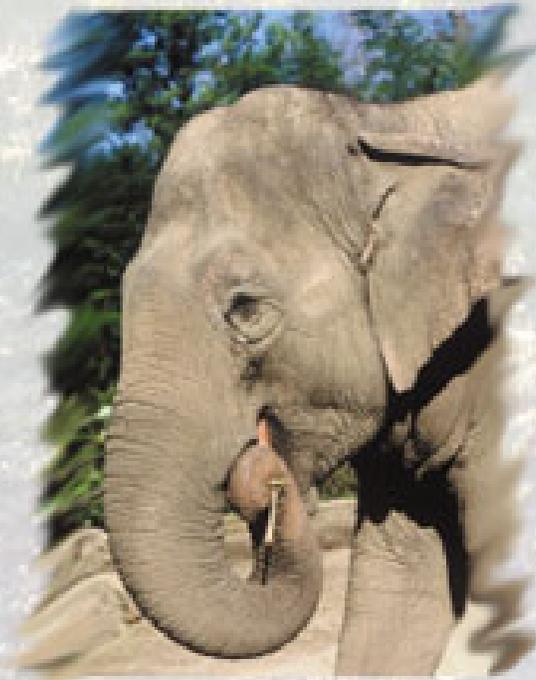




Nishorgo Support Project

MANAGEMENT PLANS FOR CHUNOTI WILDLIFE SANCTUARY



2006

LIST OF ABBREVIATIONS

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

EXECUTIVE SUMMARY

Executive Summary

Main aim of Nishorgo Program of FD is to protect and conserve the forests and biodiversity of the country's protected areas (PAs) by building gainful partnerships between FD and key stakeholders based on shared roles and responsibilities for biodiversity conservation and sustainable use. An effective implementation of the Nishorgo Program will help conserve biodiversity through facility development, capacity building, and gainful partnerships with relevant stakeholders. Under its partnership with the Government of Bangladesh (GOB), the USAID, Bangladesh is providing targeted technical support to main aspects of the Nishorgo Program through Nishorgo Support Project (NSP). 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 biodiversity.

The Chunoti forests have been an intimate interspersed of human habitations and cultivation through them with traditional dependency on neighboring forests for their livelihood. In addition to development pressures on forest land, the subsistence dependence of local communities on neighbouring forests has been an important aspect of forests management. As a result, the biodiversity conservation priorities in Chunoti cannot be set in isolation from local forest resource use and development. The Management Plan is, therefore, developed by following a landscape approach comprising, i) protection and conservation of all remaining ecosystems including natural forests and constituent biodiversity in the Sanctuary, ii) rehabilitation of degraded forest ecosystem, iii) identification and restoration of interface landscape and development of co-management agreements (by linking PA 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 Sanctuary including capacity development, infrastructure, training, and wider extension and communication.

The Plan provides for an overall five year framework for developing and managing the Chunoti Wildlife Sanctuary (WS) of Chittagong Wildlife Management and Nature Conservation division. Planned development interventions under NSP and other GOB projects/schemes are included in the Plan along with other relevant activities necessary for development of the Sanctuary. Main focus of forest management under this Plan is on rehabilitation, protection and conservation of forests and constituent biodiversity, elephants conservation, 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 Sanctuary management, and livelihood opportunities linked with biodiversity conservation in identified landscapes surrounding the Sanctuary.

Main long-term management aim of the Plan is to bring 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 Management Plan are listed as below:

- ▣ To develop and implement a landscape approach that will ensure long-term protection and conservation of biodiversity within the Sanctuary, while permitting sustainable use in designated zones by local people as key stakeholders.
- ▣ To conserve the biodiversity of the Sanctuary based on building partnerships with all the stakeholders and sharing benefits with local communities and key stakeholders.
- ▣ To refine and strengthen the policy, operational, infrastructural and institutional capacity framework for Sanctuary management
- ▣ To conserve and maintain viable wildlife population including elephants
- ▣ To restore and maintain as far as possible the floral, faunal, physical attributes and productivity of the forest eco-systems
- ▣ To encourage eco-tourism in suitable zones and develop visitor amenities
- ▣ To implement income generation activities for sustainable livelihood development and enhance skills of local stakeholders

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

- ▣ Survey, demarcate and mark the Sanctuary boundaries;
- ▣ Develop a co-management model and relevant policy guidelines, and establish co-management agreements linking Sanctuary conservation with benefits sharing arrangements with key stakeholders;
- ▣ Survey biodiversity resources;
- ▣ Strengthen FD institutional capacity for the Sanctuary management;
- ▣ Build conservation awareness, constituencies and extension activities on conservation issues including the conservation of elephants;

- ▣ Train local stakeholders including beneficiaries and FD staff in conservation management and income generation, raise awareness among stakeholders and develop Sanctuary facilities;
- ▣ Develop conservation and visitor facilities in and around the Sanctuary;
- ▣ Create awareness tree resources in adjacent agricultural and village areas of identified surrounding landscape on participatory conservation and benefits sharing basis and implement alternative income generation activities for sustainable livelihoods of key stakeholders; and
- ▣ Naturally regenerate through protection and watershed conservation measures, and enrichment plantations of indigenous species in identified gaps.

Chunoti Wildlife Sanctuary located in south-eastern region (comprising RF area of 7,763.94 ha, covering 7 forest blocks in Chunoti and Jaldi Forest Ranges) was gazetted in 1986. The Sanctuary falling within Banskhal and Lohagara Upzilas of Chittagong District and Chakoria Upzila of Cox's Bazar District covers 7 union councils (Chunoti, Adhunagar, Herbang, Puichari, Banskhal, Borohatia and Toitong). Chunoti forests originally supporting mixed tropical evergreen and semi-evergreen forests, have over the period become substantially degraded due to heavy biotic interference and many low lying areas in valleys have been converted into paddy cultivation. As a result, the habitat has fragmented, adversely affecting the wildlife including elephants by restricting their movements through a barrier effect. There is hardly any natural forests left presently; the Sanctuary has few scattered patches of garjan trees, mainly the plantations raised earlier by converting high forests of great biodiversity value. However, at places natural re-growth of grasses and bamboo has come up due to favorable climatic and edaphic conditions, thereby enhancing the Sanctuary's *in-situ* conservation values, especially as elephant movement corridor.

Few scattered large trees are mixed with evergreen bamboos (*Melocanna baccifera*, *Schizostachyum dullooa*, *Bambusa burmanica* and *Gigantochloa andamanica*) and grasses. Main tree species include Goda (*Vitex sp*), Bon-chalta (*Dillenia sp*), Menda (*Litsea sp*), Chapalish (*Artocarpus chama*), Amloki (*Phyllanthus emblica*), Bohera (*Terminalia bellirica*), Dumur (*Ficus hispida*), Gotguttia (*Bursera serrata*), Bazna (*Zanthoxylum rhetsa*), etc. The clumps of Fuljharu (*Thysanolaena maxima*) are found along the barren steep slopes and Sungrass (*Imperata cylindrical*) has invaded dry hills. Few cane (*Calamus viminalis* and *Daeomonorops jenkinsiana*) clumps occur sporadically and wild banana regenerate naturally along the moist banks of streams. Forest fires in summer have adversely affected the natural regeneration in the Sanctuary, often giving way to a process of regression to a drier scrubby or savannah type of forests.

Some animal species (mammals, birds, reptiles and amphibians), both forest-dwelling and wetland-associated species, of different genera and families have been reported in the Sanctuary. Elephant as a large mammal use the Sanctuary as movement corridor and viable population of many small and medium-sized mammal species that can survive in limited forest areas and/or disturbed or secondary habitats (e.g. small cats, wild pigs, etc.) are found in the remaining disturbed and fragmented habitat of the Sanctuary. A diversity of other faunal groups such as reptiles, vertebrates, hanumans, fishes and amphibians is present. Aquatic species including turtles and frogs are found in water bodies.

The following faunal species diversity of wild animals was recoded in a recent transect survey conducted in Chunoti Sanctuary: i) Class – Amphibia (Common Toad and Skipper Frog), ii) Class – Reptillia (Lizard and Common Skink), and iii) Class – Aves (Black-rumped Flameback-Kaththokra; Coppersmith Barbet-Chhoto Basanta Bauri; Chestnut-headed Bee-eater; Green Bee-eater-Banspati; Greater Coucal-Kanakua; House Swift-Ababil; Spotted Dove-Tila Ghughu; Black Drongo-Fingey; Jungle Myna-Bhat Shalik; and Asian Pied Starling-Gu Shalik). Thus only 2 species of reptiles, 2 species of mammals and 11 species of birds were recorded during the transect survey. In the absence of good forests the wildlife has disappeared in recent times. Only surviving wildlife with considerable population are elephant, who use Chunoti as movement corridor to visit the forests in Bandarban and Lama forest divisions. Therefore, main biodiversity conservation value of the Sanctuary stems from the conservation of elephants and their movement corridors.

Chunoti is characterized by high rainfall and a large amount of water drained from the surrounding low hill ranges. In the absence of adequate steep gradient required to carry huge monsoon rainfall, the water gets collected in depressions and valleys through small streams. A number of sandy-bedded streams/*cheras* pass through the Sanctuary and so aquatic habitats associated with forest cover, and riparian (streamside) vegetation and animal species are important part of overall habitat composition. Four main streams and a number of small streams are supported by hill ranges of Chunoti and so the restoration of forest cover of these hills is important for water bodies.

A number of villages, paddy land, settlements and forest land fall within the zone of influence of Chunoti Wildlife Sanctuary. It is intimately surrounded by a number of villages, towns, and cultivated fields. The Sanctuary is bordered on the north by RFs of Chunoti Range, and in the south-east and south by RFs of Chunoti and Barabakia Ranges. The plantations raised under different projects including Forestry Sector Project (FSP) exist in Chunoti Range, particularly near the Chittagong – Cox's Bazar Highway that crosses the eastern part of the Sanctuary. However, a number of paddy lands and settlements are found all around

the Sanctuary due to encroachments of forest land. Most of the local population, who depend on agriculture for their livelihood, depend on nearby forests for meeting their consumption needs for forest produce. Keeping in view both the relevant human system and biophysical system a 5 km-wide landscape zone along the boundary of the Sanctuary is taken as interface landscape zone for Chunoti Wildlife Sanctuary.

There are 70 settlements (locally called Paras) in 15 villages (included in 7 mouzas) in and around the Sanctuary, of which 42 Paras (Table 1) of Chunoti Range have been studied for assessing stakes in the forests of the Sanctuary. Of the 42 identified villages/paras, 24 are located within the Sanctuary, 13 are located near the boundary whereas 5 are located within 5 km from the boundary. Nearly one-third of the total local population remains unemployed as a result of which biotic pressure on the forests is indeed high. Heavy dependence on forests and forest land has resulted in an active opposition by local people to wildlife conservation efforts. Crop damages by elephants have exacerbated this animosity.

Forest land inside the WS is encroached for agriculture, betel leaf cultivation, brickfields and settlements. Most of the time the forest land is encroached permanently but also for a temporary period mainly for grazing, fishing and betel leaf cultivation. Some times the village elites are directly or indirectly associated with forest land grabbing for establishing homesteads and cultivation. Institutional encroachment of forest land is common for setting up school, madarasa, graveyard, mosque, nursery, etc. A shelter village (Guccha Gram) has been established for 100 households by the Government inside the WS.

Habitat Protection Programs: Keeping in view heavy biotic pressure in and around the Sanctuary, the main objectives of this program are to:

- i) Provide adequate protection to the Sanctuary for the conservation of its constituent biodiversity;
- ii) Update forest cover and interface landscape maps, ii) demarcating the Sanctuary boundary;
- iii) Control illegal removals from the Sanctuary and surrounding landscape; and
- iv) Check encroachment of the Sanctuary lands.

Detailed forest cover/landscape mapping for Chunoti WS and adjoining forests is available with FD. This mapping along with the CEGIS maps are used in the management zoning by identifying core zone and interface landscape zone, and also specific sub-zones within the broad core and landscape zones. It is recommended to verify this zoning during the Management Plan implementation, based on field visits and stakeholders assessments. 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 details within a 5-km wide surrounding landscape zone outside of existing Sanctuary boundaries. Mapping will be extended to include the forest land portions of the landscape and beyond, and will particularly focus on identifying remnant patches of good vegetation and encroachments. Land-use and base maps will be prepared by acquiring latest satellite imageries (e.g. high resolution IKONOS or aerial images) for the Sanctuary.

All the peripheral boundaries of the Sanctuary will be identified, surveyed and marked on the ground. The boundaries of different management 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. All the locations where primary access routes cross the Sanctuary's outer boundaries will be clearly marked with signs indicating the name and summary of key regulations in written text and symbols.

Effective protection against illicit felling, forest fires, poaching, forest grazing and forest land encroachment are necessary for the conservation of biodiversity and management of the Sanctuary. Illicit felling inside the Sanctuary will be checked through extensive joint patrolling (FD staff and local stakeholders) inside the forests, particularly the core areas. The villagers from nearby *paras*/villages will particularly be helpful in forest protection efforts through patrol and intelligence sharing. An effective checking of organized smuggling of timber and poaching will require concerted efforts from FD by using modern equipments and transport facilities. 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 the Sanctuary 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. Redeployment of FD field staff may be necessary depending upon the intensity of illicit felling in certain areas. 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 wildlife and its habitat, and control of forest fires and illicit felling. Handy fire extinguishers and other fire fighting tools (e.g. fire beater, fire rake, fire shovel, brush hook) can also be kept at Beat/Camp HQs and other convenient places. A register of forest fire occurrences

will be maintained for monitoring of fire incidences and assessing their adverse impacts. Survey and demarcation of the peripheral boundary of the Sanctuary will be done during the first year of Plan implementation when encroachment areas also will be identified and hopefully evicted, if possible after obtaining the voluntary consent of encroachers.

Management Programs: Main objectives of the Sanctuary management programs are to:

- i) Maintain ecological succession in constituent forests by providing effective protection against biotic interference,
- ii) Develop and maintain natural forests as good habitat that favors biodiversity including wildlife,
- iii) Conserve the forest resources including the constituent biodiversity, and
- iv) Establish co-management practices through local stakeholders' consultations and active participation.

Landscape management zoning is useful in implementing relevant management practices in different areas of the Sanctuary based on management objectives to be achieved spatially. The long-term management aim of maintaining the maximum possible area under vegetation cover along with its constituent biodiversity in the best possible condition will be achieved by zoning the Sanctuary area and surrounding landscape such that i) the areas of conservation value (forests and/or plantations) are protected, regenerated and managed towards natural forest composition and structure, particularly in the 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 zone.

The total notified area (7,764 ha) of Chunoti WS having conservation value is designated as the core zone, where management objective is to protect, rehabilitate/restore and maintain remaining vegetation in good stocking and encourage natural regeneration to gradually bring back natural forests through effective protection against all forms of biotic interference and maintaining natural course of ecological succession. The proposed extension (5,162 ha) towards north and south (Figure 1) of the Sanctuary (presently categorized under interface landscape zone as discussed below) will also be managed as core zone after its gazettment. Forests management in this zone will focus mainly on conserving the remaining vegetation and bringing back natural forests (composition and structure), wherever possible. This will be achieved by providing effective protection (against illicit removals of forest produce, forest land encroachment, forest grazing and forest fire) and encouraging natural processes for regeneration and rehabilitation of degraded forests. Wherever required, enrichment planting of indigenous species will be taken to supplement natural regeneration, particularly in those areas, where regenerative rootstock has depleted. Effective protection against biotic pressure will allow natural processes of regeneration in rehabilitating degraded forest areas.

Co-management practices will be implemented (by associating members of user groups, community-based organizations, co-management councils/committees) in strengthening protection efforts against biotic pressure. *In lieu* of reduced removals by the local communities from the core zone, they will be provided alternative means from interface landscape zone and other alternative income generation activities to be implemented for sustainable livelihoods. The protection efforts will be facilitated through communication/outreach activities, public awareness, stakeholders' access to interface landscape zones in meeting their subsistence requirements but also enhanced enforcement by FD, particularly for combating organized smuggling. The participants from identified villages will be engaged in alternative income generation activities for sustainable livelihoods in order to wean them away from illegal harvesting from the nearby forests.

