986) applied to a PA. It provides a basic spatial framework for protecting the areas of highest conservation value (natural vegetation/plantations, scrub forests, open forests, waterbodies, grasslands, etc.), for limiting the spatial extent of high impact activities (administrative and services, and transportation facilities), and for designating areas used to provide benefits to local people. Illegal removals and commercial harvests will be checked and stopped in order to achieve the objectives of the GR management.

Long-term management aim of maintaining the maximum possible area under dense and open forest cover along with its constituent biodiversity in the best possible condition will be achieved by zoning the GR area and surrounding landscape such that :

i) the areas of highest conservation value (forests and/or plantations, open forests, scrub forests, waterbodies, grasslands, etc.) are protected, regenerated and managed towards natural forest composition and structure, particularly in core zone, and
ii) the areas used to provide benefits to local people through sustainable use of forests are defined, and high impact activity areas, mainly as interface landscape zones.

The locations of existing GR and proposed extensions are provided in Table 4.2 as below.

Table 4.2
Location of Teknaf Game Reserve and proposed Extensions

Beat	Block	Area (ha)			
		Gazetted Area (GR)	Proposed		
			Sanctuary	Buffer Reserve	Elephant Corridor
Chotta Inani	Chotta Inani	-	1,708.5	-	-
Inani	Bara Inani	-	2,590.7	-	-
Jaliapalong	Jaliapalong	-	-	592.8	-
Rajapalong	Rajapalong	-	-	541.9	-
Swankhali	Ruppati	-	1,134.5	-	-
Swankhali	Swankhali	-	679.2	-	-
Hnila	Dakshin Hnila	742.0	742.0	-	-
Madhya Hnila	Madhya Hnila	1,537.8	1,537.8	-	-
Mathabhanga	Mathabhanga	788.3	788.3	-	-

Beat	Block	Area (ha)			
		Gazetted Area (GR)	Proposed		
			Sanctuary	Buffer Reserve	Elephant Corridor
Mochoni	Dumdumia North	749.0	749.0	-	-
Mochoni	Ledha	1,221.8	1,221.8	-	-
Rajarchara	Rajarchara	1,347.3	1,347.3	-	-
Silkhil	Silkhil	757.7	757.7	-	-
Teknaf	Dumdumia South	249.9	249.9	-	-
Teknaf	Teknaf	1,096.6	1,096.6	-	-
Dochari	Dochari	-	-	969.9	-
Thainkhali	Battali	-	868.8	-	-
Thainkhali	Palongkhali	-	1,123.9	-	-
Thainkhali	Thainkhali	-	1,090.2	-	-
Ukhia	Kutupalong	-	-	1,117.7	-
Ukhia	Uhalapalong	-	-	-	598.9
Ukhiarghat	Ukhiarghat	-	-	918.7	-
Monkhali	Monkhali	-	809.1	-	-
Raikheong	Raikheong	1,667.2	1,667.2	-	-
Saplapur	Saplapur	805.1	805.1	-	-
Whykheong	Whykheong	-	1,664.8	-	-
	Totals	10,962.7	22,632.4	4,141.0	598.9

The core zone and proposed extensions will have the highest conservation value followed by elephant movement corridors and interface landscape zones which of course are important for biotic life ; these are further subdivided into specific zones as discussed below.

4.3 Core Zone

The entire forest area gazetted by the Government of Bangladesh as GR is designated as core zone (Figure 7) due to its high conservation value and its proximity to riverine, marine, intertidal or beach areas. Main management aim in core zone is long-term protection of existing vegetation including remaining dense forests, open forests and mixed plantations, and rehabilitation of the area toward natural forest habitat. Main management objectives in the core zone are :

i) to protect and maintain remaining vegetation in good stocking and encourage natural regeneration to gradually bring back natural forests,
ii) to maintain connectivity of elephant movement corridors within the GR, and
iii) to improve forest habitat for elephants through selective management interventions while preserving and increasing the diversity and interspersion of habitat.

The core zone is constituted to preserve constituent forests and biodiversity in as near natural conditions as possible by providing an effective protection against all forms of biotic interference (illicit felling, forest land encroachment, poaching, forest fires and cattle grazing) and maintaining natural course of ecological succession. Forest management in this zone will focus on conserving remaining natural forests and bringing back natural vegetation (composition and structure), wherever possible. This will be achieved by providing protection (against illicit removals of forest produce, poaching, encroachment, grazing and fire) and encouraging natural processes for regeneration and rehabilitation of degraded forests. Monoculture of teak and other exotic species will need gradual canopy manipulation in order to create more favorable habitat for wildlife including elephants by encouraging natural regeneration and enrichment planting of indigenous trees, shrubs, herbs and palatable grasses. Subsidiary silvicultural operations will be carried out whenever necessary to encourage natural vegetation. Effective protection against biotic pressure (illicit felling, forest fires and grazing) will allow natural processes of regeneration in degraded forest areas.

Co-management practices will be implemented (through associated user groups and co-management councils/committees to be formed at different levels) in strengthening protection efforts against illicit felling, poaching, forest fires and grazing. In *lieu* of reduced removals (due to control of illicit felling) by the local communities from the core zone, they will be provided alternative means from interface landscape zones, and resources for alternative income generation activities for sustainable livelihoods. The visitor use of the

core zone will be regulated to allow low impact tourist activities in terms of hiking and wildlife watching; high impact visitor activities such as motorized transport and group pick nicks will not be allowed.

The protection efforts will be facilitated through communication outreach activities, public awareness, stakeholders' access to interface landscape zones in meeting their subsistence requirements. Enhanced enforcement by FD is required particularly in combating organized smuggling by outsiders. The members of user groups and co-management councils/committees will continue convincing local people not to send their cattle to forest areas for grazing. However, only sustainable use of selected NTFPs (e.g. bamboo, medicinal plants, honey, grasses) for bonafide consumption will be allowed in *lieu* of their increased protection efforts in the core zone. Control of forest fires will be through community efforts, and fire lines will be established in order to check spread of forest fires. Controlled burning will be used as a management tool, particularly in moist forest areas to encourage elephant fodder.

Subsidiary silvicultural operations will be carried out for encouraging natural regeneration of indigenous species. For example, gradual opening of top canopy through selective removal (leaving any indigenous and/or fruit trees) may be taken up in the areas having exotic plantations in order to create favorable conditions for natural regeneration. However, dead and hollow trees will not be removed as they provide shelter/nest to wildlife. Reduced impact logging methods (e.g. vine-cutting prior to felling, directional felling, non-mechanized skidding and hauling) will be employed during harvesting of exotic trees in order to minimize damage to natural growth and wildlife.

4.3.1 Habitat Improvement Works in Core Zone

Main factors responsible for habitat degradation will be identified by holding stakeholders consultations. Protection against the identified causal factors including illicit felling, forest fires and grazing, encroachment and poaching will be ensured by involving key stakeholders in co-management activities. Habitat improvement works including rehabilitation of degraded forest areas, enrichment planting of fruit bearing shrubs/trees and palatable grasses, thinning of exotic plantations, maintenance of glades and waterholes, replacement of exotics by gradual canopy opening in plantation areas, eradication of weeds from glades and wetlands, soil and water conservation, watershed development, water body development, etc. will be taken up. Gradual opening of top canopy in exotic plantations will be taken up mainly to replace existing exotic species and encourage natural regeneration to come up and get established. The collection of of selected NTFPs from core zone will be regulated in consultation with stakeholders. Salvage of dead, dying and diseased trees will be done only after leaving some dead trees suitable for wildlife nesting, etc. Different habitat improvement activities to be carried out in this zone are explained further as below.

4.3.1.1. Canopy Opening in Monoculture

This operation will be taken up on a limited scale in the plantation areas of core zone where the monoculture of exotics occurs. Inside the core zone there are patches of pure teak and other short rotation tree species that are not favoured by wildlife (they inhibit bushy undergrowth and middle storey to provide food and shelter for wild animals). Based on the following guidelines, the areas of monoculture will be identified for gradual (say 10 ha each year) canopy opening in teak and other exotic plantations :

- Dense teak and exotic plantations will be taken up for marking the trees, whose removal will open the canopy for natural regeneration to come up.
- Canopy opening will be done in small but irregular plots of say 2-4 ha, staggered to minimize disturbance to wildlife and its habitat (mosaic pattern of opening will provide better ground light penetration for natural regeneration).
- No canopy opening will be undertaken near waterbodies including *cheras* in order to avoid erosion.
- At least 50-150 trees/ha will be retained along with all the existing natural regeneration and advance growth.
- Marking of trees will be done after monsoon rains are over, and felling operations completed by February.
- After the felling the first year will be devoted for obtaining natural regeneration. During the second year suitable gaps will be identified for raising enrichment plantations (see below) of indigenous fruit bearing shrubs/trees (suitable for wildlife) and palatable grasses.

4.3.1.2. Enrichment Plantations of Indigenous Species

Enrichment and buffer plantations of indigenous species will be taken up in those areas where natural regeneration does not come up well due to lack of existing rootstock and mother trees. Fruit bearing species for wildlife and palatable grasses will be planted up in those areas where adequate regenerative rootstock may not exist. A list of framework species (defined as native species that grow rapidly, shade out

weeds and attract seed-dispersing wildlife) suitable for plantations is given in Volume 2. Enrichment plantations (say 360 seedlings/ha) of indigenous species may also be done after canopy is opened in monoculture of exotics. Buffer planting (spacing 2m x 2m) of indigenous shrub and tree species may be taken up in alternate rows whereas fruit tree species (nearly 10% of total stock) may be planted sporadically. Plantations of species attractive to butterflies, bees and other pollinator insects will be included in the planting species mix. A plantation journal will be maintained for each of the enrichment plantation. Nurseries will be raised well in advance. Maintenance operations including weeding and beating up operations will be taken up in subsequent years. Plantations will be protected against fire and grazing at least for initial three years. The practice of under-planting cane will be stopped as cane hinders the free movement of wildlife. Suitable species for plantations include siris, sisoo, simul, chikrasi, jarul, chalta, amla, bahera, ficus species, jackfruit, bamboo, etc.

4.3.1.3. Canopy Manipulation for Congenial Wildlife Habitat

Removal of congestion is required for easy movement of wildlife. So canopy of plantations will be manipulated properly to create congenial habitat for wildlife; two canopy manipulations say at 5th and 10th year of plantations can be taken up.

4.3.1.4. Development of Grasslands

Existing grasslands will be maintained and will be further developed by taking up the plantations of palatable grass along with other tree species as a part of enrichment plantations. Plantations of palatable grasses will be taken up in blank patches and will be protected against grazing and forest fires by involving local stakeholders. Suitable grass species for planting include *Typha angustifolia, Alpimia nigra, Themeda arundinacea, Saccharum arundinaceum, Sacharum longisetosum, Sacharum narenga, Sacharum hookeri, Phragmites karka, Arundo donax, Impreta cylinder, Sacharum spontaneum, Cymbopogan flexuosus* and *Setaria palmafolia*.

4.3.1.5. Maintenance of Waterbodies

This operation is applicable to the entire core zone. A number of natural waterbodies are present in the GR and they will be maintained for use of wildlife including elephants and also local people. An inventory of existing water bodies and a list of wildlife using different water bodies will be developed. Desiltation, cleaning and repairing may be necessary in those waterbodies where soil erosion has taken place. Biomass removed during cleaning may be handed over to local people. Stakeholders' participation will be ensured in maintenance of ponds/cheras by developing fisheries on usufructs sharing basis. Plantations of shrubs and vegetables may be taken up around water bodies by involving local stakeholders. Unauthorized fishing, hunting, cattle grazing and contamination of water should be checked by involving local people as a part of co-management activities.

4.3.1.6. Maintenance of Special Habitats

Areas rich in NTFPs including medicinal plants, orchids, grasses and other threatened species will be given special attention. Breeding sites of wildlife and any other special site (e.g. burrow) harboured by nocturnal animal will be protected and maintained. Over-storey trees with twisted boles, furrowed bark or natural cavities will be retained (say 3-5 nos./ha) to provide shelter to snakes, etc. Snags (hollow, dry, partially/fully dead standing trees, at least 1.5m in height and with a minimum of 20cm diameter at breast height) will be retained (say 3-5 nos./ha) for use by birds, small mammals and other life forms such as bacteria and fungi; fruit and NTFPs bearing trees will also be retained.

4.3.2 Habitat Restoration Works in Core Zone

Degraded habitats within the core zone will be restored naturally by carrying out low capital but labour intensive land-based habitat restoration activities in identified micro-watersheds. Specifically the following activities are recommended :

4.3.2.1. Micro-Watershed Management

Suitable micro-watersheds will be identified for carrying out habitat management practices within the natural boundaries of a drainage area. Such an identified micro-watershed will provide a context for a gainful participation of local people by taking on board the diversity of forests and human resources. Appropriate land husbandry practices in micro-watersheds will focus on *in-situ* moisture/soil conservation based on the percolation of rain water under-ground. This will enable the natural regeneration of indigenous vegetation, soil conservation and enhancement of moisture regime. Low input land husbandry technologies (e.g. half moon trenches, contour furrows, staggered trenches, mulching, hedgerows, small check dams, impounding pits, small ponds/tanks, soil barriers and traps, diversions ditches, etc.), which can be implemented by local stakeholders, will be developed by associating local stakeholders.

4.3.2.2. Eco-restoration

Good rainfall, abundant incident radiation and fertile soil are some of the favorable factors that are present in Teknaf for natural regeneration of forests ecosystem. The natural regeneration comes up rather well in Teknaf forests but do not get established due mainly to heavy biotic pressure. The protection against biotic factors will, therefore, be taken up before low-input oriented land husbandry practices can be implemented for facilitating eco-restoration process, necessary for the rehabilitation of forests and socio-economic development of local people. Degraded forests with recoverable rootstock will be restored through community protection by establishing suitable mechanisms under a co-management approach. Degraded forests with inadequate rootstock shall be taken up for assisted natural regeneration for recovering remaining rootstock, and enrichment planting in blanks.

Natural regeneration and ecological succession in this zone will be encouraged by carrying out eco-restoration activities in identified micro-watersheds. Low input soil and water conservation measures including stabilization of land slips and control of erosion of stream/*chera* banks will be taken up in identified areas. This will allow existing rootstock to be recovered through low-input forests management and land husbandry practices. Over a short period, woody vegetation cover will extend and gradually thin out the primary succession vegetation including weeds and grasses. Given protection against illicit felling and burning, plant succession will progress over a period towards semi-evergreen forests. The enrichment plantations of indigenous shrub and tree species (e.g. chapalish, chikrassi, toon, karoi, garjan, dhakijam, pynkado, gamar, albizzia, kadam, etc.) can be taken up in degraded and barren areas deficient in rootstock.

4.3.3 Elephant Movement Corridors (overlapping)

Main management objectives applicable for elephants movement corridors are to : i) ensure a continuous elephant movement corridor by checking any further fragmentation of elephant habitat, ii) provide community protection to both habitats and wildlife including elephants, and iii) provide diversified food, water and adequate shelter to elephants by restoring forests, water bodies and the habitat.

Elephants move between Bangladesh and the neighbouring forest regions of Arakan in Myanmar, and Assam, Meghalaya, Mizoram and Tripura in India. Elephants population in Bangladesh is estimated to be between 196 to 227 (IUCN, 2004). Due to habitat fragmentation elephant population in Bangladesh is now confined to isolated forest patches in Chunoti, Teknaf, Pablakhali and Bandarban/Lama, and migratory herds in Balijhuri and Durgapur Forest Ranges in Mymensigh Forest Division. Corridor establishment for elephants movement was recommended by IUCN (2004) between Chunoti and Satghar, Fasiakhali and Lama Range and Longadu and Baghaichhari. Two herds were found traveling regularly between Matirang and Rangunia. The route through Ramgarh, Manikchhari, Lakshmichhari, Fatikchhari, Kawkhali and Raozan is also recommended to as elephants corridor. Elephants are now confined only to some specific population ranges as documented by IUCN (2004) in Table 4.3.3.1 below :

Table 4.3.3.1 Elephant Movement Ranges in Bangladesh

Sl. No.	Forest Division	Present Elephant Movement Range	Previous Elephant Movement Range	Comments
1	Chittagong (South) Forest Division	Route 1 : Dudupukuria-Sukbilash-Khurushia-Komolchari-Padua-Vandalchari-Rangunia-Dohazari Route 2 : Jaldi-Chunoti-Lama	*Rangunia – Rajsthali – Chunoti - Nikheongchari	*Abondoned due to road construction, settlement, etc.
2	Chittagong (North) Forest Division	Ramgarh-Neptune tea garden-Dulu rubber garden-Dhuron-Golpahar-Manikchari-Laxmichari-Lamuchari-Bsrkol-Sorotha-Kaukhali-Adarshgram-Dhandachari tea garden-Holudia Dabura tea garden-Rauzan rubber garden-Rampahar	*Batna – Dhakya Colony – Kalapani – Sorotha - Rauzan	*Abondoned due to human settlement
3	Cox's Bazar (North) Forest Division	Fashiakhali-Dulahazara-Kotakhali-Idgao-Baisari-Gilatoli-Ramu-Rajarkul	-	-
4	Cox's Bazar	Teknaf-Shilkhali-Baharchara-Rangikhali-	*Teknaf-Cox's	*Abondoned

Sl. No.	Forest Division	Present Elephant Movement Range	Previous Elephant Movement Range	Comments
	(South) Forest Division	Horikhola-Monkhali-Inani-Panerchera	Bazar-Nikheongchari	due to Rohinga camps and Okhia TV Station
5	CHT (North) Forest Division	Route 1 : Suvolong/Chaillatoli-Boyragibazar-Mohazonpara-Rangipara-East Jalabad-Gulshakhali-Gaospur-Rajnagar-Choto Mahilla-Boro Mahilla-Schorakhali-Pablakhali Route 2 : Tin-Tila-Suknachari-Jubolaxmichari	*Sishok-Marisha-Baghaihat-Machalong-Sajek-Naraichari-Dighinala-Hatimara-Kerraillatoli	*Abondoned due to settlements
6	CHT (South) Forest Division	Route 1 : Kaptai Mouch Beat-Arachari-Dangamura-Rajsthali-Patachari-Suknachari Route 2 : Suvolong Route 3 : Sangrachari	Route 1 : Rampahar – Sitapahar Route 2 : Alikheong – Bilaichari – Urachari – Farua – Sukkurchari-Gobachari	-
7	Lama Forest Division	Fashiakhali-Kumari-Yancha-Eidgaor-Baisary-Nikheongchari-Manikpur	-	-
8	Bandarban Pulpwood Division	Dudupukria-Chemi-Rajsthali-Sitapahar	-	
9	Sylhet Forest Division	Route 1 : Jamkandi-Shamonbagh tea garden-Lathitial-Jury 2 Route 2 : Adampur border area-Pathorkhola tea garden-Kaluara no. 13 Union		
10	Khagrachari Forest Division	India-Ramgarh-Nakapa-Dhakya Colony-Batna-Datmara-Sapmara-Kalapani-Neptune tea garden-Fatikchari	-	-
11	Mymensingh Forest Division	Nalitabari-Rajibpur-Durgapur-Meghalaya		

Source : IUCN (2004)

In this Plan we will be focusing mainly on elephant movement corridors for Teknaf GR and nearby forest areas as described below.

4.3.3.1 Elephant Habitat Requirements

Elephants as umbrella wildlife species are important ecological part of a forest ecosystem and indeed indicate good biodiversity health. They inhabit a diverse habitat including tropical evergreen and semi-evergreen forests, moist forests, deciduous forests, hill forests, grasslands, scrub forests, etc. A suitable forest habitat for elephants simultaneously ensures protection of a number of other wildlife species in view of their broad habitat requirements. Elephants as large hervibore mammal require huge amount of forage, and water bodies for drinking and bathing. They prefer a mosaic of habitat types including patches of forests, scrub forests, bananas, forest clearings and intermittent open spaces, succulent grasslands and savanna. Sukumar (1989) summarizes main characteristics of elephant habitats as close proximity of seasonal foraging areas; water and mineral licks; availability of a mosaic of habitat types including forests,

clearings, scrubs, savanna, grasslands, and alluvial floodplains; availability of fodder species (mainly grasses, fruit bearing species, bamboo, banana); contiguous areas of habitat large enough to support a genetically viable population; and retention of seasonal movement corridors.

Teknaf habitat meet these requirements in terms of good amount of palatable grasses, scrub forests with open spaces, bamboo and herbs/shrubs, and a number of streams flowing through the GR. The available fodder species for elephants in Teknaf include bamboo, jackfruit, blackberry, mango, coconut, banana, fig, potato, grasses, etc.. Although a gradual change in climax evergreen forests to seral stages may result in an increase in carrying capacity of forests through enhanced forage production, further degradation to secondary forests as scrubs may indeed degrade carrying capacity. Similarly forest canopy opening through selective felling in dense plantation patches may be helpful in the regeneration of light demanders such as bamboo and palatable grasses that provide good food to elephants. Such dense forests, however, do not presently exist in Teknaf.

Controlled fires may be helpful in the development of fresh grasses in Teknaf forest areas. However, intense fires may be avoided as they might ultimately degrade the elephant habitat. A substantial contiguous forest area is required as suitable habitat for elephant, mainly for their seasonal movement but also to support a genetically viable population. However, the continuing fragmentation of the forest land in and around the GR poses a serious challenge for elephants and their habitat. As a result, the number of cases reporting crop damages by elephants in the nearby villages have off late increased. Main factors for habitat fragmentation in Teknaf include forest land encroachment for cultivation and settlement, forest degradation, Rohinga settlements, road construction, building of dams, etc.