Subsidiary silvicultural operations will be carried out for encouraging natural regeneration mainly of indigenous species. Selected dead and hollow trees will be retained as they provide shelter/nest to wildlife. The plantations of fruit bearing species for wildlife including wide crown fruit species and palatable grasses will be taken up in those forest areas where adequate regenerative rootstock has depleted. In order to improve forest habitat for key wildlife species—elephant, some selective management interventions will be taken up while preserving and increasing the diversity and interspersion of habitat. For example, food and shelter will be needed for the elephants, who use parts of Chunoti as movement corridor. Good growth of palatable grasses and bamboo are required as food for elephant. Habitat improvement works including rehabilitation of degraded forest areas, enrichment planting of fruit bearing shrubs and trees and palatable grasses, thinning of plantations, maintenance of glades and waterholes, retention of snags, eradication of weeds from glades and wetlands, soil and water conservation, watershed development, etc. will be taken up.

Enrichment plantations will be taken up in those areas where natural regeneration is not coming up due to lack of rootstock. Fodder species suitable for elephant and so to be included in plantation program are bamboo, jam, chapalish, kathal, am, segun, narikel, kola, chon, dumur, fuljharu, pahari alu, met alu, jambura, dheua and chupri alu. 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 provided by involving all local stakeholders. Salvage of dead, dying and diseased trees will be done after leaving some dead trees suitable for bird nesting, etc.

A substantial contiguous area is required as a suitable habitat for elephants 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 Sanctuary is posing a great challenge for elephants and their habitat. Due to widespread poverty, local people depend upon the Sanctuary for the collection of fuelwood and bamboo, which they use for self-consumption but also for cash. Even coppice shoots, bamboo and naturally regenerating saplings including fodder species are felled for fuelwood and providing shade/support to betel leaf cultivation. Poor infrastructure and lack of FD field staff and funds have led to weak forest protection and 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.

Chunoti Wildlife Sanctuary supports about 20 elephants that are considered to be flagship and conspicuous species. They are important ecological part of forest ecosystem and are indeed an indicator of good forest health. Elephants as large herbivore mammal require huge amount of forage and water bodies for drinking and bathing. They prefer a mosaic of habitat types including patches of forest, scrub forests, bananas, forest clearings and intermittent open spaces, succulent grasslands and savanna. Chunoti forests 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 Sanctuary. Controlled forest fires may be helpful in the development of fresh grasses but intense fires may ultimately degrade the habitat.

As a result of good rainfall, incident radiation and soil, the natural regeneration comes up rather well in Chunoti but do not get established due mainly to heavy biotic pressure. Therefore, protection against biotic factors will be taken up before low-input oriented land husbandry practices can be implemented for facilitating eco-restoration process, necessary for the rehabilitation of degraded forests and impoverished local people. Degraded forests with recoverable rootstock will be restored through community protection. Degraded forests with inadequate rootstock shall be taken for assisted natural regeneration for recovering remaining rootstock, and enrichment planting.

Natural regeneration and succession in this sub-zone will be encouraged by carrying out eco-restoration activities in identified micro-watersheds. Soil and water conservation measures, and control of erosion of stream/*chera* banks will be taken up in identified areas. This will allow the existing rootstock to be recovered by enlisting active participation of local stakeholders in the protection of forests and implementation of low-input forests management and land husbandry practices. Over the period the woody vegetation cover will extend and gradually thin out the primary succession vegetation such as weeds and grasses. Given protection against illicit felling and burning, the plant succession will progress over a period towards semi-evergreen forests. The enrichment plantations of indigeneous shrub and tree species (e.g. chapalish, chikrassi, toon, karoi, garjan, dhakijam, pynkado, gamar, albizzia, kadam, etc.) can be taken up in the identified degraded and barren areas that do not have rootstock.

All the habitations and cultivations including encroachment areas are included in this Sub-zone. Such areas will be identified and delineated with permanent markers and the existing inhabitants will be registered and further in-migration and encroachment will be discouraged. As important stakeholders, the villagers from the surrounding villages will be engaged in co-management activities. This sub-zone also comprises plantations within the Sanctuary, 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 over a period of time 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.

Intensive Use Sub-zone incorporates the relatively small areas required for administrative buildings and staff quarters, visitor accommodations and other facilities. Administrative buildings (Sanctuary Hqs/Range Office), staff quarters, visitor facilities (Rest House and an Environmental Education Centre) and other infrastructure facilities are included in this sub-zone.

Keeping in view the surrounding villages exercising influence on the Sanctuary and the adjoining forests under the management of FD, a 5-km wide landscape zone surrounding the core zone has been found suitable. Interface landscape zone is further categorized into four specific sub-zones (proposed core area

sub-zone as extension of existing core zone, buffer reserve sub-zone, assisted production sub-zone and elephant movement corridor sub-zone) depending upon the uses to which different areas are used and managed.

The proposed core sub-zone (around 5,000 ha), comprising northward and southward forest extensions (Figure 1), is currently categorized under landscape zone. But after re-gazetment these northward and southward extensions will be part of core zone. It will also provide effective protection as buffer between the present core zone and nearby habitations/cultivation. The management of this sub-zone will be as recommended in the core zone (Section 6.1).

The present subsistence harvest of wood and NTFPs (grazing, fodder, bamboo, canes, etc.) by non-residents is expected to continue, particularly in peripheral areas. However, consumptive use by non-residents will gradually be shifted, to the extent possible, to buffer reserve sub-zone comprising FD lands outside of but adjacent to the Sanctuary boundary. Two such buffer reserve sub-zones, one on the north and one on the east (Figure 1) of the Sanctuary have been identified, where management interventions are required to lessen biotic pressure on the core zone. These forest areas may be used by elephants and so also will act as elephant movement corridors. The plantations of palatable grasses and indigenous herbs, shrubs and tree species may be taken in these reserves. These plantations will be brought under co-management agreements in order to alleviate harvest pressures from adjacent settled areas as evident by heavy, commercial harvest of fuelwood and bamboo currently. Co-management activities in this Sub-zone will focus on providing a reliable and legitimate source of wood and non-wood products for local poor.

In addition to movement corridors as identified in the forests of core zone, elephants use some areas (RF/USF/private lands) of Bandarban and Lama forest divisions for their migration. It is important to maintain and indeed develop these movement corridors in order to provide good connectivity (including food and shelter) between the Sanctuary 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.

Suitable private lands bordering the Sanctuary on the west and east have been included in this sub-zone for developing wood-based energy resources. Main objectives of managing this sub-zone include reduction of use pressures on the Sanctuary, plant vacant lands with suitable fast growing tree species and develop agroforestry systems on the lands being used for cultivation. Agroforestry (alley model or trees on farm boundary) may be suitable in those lands where farmers are raising agricultural crops and may need wood either for self-consumption or for cash sale. However, detailed consultations will be held with local people before finalizing any land-based management intervention for which technical support may be provided by local FD staff.

Livelihood Programs for Landscape Development : As per the Wildlife (Preservation) (Amendment) Act, 1974 no commercial harvesting is allowed inside the Sanctuary and so no benefits flow to local people formally from the core areas of Satchuri. Other benefits flows to local communities will, therefore, be explored through off-Sanctuary activities including alternative income generation activities. Main objective of livelihood programs for landscape development is to develop appropriate linkages with livelihood programs and other projects/initiatives that will reduce biotic pressure on forests by providing alternative livelihood opportunities to poor stakeholders living in and around the Sanctuary.

Up-scaling of skills for alternative income will be taken up for generating value additions through capacity building of local people. Landscape Development Fund (LDF) will be used to provide finance for the members of user groups and co-management councils/committees, and their federations will be encouraged to set up micro-enterprises to generate value additions locally. The benefits from eco-tourism may also be ploughed back for the development of local communities and the Sanctuary. The program will be focused mainly in the identified interface landscape zone but also in the core zone where local communities are living. Networking with relevant NGOs acting in the area will be established for rendering rural development services to user groups and co-management councils/committees.

The following 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):

Agricultural and Horticultural Crops

The following production technologies are proposed:

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

Livestock Rearing

Poultry and cattle rearing with focus on milch cow rearing are suitable for poor people residing within and outside the Sanctuary. The following livestock rearing technologies are found suitable for their implementation in and around the Sanctuary:

- ▣ 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. The poultry industry has developed near many cities and towns for meeting huge demand within a short time as a supplement of animal protein.

Fisheries

The following production technologies were identified for the fishery sector:

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

Main methods of fishery would involve capture fishery, culture fishery and dry fishery activities.

Non-Timber Forest Products and Enterprise Development: Development of NTFPs through user groups can be taken up by using loans from LDF and other rural credits. Some NTFPs including honey, grasses and bamboo can be processed at local level (i.e. user groups). The federations of user groups may establish processing-cum-marketing units (e.g. handicrafts, mats, broom, honey, etc.) locally by pooling their resources. The FD may not sell NTFPs through auctions and leases; instead, the responsibility for primary collection, storage, processing and marketing can be given to user groups and/or co-management council/committee. Primary sectors for potential development around the Sanctuary include handicrafts (cane and bamboo), 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, horticulture including orchid cultivation and floriculture, eco-tourism and nature-based healing homes development. Priority sectors such as bamboo and canes, homegardens, nursery and natural dye processing may initially be taken up for enterprise development. Traditional knowledge about medicinal plants and animals will be documented in view of their contemporary relevance. *In-situ* conservation of biodiversity of use in traditional medicine will be encouraged by delineating medicinal plants conservation areas in order to conserve cross-sections of diverse eco-systems having potential for medicinal plants and animal species, and their genetic diversity.

Facilities Development Programs: During the Plan implementation the development of facilities will be undertaken to support the long-term administration of the Sanctuary. In addition to built facilities, this Development Program will focus on the procurement of transport and other equipments required for the implementation of proposed management programs. The development of built facilities should not negatively impact the area's natural resources or eco-tourism potential. Existing FD facilities will be fully utilised and incorporated in Sanctuary management where these can be renovated on a cost-effective basis. All built facility requirements at Sanctuary Headquarters, except for senior staff and Forest Guard's quarters, will be satisfied through the use of existing buildings. 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 implementation. The existing visitor facilities including two Watch Towers will be renovated to provide two covered picnic shelters and adjacent toilets.

Access to the Sanctuary Headquarters is currently provided by all-weather access roads which do not presently require upgrading. Access roads between sites at Sanctuary Headquarters (i.e., between the main office/accommodation complex and proposed Environmental Education Centre) and the two existing Watch Towers will require periodic manual maintenance, but are currently built to sufficient standards for anticipated traffic loads. All other roads within the Sanctuary will be permanently closed to 4-wheeled vehicles. Unsurfaced forest trails (former logging tracks) linking Sanctaury Headquarters/Chunoti Range Office complex with the interior areas need to be maintained and several culverts would need to be replaced to restore easy access.

Visitor Use and Visitor Management Programs: Eco-tourism in the form of nature education and interpretation tours will be a main objective of visitor use and management programs. The potential of conservation tourism is good in Chunoti due to its easy accessibility, undulating terrain and scenic beauty. So a number of conservation facilities can be developed for visitors' use and promotion of nature tourism. An eco-tourism region will be identified in and around the Sanctuary by linking with other local and regional

attractions including Rest Houses, undulating/rolling landscapes, wetlands and streams, forest roads and nature trails. Existing roads and trails will be renovated for easy movement in the identified 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. Initially the Guest Houses maintained by local NGOs at Chunoti will be able to provide accommodation to tourists. But when the number of tourists increase, the local entrepreneurs including user groups (in interface landscape zone) of the Sanctuary may be encouraged to set up nature camps, eco-lodges, dormitories, huts and cottages for tourists.

Relevant brochures, pamphlets, guide maps, hand outs, audiovisual aids and display boards will be developed at convenient points. Mass Communication Officer of FD and Communication Specialists of NSP will provide help in launching publicity program. Local youths/naturalists, preferably from the local 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 developing tools for spreading conservation awareness among the visitors. Binoculars and guide books on ornithology may be made available at tourist accommodation places. Nature camps (say of 2 days duration) may be organized (at places of interest within the Sanctuary) 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 and eco-lodges.

A network of nature trails will be developed/renovated for visitors movement on foot and bicycle in traversing key natural and cultural features of interest (e.g. patches of high forests, watch towers, cultural remnants, natural streams/cheras, religious places). 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 such trails for visitor access.

The following three existing nature trails have been initially identified and mapped:

1. **Short Trail (about 1 km with half an hour walk):** The undulating trail, with elevated hills, starts from the road near Bon Pukur (Baitussalam Mosque) to the west through the garjan forest, returning to the main road near Euro Asia Poultry Hatchery. The trail covers many big trees of garjan and other species, and the visitors may encounter birds such as *myna*, *bulbuli* and *tia*.
2. **Medium Trail (nearly 2.5 km with one hour walk):** The trail starts from the Arakan road, near a signboard posted at about 1 km to the south of Chunoti Range Office. It goes through plantations and one of the two watch towers and ends about 20 m north from the starting point. If fortunate, the visitors may encounter elephant and other wildlife including fox, civet, squirrels, wild boar, jingle fowl and birds.
3. **Long Trail (around 7 km with three hours walk):** The trail starts at the Chunoti Forest Rest House and ends at the same FRH after traversing a long loop through the watch towers and a number of elevated hills. In addition to tall trees of garjan, a number of plantation areas are worth noticing during the trail journey. Important wildlife including elephant, monkey, honuman, and birds may be observed while walking along the trail.

The publicity of the Sanctuary 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 local 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.

The concept of public-private partnership will be applied in soliciting the required inputs/contributions from private sector for facilities development in Chunoti. The nature conservation will progress 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 biodiversity 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.

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VOLUME 1

MANAGEMENT PLANS

P A R T I

ASSESSING THE PRESENT SITUATION-FINDING AND ISSUES

1. BACKGROUND

Externally funded participatory forestry projects have been implemented in Bangladesh with donor support since 1981 when a community forestry project was taken up in north Bengal by Forest Department (FD) with financial support from Asian Development Bank (ADB). Sectoral forestry projects (e.g. Forestry Sector Project, FSP) were subsequently taken up with a major policy shift in favor of a participatory management of the country's forests and protected areas (Figure 1). Local people and communities participated in developing, protecting and managing plantations/forests *in lieu* of usufructuary rights granted as per participatory benefit sharing agreements (PBSAs) signed between user groups (of participants/beneficiaries) and land owning agencies such as FD.

Protected Areas (PAs) in Bangladesh have traditionally been an intimate interspersed of human habitations and cultivation through them with traditional dependency on neighboring forests for their livelihood in a largely agrarian economy. 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, 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 habitats. So the biodiversity conservation priorities cannot be set in isolation from local forest resource use and sustainable development.

A basic principal of PA management is that every PA should have a management plan that guides and controls the management of local resources, the uses of the area, and the development of facilities needed to support forest management and use; it facilitates all development activities in an area (MacKinnon *et al.* 1986). In 2001 a two-year action plan was prepared for Chunut Wildlife Sanctuary covered under the conservation area management component of FSP. Although this action plan prescribed a list of management activities to be carried out in the Sanctuary over a period of 2 years, it required developing to a management plan in view of a co-management approach being adopted under the Nishorgo Support Project (NSP). The NSP is a project (2004-2009) of the FD, Ministry of Environment & Forest, funded by USAID and implemented by International Resources Group (IRG). The project is supporting a broad Nishorgo Program of FD, which is a comprehensive effort to improve the management of country's PAs with main aims to protect and conserve biodiversity for future generations.

This 5-year plan for Chunut Wildlife Sanctuary (Figure 2) is prepared by following a co-management approach (encompassing relevant ecosystems and socio-institutional systems in core and interface landscape zones) as against an ecosystem approach adopted while preparing the earlier Action Plan. Existing FD structure for management plans has been followed by including descriptive information in Part I and prescriptions in Part II of the main Plan (Volume 1). Volume 2 provides for all the required supporting materials including guidelines for developing PA facilities and carrying out environmental impacts analyses. Main objectives of the Plan have been presented in Chapter 1 of Part II. This plan will be implemented mainly by FD and the project staff of NSP but would also be useful to all the stakeholders including local participants, NGOs, planners, policy-makers and researchers.

2. INTRODUCTION

Chunut Wildlife Sanctuary, located in south-eastern region (comprising RF area of 7,763.94 ha, covering 7 forest blocks), was gazetted in 1986. Its administration and management has recently been transferred from Chittagong (South) Forest Division to the newly created Chittagong Wildlife Management and Nature Conservation Division. Accordingly, all the forest areas covered presently under Chunut WL (existing Chunut and Jaldi Ranges) have been transferred to the control and management of the newly created Wildlife Division. The Sanctuary falling within Banskhal and Lohagara Upzilas of Chittagong District and Chakoria Upzila of Cox's Bazar District covers 7 union councils (Chunut, Adhunagar, Herbang, Puichari, Banskhal, Borohatia and Toitong). The Sanctuary is accessible from Chittagong City via the national highway to Cox's Bazar (the Sanctuary lies almost halfway in between Chittagong and Cox's Bazar – nearly 70 km south of Chittagong), which borders the eastern boundary over a distance of nearly 15 km; another metalled road leading south from Chittagong runs parallel to the western boundary (at an average of 3-5 km away).

The Sanctuary is well connected with Dhaka through air and road via Chittagong and Cox's Bazar. A narrow railway gauge connects the nearest (nearly 25 km from the northern boundary of the WS) railway station, Dohazari to Chittagong main railway line. Although the Sanctuary is not very popular presently as eco-tourism spot, its well connectivity through road, railway and air makes it a potential future candidate for eco-tourism. A range of low hills in the extreme southern part of Chittagong District is part of Chunut WS. The existing well developed trail system can in future be used as nature trails by eco-tourists.

This Plan is developed by following a landscape approach comprising, i) protection and conservation of all remaining ecosystems including forests and constituent biodiversity in the Sanctuary, ii) rehabilitation of degraded forest ecosystem, iii) identification and restoration of interface landscape and development of co-management agreements (by linking PA 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 Sanctuary including capacity upscaling, infrastructure development, training, and wider extension and communication outreach activities.

At the heart of Nishorgo Program is a focus on building partnerships between the FD, and key local and national stakeholders, who can assist in the conservation efforts required for the co-management of Sanctuary. An effective implementation of the Nishorgo Program will help conserve biodiversity through facility development, capacity building, and gainful partnerships with relevant stakeholders. Under its partnership with the Government of Bangladesh (GOB), the USAID, Bangladesh is providing targeted technical support to main aspects of the Nishorgo Program through NSP. 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 biodiversity.

The Plan provides for an overall five year framework for developing and managing the Chunut Wildlife Sanctuary (WS) of Wildlife Management and Nature Conservation Division, Chittagong. Planned development interventions under NSP, FSP and other GOB schemes are included in the Plan along with other relevant activities necessary for the development of the Sanctuary. The stakeholders consultations on the draft Plan were held with public representatives, FD field staff, members of user groups and co-management councils/committees, village elites and leaders, journalists, NGOs, and saw mill owners. Main focus of forest management under this Plan is on the protection and conservation of forests and constituent biodiversity resources, 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 PA management and livelihood opportunities linked with biodiversity conservation in the interface landscape (5-km wide, surrounding the Sanctuary).

Part I of the Plan assesses the present situation (provides a description of the Sanctuary, an assessment of biodiversity, resources protection and management, human interactions, forest resources use patterns, interface landscape situation, past biodiversity management and practices, etc) with a documentation of main findings and issues. Additional information on the regional/national biophysical and socio-economic scenario can be found in the documents listed under References. Part II of the Plan recommends strategic programs and priorities (comprises prescriptions for future development and management of the Sanctuary and interface landscapes with detailed guidelines) for a sustainable Sanctuary management.

The scope, timing and relative emphasis on specific activities may be modified by the Sanctuary 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 management 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 co-management plans to be prepared by FD field staff and local stakeholders every year in consultation with the co-management council/committee.

3. BIODIVERSITY CONSERVATION ATTRIBUTES

3.1 Statement of Biodiversity Significance

Evergreen and semi-evergreen forests of Chunoti WS were in recent past biologically very rich due mainly to their location in the high rainfall bio-geographic zone. The Sanctuary represents several features of the bio-diversity of north-eastern subcontinent, which is one of the mega biodiversity region with many endemic floral species. The forests of Sanctuary have been important in regulating water flows and checking soil erosion in undulating terrain. Indeed the conservation of biodiversity within the Sanctuary is very important as the forest landscape, if restored, will form important catchments for many rivers and numerous water bodies. In addition to providing a sanctuary to wildlife, the restored forests landscape may in future form water sanctuaries required for conservation of water and soil, and will indeed play an important role in carbon sequestration. The protection and conservation of the remainder vegetation are particularly important in view of significant loss of natural forests in the country in general and the Sanctuary in particular.

3.2 Biodiversity Conservation Values

Important biological values of the Sanctuary include:

- ▣ Providing shelter to biodiversity,
- ▣ Habitat connectivity,
- ▣ Presence of threatened and endemic species, and
- ▣ Improvement of degrading habitat.

Main ecological functions of the Sanctuary are:

- ▣ Catchment conservation of rivers and water bodies (*haors, beels, ponds, etc.*),
- ▣ Control of soil erosion,
- ▣ Ecological security,
- ▣ Irrigation and agricultural production,
- ▣ Carbon sink, and
- ▣ Environmental amelioration.

The Sanctuary provides scope for wildlife education and research, nature interpretation and conservation awareness. It represents a fragile landscape with good biodiversity, which if not conserved timely, may be lost for future generations. The Sanctuary also is a potential source of eco-tourism, aesthetic values, high forests, historical and cultural values and scenic beauty. Finally many conservation values of the Sanctuary are national but also with regional implications.

3.3 Wildlife Conservation

Special protection measures were contemplated quite early for the preservation of elephants under Bengal Elephant Preservation Act, 1879. Subsequently 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. *In-situ* conservation of wildlife was planned to be achieved by designating and managing PAs in representative zones. A Wildlife Advisory Board was set up for performing such functions as the Government may assign to it. The Act provided a legal basis for the preservation of wildlife in Bangladesh but needs updating in view of national and international changes that have taken place over the period. Accordingly, the NSP has provided support to FD in the draft Act finalization process as recommended in Part II of the Plan. A new circle (Wildlife and Nature Conservation) was created in 2001 exclusively for looking after the affairs related to wildlife and nature conservation.

3.4 Forest Boundaries

The Sanctuary comprises 7 RF blocks (Figure 3), which were reserved in early nineteenth century as per the Forest Act 1927. Working Plans were prepared with topographical maps and specific recommendations for the maintenance of legal boundaries of forest blocks and compartments were given. However, most of the prescriptions of the working plans were not implemented and so the boundaries of forests/PAs could not be maintained. As a result, some forest areas have been brought under encroachment, mainly for cultivation and settlements. Although the Sanctuary was notified by the Government in 1986, no efforts have so far been made to physically demarcate the boundaries in the field. The situation got exacerbated with heavy biotic pressure on forests and encroachment of forest land. These forests have become fragmented with

reduced extent of wildlife habitats and ensuing adverse effects on biodiversity. This has adversely affected the ecological boundaries of the Sanctuary with limited wildlife corridors and breeding space. However, at places natural re-growth of grasses and bamboo has come up due to favorable climatic and edaphic conditions, thereby enhancing the Sanctuary's *in-situ* conservation values, especially as elephant movement corridor.

3.5 Forest Geology, Rock and Soil

The low and rolling hills (Figure 4) of the Sanctuary are composed of upper tertiary rocks in which soft sandstone predominates. The soils developed on unconsolidated sandstone of the low hills are brown, loamy and acidic (Typic or Orthic Hapludult). These soils permit deeper penetration of tree roots, unless obstructed by the presence of lateritic, plinthitic or placic horizons at shallow depths. The high hill soils are developed usually on consolidated or semi-consolidated sandstone or stratified shale beds. Deeper penetration of tree roots is hindered on steep slopes and stratified hard shale or consolidated sandstone, wherever present at shallow depth. The high hill soils are Lethic or Orthic Dystrocrepts or Hablotthent, whereas the soils in valleys are imperfectly drained alluvial soils – these are Typic Haplaquept or Aeric Haplaquept. Some of the hilly lands under private ownership are used for homesteads, orchards, woodlots, etc. and valleys are used for dry land agriculture during the rabi season and rainfed transplanted aman during the kharif season.

3.6 Micro-Climate

Chunoti WS belongs to humid megathermal ($MAT \geq 22$ degrees) climate with little or no water deficit in the root zone at any part of the year. The climate is in general warm and humid but the weather is cool and pleasant during winter. Temperature efficiency is normal that favors tree growth throughout the year. The temperature varies on an average from minimum of 14 degrees in January to maximum of 32 degrees in May. The humidity is high in the Sanctuary throughout the year. The rainfall is high with an annual average of 3,000 mm approximately (mean annual evaporation is 1,466 mm), with maximum rainfall falling during June to September from South-West monsoon. The moisture control section does not become biologically dry for more than 90 consecutive days after the summer solstice at 50 cm depth. A large part of total rainfall on hilly areas is drained by run-off. The hill soils may, therefore, become draughty even for a longer at the tree zone (50 mm). Pre-monsoon Nor'westerly and cyclonic storms are accompanied by high speed winds and rains, which do considerable damage to property and trees. The valleys that occur above normal flood level are subjected to periodic flash flood following the heavy rains on the adjacent uplands. The surface water hydrology is regulated by local rainfall, run-off from adjacent hills and the relief pattern of the plain land.

4. BIODIVERSITY AND HABITAT

The conservation of biodiversity in each of the representative bio-geographic zone is an important objective of the establishment and management of PAs in Bangladesh. The influence of socio-economic, microclimatic and edaphic factors including dense population, good rainfall, humidity, aspect, sunshine and soil is predominant on the biodiversity of Chunut.

4.1 Ecosystems Analysis

A community and the surrounding environment with which it interacts is referred to as an ecosystem. The Sanctuary and its surrounding landscape encompasses terrestrial, aquatic and forest ecosystems. A variety of plants, animals and micro-organisms, and the ecological processes that govern their functions are noticed in the Sanctuary. The erstwhile forests of Chunut were characterized by high rainfall and a multi-tier vegetational assemblage of rich biodiversity. The predominant influence of edaphic and microclimatic factors including rainfall, humidity, sunshine, aspect and soils led to the development of typical ecosystems in Chunut. The following 5 broad ecosystems (habitat types) in Chunut WS and its interface landscape are identified as:

- i) remaining small patches of secondary forests,
- ii) plantations,
- iii) grasslands and bamboos,
- iv) wetlands and water bodies, and
- v) cultivated fields.

The first three ecosystems are the largest in extent and also important from the Sanctuary management point of view. The cultivated fields (mainly of paddies) and grasslands, harbour some mammals and reptiles. The water bodies harbour important fish species, water birds and amphibians that are food to local communities. The following main components of Chunut ecosystem are described in order to have a better understanding of the habitat. Important land-uses are described further in detail in Chapter 6 of Part I. Although the results from the inventories of fauna and flora conducted earlier in Chunut are available (see Khan, 1990 for example), a new inventory may be conducted to identify composition and inter-relationships among fauna, flora and micro-organisms including food chain.

4.1.1 Forests

The forests (mainly mixed tropical evergreen and moist deciduous forests) covered under the Sanctuary were reserved in early nineteenth century under Section 20 of the Forest Act, 1927. All the hill forests of Chunut were subjected to heavy biotic interference including jhum (shifting cultivation) and so the vegetation has developed characteristic appearance of a secondary status. There is hardly any natural forests left presently; the Sanctuary has few scattered patches of garjan trees (e.g. garjan patch near Bonpukur in Chunut Beat), mainly the plantations raised earlier by converting high forests of great biodiversity value. An Eco-Park is currently under development inside the Sanctuary (2.73 km from Jaldi town). the biodiversity of Chunut is well known due to various floral and faunal inventories taken up in past (see Khan and Haq, 2001; Rahman *et al* 2000; Rahman and Hossain, 2003). A total of 143 plant species, including 17 fodders species suitable for elephants, were reported by IUCN (2003). The fodder species found in Chunut forests include bamboo, black berry, chapalish, jack fruit, mango, coconut, banana, chon, fuljharu, yams, alu, jambura, dhenu, etc.

Large trees are mixed with evergreen bamboos (*Melocanna baccifera*, *Schizostachyum dullooa*, *Bambusa burmanica* and *Gigantochloa andamanica*) and grasses. Main tree species include Goda (*Vitex sp*), Bonchalta (*Dillenia sp*), Menda (*Litsea sp*), Chapalish (*Artocarpus chama*), Amloki (*Phyllanthus emblica*), Bohera (*Terminalia bellirica*), Dumur (*Ficus hispida*), Gotguttia (*Bursera serrata*), Bazna (*Zanthoxylum rhetsa*), etc. The clumps of Fuljharu (*Thysanolaena maxima*) are found along the barren steep slopes and Sungrass (*Imperata cylindrical*) has invaded dry hills. Few cane (*Calamus viminalis* and *Daeomonorops jenkinsiana*) clumps occur sporadically, and wild banana regenerate naturally along the moist banks of streams. A number of fodder and fruit bearing plants regenerate naturally in the Sanctuary due to good rainfall but do not get established due to heavy biotic interference. Forest fires in summer have adversely affected natural regeneration in the Sanctuary, often giving way to a process of regression to a drier scrubby or savannah type of forests.

On review of the old working plans of Chittagong forest division, it can be inferred that the natural regeneration in different forest blocks of Chunut was still good (in sixties) with good undergrowth in mixed irregular top canopy. Therefore, it can be concluded that the conversion of natural forests of high biodiversity was not justified due to disturbances to the forest ecosystem brought by clearfelling and plantation activities.

The original forests are no more present and main conservation value of the Sanctuary currently stems mainly from the fact that Chunoti is used as movement corridor by elephants. The area represents the most accessible hill forest land in Chittagong area.

4.1.2 Fauna

Many animal species (mammals, birds, reptiles and amphibians), both forest-dwelling and wetland-associated species, of different genera and families have been reported in the Sanctuary (for details see Ahsan, 1994; Feeroz, 1991; Feeroz and Islam, 1992; Hussain, 1991; Islam et al, 2004; FRMP, 1997). Elephants as large mammals use the Sanctuary as movement corridor. A viable population of many small and medium-sized mammal species that can survive in limited forest areas and/or disturbed or secondary habitats (e.g. small cats, wild pigs, etc.) are found in the remaining disturbed and fragmented habitat of the Sanctuary. A diversity of other faunal groups such as reptiles, vertebrates, invertebrates, fishes and amphibians is present. Aquatic species including turtles and frogs are found in water bodies.

The following faunal species diversity of wild animals was recorded in a recent transect survey (Feeroz, *et al*, 2005) conducted in Chunoti Sanctuary: i) Class – Amphibia (Common Toad and Skipper Frog), ii) Class – Reptillia (Lizard and Common Skink), and iii) Class – Aves (Black-rumped Flameback-Kaththokra; Coppersmith Barbet-Chhoto Basanta Bauri; Chestnut-headed Bee-eater; Green Bee-eater-Banspati; Greater Coucal-Kanakua; House Swift-Ababil; Spotted Dove-Tila Ghughu; Black Drongo-Fingey; Jungle Myna-Bhat Shalik; and Asian Pied Starling-Gu Shalik). Thus only 2 species of reptiles, 2 species of mammals and 11 species of birds were recorded during the transect survey. In the absence of good forests many wildlife species have disappeared in recent times. Only surviving wildlife with considerable population are elephant, who use Chunoti as movement corridor to visit the forests in Bandarban and Lama forest divisions. Therefore, main biodiversity conservation value of the Sanctuary stems from the conservation of elephants and their movement corridors.

4.1.3 Water Bodies

Chunoti is characterized by high rainfall and a large amount of water is drained from the surrounding low hill ranges. In the absence of adequate steep gradient required to carry huge monsoon rainfall, the water gets collected in depressions and valleys through small streams. The Sanctuary forms the catchment of a number of small streams, locally known as *cheras* (e.g. Puichara in Jaldi Range). Four main streams and a number of small streams are supported by hill ranges of Chunoti and so the restoration of forest cover of these hills is important for water bodies. They provide good habitat, drainage and drinking water source for the wild animals and local people. The waters are surcharged with materials brought from surrounding hills during monsoon rains and a large portion of the silt is deposited in the immediate neighbourhood of the streams. The water recedes during dry season, enabling local people to cultivate the remainder land with winter crops. The level of water bodies is, however, being raised gradually due to siltation. A number of sandy-bedded streams/*cheras* pass through the Sanctuary and so aquatic habitats associated with forest cover, and riparian (streamside) vegetation and animal species are important part of overall habitat composition.