Main considerations regarding elephant habitat change are summarized as below :

1. conversion of evergreen forest from climax to seral stages can result in an increase in browse and forage production, and hence increased carrying capacity for elephants, but carrying capacity may decrease if secondary forest is further degraded to the scrub stage;
2. selective logging in closed canopy forest can result in positive habitat changes, to the extent that light-demanding plants that are also elephant food species (e.g. bamboos and other grasses) become established in disturbed areas;
3. occasional ground fires in forests can increase forage availability, but regular fires reduce carrying capacity by degrading tree cover and species composition;
4. clearing for plantations causes adverse habitat changes, although impacts may be reduced where planted species have some value as elephant forage (e.g. acacia, eucalyptus), the scale of plantations is limited, and/or forage plants are retained in the understorey;
5. heavy removal of fuelwood ultimately degrades natural vegetation cover, reduces standing biomass, and reduces food availability for elephants, and
6. elephants that loose parts of their home range to agricultural production, or that otherwise are confined to highly fragmented habitats, are prone to becoming crop raiders.

4.3.3.2 Elephant Habitat Suitability Assessment

Habitat suitability models focusing on key wildlife species are widely employed for attaining biodiversity conservation within the context of sustainable landuse management (Verner et al. 1986 and Kernohan 1999). Elephant habitat suitability assessment in Teknaf is necessary for providing a quantitative basis for implementing and monitoring management programs, and also taking decisions on extending the GR area. The details (see Table 4.1 as below) of forest/landuse cover (Figure 8) in the existing GR and the proposed areas are obtained from the database maintained by FD.

Table 4.3.3.2 Forest/Landuse Cover and Habitat Suitability in Teknaf

Cover Type	Assigned HSI value	Gazetted GR Area (ha)	HUs for GR	Proposed Sanctuary Area (ha)	HUs for Sanctuary	Proposed Buffer Reserve (ha)	Proposed Elephant Corridors
Dense forest	0.7	887.5	621.2	3678.0	2574.6	9.4	0.0
Open forest	1.0	1511.1	1511.1	5147.1	5147.1	1368.3	2.9
Scattered trees	0.8	4393.4	3514.7	4512.8	3610.2	67.3	0.0
Brush	0.6	423.4	254.0	693.1	415.9	230.8	0.0
Long rotation plantations (more than 50 years old)	0.5	22.6	11.3	91.0	45.5	0.0	0.0
Long rotation plantations (25-50 years old)	0.5	398.6	199.3	1940.6	970.3	12.1	268.6
Long rotation plantations (less than 25 years old)	0.2	1701.0	340.2	3798.8	759.8	1001.8	14.5
Short rotation plantations (more than 10 years old)	0.3	106.6	32.0	167.7	50.3	80.8	30.9
Short rotation plantations (1-10 years old)	0.1	164.2	16.4	285.6	28.6	401.7	109.1
Failed plantations	0.2	713.0	142.6	1244.5	248.9	905.3	8.5
Encroachments	0.0	11.9	0.0	60.7	0.0	16.7	159.9
Agriculture (no FD jurisdiction)	0.0	628.3	0.0	994.8	0.0	30.1	4.5
Open/eroded areas	0.0	0.0	0.0	6.7	0.0	0.0	0.0
Waterbodies	1.0	1.1	1.1	11.0	11.0	0.0	0.0
FRI area		0.0		0.0		16.7	0.0
TOTAL		10,962.7	**6,644.9**	22,632.4	**13,862.2**	4,141.0	598.9

A generic habitat suitability index (HSI) value (on a scale of 0.0 – indicating no habitat value to 1.0 – indicating the best possible habitat conditions) was assigned (Table 4.3.3.2) to each of the forest/landuse types based on the above-described elephant habitat requirements. Disaggregated Habitat Units (HUs) have been estimated, both for the gazetted GR and the proposed Sanctuary (extended GR), by multiplying the assigned HSI value to the corresponding forest/landuse area. Aggregated HUs for the GR and Sanctuary are 6,645 and 13,862 respectively. The estimated loss of elephant habitat from the GR area of 10,963 ha to 6,645 HUs is not very high due mainly to the fact that elephants prefer habitats characterized by open forests and scattered trees. This means that although high forests have been degraded to open forests (providing 53% of the GR's HUs) and scattered trees (providing 23% of the GR's HUs), there is not much reduction in the habitat area suitable for elephants. In case the Sanctuary is notified with proposed extended area, the suitable elephant habitat will indeed more than double (from the present 6,645 to 13,862 HUs); most of the proposed extension comprises open forests and scattered trees (providing 63% of the extended GR's HUs) that are very suitable for elephant habitat.

An important management implication emerging from this habitat suitability assessment is to prioritize habitat protection and management efforts in the identified open forest and scattered tree areas as shown in Figure 8. Planted areas can be managed as sustainable use areas without much disturbance to elephant habitats. The conversion of forests to non-forestry purposes including agriculture and other encroachments should be stopped herewith. A periodic assessment of forest/landuse cover (and estimation of HUs) will help monitor the effectiveness of co-management interventions being currently undertaken under NSP.

4.3.3.3 Challenges and Opportunities for the establishment of Elephant Movement Corridors

Elephants are listed in the Third Schedule of the Bangladesh Wildlife (Preservation) (Amendment) Act, 1974 implying thereby their full protection from hunting, killing and capture from the wild. The Asian Elephant is included in CITES Appendix I, and so completely interdicting international trade. It also is included in IUCN Redbook (2000) and so categorized as a critically endangered species. IUCN (2004) has identified 4 main threats to elephants in Teknaf as i) habitat loss, ii) elephant fodder species scarcity, iii) jhum, and iv) fragmented corridors. As a result of encroachment of forest land (loss of habitat and movement corridors for elephants) for agriculture and settlements, local people are generally opposed to elephant conservation efforts. Elephants sometime damage their cultivated fields, thereby generating man-animal conflicts due to reduced availability of food and habitat for elephants.

Due to widespread poverty local people depend upon the GR for the collection of fuelwood, sungrass and bamboo, which they use mainly for self-consumption but also for cash sale. Even coppice shoots, bamboo and naturally regenerating saplings including fodder species are felled for fuelwood. Sun grass is over-harvested by local people as thach material. Poor infrastructure and lack of FD field staff and funds have led to weak forest protection and inadequate control of forest land encroachment. The control of illegal felling, forest land encroachment, poaching of wild animals, forest fires and grazing is not possible without active involvement of local people. It is, therefore, necessary to involve local people in biodiversity conservation through co-management efforts including sustained motivation and alternative income generation activities.

4.3.3.4 Development of Elephant Movement Corridor in Teknaf

Habitat improvement works (see Section 4.3.1) and eco-restoration activities (see Section 4.3.2.2) will be undertaken to develop elephant movement corridors within the core zone. Buffer plantations can be raised on the periphery of the GR by involving local people on usufructs sharing basis. The existing elephant corridors will be protected from any further fragmentation. For the development of Teknaf (and Chunoti) corridors a separate scheme entitled as Project Elephant may be taken by FD.

4.3.4 Sustainable Use Sub-zone

The existing habitations and cultivations including encroachment areas inside the GR are included in this Sub-zone. Such areas will be identified in the first year and delineated with markers and the existing inhabitants will be registered and further in-migration and encroachment will be discouraged. As important stakeholders, the villagers from the inside villages will be engaged in co-management activities. This sub-zone also comprises plantations within the GR 9particularly the plantations located on the periphery of GR), which can be protected by local people on a sustainable use basis (short-rotation plantations, which may be assigned to local communities for meeting their bonafide consumption needs for fuelwood, timber, NTFPs and other products). The participants will, in addition to the protection of plantations, be responsible for providing biodiversity protection in core zone. These plantations will not be clear-felled but instead be managed under selection felling (mainly of exotic species) so that the area can be naturally regenerated as a mixed forest of indigenous species. In such a case, the existing participants will be well compensated through off-PA alternative income generation activities to be carried out for their sustainable livelihoods and biodiversity conservation of the GR.

4.3.5 Special Visitor Use Sub-zone (overlapping)

This sub-zone will comprise identified hiking trails, watch towers, view points, caves, rest sheds, litter collection points, and other natural features that visitors may find attractive, and where special management measures are required to maintain safety and prevent damage to the resource.

4.4 Interface Landscape Zones

Interface landscape zones will focus on the surrounding landscape that is helpful in protecting and conserving the core zone, and creating congenial habitat for wildlife including protecting and maintaining elephant movement corridors. As opportunities for receiving tangible benefits from the conservation-oriented management of core zone are less, adequate provisions will be made for off-forest livelihood opportunities provided to the local stakeholders in the interface landscape. Subsistence consumption needs of local people for fuelwood, NTFPs and timber will be met through co-management practices. Though interface landscape zones/sub-zones will have comparatively less conservation value, they will play an important role in supporting the biodiversity conservation in the core zone including connectivity of elephant movement corridors. Interface landscape zone is further categorized into four sub-zones (buffer reserve

sub-zone, intensive use sub-zone, transport corridor sub-zone and elephant movement corridors sub-zone) depending upon the uses to which different areas are managed. The management of these specific sub-zones is discussed as below. In addition, appropriate mechanisms will be explored to ensure that important ecosystems/landscapes elepments including marine, intertidal or beach zones are included under effective and integrated PA management.

4.4.1 Proposed Extension Sub-Zone

This sub-zone (see Figure 7) comprises the remainder natural vegetation/plantations and degraded forests (an extension to the north of the GR incorporating the remaining portion of Whykheong Range and parts of Ukhia and Inani Range), which can over the period be gazetted (10,985 ha of RF land) by FD as part of core zone and managed based on the principles and practices described as above (Section 4.4). Expansion to include adjacent forests would, therefore, nearly double the size of GR where main long-term aim will be to maintain the maximum possible area under forest cover with significant potential for biodiversity conservation, nature-based recreation and eco-tourism.

4.4.2 Buffer Reserve Sub-Zone

This sub-zone (see Figure 7) comprises the remainder open forests/plantations (nearly 4,100 ha of RF in Ukhia and Inani Ranges, located further to the north-east of the proposed extension sub-zone as described in Section 4.5.1) that can be put under sustainable use to reduce biotic pressure in the re-gazetted GR. Management of this area will focus on intensive production of replacement resources, particularly fuelwood, poles and timber, and on maintaining stability as elephant habitat. Existing short and long rotation plantations will be brought under PBSAs as applicable under FSP. However, the participants will, in addition to the protection of plantations, be responsible for providing biodiversity protection in the GR areas. These plantations will not be clearfelled but instead be managed under selection felling (mainly of exotic species) so that the area can be naturally regenerated to be ultimately included in core zone as a mixed forest. In such a case the existing participants will be well compensated through off-PA alternative income generation activities to be carried out for sustainable livelihoods. Vacant forest lands without adequate rootstock will be taken up for buffer plantations and managed by following the relevant FSP guidelines.

The management of FD lands in this sub-zone will focus on sustainable use of the remaining natural patches, bringing existing plantations under co-management practices, raising participatory plantations of indigenous species in vacant areas, checking conversion of forest land into agriculture and maintaining biodiversity conservation values. Local stakeholders will be identified and co-management agreements signed for providing livelihood opportunities and protecting habitat. Co-management forestry consistent with biodiversity conservation will be implemented after preparing a site-specific annual plan. For example, enrichment planting and subsidiary silvicultural operations will be defined in this site specific annual plan. Reduced impact logging techniques will be followed in case selective harvesting is prescribed in the site specific plan.

4.4. 3 Elephant Movement Corridors Sub-Zone

It is important to ensure good connectivity between the re-gazetted GR, buffer reserve sub-zone and, the existing FD lands/elephant habitat (nearly 600 ha : see Figure 7) that lies to the east (of proposed buffer reserve sub-zone, between the Cox's Bazar-Teknaf Road and the boundary with Lama Forest Division) in order to maintain seasonal elephants movement corridors. The management focus in this sub-zone will be on ensuring that existing or traditional elephant movement corridors through this area, linking elephant habitat in the GR with more extensive habitat in Lama Forest Division, the Chittagong Hill Tracts and Myanmar, are maintained. Suitable mechanisms will be explored to ensure that existing or traditional elephant movement corridors through this area (specifically Uhalapalong Block of Ukhia Range, an area of approximately 600 ha), linking elephant habitat in the GR with more extensive habitat in Lama Division, the Chittagong Hill Tracts and Mynamar, are maintained. This elephant movement corridor in the landscape zone is in addition to the core zone areas that are used by elephants for their movements. It is important to maintain and indeed develop these movement corridors in order to provide good connectivity (including food and shelter) between the GR and other adjoining habitats of elephants. Main efforts in this sub-zone will focus on maintaining these corridors by checking their further fragmentation and encroachment, and forest restoration activities.

4.4.4 Intensive Use Sub-Zone

Intensive Use Sub-Zone incorporates the relatively small areas required for administrative buildings and staff quarters, visitor accommodations and other facilities. The GR HQ will be developed at Teknaf with administrative buildings (GR Hqs, Beat Office, etc.), staff quarters, visitor facilities (e.g. Environmental Education Centre) and other infrastructure facilities. Future facility development will be based on environmentally friendly guidelines and green management principles. Adverse environmental impacts of

infrastructure development will be minimized by carrying out Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) before taking up design, construction and operation building works. Green management will ensure that designs, materials and construction works are compatible with the natural background; that water, air and solid waste pollution is checked; and that other adverse environmental impacts are avoided or minimized during construction and operation. Detailed guidelines for facilities development are discussed in the next Chapter.

4.4.5 Transportation Corridor Sub-Zone

The FD management will take proper initiatives in developing the necessary communication channels and agreements with the operators of roads and other linear facilities (Roads and Highway Department) in order to get their cooperation in preventing and limiting noise and chemical pollution and by minimizing the width of vegetation clearing during RoW maintenance. For example, the Roads and Highways Department will not only provide to FD staff free access to GR but also help regulate traffic in order to avoid damage to wildlife and vegetation.

4.5 Zonal Boundaries

Boundaries of intensive use zone and transportation corridor zone will be identified by permanent physical features such as streams, roads, settlements/villages, concrete pillars, etc. The boundaries of core zone will be marked with posts having legible inscriptions in Bangla for easy differentiation. One corner of each use area will be marked by a concrete signboard indicating the management regime and the identification of user group responsible for co-management of the forest area. The GR staff will explain the system to local stakeholders for their wide acceptance and publicity.

4.6 Summary of Main Prescriptions

Main prescriptions outlined under the above-developed management programs in Core and Landscape Zones are summarized in Tables 4.7.1 and 4.7.2 with respect to timing of each proposed activity and responsibility assigned.

4.6.1 Summary of Main Prescriptions in Core Zone

Main prescriptions outlined under the above-developed management programs in Core Zones are summarized in Table 4.2 with respect to timing of each proposed activity and responsibility assigned.

Table 4.6.1 Summary of Main Prescriptions in Core Zone

Yr	Zones	Main Activities	Main Outputs/ Success Criteria	Responsibility
1	Core Zone	-Carrying out subsidiary silvicultural operations required for encouraging natural regeneration (including gradual canopy opening in exotic monoculture and enrichment planting in identified gaps without rootstock)	Natural regeneration established	FD
		-Carrying out silvicultural operations for improving habitat for elephants including enrichment plantations of fruit/fodder species	Enhanced elephants conservation	FD
		-Implementing elephant habitat improvement works (canopy manipulation, grassland development, special habitats maintainance, waterbodies development, etc.)	Improved elephant habitat	FD
		-Implementing elephants habitat restoration works (identification of micro-watersheds, watershed management, eco-restoration	Rehabilitated elephant habitat	FD

Yr	Zones	Main Activities	Main Outputs/ Success Criteria	Responsibility
		activities including soil/water conservation and other low input land husbandry practices)		
		-Maintaining special habitats	Special habitats restored	FD
		-HSI model implemented and used for monitoring elephant habitat extension	Extended elephant habitat	FD
		- Involving local stakeholders in forest/elephants protection, and in income generation activities by using LDF	Forests regenerated & Villagers' income enhanced	FD/ Villagers/ NSP
	Special Visitor Use Sub-zone (overlapping)	-Motivating local people to adopt biodiversity friendly betel leaves growing practices	Cleaning of forest floor stopped	FD/ Villagers/ NSP
		-Signing benefit sharing agreements with the villagers for protecting nearby plantations and associating them in LDF funded activities	Income of villagers enhanced and forests protected	FD/ Villagers/ NSP
		Existing hiking trails (3) are used by eco-tourists	Increased flow of eco-tourists	FD/NSP
2	Core Zone	-Carrying out subsidiary silvicultural operations required for encouraging natural regeneration (including gradual canopy opening in exotic monoculture and enrichment planting in identified gaps without rootstock)	Natural regeneration established	FD
		-Carrying out silvicultural operations for improving habitat for elephants	Enhanced elephants conservation	FD
		-Implementing habitat improvement works (canopy manipulation, grassland development, special habitats maintainance, waterbodies maintainance, etc.)	Improved elephant habitat	FD
		-HSI model implemented and used for monitoring elephant habitat extension	Extended elephant habitat	FD
		-Developing special habitats	Specials habitats developed	FD
		-Implementing habitat restoration works (identification f micro-watersheds, watershed management, eco-restoration activities including soil/water conservation and other low input land husbandry practices)	Rehabilitated elephant habitat	FD
		- Local stakeholders continue to involved in forest protection, and in income generation activities by using LDF	Stakeholders' income enhanced	FD/NSP/ Stakeholders FD/Villagers

Yr	Zones	Main Activities	Main Outputs/ Success Criteria	Responsibility
		-Encourage local Villagers to adopt biodiversity friendly betel leaves growing practices	Cleaning of forest floor stopped	FD/Villagers/ NSP
	Special Visitor Use Sub-Zone	-With the villagers of peripheral villages continue protecting nearby plantations and core areas by associating them in LDF funded activities	Income of villagers enhanced and plantations and core protected	FD/NSP
		-New hiking trails are identified and used by eco-tourists	More no. of eco-tourists visiting the GR	
3	Core Zone	-Carrying out subsidiary silvicultural operations required for encouraging natural regeneration (including gradual canopy opening in exotic monoculture and enrichment planting in identified gaps without rootstock)	Natural regeneration established	FD
		-Carrying out silvicultural operations for improving habitat for elephants	Enhanced elephants conservation	FD
		-Implementing habitat improvement works (canopy manipulation, grassland development, special habitats maintainance, waterbodies maintainance, etc.)	Improved elephant habitat	FD
		-Implementing elephants restoration works (identification f micro-watersheds, watershed management, eco-restoration activities including soil/water conservation and other low input land husbandry practices)	Rehabilitated elephant habitat	FD
		-Continue involving local stakeholders on, and in income generation activities by using LDF	Local Stakeholders' income enhanced	FD/Local Stakeholders/ NSP
		-Continue motivating local villagers to adopt biodiversity friendly betel leaves growing practices	Cleaning of forest floor stopped	FD/villagers/ NSP
		-Villagers of peripheral villages continue protecting nearby plantations	Plantations protected	FD/Villagers/ NSP
4	Core Zone	-Carrying out subsidiary silvicultural operations required for encouraging natural regeneration (including gradual canopy opening in exotic monoculture and enrichment planting in identified gaps without rootstock)	Natural regeneration established	FD

Yr	Zones	Main Activities	Main Outputs/ Success Criteria	Responsibility
		-Carrying out silvicultural operations for improving habitat for elephants	Enhanced elephant conservation	FD
		-Implementing elephant habitat improvement works (canopy manipulation, grassland development, special habitats maintainance, waterbodies maintainance, etc.)	Improved elephant habitat	FD
		-Implementing habitat restoration works (identification f micro-watersheds, watershed management, eco-restoration activities including soil/water conservation and other low input land husbandry practices)	Rehabilitated elephant habitat	FD
		-Continue involving local people in forest protection, and in income generation activities by using LDF	Stakeholders' income enhanced	FD/NSP/Local people
		-Continue motivating farmers to adopt biodiversity friendly betel leaves growing practices	Cleaning of forest floor stopped	FD/Local farmers/NSP
		-Villagers of peripheral villages continue protecting nearby plantations raised under FSP and other GOB schemes	Plantations protected	FD/Villagers/ NSP
5	Core Zone	-Carrying out subsidiary silvicultural operations required for encouraging natural regeneration (including gradual canopy opening in exotic monoculture and enrichment planting in identified gaps without rootstock)	Natural regeneration established	FD
		-Carrying out silvicultural operations for improving elephant habitat	Enhanced conservation of elephants	FD
		-Implementing elephant habitat improvement works (canopy manipulation, grassland development, special habitats maintainance, waterbodies maintainance, etc.)	Improved habitat for elephants	FD
		-Implementing habitat restoration works (identification f micro-watersheds, watershed management, eco-restoration activities including soil/water conservation and other low input land husbandry practices)	Rehabilitated habitat for elephants	FD
		-Continue involving local people in forest protection, and in income generation activities by using LDF	Villagers' income enhanced and forests protected	FD/Villagers/ NSP
		-Continue motivating local villagers to adopt	Cleaning of	FD/Villagers/ NSP

Yr	Zones	Main Activities	Main Outputs/ Success Criteria	Responsibility
		biodiversity friendly betel leaves growing practices -Villagers of peripheral villages continue protecting nearby plantations	forest floor stopped Plantations protected	FD/NSP/ Villagers

4.6.2 Summary of Main Prescriptions in Landscape Zone

Main prescriptions outlined under the above-developed management programs in various sub-zones of the Landscape Zone are summarized in Table 4.7.2 with respect to timing of each proposed activity and responsibility assigned.

Table 4.6.2 Summary of Main Prescriptions in Landscape Zone

Yr	Sub-Zones	Main Activities	Main Outputs/ Success Criteria	Responsibility
1	Proposed Extension Sub-Zone	-proposed extended RF area identified on the ground as per Plan map	Revised map and field identfication	FD
		-Proposal for re-gazettment as Wildlife Sanctuary submitted to MOEF	Gazette Notification	FD/MOEF
		-MOEF issues the Notification		
	Buffer Reserve Sub-Zone	-Short rotation plantations brought under co-management agreements for participatory protection based on usufruct sharing basis	Agreements signed	FD/ Stakeholders
		-identified villages/paras are grouped for LDF activities in *lieu* of their protection efforts for assigned plantations, and forests in core zone	Groups formed	FD/NSP/ Stakeholders
		-Vacant FD lands brought under buffer plantations	Woodlots established	FD
		-Existing patches of natural forests managed by following the guidelines as in case of core zone	Rehabilitated forests and elephant habitat	FD
	Elephant Movement Corridors Sub-Zone	-Identified corridors will be maintained by avoiding their further fragmentation and degradation	Elephant corridors connectivity maintained	FD
			Rehabilitated corridors	
	Transportation Corridor Sub-Zone	-Rehabilitate identified habitats by following the recommendations made in core zone	Land Owning Agencies contacted	FD/Land Owning Agencies
		-Establishing communication channels with the land owning agencies (R&H)	Nurseries and	FD

Yr	Sub-Zones	Main Activities	Main Outputs/ Success Criteria	Responsibility
			plantations established	
	Intensive Use Sub-Zone	-Establishing strip plantations along the road		FD/NSP
			FD buildings maintained	
		-Existing FD buildings maintained by following environmental friendly guidelines	FD buildings constructed	FD
		–New FD buildings constructed		
2	Proposed Extension Sub-Zone	-Comanagement activities and habitat restoration works started as proposed in Core Zone	Integrated management of WS	FD
	Buffer Reserve Sub-Zone	-Existing plantations protected under co-management arrangements agreed with local stakeholders as per Social Forestry Rules, 2004	Plantations protected and core zone forests rehabilitated	FD/ Stakeholders FD
		-Remaining vacant FD lands brought under participatory plantations	Plantations established	NSP/FD/
		-Villagers from the identified villages start LDF funded activities in *lieu* of their forest protection efforts	Income of the villagers enhanced and forests protected	Stakeholders FD
		--Existing patches of natural forests managed by following the guidelines as in case of core zone	Rehabilitated forests and elephant habitat	FD
	Elephant Movement Corridors Sub-Zone	-Identified corridors will be maintained by avoiding their further fragmentation and degradation	Elephant corridors connectivity maintained	FD/Land Owning Agencies
		-Rehabilitate identified habitats by following the recommendations made in core zone	Rehabilitated corridors	FD
	Transportation Corridor Sub-Zone	-Maintaining communication channels with the land owning agencies (R&H)	Regular contacts established	FD/R&H
		-Planting and managing strip plantations along roads	Nurseries and plantations established	FD
	Intensive Use Sub-Zone	-Proposed FD buildings are developed by following environmental friendly guidelines	Buildings constructed	
3, 4 and 5	Buffer Reserve Sub-Zone	-Continue protecting participatory plantations	Plantations protected	FD/ Stakeholders
		-Identified villages/paras continue to be covered under LDF in *lieu* of their forest protection efforts	Villagers' income enhanced and forests protected	NSP/FD/ Stakeholders FD/FSP
		-Plantations raised on vacant FD lands continue to be protected	Protected plantations	FD

Yr	Sub-Zones	Main Activities	Main Outputs/ Success Criteria	Responsibility
	Elephant Movement Corridors Sub-Zone	-Existing patches of natural forests continue to be managed by following the guidelines as in case of core zone -Identified corridors will be maintained by avoiding their further fragmentation and degradation -Rehabilitate identified habitats by following the recommendations made in core zone	Rehabilitated forests/habitat Elephant corridors connectivity maintained Rehabilitated corridors	FD FD FD/NSP/Land Owning Agencies FD/FSP
	Transportation Corridor Sub-Zone	-Continuing good communication with the land owning agencies (LGED, Railways) -Establishing strip plantations along the road	Land Owning Agencies convinced Nurseries and plantations established	
	Intensive Use Sub-Zone	-FD buildings are maintained by following environmental friendly guidelines	Better maintained FD buildings	FD

5. LIVELIHOOD PROGRAMS

5.1 Program Objectives

Relevant mechanisms for benefit flows to local communities need to be explored as minimum benefits (mainly from NTFPs, which may currently not be sufficient to motivate local people) presently accrue from the GR. For example, some tangible benefits can be mobilized through off-GR activities including alternative income generation activities and self-employment opportunities in and around the GR.

Main objective of livelihood program is to develop appropriate linkages with relevant livelihood opportunities and other projects/initiatives that will reduce biotic pressure on the GR by providing alternative livelihood opportunities to local stakeholders. Up-scaling of skills will be taken up for generating value additions through capacity building of local people. Landscape Development Fund (LDF) will be used to provide grants to the co-management councils/committees, and the members of user groups, and their federations will be encouraged to set up micro-enterprises to generate value additions locally. The members of user groups shall preferably be local forest users who are poor, landless, widow, ethnic minority, etc. The benefits from eco-tourism will be ploughed back for the development of local communities and the GR. This program will be implemented in the interface landscape zones as identified in Chapter 6 of Part I of the Management Plan. Networking with relevant NGOs active in the area will be established for rendering other rural development services to local stakeholders.

5.2 Production Technologies

Appropriate production technologies, which may be implemented as a part of off-PA development interventions, were identified based on field investigations done by the partner NGO (CODEC); the following production technologies are proposed to be implemented in and around the GR :

5.2.1 Agricultural and Horticultural Crops

The following production technologies are proposed :

- Integrated homestead farming
- Cultivation of high value crops
- Village tree nursery
- Food storage and processing

Integrated Homestead Farming

Many villagers, mainly on the fringes of the GR practice subsistence farming (low input and low output) on their homesteads (small yard, backyard ditch, etc.). Inter-dependency among the various components of the production technology package can be designed to maximize output, which can be used for household consumption and surplus being sold for buying non-agricultural daily necessities. This will help provide livelihood security and enhance their income by creating livelihood assets and self-employment opportunities to local stakeholders. Diversification of production possibilities will help avert production risks and reduce vulnerability of livelihood during natural calamities such as cyclones. Possible components of such an integrated production technology package may include vegetables (on open fields, dykes and other unutilized places around houses), cash crops, horticultural and tree nursery, poultry rearing , cow rearing (local improved breed with crossing for fattening), fish culture (in micro-ponds), duck-cum-fish culture (in family ponds), pigeon farming (six pairs of pigeon reared as scavengers) and apiculture (domesticated wild bees). Complementary off-farm activities may include food processing (threshing, winnowing, drying, grading, husking, etc.), food preservation, and other cottage and small scale value addition activities.

Cultivation of High Value Crops

High value crops have more nutritive value, high price and demand. But this production technology is suitable to those farmers, who have cultivable land and can make a minimum investment. Suitable high value crops for the GR landscape include tomato, potato, fine rice, papaya, ginger, turmeric, yard long bean, leafy vegetables, aroids, chilly, beetle leaf, maize, guava, banana, jackfruit, pineapple, etc. Some vegetables can now be grown all year round and so will fetch more prices during off-season.

Village Nursery

Many private nurseries have grown up in the nearby towns for meeting the demand for quality seedlings and seeds of horticultural, vegetables and tree species. Village nurseries to be developed by local people, having some land, will be encouraged to meet the local demand for quality seedlings and seeds. Technical and logistic support will be arranged to prospective farmers. Seedlings to be raised in village nursery will be

as per local preferred species that may include timber, fruit, vegetable, flower, fuelwood, fodder, medicinal and other NTFPs bearing species.

Nursery planning activities will be started at least one year in advance with proper attention on i) collection, processing and storage of seeds, ii) testing, certification and distribution of quality seeds, iii) training and awareness on improved nursery techniques and inputs, iv) seed orchards, v) water source and watering regime, vi) nursery management intensity and technical supervision, vii) culling, root coiling and fibrous root development, viii) standardization of nursery techniques, ix) improved transportation of seedlings from nursery to planting sites.

Food Storage and Processing
Simple food storage, processing and preservation techniques will be explained to local people for creating value addition locally and providing self-employment opportunities. For example, pickles of mango, lemon and jackfruit can be made locally for households nutrition and cash sale.

5.2.2 Livestock Rearing

Livestock-poultry sub-sector is an important part of agriculture sector. Cattle rearing with focus on milch cow rearing is particularly suitable for poor people residing within and outside the GR. The following livestock rearing technologies are found suitable for their implementation in and around the GR :

- Beef fattening
- Milch cow rearing
- Broiler/Layer rearing

Beef fattening can be achieved within a short period (3-12 months) by using a local improved breed cow with crossing hybrid. Milk provides a balanced diet by meeting the required demands of nutrition. So at least one milch cow of a locally improved bred or crossbred cow with average milk production can be targeted for the identified households. The poultry industry has developed near cities and towns for meeting huge demand within a short time as a supplement of animal protein. Females are particularly suitable for carrying out broiler/layer rearing activities carried out in households.

5.2.3 Fisheries

The following production technologies were identified for the fishery sector :

- Rice fish farming
- Fingerling rearing
- Carp polyculture
- Fish culture

Broadly three main methods of fishery would involve capture fishery, culture fishery and dry fishery activities.

5.3 Non-Timber Forest Products (NTFPs)

Short-term production objectives of NTFPs management will be linked with long-term biodiversity conservation objectives in order to create personal stakes among the members of co-management councils/committees and user groups formed in and around the GR. The flow of NTFPs from the natural forests of Tekmaf will start from the first year of co-management activities; their volume and composition increasing gradually as the forests are provided an effective protection against biotic interference through co-management approach. The importance of NTFPs depends on a number of factors including use value, barter (exchange) value, market demand, accessibility to markets, storage and perishibility. An important objective of NSP is to create stakes among local stakeholders for biodiversity conservation by ensuring adequate benefits to them from the GR and off-PA based income generation activities. In the forests being managed for biodiversity conservation in the GR, this objective can be achieved by facilitating close linkages with the livelihoods of local stakeholders and NTFPs development.

In addition to the benefits from NTFPs, forest management interventions such as pruning. coppicing and cleaning would enhance the flow of intermittent benefits. The NTFPs based activities (Table 5.1) are more suitable for the rural poor including tribal women and children due to specific characteristics of NTFPs management such as labor-intensive (for instance, the collection and primary processing of bamboo and canes requires substantial labor), simple technologies (many times the collection techniques are inherited and handicrafts made by employing family skills) , easy accessibility and benefits to poor, seasonal

collection, supplementary income to forest dwellers and household activities with low volume. However, a number of NTFP yielding trees (e.g. medicinal plants) are distributed dispersely and the collection of some NTFPs is to be completed within a short period.

Table 5.1 Candidate Management Practices for Non-Timber Forest Products

Sl. No.	Functions	Potential Management Practices
1	Production/Regeneration	Manage the PA's forests for sustainable development of NTFPs. Protect forests by associating local stakeholders. Take enrichment planting of NTFPs yielding species in identified blanks.
2	Collection/Harvesting	Harvest/collect NTFPs sustainably by employing members of beneficiary groups. Use better harvesting tools and equipments. Impart training and skill development to beneficiary groups in improved harvesting/collection techniques.
3	Pre-processing	Train the groups in primary processing activities including storing, sorting, cleaning and drying. Help establish primary collection centres for storage after primary processing. Provide better pre-processing tools and equipments to group members.
4	Self-consumption	Awareness training. Basic storage facilities.
5	Marketing of unprocessed NTFPs	Provide useful information on use patterns, market channels, prices, demand, etc.
6	Storage and Processing	Provide relevant technology, training, finance, quality control, etc.
7	Marketing of processed NTFPs	Conduct a market assessment and develop a marketing strategy. Linkages with centres of production and marketing. Financing for storage, transport and marketing.

The collection, processing and marketing practices for NTFPs to be adopted by user groups need to be such as to enable them earn their subsistence living regularly. Development of NTFPs through user groups can be taken up by using LDF and rural credits. Poor harvesting practices for NTFPs will lead to waste and unsustainable practices. Raw materials (e.g. medicinal plants), which are to be kept after harvesting need to be dried and stored properly in order to prevent any quality deterioration. Some NTFPs including honey, grasses and bamboo can be processed at local level (i.e. user groups). Federations of user groups may establish processing-cum-marketing units (e.g. handicrafts, mats, broom, honey, etc.) locally by pooling their resources. These will not only help in accessing better harvesting tools and equipments but will also help in marketing of processed NTFPs at remunerative prices. The FD may not NTFPs into auctions and leases. Instead, the responsibility for primary collection, storage, processing and marketing can be given to user groups and co-management committees. This will help in biodiversity conservation through consumers of NTFPs becoming their primary producers with livelihood opportunities in terms of NTFPs based products, employment and income generation.

5.4 Enterprise Development

Primary sectors for potential development around the GR include handicrafts (cane, bamboo and murta), nursery development, food processing (pickle, jam, jelly), weaving and natural dye processing, and bee keeping. Secondary sectors include herbal tea (basak, chamomile, shefali) cultivation and processing, medicinal plantations and processing, essential oil processing, buffer plantations, orchid cultivation and floriculture, eco-tourism and nature-based healing homes development. Priority sectors such as bamboo and canes, nursery and natural dye processing may initially be taken up for enterprise development.

Bamboo occur naturally in the forests of Teknaf and used widely by local people in a variety of ways (making household articles, furniture, domestic utensils, house constructions, rafters, batons, binding

material and handicrafts). Canes have been under-planted by FD : Cane (rattan) is a climbing plant that produces flexible stems used for making handicrafts, furniture, domestic utensils, house constructions and binding material. Its products have export markets as fine quality finished products can be made with a variety of designs. The skills and artisanship for making handicrafts are learnt by local people from one generation to another. Bamboo and cane based cottage industries and enterprises will a good source of wage and self-employment. Unlike bamboo, no formal rules have been developed for cane harvesting for which permits by FD are issued after collecting royalty. Canes of adequate length are harvested manually by local people for their own use but also sold in bundles to local traders. Villagers sell sometimes standing crop of bamboo and canes from their homesteads based on stumpage prices. Selection-cum-Improvement silvicultural system is more suitable for the management of natural forests having bamboo and canes as middle story vegetation.

A well planned marketing of NTFPs can be a means for employment and income generation by optimizing the values of NTFPs and ensuring the distribution of enhanced benefits among the participants. The role of marketing is in creating better linkages between the NTFPs management, processing and end-use. Proper marketing can reinforce sustainable management of NTFPs by indicating the kind of products and raw materials required. The NTFPs markets, which are essentially local, exhibit seasonal behavioral patterns because NTFPs production is seasonal in character.

The development of NTFPs based enterprises may be hampered due to a number of factors. Lack of adequate facilities for processing and storage will result in losses, especially for perishable NTFPs. Other constraints include limited availability of finance and uncertain markets. Government restrictions on the transit and movement of some of the collected NTFPs (in terms of transit permits to be issued by FD) discourage the collectors for their collection and sale. If the collected NTFPs are processed at local level then the value added (e.g. broom making, cane processing, leaf collection for puffed and parched rice, basket making, handicrafts making, etc.) can be retained locally thereby generating forward and backward linkages for socio-economic development.

Traditional knowledge about medicinal plants and animals should be documented in view of their contemporary relevance. Revitalization of folk traditions on medicinal plants holds a real potential for self-reliance of rural people on primary health care. *In-situ* conservation of biodiversity of use in traditional medicine should be encouraged by delineating medicinal plants conservation areas to conserve cross-sections of diverse eco-systems having potential for medicinal plants and animal species, and their genetic diversity.

5.5 Summary of Main Prescriptions

Main prescriptions outlined under the above-developed protection programs are summarized in Table 5.2 as below :

Table 5.2 Summary of Main Prescriptions

Year	Main Activities	Main Outputs/Success Criteria	Responsibility
1	-Conducting reconnaissance surveys and demand-supply assessment	Demand-supply situation assessed	NSP
	-Identifying a list of feasible production technologies	Feasible production technologies identified	NSP/ Stakeholders
	-Holding discussions with local stakeholders on feasible production technologies	-Stakeholders' consultations held	NSP/FD/ Stakeholders
	-Finalizing a short list of candidate production technologies	Short list of production technologies finalized	NSP/FD/ Stakeholders
	-Identifying and selecting master trainers	Master trainers identified	NSP
	-Preparing training material on the	Training materials prepared	NSP

Year	Main Activities	Main Outputs/Success Criteria	Responsibility
	finalized production technologies		
	-Designing demonstration centres for proven technologies	Design of demonstration centres completed	NSP
	-Identifying farmers training schools	Farmers training schools identified	NSP
	-Finalizing preparations for imparting training to local stakeholders	Preparations for training completed	NSP/FD/ Stakeholders
	-Finalizing operational guidelines for LDF	LDF operational guidelines finalized	NSP/FD/ Stakeholders
2	-List of feasible production technologies refined based on the first year experiences	List of production technologies refined	NSP/ Stakeholders
	-Continue holding discussions with local stakeholders on feasible production technologies	-Stakeholders' consultations continued	NSP/FD/ Stakeholders
	-Short list of candidate production technologies refined based on the first year experiences	Short list of production technologies refined	NSP/FD/ Stakeholders
	-Finalizing training material on the finalized production technologies	Training materials finalized	NSP
	-Establishing demonstration centres for proven technologies and arranging for stakeholders visits	Demonstration centres established	NSP
	-Establishing farmers training schools and arranging for stakeholders visits	Farmers training schools established	NSP
	-Imparting training to local stakeholders	Training to groups imparted	NSP/FD/ Stakeholders
	-Training in simple storing and processing technologies	Stakeholders trained	NSP/ Stakeholders
	-Encouraging low-input small scale and cottage industries	Stakeholders encouraged	NSP/ Stakeholders
	-Conducting enterprise development assessment	Enterprise development studied	NSP
3	-Continue holding discussions with local stakeholders on selected production technologies	-Stakeholders' consultations continued	NSP/FD/ Stakeholders
	-Training material on the finalized production technologies reviewed based on the project experiences	Training materials reviewed	NSP
	-Demonstration centres for proven technologies improved based on the project experiences	Demonstration centres improved	NSP
	-Upgrading farmers training schools based on the project experiences	Farmers training schools upgraded	NSP

Year	Main Activities	Main Outputs/Success Criteria	Responsibility
	-Continue imparting training to local stakeholders -Helping in developing market linkages -Training on small enterprise development	Training to groups continued -Market linkages established Stakeholders trained	NSP/FD/ Stakeholders NSP/Federations NSP/Federations
4	-Continue holding discussions with local stakeholders on selected production technologies -Continue arranging visits to demonstration centres -Continue arranging training in farmers training schools -Continue imparting training to local stakeholders -Helping in enterprise development	-Stakeholders' consultations continued Demonstration centres visited Training in Farmers training schools continued Training to groups continued Small enterprises establihsed	NSP/FD/ Stakeholders NSP NSP NSP/FD/ Stakeholders NSP/Federations
5	-Continue holding discussions with local stakeholders on selected production technologies -Continue arranging visits to demonstration centres -Continue arranging training in farmers training schools -Continuing with enterprise development and market assistance activities	-Stakeholders' consultations continued Demonstration centres visited Training in Farmers training schools continued Enterprise development continued	NSP/FD/ Stakeholders NSP NSP NSP/Federations

6. FACILITIES DEVELOPMENT PROGRAMS

During the implementation of the Management Plan the development of GR facilities will be undertaken to support its long-term management and administration. In addition to built facilities, the Facilities Development Program will focus on the procurement of transport and other equipments required for the implementation of proposed management programs.

6.1 Objective

Main objective of this program is to develop necessary facilities including accommodation and field equipments for FD field staff responsible for the management of GR.

6.2 Built Facilities

The development of built facilities will proceed in a well-planned and phased manner, that is appropriate to a GR setting, in order to ensure that they do not negatively impact the area's natural resources or eco-tourism potential. Existing FD facilities will be fully utilized and incorporated in GR management where these can be renovated on a cost-effective basis. Built facilities will be concentrated AT GR Headquarters (incorporating the existing Teknaf Range Office) and Range Offices at Whykheong and Silkhali.

Built facilities requirements during the Management Plan period are summarised in Tables 6.1 and 6.2.