4.1.4 Non-Timber Forest Products (NTFPs)

Important role of NTFPs in providing livelihoods, employment and income to forest dependent communities is recognized with international surge on rural poverty alleviation, biodiversity conservation and empowerment of local communities. NTFPs can play an important role in sustaining livelihoods of rural poor and forest dwellers in Chunoti as they depend on forest produce such as fruits, medicinal plants, leaves, grasses, cane and bamboo. Usufructury rights in terms of both timber and non-timber products can be granted to local communities through PBSAs.

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

4.2 Biodiversity Utilization

Chunoti WS and its surrounding landscape are densely populated and a majority of population depend on agriculture and fishing for earning their livelihood. The forests of Chunoti are highly degraded and the encroachment of forest land for cultivation is widespread. Grass, bamboo and fuelwood are collected by local people for meeting their demand mainly for subsistence consumption but also for cash sale. Even surrounding urban population use the Sanctuary for earning their livelihood through commercial sale of illicitly collected fuelwood and timber. Although good accessibility provides easy access to visitors to the Sanctuary, it also provides scope for illicit removal of forest produce from the forests, and the encroachment of forest land. Therefore, the protection of forests and wildlife against smuggling and poaching, and encroachment of forest land pose a big challenge for the FD staff.

Important local markets for forest produce (mainly fuelwood) from the remaining forests of Chunoti include Lohagara, Banskali and Anwara. Easy accessibility of forests through roads and railways has greatly facilitated the transport of timber, bamboo and fuelwood. The predominantly agrarian economy of local people puts a heavy demand on forest produce including timber for agricultural implements and boat construction. A large part of the demand for forest produce is met by homesteads, which in addition to meeting the subsistence needs of local farmers are important source of meeting the demand-supply gap. The supply of forest produce from the government forests has declined substantially due mainly to deforestation, shrinking forest lands and ban on felling in natural forests. Other NTFPs that are harvested and can be marketed include vines, medicinal plants, grasses, fodder and mulch. Illicitly harvested timber and fuelwood are also marketed in nearby towns and markets.

5. ASSESSMENT OF BIODIVERSITY MANAGEMENT PRACTICES

5.1 Forest Management Systems

Before British implemented scientific forests management in early 19th century, the management for Chunoti forests was characterized by:

- i) Local men had free run of the forests for domestic consumption,
- ii) Individuals desirous of exporting forest produce had to take a permit to cut or remove forest material, and
- iii) On passing certain revenue/check stations situated on the banks of rivers, the Government levied a toll on the forest produce.

The detrimental effects of unrestricted cuttings adversely affected the growing stock, and the shifting cultivation (jhum) practiced on a wide scale further depleted the forests. During the British rule the then Conservator of Forest, Bengal, therefore, imposed the following restrictions on forest exploitation:

- i) Two classes of forests, reserved forests (RFs) under FD, and unclassed state forests (USFs) under Revenue Department were formed,
- ii) No jhum was to be allowed in RFs, and
- iii) Local people will meet their requirements of forest produce from USFs.

The first working plan for the Chunoti forests was prepared for twenty-years by Cowan in 1923 in which the forests were divided into i) timber working circle (clearfelling followed by artificial regeneration), ii) bamboo working circle (with 2 years cutting cycle), and iii) Jaldi coppice working circle (20 years rotation coppice with standards). This working plan was cancelled in 1939 and the accessible forests were heavily depleted due to the World War II (1942-45). After the partition, Mr. Q. Ghani prepared a working plan (1950-51 to 1969-70) for Chittagong forest division that included Chunoti forests. New centres were opened for clearfelling of natural forests, followed by plantations of long rotation species, especially after new development schemes on conversion of natural forests were introduced in the 2nd Five Year Plan (started from 1960-61). Accordingly the existing working plan was revised by Baten (1968-69 to 1977-78) after accommodating the excess fellings carried out while implementing the development schemes. The plan prescribed three working circles, long rotation working circle, short rotation working circle and bamboo (overlapping) working circle. The clearfelling at 60 years rotation followed by plantations (of teak, garjan, chapalish, gamar, jarul, champa, mahogany, jam, tali, telsur, chikrasi, etc.) was adopted in long rotation working circle. The plantation of non-teak species in mixture with teak (without adequate knowledge of raising such species in mixture) resulted in greater proportion of hardy teak surviving, with poor success for non-teak species.

Baten's plan was revised by S.A. Khan (1978-79 to 1987-88) in which speedy conversion of high forests was achieved by establishing short rotation, medium rotation and long rotation plantations in three working circles created for the purpose. This plan was revised by E.G. Balmforth and N.I. Howlader (1988 to 1997) wherein conversion of natural forests for raising long rotation plantations, and raising of short rotation species were added as important management objectives in order to satisfy local demand through participatory forestry. An important addition in the list of management objectives was made on the protection and preservation of forest areas of environmental values (relating to wildlife, conservation of biodiversity and ecological gene-pool sources, and amenity areas) by creating a new preservation working circle. J.H. Chowdhury (1991-92 to 2000-01) revised the existing working plan to accommodate higher plantation targets under the World Bank funded Forest Resources Management Project. A ten year integrated forest management plan (2000-09) prepared by A. Mabud is currently under implementation and provides for the preservation and recreation working circle for the management of PAs.

5.2 Wildlife Management

The management plans of Chowdhury (1991/92-2000/01) and Mabud (2000-09) provided for a preservation working circle (Chunoti WS and the proposed Hazarikhil WS) for the management of PAs of Chittagong forest divisions. Although the main prescription of stopping commercial fellings in Chunoti WS was implemented, other recommended wildlife management practices could not be carried out due mainly to paucity of funds. However, a 3-year GOB funded wildlife scheme (1993-96) was implemented for Chunoti by developing some visitor facilities (a rest house and two wildlife Watch Towers). Similarly plantations of fruit and fodder species for wildlife have been established under a GOB scheme. These plans also recommended to prepare separate schemes/plans for the management of PAs. Accordingly a separate management plan was prepared for Chunoti WS by Rosario (1997), and a two year action plan by (Tecsult, 2001). However, neither of these two management plans were approved nor implemented.

5.3 Habitat Protection

The forests of Chunoti were subject to indiscriminate felling prior to their reservation in early nineteenth century. The forests were brought under scientific management during British rule when FD was established in 1865 and the Forest Acts of 1878 and 1927 were implemented. The hill forests were declared as RFs by following due reservation procedures. As a result, the legal status of these forests got enhanced and the protection of habitat against illicit felling, encroachment, forest fires and grazing was organized by FD staff. The provisions of Wildlife (Amendment) (Preservation) Act, 1974 provided further protection to the Sanctuary and its constituent biodiversity after gazetting Chunoti forests as Wildlife Sanctuary in 1986. The Sanctuary is approachable by jeeps, bicycles and foot, and this easy accessibility available to huge local population (combined with fertile soil and suitable topography) has contributed to the encroachment of forests lands, over-exploitation of forest produce and resulting severe degradation of habitat.

5.4 Eco-Tourism

The easy accessibility of the Sanctuary from Cox's Bazar, Chittagong and Dhaka through air and road makes it attractive for eco-tourism, if the habitat is restored. A large number of tourists visiting easily accessible parts of the Sanctuary may feel vegetation in the beautiful landscape with rolling hills and interspersed valleys. The chartered eco-tours on the pattern of Sundarbans may be organized in the Sanctuary, once habitat is improved.

5.5 Management Practices for Non-Timber Forest Products

Forest management practices in Chunoti forests have in past focused mainly on timber production due mainly to its commercial value. The forest management practices laid more emphasis on the development of major forest products such as timber whereas NTFPs received relatively low priority by treating them as by-products of forest management. As a result, the management of NTFPs did not receive its due importance. The Chunoti forests managed in past under clearfelling system have reduced biodiversity and there is inadequate regeneration of NTFPs bearing species. With dwindling forests many NTFPs have become extinct and the symbiotic relationship that existed in past between forest dwellers is disturbed, leading to further deforestation and loss of NTFPs. Clearfelling, jhum, encroachment and forest degradation without adequate replenishment through natural and artificial regeneration, have considerably reduced the availability of many NTFPs.

There is a lack of appropriate policies, harvesting rules and regulations to the management, harvesting and development of many NTFPs. Whatever harvesting rules are existing for some NTFPs such as bamboo and canes do not get implemented in the absence of adequate funds and field supervision. Although many NTFPs yielding species can be well integrated in the FD plantation program through inter-planting and under-planting, no such efforts have been made in past. The plantation programs, focused mainly on few commercially important species such as teak (*Tectona grandis*) and gamar (*Gmelina arborea*).

5.6 Conservation Research, Monitoring and Training

Presently there is neither any wildlife research staff nor research facility (e.g. laboratory) for the Sanctuary. 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 in-country training of FD staff on wildlife 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, co-management of PAs, legal aspects of PA management, capture of wildlife, census operations, captive breeding, etc. Such topics should be included in regular syllabus prepared for training of FD staff.

5.7 Administrative Set Up

Under the overall charge of the CCF, a wildlife and nature conservation circle (with CF as head, who is assisted by a staff officer of DCF rank) operates with six field level DFOs as approved by the Govt. of Bangladesh. Of the six DFOs, four are to be in-charge 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. Chunoti WS is administered and managed by the WMNC Division, Chittagong. There is a need of adequate staff including trained ACFs posted at PA level.

6. INTERFACE LANDSCAPE SITUATION

6.1 Interface Landscape Approach

The Plan has adopted a landscape approach of Sanctuary management by focusing on a broader spatial scale (Figure 5) in order to integrate relevant habitat/forest system, ecosystem and relevant social/institutional system. It is an holistic approach taking into account factors that impinge on the management of Chunoti WS in the context of a mosaic of different land-use patterns and socio-economic growth. It recognizes the fact that the WS cannot be viewed in isolation from the surrounding socio-economic realities and development priorities, and so calls for a cross-sectoral and cross-disciplinary approach. The landscape is taken as a planning and development unit for an integrated management of the Sanctuary in order to address the needs of households and co-management activities in the context of a broader economic, natural resource and socio-institutional environment of Chunoti. It provides a framework to manage the Sanctuary for multiple uses by addressing interactions between local economy, stakeholders and natural resource base.

Interface landscape management of the Sanctuary will entail biodiversity conservation by linking surrounding ecosystems with relevant human systems. It will help restore ecological processes both within the Sanctuary and in surrounding landscape by accounting presence and needs of local inhabitants. It promotes active involvement of main stakeholders in Sanctuary 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 are accounted for in the Sanctuary management.

6.2 Interface Landscape of Chunoti Wildlife Sanctuary

A number of villages, paddy land, settlements and forest land fall within the zone of influence of Chunoti Wildlife Sanctuary. It is intimately surrounded by a number of villages, towns, forest areas, and cultivated fields. The Sanctuary is bordered on the north by RFs of Chunoti Range, and in the south-east and south by RFs of Chunoti and Barabakia Ranges. The plantations raised under different projects including FSP exist in Chunoti Range, particularly near the Chittagong – Cox's Bazar Highway that crosses the eastern part of the Sanctuary. However, a number of paddy lands and settlements are found all around the Sanctuary, sometimes on encroached forest land. Most of the local population, who depend mainly on agriculture for their livelihood, use forests for meeting their consumption needs for forest produce. Keeping in view both the relevant human system and biophysical system a 5 km-wide landscape zone along the boundary of the Sanctuary is taken as interface landscape zone. However, the NSP will start first by focussing conservation efforts in and around an elephant movement corridor sub-zone that has been identified by NACOM (2005) within the core zone.

6.21 Interface Villages

There are 70 settlements (locally called Paras) in 15 villages (included in 7 mouzas) in and around the Sanctuary. However, only 42 Paras (Table 3.21) of Chunoti Range have been studied for assessing stakes in the forests of the Sanctuary (NACOM, 2004). Of the 42 identified villages/paras, 24 are located within the Sanctuary, 13 are located near the boundary whereas 5 are located within 5 km from the boundary. Nearly one-third of the total local population remains unemployed as a result of which biotic pressure on Chunoti forests is indeed high. Heavy dependence on forests and forest land resulted in an active opposition by local people to wildlife conservation efforts. Crop damages by elephants have further exacerbated this animosity. Nearly three-fourth of the total Paras were found having major stakes in the WS as evident from Table 6.1.

Table 6.1 Interface Villages/Paras having stakes in Chunoti Wildlife Sanctuary

SI No	Village	Total HHs No	Beat	Location	Level of Stake
1	Khalifer Para	70	Chunoti	Inside	Major
2	Rashider Ghona	500	Chunoti	inside	Major
3	Bangha Pahar	200	Chunoti	Adjacent	Major
4	Sultan Mouluvi para	200	Chunoti	inside	Major
5	Munshi para	250	Chunoti	inside	Major
6	Damir Ghona	200	Chunoti	inside	Major
7	Mirikhil	500	Chunoti	inside	Major
8	Hindhu para-1	100	Chunoti	Inside	Major
9	Boro Miaz Para	200	Chunoti	Adjacent	Major
10	Baghan Para	100	Chunoti	Adjacent	Moderate
11	Sikder Para	800	Chunoti	Near to Adjacent	Moderate
12	Kathuria Para	300	Chunoti	Near to Adjacent	Moderate
13	Deputy Para	100	Chunoti	Near to Adjacent	Moderate
14	Hindhu Para-2	30	Chunoti	Adjacent	Moderate
15	Kalu Sikder Para	30	Chunoti	Adjacent	Moderate
16	Kumudiaduri	70	Chunoti	Adjacent	Moderate
17	Moulana Para	200	Chunoti	Near to Adjacent	Moderate
18	HutKholamura	80	Chunoti	Adjacent	Major
19	Rosainga Ghona	30	Chunoti	Adjacent	Major
20	Barua para	40	Chunoti	Near to Adjacent	Major
21	Null Bonia	40	Chunoti	Adjacent	Moderate
22	Munshi para	250	Chunoti	Inside	Major
23	Sufri Nagar	400	Chunoti	Inside	Major
24	Gucchagram/ Ashrayan (Shelter)	100	Chunoti	Inside	Major
25	RatarKul	40	Chunoti	Inside	Major
26	hasainna kata	15	Chunoti	Inside	Major
27	TeenGhoria para	10	Chunoti	Inside	Major
28	Bon Pukur	50	Chunoti	Adjacent	Major
29	Kolatoli	20	Aziznagar	Inside	Major
30	Aziz nagar	50	Aziznagar	Inside	Major
31	Gainna Kata	50	Aziznagar	Inside	Major
32	Jungle basti Area	70	Aziznagar	Inside	Major
33	West Villager Para	300	Aziznagar	Inside	Major
34	Nayapara	50	Aziznagar	Inside	Major
35	Purba Villagerpara	250	Aziznagar	Inside	Major
36	Ichachari	30	Aziznagar	Adjacent	Major
37	Taillar bill (Goyal mara Villager para)	800	Herbang	Inside + Adjacent	Major
38	Vandari Dhoba	200	Herbang	Adjacent	Moderate
39	Hormudhi para	1000	Herbang	Adjacent	Moderate
40	barua para	40	Herbang	Inside	Major
41	West Charpara	10	Herbang	Inside	Major
42	Napiter Chita	5	Herbang	Inside	Major

Level of stake was determined on the basis of distribution of different resource users and people having land within the sanctuary.

6.22 Stakeholders Assessment

Of the total 24 stakeholder groups, 19 are identified as primary stakeholders (forest land encroacher, fuelwood/vegetable collector, fisherman, illicit logger, forest produce collector, betel leaf cultivator, farmer, hunter, fruit collector, etc.) being directly associated with forest resource extraction activities whereas the remainder 5 groups (brickfield owner, saw mill owner, timber merchant, tea stall owner, etc.) are secondary stakeholders linked indirectly with forest-based activities. Most of the primary stakeholders from the neighboring villages are poor, who earn their livelihoods by carrying out forest-based activities. Main institutional stakeholders include Forest Department, LGED, local government and councils, and Police.