Table 6.1

Built facilities development in Teknaf Game Reserve : use of existing facilities

Location	Facility (current use)	Use during Plan Period	Action Required
Game Reserve Headquarters (Teknaf)	Teknaf Forest Rest House (new)	Forest Rest House	-regular maintenance
	Range Officer's Quarter	Deputy Range Officer's Quarter	-septic tanks, doors & windows -repainting and regular maintenance
	Teknaf Forest Rest House (old) – Project Office	Annexe to GR Office and Store Room	-regular maintenance
	Range Office	Office (office space Dy. Ranger and Foresters)	-general renovation/repairs -installation of water supply, electricity hookup and telephone -repainting and regular maintenance
Teknaf Range Silkhali Range Whykheong Range	Range Offices Range Office Residences Beat Officer's office-cum-residence (15 Beat Offices @ 120 m^2)	Range Offices Range Office Residences Beat Officer/ Dy. Ranger's Quarters	-renovations to improve rainwater drainage, grill repairing, etc. -repainting and regular maintenance
	Forest Guard Quarters (45 FG's Quarters @ 80 m^2)	Gaurds' Quarters	-general renovation/repairs -septic tanks, doors & windows -repainting and regular maintenance
Old Forest Rest Houses at Mankhali, etc.	FRH	FRH	-renovations and regular maintenance
Moribund Rest Sheds, etc.	Picnic Spot	Picnic Spot	-replace with appropriate structure for eco-tourists

Table 6.2
Built facilities development in Teknaf Game Reserve : new facilities

Location	Facility and use during Plan period	Action Required
Park Headquarters (Teknaf Range Office Complex)	ACF's (OIC) Quarter (1, area ~ 87.5 m^2)	-site selection -design and construction -installation of water supply and electricity hookup -regular maintenance
	GR Office (semi-permanent)	-site selection -design and construction -installation of water supply and electricity hookup -regular maintenance
	Dormitory/Barrak for Staff (1, ~ 300 m^2)	-as above
	Nature Education Center/Visitors Information Centre (1, ~ 100 m^2)	-as above
	Student Hut/Dormitory (1, ~ 150 m^2)	-as above
	Wash Room, Sitting Bench, Ticket Counter, Parking Area and Others	-as above
Teknaf Range Silkhali Range Whykheong Range	Forester's Quarters (3, area ~80 m^2)	-site selection -design and construction -installation of water supply and electricity hookup -regular maintenance
	Guard's Quarters (12, each ~60 m^2)	-as above
	Public Toilet	-as above
	Foot trails	-as above

Renovations, and a regular schedule of maintenance, will be initiated during the first year of the Plan. New constructions will be initiated during the second year of the Management Plan. The existing toilets will be removed and replaced with a new facility. New quarters will be constructed for the staff on priority basis. Forest Guard and Forester quarters will be renovated to provide electricity and piped water, and will be repainted and maintained on a regular basis.

At each location, design standards for both renovations and new construction will be based on the "Guidelines for Conservation Area Facilities Development" (Tecsult 2001). A regular schedule of maintenance and upkeep will be maintained and all irreparable or unused buildings will be removed. Renovation and construction work will be completed at the Headquarters as a matter of priority.

6.3 Forest Roads and Trails

Access to the GR Headquarters is currently provided by all-weather access road, which does not require upgrading. Access roads between sites at GR Headquarters (*i.e.*, between the main office/accommodation complex, the Resthouse and proposed Environmental Education Centre) will require periodic manual maintenance, but are currently built to sufficient standards for anticipated traffic loads. All other roads within the GR will be permanently closed to 4-wheeled vehicles. Restoration of existing trails would provide quick and easy access to the GR for management staff. But these would also provide unimpeded public access, thereby potentially increasing the severity and spatial extent of management problems. Due to the nature of the terrain, techniques commonly used to block public use of access roads (*e.g.*, barriers, locked gates) could easily be circumvented, and do not provide an effective solution to the potential problems of improved public access. Additionally, most access by the staff is currently and will continue to be by foot and motorcycle, and the distances involved are short. Foot patrols are much more effective than vehicle patrols and so the trails linking will be maintained for foot and motorcycle access, but not for access by vehicles with four wheels. These trails will be incrementally narrowed to an average width of approximately 2 m, through replanting bypass areas and permitting ingress of undergrowth.

Numerous other foot trails have been developed throughout the GR mainly at the time of plantation establishment, and linking settled areas within and on the periphery of the GR with subsistence use areas. Some of these, particularly those that tie in with the main road and trail access system described above, could also be used as nature trails (described in detail in Chapter 7). However, only existing trails will be renovated and maintained as nature walks and trails during the first five years and new trails will be laid out only during the subsequent years after assessing their potential and use. Reconnaisance surveys will be taken up to select trails that pass through diverse habitats and landscapes of interest. The trail selection and development will be taken up with specific objectives : i) to demonstrate the importance of biodiversity conservation to visitors and policy makers, ii) to make outing and hiking for observing the beauty of a PA, iii) to learn interesting things about the local environment, ecology, culture and wildlife, iv) to raise public awareness for biodiversity conservation and wildlife management. Each trail will be marked on the ground and base map and adequate information will be provided in shape of sign boards (at entry/start point) and also through printed materials including brochures. Some minimum visitor amenities such as resting places, rest rooms, waste disposal bins and hides may in future be provided along the identified trails. Adequate provisions should be made for the renovation and maintenance of these public utilities.

6.4 Field Equipments

Vehicles, field equipments and office equipments will be needed to support the management and administration programs. Double-cab pickups will be provided for the ACF/OIC. In addition, two 100 cc motorcycles will be provided for use at GR Headquarters, and one at Beat Offices. Two walkie-talkies will be provided for use at GR Headquarters, and one each at Beat Offices. These will be suitable for communication among these sites. Compasses, binoculars, GPS and other field equipment will be provided as required for support of the GR management programs.

6.5 Office Equipments

Office equipments (telephone, computer, etc.), furniture (desks, filing cabinets *etc.*) and supplies will be provided as required for use at GR Headquarters and Beat Offices. Similarly all necessary equipment and supplies for development and operation of the Environmental Education Centre will be provided. Specific requirements will be detailed in conjunction with the development of environmental education and other visitor use programs.

6.6 Summary of Main Prescriptions

Main prescriptions outlines under the above-developed facilities development programs are already summarized in Tables 6.1 and 6.2.

7. VISITOR USE AND VISITOR MANAGEMENT PROGRAMS

7.1 Program Objective

Regulated eco-tourism in the form of nature education and interpretation tours will be a main objective of visitor use and management programs. This will help promote biodiversity conservation and educate the visitors as enlightened nature tourists. Socio-economic benefits of eco-tourism will be ensured to local people through forward and backward linkages.

7.2 Conservation Tourism

The potential of conservation tourism is high in Teknaf due to its strategic location, high biodiversity value and, easy accessibility from long beach of Cox's Bazar that is visited by a large number of tourists. So a number of facilities can be developed for future visitor use. Basic information about the GR will be made available to visitors in the form of information handouts and brochures.

7.2.1 Identification of Tourism Areas

An initial tourism region encompassing the three hiking trails has been identified. However, during the first year of Plan implementation a broad eco-tourism region will be identified around the GR by linking with other local and regional attractions including Guest Houses, tribal villages, rolling landscapes, Naf river banks, sea beaches, wetlands, existing forest roads and trails. Adequate care will be taken to preserve the local traditions and culture of tribals by avoiding intrusive, exploitative and commercial behavior activities while implementing visitor program. Existing roads and trails will be renovated for easy movement in eco-tourism zone. Initially tourists will use their own transport but a regular vehicular arrangement by FD on payment basis may be considered subsequently. Elephant ride may also be considered by FD as many tourists may be interested to have a close look of nature from elephant back. A part of revenue (e.g entry fee, etc.) may be retained for ploughing back for the development of GR and local community. Initially Forest Rest Houses (FRHs) and Hotels will provide accommodation to eco-tourists. But when the number of tourists increase local enterprenuers on the GR's fringes (in interface landscape zone) will be encouraged to set up nature camps, lodges, dormitories, huts and cottages for tourists. Eco-guides to be identified amongst local communities will be employed for the guidance of eco-tourists and visitors.

Brochurs, pamphlets, guide maps, hand outs, audiovisual aids, display boards will be developed at convenient points. Mass Communication Officer of FD will provide help in launching a publicity program. Local youths/naturalists preferably from the co-management communities will be encouraged to act as eco-guides and nature interpreters. They will be trained as eco-guides by organizing a series of training workshops on communication and interpretation skills (including on what to speak, how to speak, presentation skills, body language assessment, team building exercises, etc.). Main message in these workshops will be on spreading conservation awareness among the visitors. Binoculars and suitable books on ornithology may be provided to tourists on rent. They may also be provided catering facilities at tourist accommodation places.

Nature camps (of 1-2 days duration) may be organized at places of interest within the GR for students and youths for learning by experience and discussions on biodiversity conservation issues. Camp accommodation will be provided in temporary tents to be established near sites of interest. Local NGOs and naturalists may help in establishing nature camps.

7.2.2 Facility Development

7.2.2.1 Use Types and Facilities

Existing Forest Rest Houses (FRH) will be made available to eco-tourists for night halts on payment. Longer-term visitors can get accommodation outside the GR area in reasonable hotel accommodation. The tourists can travel to Teknaf on a day trip and return back to Cox's Bazar where a number of hotels are available for night halt. Publicity and information materials having basic information about the GR will be provided to visitors by means of fixed signs, brochures, leaflets, printed guides, etc. at key road access points. An Environmental Education Centre to be established at the GR's office will serve as Nature Interpretation Centre (NIC) with update information. Suitably trained staff will be posted at all of these locations with adequate information and publicity material about the GR's importance and facilities. Additional training on public relations and visitors management will be provided to the staff.

7.2.2.2 Nature and Hiking Trails

A network of nature trails will be developed for visitors movement on foot and bicycle, traversing key natural and cultural features of interest (e.g. patches of dense forests, caves, cliffs, cultural remnants, natural streams/*cheras*, religious places, tribal areas, etc.). The existing FRHs will be connected with existing and new nature trails. Priority will be given to develop existing foot paths and vehicle tracks as far as possible in order to minimize creation of new paths and consequent vegetation clearances and soil erosion. The Environmental Education Centre will be connected by one such trail for visitor access. The following guidelines/standards will be followed while designing, developing and maintaining the trails.

- Existing trails will be renovated by using local hard soil materials (e.g. laterite soils from nearby forest areas) in order to maintain them in as natural condition as possible;
- Renovation of trails will be done by maintaining minimum necessary surface area and vegetation clearances will be limited, wherever possible for easy access;
- Sign-posts with adequate information will be provided at main trail heads and printed materials will be distributed by the FD staff to interested visitors for their education and awareness. A list of dos and don'ts for visitors will also be prepared and made available at important visit places;
- Hygenic conditions will be maintained and simple toilets and litter disposal facilities will be provided at key points; and
- Motor traffic will not be allowed.

Self-guided trails with adequate information/interpretation will help bring visitors close to nature and provide aesthetic sense. In long-term, these visitors will be future ambassadors of biodiversity conservation. A leveled sketch map, depicting significant natural features along the trail, will be posted at the starting point.

As a part of the management planning exercise the following three hiking trails have been identified and mapped (Figure 9) for eco-tourism sub-zone within the core zone:

1. Short Trail : This half hour trail starts from Shaplapur Beat Office, which can be reached from Whykeong Bazar by *Chander Gari* (along beautiful beach on right and high hills on left). From Shaplapur the trail runs through banana and betel leaf gardens before entering into hills and a patch of garjan forests, and finally back to the Beat Office.

2. Medium Trail : This one hour trail starts 300 m west of Harikhola Primary School from the road to the south under Whykeong Beat. The 2 km trail runs through wet and muddy places, Kudung Guha, and small hills where elephants can occasionally be seen.

3. Long Trail : This three hour trail (nearly 7 km) starts from one Abdur Rahman's shop (Bhubunia village) in Raikhong Beat, passing through rather difficult terrain. Beautiful view of sea beach can be seen from Taingya Hill that can be reached after crossing few small hills. While traversing a natural water fall and Kuti cliff would be worth enjoying.

7.2.2.3 Picnic Facilities

Basic picnic facilities such as sheltered and outdoor tables, simple toilets and litter disposal buckets/boxes will be provided (for visitors in small groups) at the GR's HQ and also along main trails. However, the use of loudspeakers, amplifiers and other activities that could affect the use and enjoyment of the area by others, will not be permitted inside the GR.

7.2.3 Community-Based Tourism

Guided tourism will be developed over a period of time by involving unemployed youth members/naturalists of co-management councils/committees and user groups as eco-guides. They will be trained on eco-tourism including animal signals and calls, bird identification, biotic influences, local culture, etc. They will be involved in the management of eco-tourism in order to create stakes among them. Involvement of local community-based organizations and organized groups will be sought in developing community-based tourism.

7.2.4 Regulation of Eco-Tourism

Eco-tourism will be restricted to specific areas identified for the purpose. The movement of vehicles and tourists will be regulated within the identified eco-tourist paths for which physical barriers and check posts will be established at appropriate places and manned by adequate staff to regulate the traffic into the core zone. Tourists will be allowed during day time only and all the visitors must leave the core zone by sun set. No night driving will be allowed and entry hours will be specified. Similarly the GR may be closed during rainy season. Slow driving (say 25 km/hour) will be allowed for motor vehicles, and blowing of horns will not be permitted. Wlidlife will not be chased and food from outside will not be allowed. Litting of fire will not be allowed during excursions. Dogs and pets will not be allowed. Empty canes, tins and polythene will not be allowed. The ACF in-charge of GR will regularly get feed back from his field staff about the tourists through periodic reports and briefings.

7.3 Conservation Education, Awareness and Interpretation

The publicity of the GR management activities will be improved for propagating the biodiversity conservation, environment, and wildlife and the cause of its habitat. Electronic and print media (TV, Radio, Videos, newspaper, magazines, brochures, etc.) will be employed for this purpose. Schools and colleges will be targeted for conservation education and building an informed wildlife constituency. Conducting talks, essays writing and competition will be included in neighbouring schools as a part of publicity campaign. Sabuja Vahinis (Green Brigades) will be formed and trained in nearby schools and madarsas. Professional publicity and communication personnel will be invited for such tasks. Communication strategy as developed under NSP will be implemented. Efforts will be undertaken to improve relations and communications between the FD field staff and the media.

7.3.1 Interpretative Media for Eco-Tourist Education

Nature interpretation will, as an educational activity, focus on revealing meaning and relationships of complex ecosystems, landscapes and seascapes. Public awareness of the laws related to wildlife will be enhanced and prosecutions under the laws will be publicized. Nature Interpretation Centres will be developed at accessible place (say at the GR HQ). Landscape features of GR may be depicted in pictorial forms including topographical and biodiversity patterns. Depending upon the availability of resources a sound and light program can be added for explaining to visitors. Local exhibits, murals, dioramas, specimen of plants and wildlife, trophies and photographs may be added. Socio-cultural traditions/features (handicrafts, uniforms, dances, tools, furniture, ornaments, carvings, etc.) of local people including tribals may be added with proper leveling and description.

Appropriate signages will be used for the benefits of tourists in finding their ways without any enquiry. These signages may be i) directional signages showing the way to different places, ii) cautional signages indicating about prohibitory acts, iii) orientational signages helping in tourists orientation, and iv) interpretive signages kept at conspicuous places to help interpret strategic themes and issues.

7.3.2 Environmental Education

An Environmental Education Centre will be developed at the GR HQ as a Nature Interpretation Centre, the design and development of which will be assigned to a professional organization. It will consist of walk-through displays, audio-visuals, explainatory printed materials, items of historical and conservation significance, computer interactive media, etc. A video film on wildlife and its habitat and cultural aspects may be developed for showing to visitors at NIC. Other relevant topics may include ecological processes at work in the GR, wildlife behavioural ecology, conservation history, role of local people in conservation, man-wildlife conflicts, etc. A library will be developed at NIC with books, magazines and journals relating to biodiversity, wildlife, environment and forestry.

7.4 Inter-sectoral Conservation Planning

Many times other sectors, particularly land-based sectors, have profound effects (both negative and positive) on the GR management. Therefore, the FD needs to establish clear linkages and programs for collaborative conservation planning with other relevant agencies/institutions both within and outside the country. A collaborative conservation strategy should be developed to provide mechanisms for improving inter-sectoral coordination and information sharing to maximize biodiversity conservation efforts.

7.5 Conservation Partnerships

The concept of public-private partnership will be applied in soliciting the inputs/contributions from private sector for the facilities development in Teknaf. It has been shown in many countries that nature conservation progresses rapidly when leading members of the private sector perceive nature conservation as good for the economic well being of the country. Nature conservation partnerships can be designed to offer interested businesses a vehicle for contributing to long-term forest conservation in a way that is transparent with low transaction costs, generates beneficial public image for the contributor and makes a long-term difference in forest conservation.

A well designed Partnerships program may be implemented in the following ways :

1. It may help improve livelihoods of local people around the GR by building a strong and mutually self-interested relationship with the local communities. Such a relationship may be formalized by signing co-management agreements under which community representatives maintain joint responsibility for protection with FD, and in return receive benefits generated from the GR or provided by NSP. Contributors can support community needs for improved health and sanitation, womens' empowerment and livelihoods improvements.

2. Contributors can help create visitor facilities including educational exhibits, public utilities, sitting areas and other visitor amenities by making donations in lieu of recognition on appropriate plaques at GR level to attest to their contribution.

3. Contributors may support/co-finance NSP's communication and outreach efforts by help organizing events such as Earth Day, Nishorgo Day, Wildlife Week, etc.

4. NSP may offer an opportunity to potential contributors to license the Nishorgo logo and name for use in creating and selling nature-based products and souvinor including postcards and T-shirts with wildlife pictures. The receipts from the licensing program may be ploughed back either for local community development and/or improved Park management.

5. Private businesses located in the interface landscape zone will be rewarded for their PA-friendly behabiour/activities. For example, those businesses supporting PA conservation may be given right to use the, "Certified Nishorgo-Friendly" level.

7.6 Summary of Main Prescriptions

Main prescriptions outlined under the above-developed protection programs are summarized in Table 7.1 as below :

Table 7.1 Summary of Main Prescriptions

Year	Main Activities	Main Outputs/Success Criteria	Responsibility
1	-Identifying tourism areas within the GR	Possible tourism areas identified	FD
	-Designing and developing basic picnic facilities for eco-tourists	Minimum tourist facilities are in place	FD/NSP
	-Identifying suitable sites for nature camps	Possible sites for 1-2 days nature camps identified	FD/NSP
	-Designing and preparing publicity materials including pamphlets, brochures and maps	Publicity material developed	NSP/FD
	- Identifying and training eco-guides	Eco-guides identified and trained	NSP
	-Developing and propagating conservation awareness and education through electronic and print media	Conservation awareness program developed	NSP/FD
		Number of schools identified and students motivated	NSP/FD
		Building for NIC selected	

Year	Main Activities	Main Outputs/Success Criteria	Responsibility
	-Identifying and motivating students and volunteers (Sabuj Vahini) for biodiversity conservation	Existing trails mapped	FD
	-Identifying an existing building for establishing Nature Interpretation Centre	Relevant ministries and departments contacted	FD/NSP
	-Identifying and mapping existing nature and hiking trails	Public-Private partnership policy drafted	FD
	-Establishing regular contacts with relevant ministries and departments for inter-sectoral conservation planning		NSP
	-Developing a policy on public-private conservation partnership		
2	-Tourism areas shown on maps and brochures	Tourism areas notified	FD
	-Regulating tourism within the GR	Tourism regulated	FD
	-Developing basic picnic facilities for tourists	Tourist facilities are developed	FD/NSP
	-Developing suitable sites for nature camps	Possible sites for 1-2 days nature camps developed	FD/NSP
	-Preparing publicity materials including pamphlets, brochures and maps	Publicity material development completed	NSP/FD
	- Training eco-guides	Panel of possible Eco-guides trained	NSP
	-Propagating conservation awareness and education through electronic and print media	Conservation awareness propagated	NSP/FD
	-Motivating students and volunteers (Sabuj Vahini) for biodiversity conservation	Number of students motivated	NSP/FD
	-Establishing Nature Interpretation Centre (NIC)	NIC established	FD
	-Developing existing nature and hiking trails	Existing trails developed	FD/NSP
	-Holding meetings with relevant ministries and departments for integrating Nishorgo Program with other sectoral programs	Relevant ministries and departments pursued	FD
	-Approving a policy on public-private conservation partnership	Public-Private partnership policy approved	FD/MOEF/ NSP
3, 4	-Regulating tourism within the GR	Tourism regulated	FD

Year	Main Activities	Main Outputs/Success Criteria	Responsibility
and 5	-Continuing to develop picnic facilities for tourists	Tourist facilities are developed	FD
	-Maintaining suitable sites for nature camps	Possible sites for 1-2 days nature camps maintained	FD/NSP
	-Continuing to distribute publicity materials including pamphlets, brochures and maps	Publicity material development distributed	FD/NSP
	- Maintaining the panel on eco-guides	Panel of possible Eco-guides maintained	NSP
	-Continue propagating conservation awareness and education through electronic and print media	Conservation awareness propagated	NSP/FD
	-Continue motivating students and volunteers (Sabuj Vahini) for biodiversity conservation	Number of students motivated	NSP/FD
	-Maintaining Nature Interpretation Centre (NIC)	NIC maintained	FD/NSP
	-Developing new nature and hiking trails	New nature trails developed	FD
	-Continue liaisoning with relevant ministries and departments for integrating Nishorgo Program with other sectoral programs	Relevant ministries and departments pursued	FD/MOEF/ NSP
	-Approving a policy on public-private conservation partnership	Public-Private partnership policy approved	FD/MOEF/ NSP

8. CONSERVATION RESEARCH, MONITORING AND CAPACITY BUILDING PROGRAMS

8.1 Objectives

A research, monitoring and capacity building program will be developed with main objectives i) to better understand the biodiversity resources, ecosystem and landscape environment, ii) to establish a baseline listing of all flora and fauna species for assessing their current abundance, distribution, and functional relationship among biotic communities iii) to develop quantitative population estimates for elephants, and develop detailed information on their current distribution and habitat use, iv) identify and map key patches of remnant forests and other critical habitats, v) to identify priority research and monitoring topics to help guide the development of GR's management program, and vi) to gradually reduce the extent and degree of uncertainty while taking management decisions.

8.2 Conservation Research

Presently conservation research is not being undertaken by FD and there is no funding source earmarked for carrying out such research. It is, therefore, necessary to establish appropriate linkages with related research organization such as FRI, BARC and relevant Universities and NGOs. In view of scarcity of funding for conservation research, adequate collaboration and networking with other relevant research organizations is necessary.

Conservation research may include aspects such as diverse types of flora and fauna, status of endangered species, wildlife behavior, elephant ecology, socio-economic issues, livelihood impacts of biodiversity conservation, silvicultural aspects, man-animal conflicts, impact of anthropogenic pressures on natural systems, etc. Applied research relating to management aspects of the GR will be given priority by FD over academic studies, which may be conducted by Universities and research institutes.

8.2.1 Applied Socio-economic Research

Management driven studies for conservation research will be taken up on priority basis. In the absence of research laboratories, pure research will not be taken by FD (and so would be left to other research institutes). Possible topics of investigation may include the institutional development and financial sustainability of co-management councils/committees to be formed at different levels and their federations, impacts and dependence of local people on habitat, impact of eco-tourists on local livelihoods, project impacts on livelihood opportunities, forward and backward linkages of eco-tourism, sustainable collection, harvesting, storage and processing and marketing of NTFPs (means of multiplication), impacts of NTFPs on local economy, collection of NTFPs by the members of co-management committees. Many of these studies will be carried out through action research and by associating the stakeholders. Prioritization of research topics will be decided in a Workshop in which key persons from FD and other stakeholders will participate. A computerized data base and retrieval system will be established.

8.2.2 Applied Biological Research

Some relevant topics of biological research may include wildlife-population viability analyses, population dynamics and feeding behaviour, wildlife habitat/niche use behabiour, elephant ecology, wildlife distribution patterns, wildlife seasonal variability and movements, and wildlife health and diseases. Population viability analyses will be taken up to ensure that considerations of minimum population size and population dynamics are taken into account while formulating appropriate habitat management strategy. The needs of species that are dependent on specific habitats (e.g. streamside areas) or specific components (e.g. standing and fallen dead trees) will also be studied for site-specific habitat management. Poaching and illegal wildlife trade will be studied.

8.2.3 Silvicultural Research

Main topics of silvicultural research may include impact of forest grazing and fires on forest regeneration and wildlife (e.g. grazing intensity-how far cattle grazing be allowed), canopy manipulation for improvement of habitat through natural regeneration, habitat improvement through enrichment and under plantings, and monitoring of floristic composition and structure. Main research findings from different silvicultural studies carried out by BFRI will be reviewed in order to draw relevant inferences and frame appropriate recommendations for managing forests in ecosystem zones and habitat management zones. Further research will be required on the effects of selected silvicultural and forest management practices on forest

growth, structure and species composition, regeneration of NTFPs bearing plant species, sustainable collection and harvesting of NTFPs,

8.2.4 Ecological Research

Main topics of ecological research will include identification of fragile habitats and ecosystems, environmental impact studies, water bodies studies, forest-sea interactions, elephant ecology, impacts of forest grazing and fires on natural regeneration and wildlife, impacts of habitat changes and eco-tourism on wildlife.

8.2.5 Baseline Surveys

Existing literature on resources surveys and research will be reviewed before taking up further studies on additional assessments. The inputs from baseline surveys (for example, current population levels, distribution and habitat use) will be used in refinement and application of habitat management and monitoring.

8.2.6 Conservation Research Dissemination and Utilization

Adequate dissemination and utilization of the results/findings of research studies are very important. Pure research done for academic purposes will find less acceptability by FD and so poor dissemination among the field staff. Research dissemination and use methods may be standardized and circulated among FD staff. Useful research outputs will be included in annual development plans of FD for their implementation.

8.3 Conservation Monitoring

A well developed technique for conservation monitoring in multi-species management scenario is to select one or more key or representative species, and to ensure that habitat suitability for this species or a group of species is retained. The long-term aim will be to maximize gains in quantity and quality of habitat, and quality for these and associated species. A detailed assessment of WNCC/Park data needs will be undertaken before putting an appropriate MIS for the Park as a part of existing RIMS which will be strengthened by including MIS in addition to existing GIS.

Performance Monitoring Plan (USAID, 2003) contains guidelines for designing and implementing different levels of indicators (parameters) and intermediate results (IR) developed to track project performances and to assess project success with respect to project objectives. Within the scope of PMP the following set of core indicators has been designed by Nasim (2004) by following the USAID's guidelines :

- Indicator 6.2d : Declining incidence in illegal logging in the Park's forests
- Indicator 6b : Increased production of natural resources in targeted areas of the Park
- Indicator 6c : Increased biodiversity in targeted areas of the Park

A detailed methodology for establishing benchmark data and measuring the volume of timber loss (cubic meter/ha) during the Project period will be used in using the indicator 6.2d for assessing effectiveness of project interventions in controlling unauthorized logging in the sampled forest patches of the GR. A survey of natural regeneration (density of seedlings and saplings per ha) in the forests of GR will be taken with respect to the indicator 6b. This will be complemented by photo monitoring technique, focusing on changes in plant height as a visual evidence of success of NSP interventions. Forest dwelling bird species will be used for assessing biodiversity status with respect to the indicator 6c. A simple procedure of sighting and counting (either population or nests) the indicator bird species using the forests as their habitat will be employed by associating local stakeholders in identified transect walks. Benchmark measurements will be taken to establish initial set of values, which will act as reference for future comparison with subsequent measurements taken periodically for assessing impacts of project interventions.

A critical review of the long-term habitat management strategy based on a detailed inventory of biodiversity will be taken up during the final year of implementation of this Plan, biodiversity management practices will accordingly be adjusted.

8.4 Regional Coordination

As a part of NSP implementation a good coordination with related organizations in Asia and elsewhere will be developed. Cross-country exchange visits and training will be arranged to learn from relevant experiences from similar projects being implemented in different Asian countries. Under NSP a working group will be supported for preparing disseminating co-management best practices and lessons learned. Potential organizations for maintaining professional contacts include regional FAO office (Bangkok), RECOFTC (Bangkok), Wildlife Institute of India (Dehra Dun), ICIMOD (Kathmandu), CIFOR (Bogor, Indonesia), etc.

8.5 Conservation Training

Of the total 378 positions (of which only 105 are technical staff) allocated to WNCC, only 259 staff are in position. In Tekanf existing territorial staff continue to manage the GR based mainly on traditional forest management practices. There is great necessity of imparting conservation training to the FD field staff responsible for managing the GR. FD does not have any specialized capacity for imparting PA management training. Of the many forestry subjects only one paper relates to wildlife management being taught to cadre officers at Forest Academy, Chittagong. Other subordinate staff do not receive any significant training on PA management, although wildlife management is one of the many taught subjects. There is a lack of permanent faculty on in-situ conservation at ecosystem and landscape levels by involving local communities. However, some forest officers haven undergone overseas training on wildlife and PA management. Unfortunately many of them are working outside WNCC, thereby under-utilizing their expertise.

Other stakeholders including the beneficiaries and NGO staff also need conservation training. An exhaustive conservation training plan, covering both in-country and overseas training, will be developed under NSP and implemented over the project period. A training strategy dealing with both quality and quantity of training including refresher and orientation training courses will form part of the training plan. Significant progress has been achieved in overseas training during the current year when one senior officer was sent to US for short-term training and two ACFs were sent for long-term training at Wildlife Institute of India. Similar training programs will be conducted in future as well.

Adequate training infrastructure has been developed within FD under different donor funded projects including World Bank funded FRMP. Under the present cumbersome appointment procedures it may not be possible to recruit permanent staff in FD training institutes. So networking with other training and research institutes such as BFRI and IFESCU will be necessary.

A training needs assessment for participatory PA management was conducted under FSP (TECSULT, 2000). A provisional list of professional specialist skill is presented as below from the study (Art et al, 2004) conducted under NSP:

- Strategic and Adaptive PA Management Planning
- Information Technology (MIS)/Spatial Data Management (GIS)
- Communication Hardware Technology
- Information, Education and Communication (IEC)/Visitor Services
- Public Outreach and Extension
- Community Relations : Conflict Management and Resolution
- Community Support : Livelihoods Improvement
- Environment and Wildlife Law/Legal Support
- Law Enforcement
- Financial Management Accounting
- Wildlife Insurance and Compensation
- Co-management of PAs
- Conservation Biology
- Ecological and Biodiversity Inventory and Research
- Habitat Management of Rehabilitation Applied Research
- Wildlife Management, Rehabilitation and Species Recovery
- Socio-economic Research
- Gender and Ethnic Diversity
- Leadership Training and Decentralized Management

8.6 Summary of Main Prescriptions

Main prescriptions outlined under the above-developed protection programs are summarized in Table 8.1 as below :

Table 8.1 Summary of Main Prescriptions

Year	Main Activities	Main Outputs/Success Criteria	Responsibility
1	-Identifying possible conservation topics for taking up research studies	A list of research topics prepared	NSP/FD
	-Holding stakeholders consultations on the proposed list of identified research topics	A short list prepared after stakeholders consultations	NSP/FD/ Stakeholders
	-Identifying and networking with interested national organizations for conducting selected research studies	Interested research organizations contacted	NSP/FD
	-Developing a set of indicators for conservation monitoring	A set of indicators selected after consultations	NSP/FD
	-Collecting and developing benchmark data/information base with respect to core indicators	Benchmark surveys completed	NSP
	-Identifying regional and international organizations for networking and cross-learning	Relevant regional organizations contacted	NSP/FD
	-Preparing an overseas and in-country training plan for imparting training to all stakeholders	Conservation training plan finalized	NSP/FD
	-Finalizing the draft Wildlife Act	Draft Wildlife Act finalized and submitted to MOEF	FD/NSP
2	-Prioritizing the identified research topics	Priority list finalized after stakeholders consultations	NSP/FD/ Stakeholders
	-Developing ToRs and arranging budget for priority research studies	ToRs ready with required budget	FD/NSP
	-Contracting interested national organizations for conducting selected research studies	Interested research organizations contracted	NSP/FD
	-Collecting and developing follow up data/information base with respect to core indicators	Follow up surveys completed	NSP
	-Maintaining regular contacts with regional and international organizations for networking and cross-learning	Contacts with regional organizations maintained	NSP/FD
	-Implementing overseas and in-country training plan for imparting training to all stakeholders	Training plan implemented	NSP/FD
	-Approving the draft Wildlife Act	Draft Wildlife Act submitted to Ministry of Law and other related ministries	FD

Year	Main Activities	Main Outputs/Success Criteria	Responsibility
3, 4 and 5	-Implementing conservation research studies on the identified research topics	Priority research studies completed	NSP/FD
	-Disseminating and using research findings	FD and NSP staff use research findings	FD/NSP
	-Continue follow up data/information base with respect to core indicators	Follow up surveys completed	NSP/FD
	-Maintaining regular contacts with regional and international organizations for networking and cross-learning	Contacts with regional organizations maintained	NSP/FD
	-Implementing overseas and in-country training plan for imparting training to all stakeholders	Training plan implemented	FD
	-Approving the draft Wildlife Act	Draft Wildlife Act gazetted after Parliament approval	FD

9. ADMINISTRATION AND BUDGET PROGRAMS

9.1 Objectives

Main objective of administration and budget programs is to ensure that technical and administrative staff required to manage the GR effectively are approved, developed and posted. Improvements in financial organizational systems will aim for the financial sustainability for the GR.

9.2 Administrative Set Up

As per the approved organogram Chittagong Wildlife Management and Nature Conservation Division (with staff strength of 34) is to manage the GR within an overall supervision of Wildlife and Nature Conservation Circle (with a total of 378 staff). Each PA will be an operational unit with greater decentralized authority for decision-making with an assigned ACF (GR will be managed by an ACF/FR, who will be assisted by 1 DR/Fr and 3 FG/Boatman). However, the GR continue to be managed under the existing Cox's Bazar (South) Forest Division (it is currently managed within the overall administrative and management structure of Teknaf, Sikhali and Whykeong Forest Ranges). It is recommended to operationalize the approved organogram and adequate administrative and management structure be put in place.

9.3 Staffing Pattern

The ACF will reside at the GR's HQ and as Officer-in-Charge be exclusively responsible for the management of GR as per the Plan. He will be assisted in his office by a Deputy Forest Range Officer in developing and coordinating all GR management activities with specific responsibility for management of field staff and budget. He along with ACF will maintain a close working relationship with the territorial staff of FD in order to coordinate management activities in interface landscape zone and control illicit removals from the GR areas.

Trained Forest Guards/Foresters will be in Charge of specific areas; they, reporting directly to ACF, will be responsible for the coordination and implementation of day-to-day management activities in their respective GR areas. Over a time these posts will be upgraded and manned by trained Foresters/Deputy Range Officers. Over a period additional staff (say, FGs) will be deployed by establishing petrol camps; active help from local stakeholders and BDR will be sought during patrolling of the GR.

9.4 Duties and Responsibilities

The GR will be managed by an ACF under the overall charge of DFO, who will be work under the guidance of Conservator of Forest (Wildlife & Nature Conservation Circle).

Main responsibilities (as per the approved organogram) of CF will i) be responsible for overall administration of the Wildlife and Nature Conservation Circle; ii) supervise and coordinate all the matters related to wildlife protection and management of PAs, ecological critical areas, critical watersheds, wetlands of international importance, and environmental management under Wildlife Preservation Act and other Ordinance, Rules and Regulations and Directives issued by the government from time to time; iii) be responsible to take necessary measures and efforts to fulfill national obligations towards wildlife, biodiversity and other forestry and environmental related international treaties, protocols and conventions endorsed by the government; iv) be responsible for completion of all works within the budget provision of the Circle and distribution of funds within his budget grant among the Divisions under him; v) be responsible for all correspondences relating to wildlife management from time to time; vi) identify and draw up plans and programme for ex-situ and in-situ conservation for botanical/baldha gardens and PAs; vii) be responsible for taking programme related to conservation and management of PAs. Supervision of environmental management and nature conservation functions outside the PAs; viii) be responsible for drawing up programme for monitoring, survey and research in the PAs in relation to wildlife and biological diversity; ix) ensure the preservation of biodiversity, conservation of gene pool, germ plasm and the natural heritage of the nation; x) be responsible for preparation of budget and revised budget of his circle; xi) be responsible for appointment, promoting, disciplinary action, disposal of appeal cases, writing of ACRs of staff falling within his administrative powers; xii) be responsible for administration and ensuring execution of all functions in the forest division under him as per Policy, Acts, Ordinance, Rules and Regulations and Directives issued by the government from time to time; xiii) be responsible for providing proper executive and operational guidelines to the field staff of the Wildlife & Nature Conservation Divisions. Exercise control and supervision on the Divisions under his jurisdiction; ivx) be responsible for preparation of development/ annual programme related to conservation

of biodiversity and eco-tourism; vx) be responsible for preparation and annual inspection of divisional offices within his jurisdiction; vix) be responsible for proper execution of all development programmes within his circle; viix) be responsible for auditing of Divisional accounts and according financial and technical sanctions within his powers; viiix) be responsible for drawing and disbursing in respective offices as well as submission of accounts to the Accountant General; ixx) be responsible for inter-Divisional transfer and posting of Class III and IV staff within the Circle except the staff of his own office; and xx) be responsible for the preparation of preliminary management plan report of the Forest Divisions under his jurisdiction.
As per the approved organogram the DFO (WM & NC), Sylhet Division will i) be responsible for overall administration, management and protection of the resources of the Division and supervise, manage and control over the matters related to biodiversity, wildlife and environmental management. Strict and effective enforcement of laws, rules and regulations related to protection of wildlife including migratory birds and other amphibians and reptiles; ii) be responsible for drawing and disbursing of fund within the division; iii) be responsible for conservation and management of PAs, ecologically critical areas, critical watersheds and wetlands under his jurisdiction with the use of participatory resource management and conservation principles; iv) be responsible for appointment of employees of the Division falling within his powers and dealing with all matters relating to establishment including writing of ACRs of subordinate officers/staff; v) be responsible for transferring and posting of all subordinate staff within the Division except the staff of his own staff; vi) be responsible for preparation of annual budget and revised budget of the Division; vii) be responsible for exercise of powers given under Forest Act (Amendment), Bangladesh Wildlife (Preservation) (Amendment) Act and various Acts and Rules thereunder; viii) be responsible for annual and initiation of programs/activities for habitat improvement within his jurisdiction; ix) be responsible for annual and periodical inspection of PAs and other offices (Range, Beats) under him; x) be responsible for management and in-situ conservation of PAs and execution of all development programme within the jurisdiction of his Division; xi) be Principal Accounting Officer of his Division; xii) be responsible for all types of construction of within his jurisdiction; xiii) be responsible for motivational/contact/public relation and publicity functions within the Division; and xiv) any other responsibility assigned by the CCF/DCCF/CF.

The ACF as officer in Charge for the NP will directly report to the DFO, Wildlife and Nature Conservation Division. He will be responsible for administration, budget, planning, protection, coordination and implementation of management plan and co-management activities for the Park. He will maintain liaison with other related government departments and local NGOs for smooth implementation of co-management activities. .

The following responsibilities for ACF as officer in Charge are as per the approved organogram; he/she will i) be responsible for over all administration of the GR, Range Office and Beat Offices within his jurisdiction; ii) be responsible for exercise of powers given under various Acts and Rules thereunder; iii) help DFO in conducting smooth administration of the Division in which they are posted; iv) help DFO in the matter of all types of construction in the Division; v) help DFO in the matter of maintenance of discipline of the Division; vi) help DFO in the matter of raising plantation and nursery for habitat improvement within his jurisdiction; vii) help DFO in the matter of execution of development programme related to protected area management and wildlife conservation within his jurisdiction; viii) help DFO in the matter of checking theft and pilferage of forest produces and wildlife; ix) help DFO in the matter of checking encroachment of forest areas; and x) any other duties assigned by the CF/DFO.

He will be assisted by a Deputy Range Officer (in discharging his duties effectively), who will be responsible for the management of field staff, park budget and protection. He will reside at GR HQ and be de facto Deputy Officer-in-Charge responsible for all GR related matters.

The Forester in Charge of a Beat will be responsible for all the field management activities under his Beat and will be assisted by a FG/Plantation Mali in discharging his duties satisfactorily. Adequate support staff (e.g. clerks, etc.) will be provided for budgetary and administrative management. The present regulatory management systems will gradually be changed to collaborative management systems. Under the co-management approach the participants and resource management organizations will have defined functions in park management.

9.5 Staff Amenities

The existing Teknaf Range Office will be the HQ of ACF to be posted exclusively for managing the GR. He will be provided official residence at Teknaf along with other technical staff.

9.6 Financial Systems

The existing financial organization systems are adequate and appropriate in most areas but needs a detailed review in order to identify specific areas of financial strengthening in future. For example, under the existing budget codes neither there is any specific budget code for PA head (the WNCC is created in 2001 only whereas the budget codes were designed quite early) nor separate budget is allocated for WNCC for PA management. In many countries separate allocations are made for operational funds exclusively for the management of PAs and wildlife. This system needs to be implemented in Bangladesh in order to ensure a certain required level of annual financial stability for in-situ biodiversity conservation in the PAs managed under the WNCC. The funds flow to PA management need to be augmented by retaining and ploughing back a part (say 20%) of the total revenues generated from the PAs. Eco-tourism activities and entry fees for the PA will be a good source of revenue in future.

10. THE BUDGET

The budget requirements for the implementation of the Plan are projected based on the information gathered from FD field offices and official documents.

10.1 Input Requirements and Indicative Cost Estimates

This proposed schedule of inputs and costs is based on the major input requirements identified in Part II of the Plan. It is intended as both a summary of the major inputs required during the five year life of the Plan, and as a guide to further detailed costing by FD staff charged with its implementation. Costs shown are subject to revision during the Plan implementation period.