6.23 Brickfields

Six brickfields (located at Nolbunia, Banpukur and Kolatali in Chunoti Beat; Villagerpara and ITCL Station in Aziznagar Beat and Ichachhari in Harbang Beat) owned by local influential people operate in and around the WS. Four brickfields are located within the boundaries of Sanctuary. Fuelwood collected illegally from the forests is used in the brickfields and so these brickfields continue to adversely affect the habitat.

6.24 Betel Leaf Cultivation

Betel leaf cultivation is widely practiced in and around the WS by local people for their livelihood. Most of the betel leaf cultivation is practiced on forest land encroached by local people for establishing a betel leaf vein. A large number of betel leaf veins have been established particularly in Chunoti, Aziznagar and Harbang Beats. In view of its popularity, betel leaf cultivation is an important income generation activity of local people, who use a number of inputs (land, sapling vine, bamboo stakes, forest material for fences and roofs, irrigation, fertilizer, etc). Family labour is used in growing, harvesting, processing and marketing the betel leaves locally in the Bazars of Aziznagar, Chunoti and Deputy. The processed betel leaves also are exported to Chittagong and Dhaka by middlemen, who transport the packaged leaves after purchasing from local markets.

6.25 Forest Land Encroachment

Forest land encroachment for agriculture, betel leaf cultivation, brickfields and settlements is common inside the WS. Forest land is encroached permanently but also for a temporary period mainly for grazing, fishing and betel leaf cultivation. Many times the village elites are directly or indirectly associated with forest land grabbing for establishing homesteads and cultivation. Institutional encroachment is common for setting up school, madarasa, graveyard, mosque, nursery, etc. A shelter village (Guccha Gram) for 100 households has been established inside the WS by the Government. Although the official records of FD show 694 ha of forest land under encroachment in Chunoti Range, the extent of encroachment may be more than the officially recorded figures. In some cases the encroachment has been regularized by issuing land ownership documents as khas land. This phenomenon of forest land encroachment is still continuing and needs to be stopped immediately.

P A R T I I

RECOMMENDING STRATEGIV PROGRAMS FOR A SUSTAINABLE PROTECED AREA SYSTEM

1. PLAN OBJECTIVES AND CHALLENGES

1.1 Objectives of Management

The Plan focuses on protecting and conserving the biodiversity of Chunoti WS in accordance with the Forest Policy of 1994 and sound principles of sustainable environmental and socio-economic development. Main long-term management aim is to bring 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 below:

- ▣ To develop and implement a co-management approach that will ensure long-term protection and conservation of biodiversity within the Sanctuary, while permitting sustainable use in designated zones by local people as key stakeholders
- ▣ To conserve the biodiversity of the Sanctuary based on building partnerships with all the stakeholders and sharing benefits with local communities and key stakeholders
- ▣ To refine and strengthen the policy, operational, infrastructural and institutional capacity framework for Sanctuary management
- ▣ To conserve and maintain viable wildlife population including endangered, threatened, endemic and rare species
- ▣ To restore and maintain as far as possible the floral, faunal, physical attributes and productivity of the forest eco-systems
- ▣ To encourage eco-tourism in suitable zones and develop visitor amenities, and
- ▣ To implement income generation activities for sustainable livelihood development and enhance skills of local stakeholders

1.2 Framework Activities

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

- ▣ Survey, demarcate and mark the Sanctuary boundaries;
- ▣ Develop a co-management model and relevant policy guidelines, and establish co-management agreements linking Sanctuary conservation with benefits sharing arrangements with key stakeholders;
- ▣ Survey biodiversity resources in the Sanctuary;
- ▣ Strengthen FD institutional capacity for the Sanctuary management;
- ▣ Build conservation awareness, constituencies and extension activities on conservation issues;
- ▣ Train local stakeholders including beneficiaries and FD staff in conservation management and income generation, raise awareness among stakeholders and develop Sanctuary facilities;
- ▣ Develop conservation and visitor facilities in and around the Sanctuary;
- ▣ Create tree resources in adjacent agricultural and village areas of the surrounding landscape on participatory conservation and benefits sharing basis and implement alternative income generation activities for sustainable livelihoods of key stakeholders; and
- ▣ Naturally regenerate through protection and watershed conservation measures, and enrichment plantations of indigenous species in identified gaps.

1.3 Challenges in Achieving Management Objectives

Encroachment of forest lands and illegal removal of forest produce (e.g. fuelwood and small timber) are two main challenges facing the Sanctuary. Other important challenges include biotic pressure brought by brick kilns, hunting and poaching, soil erosion, grasslands degradation, traffic movement on roads, demarcation of Sanctuary boundaries, lack of funds, lack of trained professionals, inadequate staffing and infrastructure, man-animal conflicts, etc. Social Forestry Rules, 2004 providing for the sharing benefits from social forestry plantations will be helpful in sharing benefits with local communities in surrounding landscape. Similarly co-management agreements developed under NSP will help formalize benefits sharing. Possible benefits for local communities may include income and forest biomass from the Sanctuary and interface landscape zone, livelihood opportunities under NSP, ancillary economic activities when the Sanctuary serves as a pole of regional economic growth, and a voice in determining their own livelihoods.

2. SUSTAINABLE PROTECTED AREA MANAGEMENT SYSTEM

2.1 Sanctuary Management : Emerging Priorities

In earlier stages of forests management in the country its main objective 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 products, mainly timber. With the promulgation of Forest Policy of 1994, the emphasis formally 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 forest 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 bio-geochemical cycling of nutrients. The leaves, twigs, small branches and fruits make the litter (falling on forest floor) that is decomposed by micro-organisms (bacteria, fungi), adding nutrients to forest soils for plant growth. Forest management should thus be part of biodiversity conservation and forest land management strategy so that perennial vegetative cover is maintained. The management system should be perceived as husbandry of renewable forest resources with attention to the protection, biodiversity conservation, recreational and other values.

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 deprivation and rural poverty among local people. A gainful association of such rural mass, achieved by establishing gainful partnership mechanisms, is essential for sustainable management of the country's PAs. Co-management agreements are formal mechanisms for soliciting community interventions for the protection and conservation of PAs in *lieu* of identified benefits.

2.2 Management Strategies

Consistent with the definition of a 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 and development strategies have guided the development of this Plan including the management programs outlined in Part-II. The overall focus of management planning in the Sanctuary is to restore and manage it in as natural and undisturbed condition as possible, and to provide protection to their constituent biodiversity including wildlife. However, such a management of Chunoti WS would by necessity require gainful partnerships with local stakeholders in view of their intimate interspersed with human habitations and cultivation. A landscape approach within the parameters set by the NSP has, therefore, been adopted.

The restoration, maintenance and development of forest cover with natural structure and composition, and the conservation of its constituent plant and animal biodiversity will guide the Sanctuary management. The management of Chunoti WS will focus on restoring, maintaining and 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 based on co-management agreements, specifying roles and responsibilities for stakeholders' partnerships. As far as possible subsistence use will gradually be shifted to interface landscape zone and no new settlement or in-migration will be permitted within the core zone areas. Visitor use for outdoor recreation, research and educational purposes will be encouraged in designated areas.

Boundaries of Chunoti will be surveyed, demarcated and maintained regularly. Specific zones will be designated for achieving different management objectives. Within the Sanctuary 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. Different 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 sub-zones and so will be detailed in the relevant sub-zones. Such strategies may be related to habitat improvement, restoration and protection. Detailed strategies along with management practices are described in detail for each identified zones/sub-zones in subsequent chapters.

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 Sanctuary protection and management among the stakeholders is, therefore, an important part of co-management. An effective linking of socio-economic and ecological incentives and biodiversity conservation will be instrumental in eliciting stakeholders' participation. For Chunoti, relevant co-management actors are the FD as legal custodian of PAs, and key stakeholders that play important role in the conservation management. Co-management agreements are important for linking participatory benefit sharing arrangements to Sanctuary conservation and will help formalize symbiotic linkages.

NSP is designed to assist in achievement of the primary objective of conservation of biodiversity in the Sanctuary. This overall objective is to be achieved through support to the FD and key stakeholders in protecting, rehabilitating, conserving and sustainably managing biodiversity by building partnerships based on shared rights and responsibilities. The Project is expected to contribute significantly to sustainable economic growth in remote rural areas with a high proportion of relatively poor groups. The economic interventions to be proposed include sustainable benefits for co-management participants of locally organized forest user groups.

A two-tier institutional structure (conservation council and co-management committee) for sustainable Sanctuary co-management will be adopted. The conservation council will have a broad-based structure, drawing people from different strata of the community from an identified landscape; the total number of members will be around 50 with the following composition as a guideline:

- ▣ Upzila Nirbahi Officer as Chairperson
- ▣ 9 Representatives from NGO organized federations/groups
- ▣ 12 Representatives from Local Government
- ▣ 7 Representatives from local elite
- ▣ 5 Representatives from resources owning groups
- ▣ 2 Representatives from FD (Range Officer/Beat Officer)
- ▣ 2 Representatives from law enforcing authorities (BDR/Police/Ansar/VDP)
- ▣ 5 Representatives from NGOs/CBOs
- ▣ 3 Representatives from ethnic communities
- ▣ 5 Representatives from other Government Departments
- ▣ ACF as Member-Secretary

A co-management committee (see below as a guideline), responsible for overall management of a PA, will consist of maximum 19 members (ideally 15), elected by the conservation council by following a structured guideline that will contain the number of people to be elected from each representative category, their election procedures and the tasks to be performed by the committee :

- ▣ Elected Chairperson from council
- ▣ 3 Representatives from Forest Villages
- ▣ 2 Representatives from NGO organized federations/groups
- ▣ 2 Representatives from Local Government
- ▣ 2 Representatives from NGOs
- ▣ 1 Representative from CBO
- ▣ 3 Representatives from local elite
- ▣ 2 Representatives from resources owning groups
- ▣ 1 Representative from Law enforcing authorities
- ▣ 2 Representatives from Government Department
- ▣ Range Officer as Member-Secretary

The Committee will have an elected Chairperson and an ex-officio Member-Secretary. Half of the members of the committee will retire voluntarily every year and new members will be elected against the vacant posts (a member cannot be elected for two consecutive terms). Specific constitution including functions of the conservation council and co-management committee will be specified. Co-management council/committee will oversee the Plan implementation and ensure active participation of local stakeholders.

2.3 Project Objectives

The NSP is working to achieve the following six separate but closely related objectives in Chunoti WS in support of the above-stated co-management objectives:

- ▣ Develop a functional model for formalized co-management of Sanctuary;
- ▣ Create alternative income generation opportunities for key local stakeholders;
- ▣ Develop policies conducive to improved Sanctuary management and build constituencies to further these policy goals;
- ▣ Strengthen the institutional system and capacity of the FD and key stakeholders;
- ▣ Build or reinforce the Sanctuary infrastructure that enable better management and provision of visitor services; and
- ▣ Design and implement a program of habitat management and restoration of the Sanctuary.

2.4 Rationale for Benefit Sharing

Local communities were put to hardships after notification of Chunoti forests as Sanctuary due mainly to curtailment of the flow of forest usufructs through 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-elephant conflicts and a tenuous interface situation. Conservation-oriented Sanctuary management with strict restrictions on forest harvesting and enhanced patrolling have further exacerbated their problems. Local people incur high opportunity costs in terms of foregone benefits, which they derived from the forests before the implementation of enforcement practices.

The local people, who hitherto used 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 Sanctuary partnership requires an equitable sharing of both benefits and costs. Due to impoverishment of local people it is not expected that they will come forward in investing cash money in the conservation efforts of Chunoti. However, due to local unemployment and under-employment it is plausible to solicit their voluntary labour contribution in an effective protection and management of the Sanctuary 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 an 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 the Sanctuary under co-management.

Main focus of co-management is on equitably sharing roles and responsibilities by key stakeholders for biodiversity conservation in the Sanctuary. Benefits sharing from the harvests of plantations is a main mechanism for eliciting peoples' participation in participatory forestry: For instance, the harvests from plantations raised under FSP are shared by the participants and also form seed money for Tree Farming Fund. With focus on biodiversity conservation, the flow of benefits to local people is much less in co-management of a PA when compared to participatory forestry. This means that the benefit stream in the Sanctuary management need to be strengthened for which LDF is designed for funding alternative income generating activities. An initial amount of USD 300,000/- is earmarked to be used as seed money for LDF. Operational guidelines for the LDF have been finalized for their field implementation.

2.5 Elements of a Sustainable Protected Area Management System

A study on the assessment of FD's institutional system and capacity to manage the PA system of Bangladesh was completed under NSP with the following main objectives:

- 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 enforcement
- ▣ 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

Keeping in view the heavy biotic pressure brought by manifold increase in population, and agricultural and industrial demands, and consequent habitat degradation and the loss of wildlife in the Sanctuary, the main objectives of this program are set as follows:

- i) To provide adequate protection to the Sanctuary for the conservation of its constituent biodiversity;
- ii) To demarcate the Sanctuary boundary;
- iii) To update forest cover and interface landscape maps,
- iv) To control illegal removals from the Sanctuary and surrounding landscape; and
- v) To check encroachment of the Sanctuary land.

3.2 Updating of Existing Forest Cover and Landscape Maps

Detailed forest cover/landscape mapping for Chunoti WS and adjoining forests is available with FD. This mapping along with the CEGIS maps are used in the management zoning by identifying core zone and interface landscape zone, and also specific sub-zones within the broad core and landscape zones. It is recommended to verify this zoning during the Management Plan implementation, based on field visits and stakeholders assessments. 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 surrounding landscape zone outside of existing Sanctuary boundaries. This is necessary to provide a spatial context for coordination of regional landscape elements including human systems and nearby forests. Mapping will be extended to include the forest land portions of the landscape and beyond, and will particularly focus on identifying remnant patches of natural vegetation and encroachments within the Sanctuary. Land-use and base maps will be prepared by acquiring latest satellite imageries (e.g. LISS or aerial images) for the Sanctuary. These maps may be standardized after comparing with the previous RIMS maps. Actual maps will be produced based on ground truthing by making use of differential GPS.

3.3 Boundary Demarcation

All the peripheral boundaries of the Sanctuary will be identified, surveyed and marked on the maps and on ground. The boundaries of different management 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*, ridges, roads, etc.) will be taken wherever possible, while carrying out demarcation. Posts (e.g. concrete pillars, relevant guidelines for which are suggested in Volume 2) or other markers (wooden or iron pillars, 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 Sanctuary's outer boundaries will be clearly marked with signs indicating the name and summary of key regulations in written text and symbols. Signboards will be of the following types:

- i) Attractively designed, large wooden/steel/iron signboards where the Chittagong-Cox's Bazar Highway crosses the northern and southern boundaries of the Sanctuary; and
- ii) Concrete slab signboards (of the type currently used to mark plantations) at all other locations.

3.3.1 Inconsistency in Sanctuary Boundaries and Forest Areas

The traditional traversing method is generally used for boundary demarcation based on Gazette Notification. This method does not employ Aerial Photographs for re-validation. Moreover, the boundaries of the Sanctuary have not been delineated keeping in view of 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 Sanctuary. Some human errors during plotting the traverses and mapping are also not ruled out. The field maps were used by RIMS to generate GIS databases (administrative boundary layers) through digitization. The notified area of Chunoti WS is 7,764 ha as against 7810.5 ha computed from the GIS data base of RIMS. 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 removing noted inconsistencies.

3.4 Control of Illicit Felling, Poaching, Forest Fires, Forest Grazing and Forest Land Encroachment

Effective protection against illicit felling, poaching, forest fires, forest grazing and forest land encroachment are necessary for effective biodiversity conservation in the Sanctuary.

3.4.1 Control of Illicit Felling

Illicit felling and poaching inside the Sanctuary will be checked through extensive joint patrolling (FD staff and local communities/stakeholders) inside the forests, particularly the core areas. The villagers from nearby *paras/villages* will particularly be helpful in protection efforts through patrol and intelligence sharing. Stakeholders' participation in controlling petty theft and poaching will be very helpful as being local people they are better informed about the points and routes of biotic pressure. In addition to controlling illicit felling and poaching, they will also check the boundaries and land encroachment within the Sanctuary. The present practice of engaging helpers from nearby villages for forest protection has not proved successful and so will be discontinued. It will be essential to regulate illegal running of sawmills and furniture shops located near the Sanctuary. Guidelines may include that no sawmill should function within 10 km boundary of the Sanctuary. Issuing transit permits by FD staff will be stopped keeping in view of biodiversity conservation in the Sanctuary.

An effective checking of organized smuggling of timber and poaching by gangs will require concerted efforts from FD by using modern equipments and transport facilities. Fire arms and ammunition and training to combat organized poachers and smugglers may be provided in such cases; one Revolver and/or Rifle to each ACF 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. 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 the Sanctuary field staff; each Beat would have at least one motor cycle.

Existing motorable roads will be maintained for easy movement of patrolling parties. But construction of new roads is not proposed as patrolling on foot will be more effective. Redeployment of FD field staff may be necessary depending upon the intensity of illicit felling in certain areas. For example, the remaining patch of garjan forest in Vhunoti Beat will require a group of FGs specially deputed for protection. 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. 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 wildlife and its habitat.

3.4.2 Regulations of Non-Timber Forest Products

NTFPs such as grasses, bamboo and medicinal shrubs/herbs are presently collected from the Sanctuary indiscriminately by whosoever gets access. This collection process should be streamlined and entrusted to the members of user groups and co-management committees/councils who will be responsible for the collection of NTFPs under overall guidance of FD field staff. However, an assessment of availability of 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 in the villages in surrounding landscape zone.

3.4.3 Control of Forest Fires

Control of forest fires will be done by involving local stakeholders and the members of user groups. Existing paths/tracks will be used as fire lines 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 and hiking trails will be cleaned every year before fire season, and additional fire lines will be created at strategic places. Local

people engaged in community patrolling 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 existing four Watch Towers in Chunoti and Jaldi Ranges developed for tourists visiting the Sanctuary, will be used as fire Watch Towers as well. The patrolling squads in association with local stakeholders also will guard against forest fires. 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) can also be kept at Beat/Camp HQs and other convenient places. A register of forest fire occurrences may be maintained for monitoring of fire incidences and assessing their adverse impacts on biodiversity regeneration.

3.4.4 Control of Forest Grazing

Villagers in and around the Sanctuary maintain cattle, who invariably graze in the nearby forests. No forest grazing will be allowed in the Sanctuary except allowed by the concerned DFOs as rotational grazing. Stakeholders will be convinced not to let loose their cattle in forests but also to 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 of stakeholders. In the buffer reserves of surrounding landscape zone, silvi-pastoral models may be implemented by FD. Villagers may be provided such technologies (including seeds/slips) so that they can raise their fodder plantations on their private lands and other unutilized *khas* lands. Improved cultivation practices carried out with mechanical appliances including power tillers will reduce the need for draught animals. Similarly the breed of livestock may be improved in collaboration of Department of Livestock. A public campaign will be undertaken by holding public meetings and distributing leaflets to make the local people aware about adverse effects of forest grazing and utility of stall feeding.

3.4.5 Control of Sanctuary Land Encroachment

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

3.4.6 Man-Animal Conflicts

Wild animal depredation (e.g. monkeys, elephants) is a problem in the nearby villages. The local villagers will be trained by FD/NSP staff and NGOs and the equipments (e.g. crackers, batteries) will be provided under the project for driving away wild animals. A provision need to be made in the draft Wildlife Act (under revision) for making compensation in case of wildlife depredation. Currently no Wildlife Insurance Schemes for human-animal conflicts (e.g. injury, death, property damage, crop damage, etc.) and no provision for damage compensation exist in FD. Some compensation schemes through wildlife insurance have developed as a mechanism to compensate the loss caused by the wildlife in Sundarbans. This scheme may be implemented in Chunoti areas as well. The budget provisions may be made to FD for compensating the damage to private property and loss of life by wildlife.

3.5 Co-Management Agreements

The plantations (woodlots, strip plantations and agroforestry) of different categories have been raised under FSP in Chittagong (South) Division. Participants formed into user groups take responsibility for protecting and managing the plantations in *lieu* of usufructuary benefits ensured through PBSAs signed between the participants and FD. The participants should have responsibility for the protection of neighbouring forests in addition to the plantations assigned to them under FSP.

As per the Wildlife (Preservation) (Amendment) Act, 1974 no commercial harvesting is allowed inside the Sanctuary. This means that no benefits flow to local people from the harvests of either plantations or naturally occurring trees. Hence other relevant mechanisms of benefit flows to local communities need to be explored. Enrichment plantations of indigenous trees, shrubs, herbs and grass species including fruit species suitable for wildlife will be taken up in identified gaps. 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 such as grasses, bamboo and medicinal plants. Water yield as a result of habitat conservation can be an additional incentive to local people for agricultural purposes. These benefits, however, may not be sufficient to motivate local people, and so additional benefits need to be mobilized through off-PA activities including alternative income generating (AIGs) activities. The upscaling of skills by NGOs (e.g. RDRS and CODEC) will be helpful in generating value additions through capacity building of local people. Landscape Development Fund (LDF) will help provide finance for user groups and other local organizations to set up micro-enterprises, AIG activities and offering self-employment opportunities to the skilled members. Benefits from eco-tourism, entry fees, etc. can also be retained by co-

management councils/committees and be ploughed back for the development of local communities and Sanctuary.

3.6 Sanctuary Conflicts Management

Main sources of conflicts among local people around the Sanctuary relate to forest extraction, forest land encroachment and other land disputes, forest offence cases, elephant damages to cultivation and humans, forest grazing, etc. Some of these conflicts are resolved by local elites and public representatives (e.g. union parishad chairman and members, village leaders, local MP and the members of Gram Sarkar). A large number of forest offence cases have been registered by FD against local people and are pending in local courts for their resolution. Loss of crops and human lives by elephants have been reported by local people. As a result local people have on number of occasions killed elephants. Crop raiding by elephants in nearby villages occurs due mainly loss of habitat and lack of food and shelter inside the degraded forests of Chunoti. Unlike the traditional forestry practiced in RFs, the chances of conflicts are more in a co-management approach being followed in Chunoti due mainly to a number of actors involved.

Identification of Sanctuary 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 Sanctuary conflict resolution based on dialogue and mutual trust. Building appropriate local institutions (e.g. regular meetings of co-management council/committee, and forming federations or umbrella groups and networks of user groups) as a platform for airing dissent and creating situations, where local stakeholders can learn together are necessary for resolving Sanctuary conflicts.

Depending upon a particular situation the following steps may help prevent/resolve PA conflicts:

- ▣ Self-sensitization of FD and NGO staff is important
- ▣ Learn from Sanctuary 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 the Sanctuary use and management
- ▣ Appreciating and nurturing grounds of common interest on the Sanctuary issues
- ▣ Generating recognition between individuals/user groups and underlining similarities of their aims and objectives on Sanctuary issues
- ▣ Establishing reliable information base on Sanctuary resources on which conflicts may be related
- ▣ Organizing short workshops and developing manuals on training on Sanctuary conflict resolution
- ▣ Conducting focus group discussions with co-management council/committee to build consensus on collective goals of co-management committees as against individual goals
- ▣ Raising questions on real Sanctuary issues, seeking options/suggestions from local stakeholders for co-management of the Sanctuary
- ▣ Developing, implementing and monitoring a plan of co-management actions for the Sanctuary, and
- ▣ Follow up, networking and process documentation for future learning

Sanctuary 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 conflict management is particularly useful when the cost being incurred due to the conflict continuance is great for all stakeholders, deforestation issues are complex and building long-term relationships among the disputing parties is important for sustainable Sanctuary management. A negotiated management of the Sanctuary conflicts 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 council/committee, FD staff and NGOs,
- iv) Collaborative approach to negotiations,
- iv) Taking adequate preparations before starting of formal negotiations, and
- v) Adopting appropriate negotiation skills/tools.

In summary, a typical conflict resolution/management process in Chunoti WS may involve:

- ▣ Develop and institutionalize a mechanism for interactions and discussions at a common platform (e.g. co-management council/committee 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 Sanctuary 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 council/committee to deflate potential Sanctuary conflicts and crises as they emerge. Seek solutions to the identified Sanctuary 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 Sanctuary 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 Sanctuary
- ▣ Maintain a list of selected persons (e.g. villager leaders/elders), who can be available as facilitators/mediators.

It needs to be remembered that conflict prevention (and/or resolution) through peaceful means is desirable and cost effective in long run than its continuation (or a conflict resolution through violent means).

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	Main Responsibility
1	<ul style="list-style-type: none"> ▣ Procurement of equipments, vehicles, tools, imageries, etc. ▣ Reviewing the existing forest cover and land-use maps and updating them by using latest imageries (LISS) and ground truthing ▣ Establishing co-management council/committee and forming forest user groups for community patrolling ▣ Signing participatory conservation and benefit sharing agreements and co-management MOUs with user groups and Councils/committees ▣ Controlling forest grazing, forest fires poaching, forest land encroachment and illicit removals from the Sanctuary ▣ Providing incentives for biodiversity protection efforts ▣ Establish Sanctuary conflict resolution mechanisms through co-management council/committee 	<p>Equipments & remote sensing products procured</p> <p>Updated maps prepared by RIMS/NSP</p> <p>Co-management council/committee and user groups are in place</p> <p>Co-management MOUs & benefit sharing agreements signed</p> <p>Reduced level of biotic interference in and around the Sanctuary</p> <p>Good FD/NSP field staff and stakeholders rewarded</p> <p>Conflict resolution mechanism in place and being invoked</p>	<p>FD/NSP</p> <p>FD/NSP</p> <p>NSP/FD/ Stakeholders</p> <p>NSP/FD/ Stakeholders</p> <p>Stakeholders/ FD/NSP</p> <p>FD/NSP/ Stakeholders</p> <p>Stakeholders/ FD/NSP</p>
2	<ul style="list-style-type: none"> ▣ Delineating the boundaries of Sanctuary and various management zones, and putting up pillars and markers ▣ Maintaining a Sanctuary register for the boundaries and pillars, and conducting annual inspections by supervisory FD field staff ▣ Conducting regular meetings of co-management council/committee and user 	<p>Boundaries delineated in field through pillars and markers, and maps prepared</p> <p>Register updated and inspections done regularly by senior FD staff</p> <p>Regenerating forests</p>	<p>FD/NSP/ Stakeholders</p> <p>FD/Stakeholders</p> <p>Stakeholders/ FD/NSP</p>

	<p>groups for providing effective protection against illicit felling, poaching, encroachment, forest grazing and fires</p> <ul style="list-style-type: none"> <input type="checkbox"/> Controlling poaching, forest land encroachment, illicit removals, forest grazing and fires in and around the Sanctuary through community patrols <input type="checkbox"/> Providing incentives for good protection efforts and disincentives for neglecting protection duties <input type="checkbox"/> Resolving Sanctuary conflicts 	<p>Reduced level of biotic interference in and around the Sanctuary</p> <p>Good FD field staff and stakeholders rewarded</p> <p>Certain number of conflicts including forest offence cases resolved</p>	<p>Stakeholders/ FD/NSP</p> <p>FD/NSP/ Stakeholders</p> <p>Stakeholders/ FD/NSP</p>
3	<ul style="list-style-type: none"> <input type="checkbox"/> Maintaining a register of the Sanctuary boundaries and pillars, and conducting regular inspections by supervisory FD field staff <input type="checkbox"/> Conducting regular meetings of co-management council/committee and user groups and patrolling groups for providing effective protection against illicit felling, encroachment, forest grazing and fires <input type="checkbox"/> Controlling poaching, forest land encroachment and illicit removals from the Sanctuary and checking forest grazing and fires by associating local stakeholders <input type="checkbox"/> Providing incentives for good protection efforts and disincentives for poor protection <input type="checkbox"/> Resolving forest conflicts 	<p>Register updated and inspections done</p> <p>Regenerating forests</p> <p>Reduced level of biotic interference</p> <p>Good FD field staff and stakeholders rewarded</p> <p>Certain no. of conflicts resolved</p>	<p>FD/Stakeholders</p> <p>Stakeholders/ FD/NSP</p> <p>Stakeholders/ FD/NSP</p> <p>FD/NSP</p> <p>Stakeholders/ FD/NSP</p>
4	<ul style="list-style-type: none"> <input type="checkbox"/> Maintaining a register of the Sanctuary boundaries and pillars, and conducting annual inspections by supervisory FD field staff <input type="checkbox"/> Conducting regular meetings of co-management council/committee and user groups for providing effective protection against illicit felling, encroachment, forest grazing and fires <input type="checkbox"/> Controlling poaching, forest land encroachment and illicit removals from the Sanctuary and checking forest grazing and fires by associating local stakeholders <input type="checkbox"/> Providing incentives for good protection efforts and disincentives for poor protection <input type="checkbox"/> Resolving forest conflicts 	<p>Register updated and inspections done</p> <p>Established natural regeneration</p> <p>Reduced level of biotic interference</p> <p>Good FD field staff and stakeholders rewarded</p> <p>Certain no. of conflicts resolved</p>	<p>FD</p> <p>Stakeholders/ FD/NSP</p> <p>Stakeholders/ FD/NSP</p> <p>FD/NSP</p> <p>Stakeholders/ FD/NSP</p>
5	<ul style="list-style-type: none"> <input type="checkbox"/> Maintaining a register of the Sanctuary boundaries and pillars, and conducting annual inspections by supervisory FD field staff <input type="checkbox"/> Conducting regular meetings of co-management council/committee and user groups for providing effective protection against illicit felling, encroachment, forest grazing and fires 	<p>Register updated and inspections done</p> <p>Reduced level of biotic interference</p>	<p>FD</p> <p>Stakeholders/ FD/NSP</p>

	<input type="checkbox"/> Controlling poaching, forest land encroachment and illicit removals from the Sanctuary and checking forest grazing and fires by associating local stakeholders <input type="checkbox"/> Providing incentives for good protection efforts and disincentives for poor protection <input type="checkbox"/> Resolving forest conflicts	<p>Reduced level of biotic interference</p> <p>Good FD field staff and stakeholders rewarded</p> <p>Certain no. of conflicts resolved</p>	<p>Stakeholders/ FD/NSP</p> <p>FD/NSP</p> <p>Stakeholders/ FD/NSP</p>
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4. MANAGEMENT PROGRAMS

4.1 Program Objectives

Main objectives of the Sanctuary management programs are to:

- i) Maintain ecological succession in constituent forests by providing effective protection against biotic interference,
- ii) Develop and maintain natural forests as good habitat that favors biodiversity including food and shelter for elephants,
- iii) Restore elephant movement corridors,
- iv) Conserve the forest resources including the constituent biodiversity, and
- v) Establish co-management practices through local stakeholders' consultations and active participation.

4.2 Management Zoning

Land-use within the Sanctuary and surrounding landscape will be managed based on sound landscape management principles and practices. A 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. Landscape management zoning is useful in implementing relevant management practices in different areas of the Sanctuary based on management objectives to be achieved spatially. The Sanctuary and its surrounding areas are, therefore, divided into two broad zones (core zone and interface landscape zone, each subdivided further into specific sub-zones) based on existing forests, 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 conservation value (plantations and natural vegetation), 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 Sanctuary management.

The long-term management aim of maintaining the maximum possible area under vegetation cover along with its constituent biodiversity in the best possible condition will be achieved by zoning the Sanctuary area and surrounding landscape such that :

- i) The areas of conservation value (forests and/or plantations) are protected, regenerated and managed towards natural forest composition and structure, particularly in the core zone,
- ii) The areas to provide benefits to local people through sustainable use of forests are defined high impact activity areas are delineated, and interface landscape zone mapped.

The core zone will have the highest conservation value followed by interface landscape zone; these two broad zones are further subdivided into specific sub-zones as discussed below.