Table 10.1 Input Requirements and Indicative Cost Estimates for Strategic Programs

Strategic Programs	Unit	Quantity/ Year						Unit Cost '000 Taka	Total Cost '000 Taka	Notes
		Y1	Y2	Y3	Y4	Y5	Total			
1. Habitat Protection Programs										
1.1 Updating of Land Use/Forest Cover Map	ha	25000					25000		1200	note 1
1.2 Boundary Demarcation										
1.2.1 signboards	nos	10	15	15			40	3	120	note 2
1.2.2 outer and zonal boundary posts	km	50	100	60	40		250	5	1250	note 3
1.3 Formation of groups and signing of participatory conservation and benefit sharing agreements by user groups	User groups (@20 partici-pants/ group)	20	35	25	10		90	2	180	
1.4 Signing of co-management agreements with co-management councils/committees	lump sum (l.s.)								55	
1.5 Control of illicit felling, poaching, encroachment, forest fires and grazing by user groups	lump sum								950	note 4
1.6 Communication networks : walki talkies, mobile telephones, etc.	l.s.								75	
1.7 Provision of arms and ammunition for control of organized smugglers	l.s.								350	
1.8 Rewards/Incentives for biodiversity protection efforts	l.s.									
1.9 Resolution of forest conflicts	no. of meet-ings	30	25	20	20	15	110	1	110	note 5
1.10 Regulating the collection of NTFPs through user groups/councils/committe es	l.s.								50	
2. Management Programs										

Strategic Programs	Unit	Quantity / Year Y1	Y2	Y3	Y4	Y5	Total	Unit Cost '000 Taka	Total Cost '000 Taka	Notes
2.1 Management Zoning										note 6
2.2 Core Zone Management										
2.2.1 Protecting forests and other biodiversity	ha	11610	11610	11610	11610	11610	11610			note 7
2.2.2 Canopy opening and enrichment planting	ha	50	50	50	50		200	8.8	1760	note 8
2.2.3 Planting framework species	ha	50	100	100	50	50	350	24	8400	note 9
2.2.4 Short-rotation plantation (woodlot) management	ha	50	100	100	50	50	350	24	8400	note 10
2.2.5 Habitat improvement works	ha	50	50	50	50	50	250	15	3750	note 11
2.2.6 Habitat restoration works	ha	50	75	75	50	50	300	10	3000	note 12
2.2.7 Renovations of existing Water bodies	No.	5	3	3	2	2	15	100	1500	note 13
2.2.8 Elephant fodder (palatable grasses/bamboo) development	Ha	50	100	100	50	50	350	10	3500	
2.2.9 Subsidiary silvicultural operations in identified areas	Ha	100	150	150	100	100	500	8.8	4400	
2.2.10 Maintaining Special Habitats	l.s.								500	
2.2.11 Participatory management of existing plantations in identified sustainable use sub-zone	l.s.								500	
2.3 Interface Landscape Zones Management										
2.3.1 Proposed Extension Sub-Zone	ha							10,985		
2.3.1.1 Survey, demarcation and mapping	ha	10,985							5000	
2.3.1.2 Submission of proposal to MOEF and follow up	l.s.								5	
2.3.1.3 Gazettement	l.s.								5	
2.3.1.4 Integrated mapping, etc.	l.s.								100	
2.3.2 Elephant Movement Corridors Sub-Zone										
2.3.2.1 Checking further habitat fragmentation	l.s.								1500	
2.3.2.2 Elephant fodder development										See 2.2
2.3.3 Intensive Use Sub-Zone										
2.3.4.1 Maintaining existing FD buildings										See 4
2.3.4.2 Constructing new FD buildings										See 4
2.3.4 Buffer Reserve Sub-Zone	ha						4100			
2.3.4.1 Managing existing plantations and natural vegetation	ha	50	100	100	100	100	450	1	450	

Strategic Programs	Unit	Quantity / Year Y1	Y2	Y3	Y4	Y5	Total	Unit Cost '000 Taka	Total Cost '000 Taka	Notes
2.3.4.2 Forming groups and implementing livelihood programs for the identified villages	No. of villages									note 14
2.3.4.3 Participatory woodlots of short rotation species	Ha	20	50	50	50	50	250	24	6000	
2.3.5 Transport Corridors Sub-Zone	ha									note 15
2.3.5.1 Liaisoning with Land Owning Agencies	l.s.								50	
2.3.5.2 Raising strip plantations along roads and railway lines	km	6	8	8	4	4	30	32	960	
3. Livelihoods Programs										
3.1 Selecting priority production technologies										
3.1.1 Conducting reconnaissance surveys and demand-supply assessment	l.s.								50	
3.1.2 Identifying a list of feasible production technologies	l.s								8	
3.1.3 Stakeholders' Consultations on the proposed production technologies	l.s.								25	
3.1.4 Agreeing on priority production technologies	l.s								5	
3.2 Developing demonstration Centers										
3.2.1 Identifying Farmers' Field Schools	l.s.								100	
3.2.2 Developing identified fields as demonstration centers	l.s.								2000	
4. Facility Development Programs										
4.1 Facilities and Infrastructure										
4.1.1 GR Headquarters (Teknaf Range Office)										
4.1.1.1 Maintenance of existing new and old FRHs at Teknaf	l.s.								500	
4.1.1.2 Maintenance of existing Range Office and Range Officer's Quarter	l.s.								500	
4.1.1.3 Maintenance of existing Forester's Quarters	l.s								400	
4.1.1.4 Maintenance of existing FG Quarters	l.s.								500	
4.1.1.4 Demolition and removal of derelict buildings	nos	100 %					100%		100	
4.1.1.5 Construction of ACF's/OIC's Quarters	m^2	100					100	12.5	1250	

Strategic Programs	Unit	Quantity / Year Y1	Y2	Y3	Y4	Y5	Total	Unit Cost '000 Taka	Total Cost '000 Taka	Notes
4.1.1.6 Construction of GR HQ and Environmental Education Centre	m^2	350					350	12.5	4375	
4.1.1.7 Construction of Forester's (4, each ~60 m^2)	m^2	80					320	12.5	4000	
4.1.1.8 Construction of Recovery Shed	m^2	100					100	5	500	
4.1.1.9 Construction of Dormiatory/Barrack for FGs	m^2	350					350	7	2450	
4.1.1.10 Construction of Students Hut/Dormitory	m^2	150					150	12.5	1875	
4.1.2 Silkhali Range										
4.1.2.1 Maintenance of existing FRHs	l.s.								500	
4.1.2.2 Maintenance of existing Range Office and Range Officer's Quarter	l.s.								500	
4.1.2.3 Maintenance of existing Beat Offices and Beat Officerss Quarter	l.s.								800	
4.1.2.4 Removal of derelict buildings	nos		100 %				100%		50	
4.1.2.5 Construction of Forester's Quarters (3)	m^2		240				240	12.5	3000	
4.1.2.6 Construction of Guard's Quarters (2, each ~60 m^2)	m^2		120				120	12.5	1500	
4.2.6 Construction of Plantation Mali's Quarters (2, each ~40 m^2)	m^2		80				80	12.5	1000	
4.2.7 Construction of Public Toilet	m^2		10				10	12.5	125	
4.1.3 Whykheong Range										
4.1.3.1 Maintenance of existing FRHs	l.s.								500	
4.1.3.2 Maintenance of existing Range Office and Range Officer's Quarter	l.s.								500	
4.1.3.3 Maintenance of existing Beat Offices and Beat Officers' Quarter	l.s.								800	
4.1.3.4 Construction of Forester's Quarters (2)	m^2		160				160	12.5	2000	
4.1.3.5 Construction of Guard's Quarters (2, each ~60 m^2)	m^2		120				120	12.5	1500	
4.1.3.6 Construction of Public Toilet	m^2		10				10	12.5	125	
4.2 Vehicles										
4.2.1 Double-cab pickups	nos	2					2	2500	5000	
4.2.2 100 cc motorcycles	nos	15					15	130	1950	
4.3 Equipment										
4.3.1 Office equipment	misc	40%	60%				100%	100	100	

Strategic Programs	Unit	Quantity / Year Y1	Y2	Y3	Y4	Y5	Total	Unit Cost '000 Taka	Total Cost '000 Taka	Notes
4.3.2 Field equipment	misc	40%	60%				100%	200	200	
5. Visitor Use and Visitor Management Programs										
5.1 Nature Interpretation Centre										Note 17
5.2 Nature trails	km	2	5	5	5	3	20	10	200	
5.3 Identifying suitable sites for Nature Camps		2					5	2	10	
5.4 Toilets/Restrooms	no.	1	2	1	1		5	75	375	
5.5 Resting Facility	no.		1				1	100	100	
5.6 Trash cans	no.	2	3	2	3		10	1.5	15	
5.7 Identifying & training eco-guides	no.	5					1	5		
5.8 Preparing publicity materials	no.	9000	7000	5000	3000	1000	25000	0.015	375	
5.9 Motivating Sabuj Vahinis	no.	500	400	300	200	100	15000	0.025	375	
5.10 Film making (audio-visuals) for NIC	no.	1					1	300	300	
6. Conservation Research, Monitoring and Capacity Building Programs										
6.1 Conservation Research										
6.1.1 Floral and faunal inventories	m-m	2	4	1			9	30	270	
6.1.2 Research studies	m-m	5	4	3	2	2	16	75	1200	
6.2 Conservation Monitoring										
6.2.1 Biodiversity health monitoring	m-m	12	2	2	2	2	20	30	600	
6.2.2 Socio-economic monitoring	m-m	4	1	1	1	1	8	30	240	
6.3 Conservation Capacity Building										
6.3.1 Overseas study tours (1 DFO, 1 ACF, 1 Forest Ranger)	m-m						2.5	200	450	
6.3.2 Overseas training (2 PG Diploma in Park Management)	m-m	20					20		800	note 18
6.3.4 In-country training (ACF (1), Forest Ranger (1), Deputy Forest Ranger (1), Foresters (4), Forest Guards (8), NGO staff (3)	m-m	25					25	12	300	note 19
6.3.5 In-country training of members of user groups and co-management committees	no.	50	150	100	50	50	400	1	400	
6.3.6 Overseas tour of user groups	No.	50	25	25			100	20	2000	note 20
7. Administration and Budget Programs										
7.1 Staffing										
-DCF (1)	m-m	12	12	12	12	12	60	10	600	
-ACF (1)	m-m	12	12	12	12	12	60	5	300	

Strategic Programs	Unit	Quantity/ Year Y1	Y2	Y3	Y4	Y5	Total	Unit Cost '000 Taka	Total Cost '000 Taka	Notes
-Forest Ranger/Deputy Forest Ranger (1)	m-m	12	12	12	12	12	60	3	180	
-Foresters (3)	m-m	36	36	36	36	36	180	2.5	450	
-Forest Guards (3)	m-m	36	36	36	36	36	180	2	360	
-Plantation Malis (3)	m-m	36	36	36	36	36	180	2	360	
7.2 Operating Costs										
-support staff, utilities, vehicle fuel and upkeep, *etc.*	months	24	24	24	24	24	120	10	1200	

Notes:

1 based on existing area of the GR, proposed extension, elephant movement corridors and landscape zones. Mapping to be produced by RIMS/CEGIS based on satellite imagery (more recent imagery, if available), updated Forest Department plantation records, ground-truthing by GR staff, and socio-economic surveys.
2 based on number of signboards to be placed at main access points and elsewhere along the GR boundary and to designate participatory use areas.
3 calculated as actual boundary length.
4 estimated mainly for conducting group meetings before proceeding for patrol duties. Vehicles and other equipments are covered under facility development programs
5 estimated expenses for conducting village level meetings for conflict resolution
6 cost for management zoning is covered under item 1.1
7 cost of protection is covered under item 1
8 based on 200 ha in the core zone that may be subject to selective felling or other silvicultural treatment followed by enrichment planting.
9 based on an area of 350 ha of long-rotation plantation of indigenous species. This area will be replanted with native framework species and managed for a rapid return to forest cover.
10 based on current area of plantations in the core zone that can be brought under PCBSA.
11 rough estimates for a number of site specific activities as listed in the text; the funds requirements will be precisely estimated after inspecting the sites.
12 rough estimates for a number of site specific activities as listed in the text; the funds requirements will be precisely estimated after inspecting the sites.
13 rough estimates for a number of site specific activities as listed in the text; the funds requirements will be precisely estimated after inspecting the sites.
14 costs are covered under livelihoods programs (Chapter 5 of Part II).
15 the guidelines for strip plantations being raised under buffer zone planting of FSP will be used for raising linear plantations in Transport Corridor Sub-Zone
16 Tea Estate workers will be covered under livelihoods programs as covered under Chapter 5 of Part II.
17 this item is already covered under 4.1.1.6
18 costs per PG Diploma are calculated as travel costs (US$450 or Tk 27,000) plus tuition fee (US$5000 or Taka 300,000) plus living costs and miscellaneous (Tk 7,200/month).
19 based on training duration of 5 weeks for ACF, 3 weeks for Forest Ranger/Deputy Forest Ranger and 2 weeks for Forester/Plantation Malis/Forest Gaurds/NGOs
20 members of user groups will visit nearby West Bengal by making bus journeys from Dhaka to north Bengal.

10.2 Budget Revision

The budget estimates as presented in the above-stated Section 11.1 are based on the information gathered from FD field offices and are subject to variations depending upon the site locations and actual work periods. It is recommended to prepare annual plans with revised budgets taking into consideration work sites and availability of labour.

10.3 Financing Sources for Management Plans Implementation :

Possible sources for funding required for implementing the recommendations made under the management plans are listed as below :

10.3.1. Government of Bangladesh (GOB)

The budget is annually allocated by GOB in the ADP for the implementation of forestry schemes/projects. The development budget is an important source of funding for implementing many activities listed in the Management Plans. However, under the existing budget codes neither there is any specific budget head for PA allocations nor separate budget allocations are made for operational funds for the management of wildlife and PAs. A separate budget head may be essential in order to ensure a certain required level of annual financial stability for PA management.

The revenue budget from GOB are available mainly for meeting the salary needs of the FD staff working in Pilot PA areas.

10.3.2. Donors

Presently the following two donor funded projects are implemented by FD in the PAs :

i) ADB supported Forestry Sector Project (ending by June 2006) is supporting some activities (such as buffer plantations, user groups formation, motivation, etc.) in 7 PAs (including Lawachara, Rema-Kalenga and Teknaf covered under NSP), and;
ii) Nishorgo Support Project (NSP) is supporting co-management activities in 5 pilot PAs.

Possible future sources for external funding could include GEF, CDM, Carbon Funds, Multilateral Funds (World Bank, ADB, EC, UNDP, etc.), Bilateral Funding, Trust Funds, Foundations, etc.

10.3.3. Public-Private Partnerships

Nature conservation can progress rapidly when leading members of private sector and NGOs perceive nature conservation as good for the economic well being. Nature conservation partnerships can be designed to offer interested businesses a vehicle for contributing to long-term forest conservation in a way that is transparent, generates beneficial public image for the contributor and makes a long-term difference in forest conservation.

10.3.4. Internal Financing

Part retention (say 25%) of locally generated revenue from the visitors to PAs can be achieved (on the pattern of social forestry plantations – an account, opened on the pattern of TFF, can be managed by FD) for funding PA management actvities. Possible sources of revenue generation from entrance and special use may include :

i) Park Entry Fee
ii) Guest House Fee
iii) Hiking Fee,
iv) Fines,
v) Donations, etc.

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VOLUME 2

SUPPORT MATERIAL

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1. NOTIFICATION

(Published in the Bangladesh Gazette, Part I, dated the 17th November, 1983)

Government of the People's Republic of Bangladesh
Ministry of Agriculture
Agriculture and Forests Division
Section XIII
NOTIFICATION
Dhaka, the 1st November, 1983

No. XIII/For-1/83/770 - In exercise of the powers conferred by Clause (1) Article 23 of Bangladesh Wild Life (Preservation) (Amendment) Act, 1974 of the Government of the People's Republic of Bangladesh is pleased to declare the Reserve Forest area covering an area of 28,688 acres of Cox's Bazar Forest Division situated within the boundaries of Forest Blocks shown in the schedule below in the district of Chittagong, to be the Game Reserve (Elephant), with effect from the date of publication of this notification :

Name of Block	No. of Block	Area (in acres)	Legal status	Remarks
1. Raikheong	53	4,376	Reserve Forests	Teknaf Range
2. Saplapur	54	2,071	Do	Do
3. Shilkhali	55	1,852	Do	Do
4. Madhyanilla	56	4,250	Do	Do
5. Dakhin-Nilla	57	2,066	Do	Do
6. Matabhanga	58	2,110	Do	Do
7. Rajachara	59	3,340	Do	Do
8. Ledha	60	3,101	Do	Do
9. Dumdumia	61	2,548	Do	Do
10. Teknaf	62	2,974	Do	Do
Total		28,688		

By order of the
Chief Martial Law Administrator
S. S. CHAKMA
Deputy Secretary

BGP-83/84-3637G-50-20. 11. 83

2. USEFUL GLOSSARY

Biodiversity : The variety of life and its processes including complexity of species, communities, genepools and ecological functions (USDA Forest Service 1993).

Den tree : A standing live tree with cavity in branches or in the bole in use or having potential for use by wildlife.

Keystone species : Animals or plants which by virtue of their presence or absence alter the structure of a community.

Limiting factor : The environmental influence through which the toleration limit of an organism is first reached, which acts as the immediate restriction in one or more of its functions or activities or in its geographic distribution.

Pinch period : A season during which either food or water or both are minimal in their quantity, quality or distribution, causing stress in animal populations.

Riparian zone : An area identified by the presence of vegetation that requires free or unbound water or conditions more moist than normally found in the area.

Sensitive site : A site vulnerable to rapid change in its biological attributes or physical character in the face of management activity or resource uses either due to its small size or due to existing species/communities, which are tolerant to change or are exacting in their habitat requirements or fragile rock/soil formation.

Stand : Plant communities, particularly of trees, sufficiently uniform in composition, constitution, age, spatial arrangement or condition to be distinguishable from adjacent communities.

Succession stage : A stage or recognizable condition of a plant community which occurs during its development from bare ground to climax.

Influence zone : The extent of area outside the legal boundaries over which local villagers have a traditional PA based forests based dependency and/or over which significant wildlife damage occurs.

3. LIST OF WILDLIFE SPECIES

The following list of wildlife species of Teknaf is based on:

BCAS (1997) *Biological Survey*. Bangladesh Centre for Advanced Studies, Dhaka.

Scientific name	Family name	Common name
Aviceda leuphotes	*Accipitridae*	Black Baza
Calotes versicolor	Agamidae	Garden Lizard
Cypsiurus parvus	Apodidae	Palm Swift
Ardeola grayii	Ardeidae	Indian Pond-Heron
Bubulcus ibis	Ardeidae	Cattle Egret
Artamus fuscus	Artamidae	Ashy Woodswallow
Bufo melanostictus	Bufonidae	Common Toad
Cuon alpinus	Canidae	Red Dog, Wild Dog, Dhole
Vulpes bengalensis	Canidae	Bengal Fox
Canis aureus	Canidae	Jackal
Megalaima lineate	Capitonidae	Lineated Barbet
Macaca mulatta	*Cercopithecidae*	Rhesus Macaque (Banor)
Macaca assamensis	*Cercopithecidae*	Assamese Macaque
Macaca nemestrina	*Cercopithecidae*	Pig tailed Macaque
Presbytis phayrei	*Cercopithecidae*	Phayre's Leaf Monkey
Presbytis pileata	*Cercopithecidae*	CAPPED monkey (Hanuman)
Cervus unicolor	Cervidae	Sambhur
Muntiacus muntjak	Cervidae	Barking Deer
Streptopelia chinensis	Columbidae	Spotted Dove
Cissa chinensis	Corvidae	Green Margpie
Dendrocitta formosae	Corvidae	Grey Tree-pie
Centropus sinensis	Cuculidae	Greater Coucal
Dicrurus paradiseus	Dicruridae	Drongo, Racket-tailed
Dicrurus remifer	Dicruridae	Lesser Racket-tailed Dron
Dicrurus adsimilis	Dicruridae	Black Drongo
Dicrurus aeneus	Dicruridae	Bronzed Drongo
Dicrurus leucophaeus	Dicruridae	Ashy Drongo
Elephus maximus	Elephantidae	Indian Elephant
Taphozous saccolaimus	Emballonuridae	Pouch-bearing Sheath-tailed Bat
Felis viverrina	Felidae	Indian Fishing Cat
Gekko gecko	Gekkonidae	Gekko
Hemidactylus	Gekkonidae	Common House Lizard
Herpestes edwardsii	Herpestidae	Common Grey Mongoose
Herpestes urva	Herpestidae	Crab eating Mongoose
Hylobates hoolock	Hylobatidae	Hoolock Gibbon
Hystrix indica	Hystricidae	Crested Porcupine
Aegithinia tiphia	Irenidae	Common Iora
Chloropsis cochinchinensis	Irenidae	Blue-winged Leafbird
Sterna aurantica	*Laridae*	River Tern
Lanius cristatus	*Laniidae*	Brown Shrike
Nycticebus coucang	*Lorisdae*	Slow Loris
Megaderma lyra	Megadermatidae	Bat
Bandicota bengalensis	Muridae	Lesser Bandicot Rat
Rattus rattus	Muridae	Common House rat
Mus musculus	Muridae	Indian House-mouse
Aonyx cinerea	Mustelidae	Small-clawed otter
Lutra lutra	Mustelidae	Otter
Garrulax moniligerus	Muscicapidae	Necklaced Laughing Thrush
Orthotomus sutorius	Muscicapidae	Tailor Bird
Nectarinia asiatica	Nectariniidae	Purple Sunbird

Scientific name	Family name	Common name
Nectarinia sperata	Nectariniidae	Purple-throated Sunbird
Gallus gallus	Phasianidae	Red Junglefowl
Oriolus xanthornus	Oriolidae	Black-hooded Oriole
Dinopium benghalense	Picidae	Woodpecker, Red-backed
Psittacula alexandri	Psittacidae	Red-breasted Parakeet
Pteropus giganteus	Pteropidae	Flying-fox, Common
Rousettus leschenaultia	Pteropidae	Fulvous Fruit Bat
Amaurornis phoenicurus	Rallidae	White-breasted Waterhen
Pycnonotus cafer	Pycnonotidae	Red-vented Bulbul
Pycnonotus jocosus	Pycnonotidae	Red-whiskered Bulbul
Rana cyanophlyctis	Ranidae	Skipper Frog
Rana tigerina	Ranidae	Bull Frog, Indian
Polypedates leucomytax	Rhacophoridae	Tree Frog
Mabuya carinata	Sciuridae	Common Skink
Callosciurus pygerythrus	Sciuridae	Irrawaddy Squirrel
Dremomys lokriah	Sciuridae	Orange-bellied Squirrel
Petaurista magnificus	Sciuridae	Hodgson's Squirrel
Sus scrofa	Suidae	Indian Wild Pig
Arctonyx collarsis	Suidae	Hog Bardger
Suncus murinus	Soricidae	Shrew, Common Indian Musk
Acridotheres fuscus	Strunidae	Jungle Myna
Acridotheres tristis	Strunidae	Common Myna
Sturnus contra	Strunidae	Asia Pied Starling
Sturnus malabaricus	Strunidae	Chestnut-tailed Starling
Arctonyx collarsis	Suidae	Hog Bardger
Sus scrofa	Suidae	Indian Wild Pig
Tupana glis	Tupiidae	Common Tree Shrew
Melursus ursinus	Ursidae	Sloth Bear
Selenarctos thibetanus	Ursidae	Asiatic Black Bear
Kerrivoula papillosa	Vespertilionidae	Painted Bat
Arctictis binturong	Viverride	Bainturong
Paradoxurus hermaphroditus	Viverride	Common Indian Palm-cat
Viverricula indica	Viverride	Small Civet-cat

4. FRAMEWORK TREE SPECIES

The framework species method of forest restoration was first developed in the late 1980's in Queensland, Australia, where planting just 20-30 carefully selected "framework" tree species resulted in rapidly regenerating forests, accumulating up to 80 tree species, within 6-10 years. The method relies on selecting tree species that: i) are fast-growing with dense spreading crowns that rapidly shade out competing weeds and ii) are attractive to seed-dispersing wildlife, especially birds and bats. In addition, framework species must be easy to propagate in nurseries. High quality seedlings of 20-30 framework tree species, 5-60 cm tall (30 cm for the fastest growing species) are planted 1.6 – 1.8 m apart at the beginning of the rainy season. Weeds are vigorously controlled and fertilizer is sometimes added, but after 2-3 rainy seasons the canopy closes, the forest becomes self-sustaining and no further maintenance is required. Once the "framework" of a forest has been re-established, the other components of the ecosystem can return naturally (Elliott et al. 1998).

- The following have been identified as potentially suitable "framework" species for use in forest restoration and enrichment planting in Chunoti Wildlife Sanctuary. The list comprises species that are known to occur in Chunoti forests, and that satisfy the above criteria.

The following list is not intended to be comprehensive and can be added to based on the criteria outlined above. Species indicated in **bold** may be available from BFRI or other nurseries. Wild seed collection will be required for other species.

Family	*Species*
Moraceae	Artocarpus lacucha
Euphorbiaceae	*Bischofia javanica*
Rhizophoraceae	*Carallia brachiata*
Leguminosae	*Cassia fistula*
	Cassia siamea
Fagaceae	*Castanopsis indica*
	Castanopsis tribuloides
Dilleniaceae	*Dillenia pentagyna*
Elaeocarpaceae	*Elaeocarpus* spp.
Juglandaceae	*Engelhardtia spicata*
Ternstroemiaceae	*Eurya acuminata*
Moraceae	*Ficus benghalensis*
	Ficus benjamina
	Ficus comosa
	Ficus hispida
	Ficus infectoria
	Ficus racemosa
	Ficus religiosa
	Ficus rumphii
	Ficus semicordata
Verbenaceae	Gmelina arborea
Euphorbiaceae	*Macaranga* spp.
	Mallotus spp.
Magnoliaceae	Michelia champaca
Fagaceae	*Quercus* spp.
Theaceae	*Schima wallichii*
Moraceae	*Streblus asper*
Myrtaceae	*Syzygium fruticosum*
	Syzygium grande
Verbenaceae	*Vitex* spp.
Leguminosae	*Xylia dolabriformis*

5. LIST OF PLANT SPECIES

The following list of plant species reported from Teknaf Game Reserve is based on the following source :

BCAS (1997) *Biological Survey*. Bangladesh Centre for Advanced Studies, Dhaka.

Scientific Name	Family Name	Common Name
Thunbergia grandiflora	Acanthaceae	Nillata
Lepidagathis incurve	Acanthaceae	Not available (Na)
Spondias dulcis	Anacardiaceae	Bilati amrah
Swintonia floribunda	Anacardiaceae	Am-Chundal/Civit
Lannea coromandelica	Anacardiaceae	Bhadi/Jiulbhandi
Mangifera sylvatica	Anacardiaceae	Uriam
Holigarna caustica	Anacardiaceae	Barela
Ichnocarpus frutescens	Apocynaceae	Shamalata
Tabernaemontana	Apocynaceae	Chottokatwadar
Alocasia indica	Araceae	Mankachu
Cordia myxa	Boraginceae	Bohanari, Lagora
Bombax ceiba	Bombacaceae	Simul, Tula
Heterophragma	Bignoniaceae	Kawatuti, Dakrum
Anogeissus acuminate	Combretaceae	Kanchoi
Terminalia chebula	Combretaceae	Kawatuti, Dakrum
Eupatorium odoratum	Compositae	Assamlata, Germanlata
Spilanthes acmella	Compositae	Marhatitiga
Mikania cordata	Compositae	Assamlata, Taralata
Ageratum conyzoides	Compositae	Ochunti, Fulkuri
Paederia foetida	Convolvulaceae	Gandhabadhuli, Gandhal
Dipterocarpus	Dipterocarpaceae	Baittya/Garjan
Hopea odorata	Dipterocarpaceae	Telsur/Tersol
Cyperus iria	Cyperaceae	Barachancha
Dillenia pentagyna	Dilleniaceae	Hargaza
Dillenia indica	Dilleniaceae	Chalita, Ulugach, Ravia
Dioscorea bulbifera	Dioscoreaceae	Rataalu, Banalu, Pagaalu
Dioscorea oppositiflia	Dioscoreaceae	Na
Dioscorea glabra	Dioscoreaceae	Shora alu
Eaeocarpus robustus	Elaeocarpaceae	Jalpai, Chekio
Sapium insigne	Euphorbiaceae	Marulia, Latmel
Glochidion	Euphorbiaceae	Keora, Keotomi
Phyllanthus reticulatus	Euphorbiaceae	Panseuli, Chitki, Pankushi
Bridelia retusa	Euphorbiaceae	Kamkui, Kantakui, Kusi
Macaranga denticulate	Euphorbiaceae	Bura, Ratabura, Madla
Phyllanthus acidus	Euphorbiaceae	Orbori, Harbari, Noar
Trewia nudiflora	Euphorbiaceae	Bhatam, Pitali
Sapium baccatum	Euphorbiaceae	Billa, Kalobel, Campata
Quercus spicata	Fagaceae	Raibatna, Barabatna, Batna
Castanopsis tribuloides	Fagaceae	Batana/Batna
Flacourtia cataphracta	Flacourtiaceae	Paniala, Lukluki
Gleichenia pectinata	Gleicheniaceae	Na
Mesua ferra	Guttiferae	Nageshwar
Actinodaaphne	Lauraceae	Madanmasta
Litsea sebifera	Lauraceae	Karjiuki, Phulgach, Paja
Cinnamomum caphora	Lauraceae	Karpur
Entada reedhei	Leguminosae	Gilla lata
Cassia fistula	Leguminosae	Shourala/Sonalu
Mucuna pruriens	Leguminosae	Kamoch, Alkushi, Banda
Cassia tora	Leguminosae	Chakunda, Galeski
Erythrina indica	Leguminosae	Palita Madar
Mimosa pudica	Leguminosae	Lajjaboti
Tephrosia purpurea	Leguminosae	Bannil, Lohamori
Erythrina spinosa	Leguminosae	Kata Madar

Scientific Name	Family Name	Common Name
Derris scandens	Leguminosae	Noalata, Kmarialata, Nisoth
Cajanus cajan	Leguminosae	Arhar
Albizzia chinensis	Leguminosae	Chakua/Chakkua-Korai
Albizzia odoratissimus	Leguminosae	Tetuya koroi
Albizzia procera	Leguminosae	Koroi
Smilax macrophylla	Liliaceae	Bulkumia, Kumarilata
Smilax aspera	Liliaceae	Kumarialata
Curculigo recurvata	Liliaceae	Bidripata
Lagerstroemia speciosa	Lythraceae	Jarul/Kanta Jarul
Hibiscus tiliaceus	Malvaceae	Bhola
Chickrasia velutina	Meliaceae	Korkoizza pitra
Melastoma malabathrica	Meastomataceae	Dadranga, Lutki, Bantezpata
Aphanamixis polystachya	Meliaceae	Pitraj
Artocarpus chaplasha	Moraceae	Cham/Chapalish
Artocarpus lacucha	Moraceae	Deua, Deophal, Dephal
Ficus hispida	Moraceae	Kakdumur, Thuska
Ficus microcarpa	Moraceae	Jir
Streblus asper	Moraceae	Asshaora, Shaora
Musa rosacea	Musaceae	Ramkola, Bamanagjkola
Musa paradisica	Moraceae	Kachakola
Maesa ramentacea	Myrsinaceae	Noamricha, Maricha
Myristica logiflia	Myristicaceae	Amboala
Syzygium claviflorum	Myrtaceae	Nalijam, Lamba nalijam
Syzygium formosanum	Myrtaceae	Paniajam, Phuljam
Syzygium grande	Myrtaceae	Dhakijam
Pholidota pallida	Orchidaceae	Orchid
Cymbidium aloifolium	Orchidaceae	Orchid
Caryota urens	Palmae	Golsagu, Golmar, Chaur
Piper betel	Piperaceae	Pn, Tambuli
Bambusa tulda	Poaceae	Kaligoda
Melocanna baccifera	Poaceae	Mulibans
Thysanolaena maxima	Poaceae	Phuljharu, Jharu
Glycosmis arborea	Rutaceae	Aidali
Zanthoxylum rhetsa	Rutaceae	Tambu, Bajna, Bajinali
Zizyphus oenoplia	Rhamnaceae	Banboroi, Gotboroi, Sheakul
Borreria articularis	Rubiaceae	Madnabata kadu
Mussaendra glabrata	Rubiaceae	Nagabali, Sadapata
Anthocephalus chinensis	Rubiaceae	Kadam
Mitragyne parviflora	Rubiaceae	Phutikadam, Kelikadam
Pavetta indica	Rubiaceae	Falda, Kukurchura, Bisophal
Randia dumetorum	Rubiaceae	Mankanta, Manphal
Aphania danura	Sapindaceae	Danura, Gothahornia
Palaquium polyanthum	Sapotaceae	Dudya/Tali
Pterospermum	Sterculiaceae	Banassar, Laona
Microcos paniculata	Tiliaceae	Assar
Grewia laevigata	Tiliaceae	Na
Grewia microcosm	Tiliaceae	Assar, Patka
Trema orientalis	Ulmaceae	Jiban, Jinal, Chikun, Sunsuni
Clerodendrum	Verbenaceae	Bant, Ghetu, Ghetuphul
Clerodendrum inerme	Verbenaceae	Sitka/Sitki
Clerodendrum nerifolium	Verbenaceae	Kayetita, Kayektita
Vitex peduncularsis	Verbenaceae	Arsol/Awal/Goda/Hornia
Vitis axyphylla	Vitaceae	na
Tectona grandis	Verbenaceae	Shagwan/Shegun/Teak
Alpinia galangal	Zingiberaceae	Sugandhbach
Zingiber purpureum	Zingiberaceae	Ban ada, Baumurgagach

Khan, MS (1990) *The Flora of Chunoti Wildlife Sanctuary*. Multidisciplinary Action Research Centre (MARC), Dhaka.

6. GUIDELINES FOR FACILITY DEVELOPMENT

6.1 General Principles

As noted in the Introduction, these guidelines focus on the development of facilities for low volume ecotourism in existing conservation areas, and on the development of support facilities required for conservation area management. This approach implies no or low impacts on natural and cultural resources, based on the following underlying principles:

- environmentally responsible design specifications, site planning and construction techniques; and,
- ongoing monitoring and mitigation of impacts through environmental audits and other measures.

In combination these will require:

- limiting the physical and ecological impacts of all facilities developments;
- limiting the visual impacts of all facilities developments; and,
- limiting the cultural impacts of all facilities developments.

General guidelines for limiting physical and ecological impacts are:

- put the environment first;
- know and follow existing environmental regulations;
- conduct an environmental assessment for all new facilities proposals;
- where possible, select development sites where natural vegetation cover has already been removed or disturbed;
- avoid siting facilities in or near key wildlife habitats or other ecologically sensitive areas;
- avoid any disturbance to aquatic habitats;
- limit construction and working area footprint to the minimum necessary;
- limit the use of machinery on site;
- limit construction to the dry season;
- specify and follow construction cleanup requirements;
- rehabilitate/reclaim working areas disturbed during construction;
- utilise applicable energy and water conservation technology and practices;
- avoid all use of toxic materials, plastics, styrofoam and other persistent wastes;
- ensure that all solid and liquid wastes are properly disposed of;
- develop and deliver an education programme to avoid visitor impacts on vegetation and wildlife;
- identify and deal with problems as they occur;
- conduct regular environmental audits to track and mitigate erosion problems, changes in drainage patterns, changes in adjacent habitats and other evidence of site degradation; and,
- develop and deliver an environmental awareness programme to all staff.

General guidelines for limiting visual impacts are:

- cluster facilities in groups;
- use natural materials and colours;
- standardise exterior designs and finishes, and maintain a regular schedule of maintenance;
- educate visitors in order to prevent graffiti and other damages to facilities;
- use only locally occurring species for landscaping;
- rehabilitate/reclaim disturbed areas, water catchment ponds *etc.* to natural contours and shapes;
- screen support facilities (*e.g.*, generators, septic tanks, staff housing) from public view;
- identify and deal with problems as they occur; and,
- conduct regular environmental audits to track and mitigate evidence of littering and other negative visual impacts.

General guidelines for limiting cultural impacts are:

- involve local communities in all aspects of conservation area management, including facilities development;
- identify local community boundaries and use areas during the planning stage of facilities development;

- respect facilities development and visitor restrictions requested by communities; and,
- develop and deliver a cultural awareness programme to all staff and visitors.

Facilities also need to be cost-effective, but at the same time fit in with environmental and cultural aesthetics. General guidelines for achieving this balance are:

- ensure that there is an existing demand or requirement, or reasonable expectation of such demand developing in the near future, before planning and developing any physical facility;
- ensure that all facilities are relevant and appropriate to the management and visitor use of natural conservation areas;
- utilise local architectural styles, and maximise the use of local materials and labor;
- utilise and promote appropriate technologies in all facilities, including indigenous or locally developed energy and water conservation practices;
- avoid use of expensive or inappropriate materials (*e.g.*, marble, terrazo, rare or exotic woods);
- avoid live animal displays, which require a high level of expertise and are expensive to maintain properly, and may have negative impacts on biodiversity conservation; and,
- provide an attractive, natural and safe environment for all visitors.

These principles and guidelines need to be followed, as applicable, during the planning, construction and operation of all conservation areas facilities.

6.2 Facility Development Guidelines

Specific guidelines for each type of facility development anticipated in FSP-supported areas are provided below, in the following order:

6.2.1 Access Roads

6.2.1.1 Paved Access Roads

Paved (asphalt-surfaced) access roads pass through Lawachara National Park and immediately adjacent to Madhupur NP, Teknaf Game Reserve and Chunati Wildlife Sanctuary. These roads are variously the responsibility of RHD and LGED, but their proper use and maintenance within the conservation area context will require cooperation between RHD/LGED and FD staff to prevent unnecessary widening of the road rights of way, to minimise habitat loss, to control vehicle speeds and hence minimise wildlife road kills, and to minimise vehicle noise.

Guidelines for Paved Access Roads:

Do	Don't
-use asphalt or other hard surfacing only on access roads with high traffic volumes, used by heavy vehicles, or requiring constant access during the rainy season -limit vegetation clearing during road maintenance to within 1 m of pavement -conduct roadside vegetation clearing by hand only -avoid use of chemicals in roadside vegetation management -post speed limits and no littering signs -limit use of horns to emergency situations -maintain working contacts with other responsible agencies to ensure that all guidelines and restrictions are followed	-permit the routing of new road alignments through conservation areas, except as specifically required for conservation area management purposes -permit the use of sand, gravel, fuelwood or any other material harvested from conservation areas to be used in road maintenance

6.2.1.2 Unpaved Access Roads

Unpaved access roads (including brick or aggregate-surfaced roads and earthen tracks) are located in or adjacent to all FSP-supported conservation areas. Some of these roads are the responsibility of LGED, and as above their proper use and maintenance within the conservation area context will require cooperation

between LGED and FD staff. Others have been established to provide access to FD plantations, while still others appear to have been informally established along the route of existing foot and cart trails and are passable to vehicle traffic only during the dry season, if at all. However even these require management attention to ensure that improved but unwanted vehicle access to the interior of conservation areas is not inadvertently created.

Guidelines for Unpaved Access Roads:

Do	Don't
- use natural surfacing (herringbone brick, crushed gravel, earth), as appropriate to traffic levels, on interior access roads - limit public access (using gates, barriers *etc.*) on roads created specifically for conservation area management purposes - limit earthwork and vegetation clearing during road maintenance to within 1 m of road edge - conduct roadside vegetation clearing by hand only - avoid use of chemicals in roadside vegetation management - immediately revegetate/stabilise bare areas created during road maintenance - limit access development and maintenance to single lane - post signs indicating speed limits, no littering, and no use of horns except in emergency situations - maintain working contacts with other responsible agencies to ensure that all guidelines and restrictions are followed	- permit the routing of new road alignments through conservation areas, except as specifically required for conservation area management purposes - permit the use of sand, gravel, fuelwood or any other material harvested from conservation areas to be used in road maintenance

6.2.1.3 Bridges and Culverts

Access roads into or through established conservation areas are primarily the responsibility of RHD or LGED. However, some forest roads and trails are the responsibility of neither of these agencies, and will need to be maintained by FD if their use is required either for patrolling or for visitor access. These roads are likely to be unsurfaced (or at most surfaced by herringbone brick) and hence adequate precautions against scouring and erosion will be required, particularly at stream crossings.

Guidelines for Bridges and Culverts:

Do	Don't
- maintain bridges and culverts sufficient to prevent washouts, and to keep key roads and trails passable - where development of new access is required, design to minimise the number of watercourse crossings - limit installation work to the dry season, utilising manual labor to the extent possible - limit stream crossings to single lane - minimise disturbance to stream banks and vegetation - make adequate provision at culvert inlets and outlets and at bridge approaches and anchor points to minimise erosion - periodically inspect all bridges and culverts and effect maintenance and repairs as necessary	- overdesign (*e.g.*, don't install a bridge designed for 4-wheel vehicle traffic where management access is by motorcycle and/or visitor access by foot) - install any crossings that block stream flow (*e.g.*, log clusters with earth fill) - operate any machinery in any watercourse during bridge or culvert installation - permit ford crossings except where traffic levels are low, where water flow depths are <0.5 m, where approaches are low gradient with low (<1 m) bank heights, and where stream substrates are solid (gravel or rock)

6.2.2 Accommodation

6.2.2.1 Staff Accommodation

All FSP-supported conservation areas are managed under FD's territorial system, which includes *in situ* accommodation for field staff (Range Officers, Beat Officers, Forest Guards, Plantation Malis) primarily clustered around Range and Beat Offices. This accommodation generally follows GoB space standards but there often are insufficient units for numbers of staff, and existing units generally are in poor repair. FSP planning completed to date indicates a need for new or renovated accommodation for all staff levels, including higher level officers (ACFs, Forest Ecologists, Social Scientists) newly posted to conservation areas.

Guidelines for Staff Accommodation:

Do	Don't
- provide staff housing and basic amenities (*e.g.*, electricity, running water) to a sufficient standard to ensure a positive effect on staff morale and efficiency. - ensure that unused or underused buildings (*e.g.*, as constructed by FD's Wildlife Conservation and Management Project) are put to appropriate use, when otherwise suitable as specified below - renovate and use existing buildings only if they will remain functional throughout at least a 5 year period - remove all derelict buildings and reclaim sites - ensure that building renovations, and new building designs and locations, are functionally and aesthetically appropriate - make maximum use of local building and living technologies (*e.g.*, sanitary latrines, production and use of biogas, fuel efficient stoves, *etc.*) - make maximum use of natural lighting and airflow in building design - locate staff accommodation out of view of visitors/ visitor traffic flow - implement a regular inspection and maintenance programme to ensure that all staff accommodation is kept in clean and habitable condition	- permit occupation of staff quarters by other than assigned staff and immediate family members - permit unauthorised construction of outbuildings or other structures

Suggested minimum area standards for staff accommodation:
ACFs, Forest Ecologists, Social Scientists: 120 m^2
Range Officers: 100 m^2 (200 m^2 when combined with office)
Beat Officers: 80 m^2 (120 m^2 when combined with office)
Forest Guards: 60 m^2
Plantation Malis: 40 m^2

All staff housing should include adequate living space, kitchen and toilet facilities, and access to clean water

6.2.2.2 Visitor Accommodation

All FSP-supported conservation areas, with the exception of Himchari, currently provide limited on-site visitor accommodation in the form of Forest Department resthouses. These resthouses are intended primarily for the use of visiting FD staff, although they also are available for use by VIPs and other visitors. Accommodation is typically limited to 1-3 bedrooms, and a maximum of 6 persons. Cooking and cleaning services are provided by a resident caretaker.