4.3 Core Zone

The total notified area (7,764 ha) of Chunoti WS is designated as the core zone (Figure 6), where management objective is to protect, rehabilitate/restore and maintain remaining vegetation in good stocking and encourage natural regeneration to gradually bring back natural forests. This will be achieved through effective protection against all forms of biotic interference and maintaining natural course of ecological succession. So main management aim in this zone as core conservation area is long-term protection of existing vegetation including remaining forests/plantations, and rehabilitation of existing degraded areas toward natural forest habitat. The proposed extension (5,162 ha) towards north and south (Figure 6) of the Sanctuary (presently categorized under interface landscape zone as discussed below) will also be managed as core zone after its gazettelement.

Forests management in this zone will focus mainly on conserving the remaining vegetation and bringing back natural forests (in composition and structure), wherever possible. This will be achieved by providing protection (against illicit removals of forest produce, encroachment, grazing and fire) and encouraging natural processes for regeneration and rehabilitation of degraded forests. Wherever required, enrichment planting of indigenous species will be taken to supplement natural regeneration, particularly in those areas, where regenerative rootstock has depleted. Effective protection against biotic pressure (illicit felling, forest land encroachment, forest fire and grazing) will allow natural processes of regeneration in rehabilitating

degraded forest areas. Existing plantations of exotics including teak will gradually be replaced by natural regeneration of local species through canopy opening.

Co-management practices will be implemented (by associating members of user groups, community-based organizations, co-management councils/committees) in strengthening protection efforts against biotic pressure. *In lieu* of reduced removals by the local communities from the core zone, they will be provided alternative means from interface landscape zone and other alternative income generation activities to be implemented for their sustainable livelihoods. The visitor use in the core zone will be allowed with low impact eco-tourist activities in terms of nature hiking and wildlife watching. High impact visitor activities such as motorized transport and group pick-nicks will not be allowed. However, rickshaws can be employed by the eco-tourists and so local rickshaw pollers will be provided training to act as eco-guides as well.

The protection efforts will be facilitated through communication/outreach activities, public awareness, stakeholders' access to interface landscape zones in meeting their subsistence requirements but also enhanced enforcement by FD, particularly for combating organized smuggling. The participants from identified villages will be engaged in alternative income generation activities for sustainable livelihoods in order to wean them away from illegal harvesting from the nearby forests. However, only sustainable use of NTFPs such as grasses, bamboo and canes will be allowed for bonafide consumption of user groups *in lieu* of their increased protection efforts in the core zone. Control of forest fires will be through community efforts but forest fire lines will be established in order to check forest fires. Controlled burning will be used as a management tool and fire lines will be created and maintained in forest fire prone areas.

Subsidiary silvicultural operations will be carried out for encouraging natural regeneration mainly of indigenous species. Selected dead, dying and hollow trees will be retained as they provide shelter/nest to wildlife. The plantations of fruit bearing species suitable for wildlife (including wide crown fruit species and palatable grasses) will be taken up in those forest areas where adequate regenerative rootstock may not exist. In order to improve forest habitat for key wildlife species – elephant, some selective management interventions will be taken up while preserving and increasing the diversity and interspersion of habitat. For example, food and shelter will be needed for the elephants who use parts of Chunoti as movement corridor. Good growth of palatable grasses, bamboo and other fodder species are required as food for elephant. Habitat improvement works including rehabilitation of degraded forest areas, enrichment planting of fruit bearing shrubs and trees and palatable grasses, thinning of exotic plantations for canopy opening, maintenance of glades and waterholes, retention of snags, eradication of weeds from glades and wetlands, soil and water conservation, watershed development, etc. will be taken up. Enrichment plantations of indigenous species will be taken up in those areas where natural regeneration is not coming up due to lack of rootstock. Fodder species suitable for elephant (and therefore to be included in plantation program) are bamboo, jam, chapalish, kathal, am, segun, narikel, kola, chon, dumur, fuljharu, pahari alu, met alu, jambura, dheua and chupri alu). 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 given by involving all local stakeholders. The privately owned land within the Sanctuary will be acquired by Government after making suitable compensations to the owners.

4.3.1 Habitat Improvement Works

Different habitat improvement activities to be carried out in the core zone are further described as below.

4.3.1.1 Enrichment Plantations

Enrichment plantations will be taken up in identified areas of the core zone; planting (spacing 2.5m x 2.5m) of indigenous shrub and tree species including wide crown species may be taken up in alternate rows whereas fruit tree species suitable for wildlife (say 10% of total stock) may be planted sporadically. Nurseries will be raised well in advance and maintenance operations including weeding and cleaning will be taken for three years after raising enrichment plantations. Maintenance operations including weeding and casualty replacement will be taken up subsequently. Beating up operations will be taken only during the first year. The plantations will be protected against fire and grazing at least for three years. Suitable species for plantations include siris, sisoo, simul, chikrasi, jarul, chalta, amla, bahera, ficus species, jackfruit and bamboo. The species attractive to butterflies, bees and other pollinator insects will be included in the planting species mix. Planting of wide crown trees such as *chapalish* and *artocarpus* will particularly be suitable for arboreal fauna. A plantation journal will be maintained for each plantation.

4.3.1.2 Development of Grasslands

Existing grasslands will be maintained and further developed by taking up palatable grass plantations along with other shrub and tree species. 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*.

4.3.1.3 Maintenance of Waterbodies

A number of natural water bodies (ponds, lakes, cheras, etc.) are present in the Sanctuary (see Figure 3) and they will be maintained and developed both for the use of wildlife and also local people. An inventory of existing water bodies and a list of wildlife using different water bodies will be developed during the first year Plan implementation. Desiltation, cleaning and repairing may be necessary (from 2nd year onwards) in those water bodies where soil erosion has taken place. Biomass removed during cleaning may be handed over to local people. Stakeholders' participation may be ensured in maintenance of water bodies by developing fisheries on usufruct sharing basis. Plantation of shrubs and vegetables may be taken up around waterbodies 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.

4.3.1.4 Maintenance of Special Habitats

Areas rich in NTFPs such as medicinal plants and threatened species identified during the first year and will be given special attention. Breeding sites of any animal and any other site (e.g. burrow) harbored 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 wildlife including birds. Snags (hollow, dry, partially/fully dead standing trees, at least 1.5m in height and with a minimum of 20 cm 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

Degraded habitats in the core zone and surrounding landscape will be restored naturally by carrying out low capital but labour intensive land-based restoration activities in identified micro-watersheds.

4.3.2.1. Watershed Management

Micro-watersheds will be identified for carrying out habitat management practices within the natural boundaries of a drainage area. An identified micro-watershed will provide a context for a gainful participation of local people by taking on board the diversity of vegetation. Appropriate land husbandry practices in such watersheds will focus on *in-situ* moisture conservation, based on the percolation of 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 tanks, soil barriers and traps, diversion ditches, etc.), which can be implemented by local stakeholders by contributing their voluntary labor, will be implemented in the identified miro-watersheds.

4.3.3 Elephant Movement Corridor Sub-zone (overlapping)

Main management objectives in this sub-zone are to:

- i) Ensure a continuous elephant movement corridor by checking any further fragmentation of habitat,
- ii) Provide community protection to both habitats and wildlife including elephants, and
- iii) Provide diversified food and adequate shelter to elephants by restoring forests and the habitat.

4.3.3.1 Wild Elephants Movement Range

Elephants move between Bangladesh and the neighbouring forests 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 Mymensingh 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:

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 – Rajsthal – Chunoti - Nikheongchari	*Abandoned 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	*Abandoned due to human settlement
3	Cox's Bazar (North) Forest Division	Fashiakhali-Dulahazara-Kotakhali-Ildgao-Baisari-Gilatoli-Ramu-Rajarkul	-	-
4	Cox's Bazar (South) Forest Division	Teknaf-Shilkhali-Baharchara-Rangikhali-Horikhola-Monkhali-Inani-Panerchera	*Teknaf-Cox's Bazar-Nikheongchari	*Abandoned due to Rohingya camps and Okhia TV Station
5	CHT (North) Forest Division	Route 1: Suvolong/Chaillatoli-Boyragibazar-Mohazonpara-Rangipara-East Jalabad-Gulshakhali-Gaospur-Rajnarag-Choto Mahilla-Boro Mahilla-Schorakhali-Pablakhali Route 2: Tin-Tila-Suknachari-Jubolaxmichari	*Sishok-Marisha-Baghaihat-Machalong-Sajek-Naraichari-Dighinala-Hatimara-Kerrailatoli	*Abandoned due to settlements
6	CHT (South) Forest Division	Route 1: Kaptai Mouch Beat-Arachari-Dangamura-Rajsthal-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-Rajsthal-Sitapahar	-	-
9	Sylhet Forest Division	Route 1: Jamkandi-Shamonbagh tea garden-Lathital-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 on an elephant movement corridor within Chunoti described below.

4.3.3.2 Elephant Movement Corridor in Chunoti

The movement of elephants was accounted for while tracing the boundaries of proposed elephant corridor (Figure 7). The first boundary starts on Roads & Highway's pillar marking, the beginning of Cox's Bazar Highway under the Cox's Bazar District. A walking trail, visible upon entering the Sanctuary from the starting point, goes through the Chunoti Beat (GPS point serial 1-5 in Table 4.3.3.1) and later forms boundary of Chunoti and Harbang Beat (GPS point serial after 5, 6 & 7). This walking trail forms one boundary of the

target sub-zone. At GPS point 7, the boundary/trail follows the West direction instead of North, cutting through the top portion of Puichori Beat (GPS point serial 7-12). From GPS point 11 to 16 and onwards the stream “bak-khai er khal” forms the boundary of Napura and Puichori Beat as well as the proposed southern boundary of target sub-zone. The last sign of elephant movement was found up to GPS location 8, from where and upto GPS point 10, human disturbance increased in the form of forest fires, forest clearances and cultivation of betel leaves and vegetables in valleys.

The second boundary of the elephant movement corridor starts at the last end of the rural road that starts from a small market, beside Chunoti office (GPS point 1 in Table 4.3.3.2). This boundary in Chunoti Beat goes along a stream called “Pagleer Chara” upto GPS point 6; local name of the area is Gamari Tolla. The boundary then passes through Baring Tolla (GPS point 7) to the border of Chunoti and Napur Beat (GPS point 8). The boundary enters in to the Napura Beat and goes towards the stream called “Lal Jhiri” (GPS point 10). The boundary from this point onwards follows a stream that forms the border of Napura and Chample Beats. The boundary ends at a location named “Jungle Chample” (GPS point 18).

The details of elephant movements are presented in Tables 4.3.3.1 a and 4.3.3.2 b as below:

Table 4.3.3.1 a Details of the Elephant Markings 1

Sl. No.	Northing	Easting	Comments
1	21 55 21.8	92 03 41.4	Starting point of one boundary of elephant corridor: The point starts after passing the Range Office towards Cox’s Bazar, from where the sign board of Roads and Highway of Cox’s Bazar District is located.
2	21 55 19.6	92 03 27.1	Right hand side of this location is encroached for cultivation; adjacent hills are burned.
3	21 55 16.6	92 03 17.3	Location of Watch Tower-1 . At the left hand side of the walking trail, agricultural activity and betel leaf cultivation is visible. Old elephant dung found.
4	21 55 14.5	92 02 69.0	Very recent elephant dung is on the walking trail.
5	21 55 13.7	92 02 63.0	Location of Watch Tower-2 . Hills burned to collect dried bamboo.
6	21 55 18.2	92 02 44.1	On the right hand side of the trail or boundary stream – Khoi-er-jhiri and on the left hand side – sap-er-jhiri located. Jhiri – stream; sap-snake.
7	21 55 20.7	92 02 34.5	On the right hand side of the boundary – Hindur-Jhiri located.
8	21 55 20.9	92 02 20.2	The boundary / walking trail merges with stream, local name – bak-khai er khal. Sign of elephant sliding down at the hill on the left hand side.
9	21 55 21.1	92 01 59.8	No sign up to this point of elephant movement.
10	21 55 22.1	92 01 56.8	Conjunction of two stream, bak-khai er khal and Ulta-Mochor Khal. Ulta-Mochor Khal runs down from Chunati beat and forms the boundary of Chunati and Pui Chari Beat.
11	21 55 19.6	92 01 40.1	No sign up to this point of elephant movement. Human disturbance is more here.
12	21 55 21.5	92 01 32.6	No sign up to this point of elephant movement. More agricultural lands.
13	21 55 19.6	92 01 25.5	No sign up to this point of elephant movement. More agricultural lands.
14	21 55 04.3	92 00 59.8	No sign up to this point of elephant movement.
15	21 54 57.8	92 00 51.3	No sign up to this point of elephant movement. More agricultural lands.
16	21 54 46.1	92 00 41.3	No sign up to this point of elephant movement. More agricultural lands.

Coordinates data is in Degree Minute Second format

Table 4.3.3.2 b Details of the Elephant Markings 2

Sl. No.	Northing	Easting	Comments
1	21 57 37.5	92 02 52.7	Starting point of Corridor Boundary. Down the road from Chunati Beat Office, boundary starts near at Khachar Pukur and Sufee Nagar.
2	21 57 32.1	92 02 19.4	On the right hand side is Pagleer-Chara (stream). Left two dead trees where lots of birds have made nests.
3	21 57 17.6	92 02 00.6	No sign of elephant movement.
4	21 57 15.8	92 01 57.5	First sign: elephant dung as well as sign of elephant sliding along the slope.
5	21 57 11.9	92 01 55.7	At this point along the boundary, lots of hill banana trees are present on the hill side slope. Elephant dung present.
6	21 57 11.9	92 01 48.0	Huge amount of elephant dung present. Local name of the area is - Gamari Tolla.
7	21 57 15.2	92 01 39.4	No sign of elephant movement. Local name of the area is – Baring Tolla / Tolle
8	21 57 14.8	92 01 33.3	Boundary of Chunati and Napura Beat. Local name of this location is – Doe Chala. (Doe = Two; chala - area)
9	21 57 01.5	92 01 13.6	No sign of elephant movement.
10	21 57 01.1	92 01 09.9	Lal-jhiri (Red-Stream).
11	21 56 54.1	92 01 03.5	Elephant dung present. On the stream, probably used as water source.
12	21 56 56.6	92 00 53.0	Intersection of two streams – Lal-Jhiri and Boro Tollar Chara. Boundary turns right on way to Chambal, other direction goes to Napura.
13	21 56 52.7	92 00 36.9	Elephant dung found.
14	21 56 43.0	92 00 19.2	No sign of elephant movement. Stream, local name – Ghui-er Jhiri.
15	21 56 32.3	92 00 03.8	No sign of elephant movement.
16	21 56 23.9	91 59 54.3	On the right hand side of this point, a big cotton tree where lots of bird's nests are present. Human disturbances are increasing gradually.
17	21 56 23.2	91 59 50.8	On the face of the hill, lots of bird's nests.
18	21 57 03.8	91 59 01.5	Location name Jungle Chamble, Dhulia –er- Jhiri.

Coordinates data is in Degree Minute Second format

4.3.3.2 Elephant Habitat Suitability Assessment

Chunoti Wildlife Sanctuary is a MIKE site of the country, supporting about 20 elephants that are considered to be flagship and conspicuous species (Feeroz, 2005). As an umbrella species they are important ecological part of forest ecosystem and are indeed an indicator of good biodiversity health. They inhabit a diverse habitat including tropical 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 species in view of broad habitat requirements for elephants. Elephants as large herbivore 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.

Chunoti forests 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 Sanctuary. The available fodder species for elephants in Chunoti include bamboo, jackfruit, blackberry, mango, coconut, banana, fig and potato. 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 grasses that provide good food to elephants. Such dense forests, however, do not presently exist in Chunoti.

Controlled fires may be helpful in the development of fresh grasses. However, intense fires may be avoided as they might ultimately degrade the 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 Sanctuary is posing a great challenge for elephants and their habitat. As a result, the number of cases reporting crop damages by elephants in the nearby villages have increased off late. Main factors for habitat fragmentation in Chunoti include forest land encroachment for cultivation and settlement, forest degradation, road construction and building of dams, etc.

4.3.3.3 Challenges and Opportunities for the establishment of Elephant Movement Corridor

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 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 (including paddy and betel leaf) 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. In West Bengal FD and local people have erected electric fences to check elephant losses. This technique, though suitable in Chunoti, is expensive as barrier to elephant movement.