FSP planning completed to date has identified a need for additional resthouses in Himchari NP, Teknaf GR, Chunati WS and Hazarikhil WS, primarily for the use of FD staff, NGO staff and others working on a short-term basis in these revised/expanded areas. Current planning for ecotourism-related facilities is based on the assumption that most ecotourism activities will be small scale and/or primarily day use, and no additional development of visitor accommodation within conservation areas is proposed. Should future use of conservation areas raise demand levels for overnight visitor accommodation, this would best be provided by Parjatan Corporation (*e.g.,* as per their most recent development in the Teknaf area) or the private sector (as per recent hotel developments in Cox's Bazar). Any such additional accommodation should be developed outside of conservation area boundaries.

Immediate needs in terms of FSP/FD inputs are for renovation of existing resthouses and construction of new facilities in priority areas.

Guidelines for Visitor Accommodation:

Do	Don't
- provide facilities primarily for the use of FD staff and others engaged in area management on a short-term or periodic basis - renovate and use existing buildings only if they will remain functional throughout at least a 5 year period - remove all derelict buildings and reclaim sites - ensure that building renovations, and new building designs and locations, are functionally and aesthetically appropriate - make maximum use of local building and living technologies (*e.g.*, sanitary latrines, production and use of biogas, fuel efficient stoves, *etc.*) - use natural materials (*e.g.* wood, stone, brick) for exteriors, stairs and flooring. Avoid use of bare concrete and terrazzo - use tile, wooden shingles and other natural materials for roofing. Avoid CI and plastic sheeting - make maximum use of natural lighting and airflow in building design - implement a regular inspection and maintenance programme to ensure that all visitor accommodation is kept in clean and well-maintained condition	- use visitor accommodation for other purposes (*e.g.*, staff housing) - initiate construction unless adequate capital and maintenance funds are available

Resthouses constructed by the Forest Department were previously based on wood-frame and siding construction, with airflow and cooling maximised by raising the structure on stilts and by appropriate placement of window openings. Recently constructed resthouses have all been concrete construction, with a utilitarian or futuristic design that is out of place in a natural setting, and with a finish that deteriorates and becomes unsightly very rapidly. In addition, generally little or no attention is paid to natural cooling and lighting. A return to previous design principles, using natural materials, and maximising the use of natural airflow and lighting, is required for newly constructed resthouses in conservation areas.

6.2.3 Landscaping

Landscaping is an important consideration in high public use areas, such as around conservation area offices, environmental education/visitor information centres, and picnic areas. It also includes reclamation and revegetation of earthworks such as tanks and roadways.

Guidelines for Landscaping:

Do	Don't
- minimise clearing of natural vegetation (and hence the need for landscaping) to the immediate vicinity of facilities - use low maintenance landscaping designs - mimic 'natural' vegetation structure (*e.g.*, layering, non-geometric planting patterns) - use indigenous species to the extent possible - incrementally replace exotic tree plantings (*e.g.*, eucalypts) along roadsides with indigenous species - minimise fencing. Where fencing is necessary use natural materials (stone, wood, bamboo, living fencing) to the extent possible - revegetate bare areas (*e.g.*, roadsides, tank margins) as soon as possible after completion of earthworks - design artificial waterbodies (tanks, reservoirs *etc.*) to look as natural as possible. Use natural shoreline shapes and bank grades, and shoreline and bank revegetation. Avoid square or rectangular shapes, steep banks, and unvegetated areas	- use geometric planting designs (straight lines, squares, circles *etc.*) - use elaborate planting designs - use exotics - use barbed wire fencing - locate facilities in areas requiring felling of large trees, or clearing of extensive areas of natural vegetation and subsequent landscaping

6.2.4 Litter Collection

Litter collection facilities are required in all areas of high public use, including park/sanctuary offices, environmental education/visitor centres, and picnic areas.

Guidelines for Litter Collection Facilities:

Do	Don't
- provide litter collection facilities in all public contact and public use areas - ensure that litter collection facilities are well sign-posted - use natural materials and colors, at least for outer containers - ensure that litter collection facilities are animal-proof and waterproof - empty litter collection facilities on a regular basis (daily or as otherwise required) and dispose of at an established, preferably offsite sanitary waste disposal facility - ensure that final disposal of litter has no or low environmental impact - implement a regular inspection and maintenance programme for all litter collection facilities - ensure that disposal of organic litter such as leaves and other vegetation (*e.g.*, by burning, composting) has no visitor impact	- permit litter collection sites to become general dumping areas for domestic waste; confine use to conservation area visitors only

6.2.5 Observation Towers and Platforms

Towers and platforms provide points from which to observe wildlife, vegetation and scenery. However, they need to be properly sited with a specific purpose in mind. Also, as these facilities can be difficult and expensive to construct and maintain, they should be developed primarily where there is a reasonable expectation of at least moderate visitor use.

Guidelines for Observation Towers and Platforms:

Do	Don't
- for maximum field of view, locate observation towers and platforms on hilltops, or in open habitats (wetlands, meadows, forest edges) when in flat terrain - ensure that there is an appropriate "point of interest" (*e.g.*, panoramic or scenic view, wildlife feeding area, variety of trees and other vegetation) - where possible use a screened or concealed approach - make the facility as inconspicuous as possible, using natural materials and colors. Avoid use of bright or gaudy colors - orient to avoid views directly into the sun - ensure that towers and platforms are safe for public use; this will require solid construction, adequate guard rails, caution signs, and frequent inspection and maintenance	- locate towers and platforms where public use will result in negative impacts on wildlife - rely on observation towers as a means of policing illicit use of forest products, as they provide a very limited field of view in flat, densely wooded terrain (foot patrols are a much more effective means of controlling forest use)

6.2.6 Offices

Comfortable and functional office facilities for senior field staff are an essential requirement in every conservation area. Although these should not be large or elaborate, sufficient space and support facilities need to be provided to ensure efficient administration of each area. In some areas the park/sanctuary office will also function as the contact point at which visitors obtain information, and hence needs to be open and presentable to the public.

As all FSP-supported conservation areas are managed under FD's territorial system, Range Offices and/or Beat Offices have already been established in or adjacent to each area. In general one of these locations can be selected to function as a main park/sanctuary office. However, existing buildings generally are in poor repair, and will need to be renovated or replaced as appropriate.

Guidelines for Offices:

Do	Don't
- provide facilities adequate for the use of all senior FD staff and others engaged in area management (*i.e.,* ACF, Forest Ecologist, Social Scientist, Range Officers, Beat Officers) - in areas without other environmental education/ visitor information facilities, locate offices where they are easily accessible to the public, and clearly identify with appropriate signs - utilise natural landscaping around all office buildings - renovate and use existing buildings only if they will remain functional throughout at least a 5 year period - remove all derelict buildings and reclaim sites	- use security fencing; this gives the wrong message to the public - initiate construction unless adequate capital and maintenance funds are available

Do	Don't
- ensure that building renovations, and new building designs and locations, are functionally and aesthetically appropriate - use natural materials (*e.g.* wood, stone, brick) for exteriors, stairs and flooring. Avoid use of bare concrete and terrazzo, and of rugs or other unwashable flooring - use tile, wooden shingles and other natural materials for roofing. Avoid CI and plastic sheeting - make maximum use of natural lighting and airflow in building design - implement a regular inspection and maintenance programme to ensure that all offices are kept in clean and well-maintained condition	

6.2.7 Picnic Areas

Available information on existing outdoor recreation demand/use patterns in Bangladesh suggests that picnicking is likely to be the main visitor use of conservation areas that are easily accessible by road. Several tens of thousands of visitors annually visit Bhawal National Park outside of Dhaka for just this purpose, and FD has gained significant experience in developing facilities to meet this demand. Among FSP-supported areas, Madhupur NP and to a lesser extent Lawachara NP already are used by picnickers, and demand is likely to increase in future.

This activity often involves large groups travelling by bus, and may involve other activities (*e.g.*, the use of loudspeakers, and attraction of hawkers and concessionaires) that are not appropriate in a conservation area setting, and that impact the use and enjoyment of the area by others. Providing appropriate facilities, but at the same time maintaining adequate controls, presents a unique set of challenges to conservation area managers.

Guidelines for Picnic Areas:

Do	Don't
- provide information on picnic facilities at vehicle entrance points - confine picnicking, including vehicle parking, to designated areas - space facilities to achieve a balance between limiting the physical footprint and avoiding crowding - wherever possible, locate picnic sites and parking in areas where natural vegetation cover has already been removed or disturbed - use natural landscaping to prevent the development of bare/eroded areas. Rotate heavy use areas as necessary to allow ground vegetation to recover - provide easy vehicle access appropriate to facilities location and spacing (*e.g.*, linear, branched or ring road design) and to prevent off-road driving - develop appropriate signage and facilities - provide adequate information on use restrictions (*e.g.*, no loudspeakers or amplified music; no collection of plants, fossils or other natural materials; no cutting of vegetation; no feeding or harassment of wildlife; no off-road vehicle use; no graffiti; no damage to facilities; no littering) - train staff in visitor management, and control and supervise use of all designated sites - provide adequate litter disposal facilities - provide adequate drinking water facilities - provide adequate toilet facilities and keep clean and in working order	- use security fencing; this gives the wrong message to the public - develop picnic sites in or adjacent to key wildlife habitats, including natural wetlands - initiate facilities construction unless adequate capital and maintenance funds are available

Do	Don't
- ensure that toilets and grey water disposal do not pollute surface or groundwater sources - provide picnic shelters (providing shelter from rain and sun) and picnic tables as required. Use standard, sturdy designs, and maximise use of natural materials and natural color schemes appropriate to a conservation area setting - provide fuelwood (*e.g.,* from harvest of plantations) - control contractors and unauthorised concessionaires (*e.g.*, food sellers, animal rides, boat rentals *etc.*), and ensure that services provided are appropriate to the setting and public use programme - provide access to simple nature trails and other interpretive facilities to broaden visitor experience - develop a mechanism for obtaining and using visitor feedback - keep all facilities clean and free of litter. Clean up all sites immediately after use - implement a regular inspection and maintenance programme	

6.2.8 Public Toilets

Toilet facilities are required in all areas of high public use, including park/sanctuary offices, environmental education/visitor centres, and picnic areas.

Guidelines for Public Toilets:

Do	Don't
- provide toilet facilities, including clean water, in all public contact and public use areas - provide adequate signage to ensure that facilities are easy to find - provide separate facilities for men and women - keep toilets clean and in working order - ensure that toilets and grey water disposal do not pollute surface or groundwater sources - implement a regular inspection and maintenance programme	- develop facilities in or adjacent to key wildlife habitats, including natural wetlands - initiate facilities construction unless adequate capital and maintenance funds are available

6.2.9 Signs and Markers

A well-designed sign system helps accomplish two main operational goals, providing an enjoyable and safe experience for all visitors, and helping to protect the land base and on-site facilities
(Alberta Community Development 1993)

6.2.9.1 Boundary Signs and Markers

Clear and unambiguous marking of outer boundaries is a priority in all FSP-supported conservation areas, and will be one of the first steps in gaining effective management control. Participatory management and use areas, wherein local residents will have access to forest resources on a sustainable use basis, also need to be clearly marked.

Guidelines for Boundary Signs and Markers:

Do	Don't
- based on boundary descriptions in the conservation area notification, delineate and mark all outside boundaries at turning points and at maximum 200 m intervals along straight stretches - delineate and mark all zonal boundaries - ensure that the boundary marking system is as tamper-proof as possible, to prevent removal or shifting of boundary markers - conduct periodic inspections to ensure that boundary marking remains intact - develop, install and maintain sturdy, tamper-proof signboards at access points to external and zonal boundaries (trail and road crossings) giving the conservation area's name and summarising key use restrictions with symbols and in Bangla	- create wide cleared corridors along boundaries - blaze trees along boundaries unless no other boundary marking option is feasible

6.2.9.2 Entrance Signs

Each of the FSP-supported conservation areas has one or more main entrance points, and these need to be clearly sign-posted. As they create the visitor's first impression of the conservation area, it is important that entrance signs be designed for both attractiveness and clarity.

Guidelines for Entrance Signs:

Do	Don't
- post a large entrance sign indicating the area's name, and readable from a moving vehicle, at the main road entrance or entrances of the conservation area - post a large area sign/information board near the entrance sign, providing a simplified map of the site showing road and trail systems, and recreational and other facilities - utilise natural materials and colors in sign construction	- clutter up the entrance with too many signs. Two large signs as indicated are better than a proliferation of small signs

6.2.9.3 Facility/Amenity Signs

Facility and amenity signs are necessary to let visitors know where they are, or how to get to where they want to go.

Guidelines for Facility/Amenity Signs:

Do	Don't
- identify each major facility accessible to the public (environmental education/visitor information centre, offices, picnic areas, toilets, water supply points) with a clear and unambiguous sign at the location entrance - supplement these with directional signs (indicating direction and distance) as necessary - utilise natural materials and colors in sign construction	- use too many signs

6.2.9.4 Trail Signs

Nature trails are likely to be developed in the three FSP-supported national parks, and could also be developed to a limited extent in wildlife sanctuaries. Well-posted trails are a low cost, effective means of providing both recreation and environmental education to conservation area visitors.

Guidelines for Trail Signs:

Do	Don't
- provide a trail entrance sign, which identifies the trail head and provides the visitor with information on the trail name, length and walking time - provide supplementary directional signs to orient the user at decision points (*e.g.*, forks in the trail) - provide supplementary interpretive signs, providing information at points of interest, or keyed to a more comprehensive, written trail guide - utilise natural materials and colors in sign construction	- use too many signs

Conservation area signs need to be both effective and quiet

"A sign system is effective when it allows visitors to move with safety and minimum confusion to their destination, as well as informing them of the site's facilities, opportunities, points of interest, and regulations. It is quiet when it accomplishes these objectives with minimum intrusion on the natural beauty of the area. In general, an effective and quiet system is composed of a variety of signs"
(Alberta Community Development 1993)

6.2.10 Trails

6.2.10.1 Nature Trails

As noted above, nature trails are likely to be developed in the three FSP-supported national parks (and possibly to a limited extent in wildlife sanctuaries), providing both recreation and environmental education to conservation area visitors. Care needs to be taken both to ensure visitor safety, and to avoid environmental impacts.

Guidelines for Nature Trails:

Do	Don't
- develop nature trails in areas of ecological interest, utilising existing trails to the extent possible - vary trail lengths to cater to a variety of visitor interest levels and physical capabilities - clearly mark all trails with identification and directional signs, and provide supplementary printed information - provide guidelines on expected visitor behaviour (*e.g.*, no littering, no defacing of trees or rock faces, no collecting of plants or harassment of wildlife) - provide litter disposal facilities along the trail - ensure visitor safety, at least on longer trails, through a registration system and frequent patrols by conservation area staff - minimise trail width and grooming (clearing of adjacent vegetation and maintenance of the trail surface) to the minimum necessary to maintain easy passage and to prevent erosion problems - maintain natural surfacing and use natural erosion controls (live vegetation, plant debris, rock) to the extent possible - monitor visitor use and develop a system for obtaining and using visitor feedback	- develop trails through key wildlife habitats, including natural wetlands - clutter up the trail with too many signs - permit motor vehicles, including motorcycles, on the nature trail system (except for motorcycles used by conservation area staff on patrol)

6.2.10.2 Patrol Trails

All FSP-supported conservation areas have existing road and trail systems that have been developed in conjunction with plantation establishment, that link settled areas, or that are used by local residents for access to forest resources. These also provide an access network that can be used by conservation areas staff for patrolling each area.

Guidelines for Patrol Trails:

Do	Don't
- develop a patrolling system which regularly covers all parts of the conservation area, utilising existing trails to the extent possible - except as required for approved public access (*e.g.,* leading to main conservation area facilities) close minor roads and trails to all vehicles with four wheels or more - maintain patrol trail system for foot or motorcycle access only - minimise trail width and grooming (clearing of adjacent vegetation and maintenance of the trail surface) to the minimum necessary to maintain easy passage and to prevent erosion problems - replant bypass areas and avoid future "braiding" of trails through wet areas - maintain natural surfacing and use natural erosion controls (live vegetation, plant debris, rock) to the extent possible - monitor use of patrol trails by local residents and illicit resource users	- develop trails through key wildlife habitats, including natural wetlands

6.2.11 Utility Corridors

Existing utility corridors in FSP-supported conservation areas are limited to power transmission and telephone lines, although future developments could conceivably include other linear facilities such as gas pipelines. When constructed through forested areas, such developments involve direct permanent loss of habitat, habitat fragmentation (*e.g.,* preventing arboreal species such as gibbons from crossing the cleared corridor), and major human and mechanical disturbances during the construction phase. They also require periodic inspection and maintenance which may include repeated clearing of regenerating woody vegetation along the long, narrow strip occupied by the utility. These are important considerations in management of conservation areas, and negative impacts need to be minimised to the extent possible.

Guidelines for Utility Corridors:

Do	Don't
- zone existing utility corridors as designated use areas during conservation area management planning, and specify use conditions and limitations - limit vegetation clearing to the immediate RoW - conduct vegetation clearing by hand only - maintain connectivity of vegetation cover wherever possible (*e.g.,* in shrub and lower canopy layers) to facilitate wildlife movements - avoid use of chemicals in vegetation management - maintain working contacts with agencies responsible for existing utilities to ensure that all guidelines and restrictions are followed	- permit the routing of new utility corridors through conservation areas, except as specifically required for conservation area management purposes - develop new aerial facilities (*e.g.,* power and telephone lines) where buried lines are a viable option

7. GUIDELINES FOR ENVIRONMENTAL ANALYSES

The purpose of environmental analysis is to ensure that the forests/plantation management options under consideration are environmentally sound and sustainable and that the environmental consequences are recognized early and taken into account. The activity is designed I) to identify and assess the potential impacts of the activities proposed ;to be undertaken, aiming at regeneration of forests, ii) to assess the degree to which environmental safeguards are incorporated in the existing plans iii) to interpret and communicate the information about such impacts, and iv) to recommend appropriate measures for strengthening the environmental management in the plans.

The steps involved in environmental analysis could be detailed as below:

- List all activities envisaged in the plan,
- Identify their potential impacts,
- Predict the magnitude of potential impacts on physical and social environment,
- Evaluate, and interpret the significance, urgency and irreversibility of the impacts,
- Formulate the mitigatory strategies, and
- Communicate the results of environmental analysis.

Screening of activities is a process involving a quick run through the list of proposed activities that have significant potential adverse impacts. A check list of questions, providing basic ;check of any disorder in the environmental components that could be associated with any activity of the plan, is drawn. Such questions could be as follows:

Land
- Will the activity alter the landscape character and visual quality
- Does the work involve excavation and earth moving and would lead to soil erosion
- Will the activity alter the fertility of the soil
- Will the activity lead to land pollution
- Is restoration of the site possible.

Water
- Will the activity affect the water table
- Will the activity alter the direction of ground water flow
- Will the activity pollute the surface and/or ground water
- Will the activity lead to flood/drought condition
- Is mitigation possible.

Air
- Will the activity generate gaseous emissions
- Will the activity generate particulate emission
- Will the activity lead to air pollution
- Are mitigation measures available.

Biota
- Is the activity compatible with ecological conditions of the area
- Will the activity have negative effect on floral and/or faunal diversity
- Will the activity adversely affect any function of the ecosystem (including mycorrhiza)
- Is mitigation possible

Social
- Will the activity have impact on subsistence and/or commercial needs of the community
- Are mitigatory measures (alternative sources) available to the community
- Does the community agreed to such alternate arrangement.

Having determined the range of impacts associated with proposed activities it is crucial to determine the seriousness and magnitude of the identified impacts. The impact matrix provides a mix of negative and positive impacts of activities without providing any rating of their signifcance. This would decide whether the impacts are acceptable or would require mitigatory measures. The significance of the negative impacts is determined by asking the following questions.

- How importance is the impact in relation to others
- What proportion of the local population is affected by this impact
- How much important is the impact to the affected people
- How much importance is the impact to the affected people
- How much of a particular resources will be affected over which the effect will be felt
- How much area and time duration the impacts would affect.

The urgency of impact is the function of rate at which is significant problem will get worse if the negative impact is allowed, ;how quickly the natural system might deteriorate and how much time is available for it's stabilization or enhancement.

Whether the impact is negative or positive, direct or indirect, net of residual, long or short term, reversible or irreversible, is what would determine the ability to mitigate the effects of potential negative impacts of proposed activities. It is ultimately the outcome of decision on the magnitude of impact that would aid developing the mitigatory strategies.

The environmental analysis is expected to result in following outputs:

- Identification of positive and negative impacts on physical and social environment
- Suggestions for mitigatory measures ;which might reduce or prevent the adverse impacts.
- Identification of the residual adverse impacts ;which can not be mitigated
- Identification appropriate monitoring strategies to tract the impacts and provide ;early warning system.
- Incorporation of environmental information related to the proposed activities into decision making process, and

Selection of optimum alternatives.