Due to widespread poverty local people depend upon the Sanctuary for the collection of fuelwood, sungrass and bamboo, which they use for self-consumption but also for cash. Even coppice shoots, bamboo and naturally regenerating saplings including fodder species are felled for fuelwood and also for providing shade/support to betel leaf cultivation. Sun grass is over-harvested by local people as thaching material. Poor infrastructure and lack of FD field staff and funds have led to weak forest protection and inadequate control of 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 Chunoti

As a result of good rainfall, incident radiation and soil, the natural regeneration comes up rather well in Chunoti but do not get established due mainly to heavy biotic pressure. Therefore, protection against biotic factors will be taken up before low-input oriented land husbandry practices can be implemented for facilitating eco-restoration process, necessary for the rehabilitation of degraded forests and local people. Degraded forests with recoverable rootstock will be restored through community protection by establishing suitable mechanisms under the proposed co-management approach. Degraded forests with inadequate rootstock shall be taken for assisted natural regeneration for recovering remaining rootstock, and enrichment planting of elephant fodder species including bamboo and palatable grasses.

Natural regeneration and succession in this sub-zone will be encouraged by carrying out eco-restoration activities in identified micro-watersheds. Bamboo brakes, reeds and sun grass will be retained in hill slopes as elephant fodder. 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 the existing rootstock to be recovered by enlisting active participation of local stakeholders in the protection of forests and implementation of low-input forests management and land husbandry practices. The woody vegetation cover will over the period extend and gradually thin out the primary succession vegetation such as weeds and grasses. Given protection against illicit felling and burning, the plant succession will progress over a period towards semi-evergreen forests. The enrichment plantations of indigeneous shrub and tree species (e.g. chapalish, chikrassi, toon, karoi, garjan, dhakijam, pynkado, gamar, albizzia, kadam, etc.) can be taken up in the identified degraded and barren areas that do not have rootstock. Buffer plantations can be raised on the periphery of the Sanctuary by involving local people on usufructs sharing basis. The existing elephant corridor between Chunoti and Satghar will be protected from any further fragmentation. For the development of Chunoti corridors a separate scheme entitled as Project Elephant may be taken by FD. Encroched areas as identified in Figure 3 will gradually be brought under forest regeneration in order to maintain connectivity between forest patches that are part of elephant movement corridors.

4.3.4 Sustainable Use Sub-zone

The existing habitations and cultivations including encroachment areas inside the Sanctuary 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 Sanctuary, 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 over a period of time. 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 and biodiversity conservation.

4.3.5 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. Administrative buildings (Sanctuary Hqs/Range Office), staff quarters, visitor facilities (Rest House and an Environmental Education Centre) and other infrastructure facilities are included in this sub-zone. 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 (see Volume 2 for the guidelines on IEE and EIA). 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.

4.4 Interface Landscape Zone

The identification of interface landscape zone will focus on the surrounding landscape helpful in protecting and conserving the core zone and creating congenial habitat for wildlife including protecting and maintaining wildlife corridors. As opportunities for receiving tangible benefits from the conservation-oriented management of the core zone are less, off-core zone livelihood opportunities will help motivate the local stakeholders of the surrounding landscape for biodiversity conservation. Subsistence consumption needs of local people for fuelwood, NTFPs and timber can be met by entering into co-management agreements on sharing of usufructs. Though interface landscape zone will have comparatively less conservation value, it will play an important role in supporting the biodiversity conservation in the core zone. Keeping in view of the surrounding villages exercising influence on the Sanctuary and the adjoining forests under the management of FD, a 5-km wide landscape zone surrounding the core zone has been found suitable. Interface landscape zone is further categorized as below into four specific sub-zones (proposed core area sub-zone as extension of existing core zone, buffer reserve sub-zone, assisted production sub-zone and elephant movement corridor sub-zone) depending upon the uses to which different areas are designated and managed.

4.4.1 Proposed Core Area Sub-zone

The proposed core sub-zone (around 5,000 ha), comprising northward and southward forest extensions (Figure 6), is currently categorized under landscape zone. But after re-gazetment these northward and southward extensions will be part of core zone. These extensions are proposed in order to improve the viability of plant and animal populations by bringing more habitat under core zone for active conservation management. It will also provide effective protection as buffer between the present core zone and nearby habitations/cultivation. The management of this sub-zone will be as recommended in the core zone (as discussed above).

4.4.2 Buffer Reserve Sub-zone

The present subsistence harvest of wood and NTFPs (grasses, fodder, bamboo, canes, etc.) by non-residents is expected to continue, particularly in peripheral areas. However, consumptive use by non-residents will gradually be shifted, to the extent possible, to buffer reserve sub-zone comprising FD lands outside of but adjacent to the Sanctuary boundary. Two such buffer reserve sub-zones, one on the north and one on the east (Figure 6) of the Sanctuary have been identified, where management interventions are required to lessen biotic pressure on the core zone. These forest areas may be used by elephants and so will act as elephant movement corridors. The plantations of palatable grasses and indigenous herbs, shrubs and tree species may be taken in these reserves. These plantations will be brought under co-management agreements in order to alleviate harvest pressures from adjacent settled areas as evident currently by heavy, commercial harvest of fuelwood and bamboo. Co-management activities in this Sub-zone will focus on providing a reliable and legitimate source of wood and non-wood products for local poor.

4.4.3 Elephant Movement Corridor Sub-zone (overlapping)

In addition to movement corridors as identified in the forests of core zone, elephants use some areas (RF/USF/private lands) of Bandarban and Lama forest divisions (Figure 6) for their migration. It is important to maintain and indeed develop these movement corridors in order to provide good connectivity (including

food and shelter) between the Sanctuary 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.

4.4.4 Assisted Biomass Production Sub-zone

Suitable private lands bordering the Sanctuary on the west and east have been included in this sub-zone for developing wood-based energy resources. Main objectives of managing this sub-zone include reduction of use pressures on the Sanctuary, plant vacant lands with suitable fast growing tree species and develop agroforestry systems on the lands being used for cultivation. Agroforestry (alley model or trees on farm boundary) may be suitable in those lands where farmers are raising agricultural crops and may need wood either for self-consumption or for cash sale. However, detailed consultations will be held with local people before finalizing any land-based management intervention for which technical support may be provided by local FD staff.

4.5 Zonal Boundaries and Management Objectives

Main management objectives under each zone are summarized in Table 4.1 as below:

Table 4.1 Management Zoning for Chunoti Wildlife Sanctuary

Management Zone	Main Management Objective	Indicative Area
CORE ZONE	long-term rehabilitation and protection of existing degraded/open forests including bamboo and grasses, and other degraded habitats	all of currently gazetted Sanctuary area (7,764 ha)
Elephant Movement Corridor Sub-zone (overlapping)	maintaining connectivity of habitats and management of land-use to support elephant seasonal movement corridors	Nearly 2,000 ha (overlapping to the core zone area)
Sustainable Use Sub-zone (overlapping)	sustainable use of plantations near the boundary of the existing Sanctuary by involving local stakeholders	nearly 200 ha
Intensive Use Sub-zone (overlapping)	site management around administrative buildings and built visitor facilities	total area less than 10 ha
INTERFACE LANDSCAPE ZONE		
Proposed Core Area Sub-zone	restoration of habitat and inclusion in the core zone after re-gazettement	around 5,000 ha
Buffer Reserve Sub-zone	sustainable use of forests compatible with elephant habitat conservation	around 4,000 ha
Elephant Movement Corridor Sub-zone (overlapping)	maintaining connectivity of habitats and management of existing land-uses in support of elephant seasonal movement corridors	RF/USF/Private lands (around 3,000 ha)
Assisted Production Sub-zone	intensification of wood production and management of land-use to discourage utilization by elephants	around 2,000 ha of private lands to the west and east of Sanctuary

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, wherever applicable. The Sanctuary staff will explain the system to local stakeholders for their wide acceptance and publicity. The boundaries of agricultural/settlement encroachment will be surveyed and marked using posts.

4.6 Summary of Main Prescriptions

Main prescriptions outlined under the above-developed management programs in Core and Landscape Zones are summarized in Tables 4.2 and 4.3 with respect to timing of each proposed activity and responsibility assigned.

4.4.1 Summary of Main Prescriptions in Core Zones

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

Table 4.2 Summary of Main Prescriptions in Core Zone

Year	Zones	Main Activities	Main Outputs/ Success Criteria	Responsibility
1	Core Zone	<input type="checkbox"/> Protecting biodiversity against biotic interference (illicit removals, poaching, land encroachment, forest grazing, fires, etc.)	Reduced level of biotic interference including illicit felling	Stakeholders/ FD/NSP
		<input type="checkbox"/> Carrying out subsidiary silvicultural operations required for encouraging natural regeneration (including watershed management and enrichment planting in identified gaps without rootstock) and improving habitat for wildlife	Natural regeneration established	FD/Stakeholders/ NSP
		<input type="checkbox"/> Implementing habitat restoration works (identification of micro-watersheds, grassland development, waterbody maintenance, watershed management, eco-restoration activities including soil/water conservation and other low input land husbandry practices)	Rehabilitated/ improved habitat	FD/NSP/ Stakeholders
		<input type="checkbox"/> Identification of special habitats	Identified habitats	FD/NSP
		<input type="checkbox"/> Inventory of existing water bodies being used by elephants	No. of water bodies	FD/NSP
	Elephant Movement Corridor Sub-zone	<input type="checkbox"/> Taking adequate measures for providing food and shelter for migrating elephant	Less fragmented forests	FD/NSP/ Stakeholders
		<input type="checkbox"/> Planting palatable grasses in open areas of the Sanctuary	Grass plantations	FD
	Sustainable Use Sub-zone	<input type="checkbox"/> Delineating the forest land under habitations/cultivation	Forest land use areas delineated on ground and maps	FD/NSP Villagers
		<input type="checkbox"/> Involving local villagers in forest protection, and in income generation activities by using LDF	Forests regenerated & villagers' income enhanced	FD/ Villagers/NSP
	Intensive Use Sub-zone	<input type="checkbox"/> Signing participatory conservation benefit sharing agreements with user groups	Signed PCBSAs	User Groups/ NSP
		<input type="checkbox"/> Existing FD buildings maintained/constructed by following environmental friendly guidelines	FD buildings maintained	FD/Forest Villagers/NSP
2, 3, 4 and 5	Core Zone	<input type="checkbox"/> Continue protecting biodiversity against biotic interference	Reduced biotic pressure on the Sanctuary forests and forest land	Stakeholders/ FD/NSP
		<input type="checkbox"/> Continuing with subsidiary silvicultural operations and habitat improvement works required for encouraging natural regeneration and wildlife	Established natural regeneration	FD/Stakeholders/ NSP
		<input type="checkbox"/> Implementing habitat restoration works (identification of micro-watersheds, grassland development, waterbody maintenance, watershed management, eco-restoration activities including soil/water conservation and other low input land husbandry practices)	Rehabilitated/ improved habitat	FD/NSP/ Stakeholders
		<input type="checkbox"/> Maintenance of existing water bodies	Maintained Water bodies	FD/NSP
	Elephant Movement Corridor Sub-zone	<input type="checkbox"/> Continuing with the measures started for providing food and shelter for migrating elephant	Less fragmented forests	FD/NSP/ Stakeholders
		<input type="checkbox"/> Planting and managing palatable grasses in	Grass plantations	FD

	Sustainable Use Sub-zone	<p>open areas of the Sanctuary</p> <ul style="list-style-type: none"> <input type="checkbox"/> the forest land under habitations/cultivation developed through appropriate land-use interventions <input type="checkbox"/> Involving local villagers in forest protection, and in income generation activities by using LDF 	<p>maintained</p> <p>Forest land use areas delineated on ground/maps</p> <p>Forests regenerated & villagers' income enhanced</p>	<p>FD/NSP Villagers</p> <p>FD/ Villagers/NSP</p>
	Intensive Use Sub-zone	<ul style="list-style-type: none"> <input type="checkbox"/> Signing participatory conservation benefit sharing agreements with user groups <input type="checkbox"/> Existing FD buildings maintained by following environmental friendly guidelines 	<p>Signed PCBSAs</p> <p>FD buildings maintained</p>	<p>User Groups/NSP</p> <p>FD/Forest Villagers/NSP</p>

4.4.2 Summary of Main Prescriptions in Landscape Zone

Main prescriptions outlined under the above-developed management programs in Landscape Zones are summarized in Table 4.3 with respect to timing of each proposed activity and responsibility assigned.

Table 4.3 Summary of Main Prescriptions in Landscape Zone

Year	Zones	Main Activities	Main Outputs/ Success Criteria	Responsibility
1	Proposed Core Area Sub-zone Buffer Reserve Sub-zone Elephant Movement Corridor Sub-zone (overlapping) Assisted Biomass Production Sub-zone	<input type="checkbox"/> Identify, survey and demarcate the proposed area to be included in the core zone <input type="checkbox"/> Submit a proposal to MOEF by FD for gazetting and ensure gazette notification <input type="checkbox"/> Implement all the development activities as recommended for Core Zone as above <input type="checkbox"/> Restore/improve degraded buffer reserves by associating local stakeholders <input type="checkbox"/> Planting of degraded forest areas with suitable tree, shrub and grass species by entering into PCBSAs with local people <input type="checkbox"/> Taking adequate measures are taken for providing food and shelter for migrating elephant <input type="checkbox"/> Planting palatable grasses in open areas of the Sanctuary <input type="checkbox"/> Maintain corridor connectivity by avoiding further fragmentation <input type="checkbox"/> Encourage local people to create tree resources on their private lands through FD technical support	Proposed core area demarcated & mapped Gazette notification As in core zone Regenerating forests Plantations protected by local stakeholders Less damage to cultivated fields and humans Grass plantations maintained Less fragmented forests Less pressure on core zone for fuelwood, etc.	FD FD/MOEF FD/Stakeholders /NSP FD/Stakeholders FD/Stakeholders FD FD/NSP/ Stakeholders FD/NSP/ Stakeholders
2, 3,4 and 5	Proposed Core Area Sub-zone Buffer Reserve Sub-zone Elephant Movement Corridor Sub-zone (overlapping) Assisted Biomass Production Sub-zone	<input type="checkbox"/> Newly notified area to be included in the core zone by putting markers and pillars <input type="checkbox"/> Publicize gazette notification <input type="checkbox"/> Continue implementing the development activities as recommended for Core Zone as above <input type="checkbox"/> Continue restoring/improving degraded buffer reserves by associating local stakeholders <input type="checkbox"/> Continue planting degraded areas with suitable tree, shrub and grass species by entering into PCBSAs with local people <input type="checkbox"/> Providing food and shelter for migrating elephant <input type="checkbox"/> Continue planting palatable grasses in open areas of the Sanctuary <input type="checkbox"/> Continue maintaining corridor connectivity by avoiding further fragmentation <input type="checkbox"/> Local people continue to create tree resources on their private lands through FD technical support	Entire core area marked Gazette notification widely publicised As in core zone Restored forests Plantations protected by local stakeholders Less damage to cultivated fields and humans Grass plantations maintained Less fragmented forests Less pressure on core zone for fuelwood, etc.	FD FD/MOEF FD/Stakeholders /NSP FD/Stakeholders FD/Stakeholders FD FD/NSP/ Stakeholders FD/NSP/ Stakeholders

5. LIVELIHOOD PROGRAMS FOR LANDSCAPE DEVELOPMENT

5.1 Objectives

As per the Wildlife (Preservation) (Amendment) Act, 1974 no commercial harvesting is allowed inside the Sanctuary. So in the absence of any timber harvests minimum benefits (mainly from NTFPs, which may not be sufficient to motivate local people) flow to communities from the core areas. Therefore, relevant mechanisms of benefits flows to local communities need to be explored through off-Sanctuary activities including alternative income generation activities and self-employment initiatives. Main objective of livelihood programs for landscape development is to develop appropriate linkages with livelihood initiatives and other projects/schemes that will reduce biotic pressure on forests by providing alternative livelihood opportunities to poor stakeholders living in and around the Sanctuary.

5.2 Production Technologies

Up-scaling of skills for alternative income will be taken up for generating value additions through capacity building of local people. Landscape Development Fund (LDF) will be used to provide finance for the members of user groups and co-management councils/committees, and their federations will be encouraged to set up micro-enterprises to generate value additions locally. The benefits from eco-tourism including a portion of entry fee may also be ploughed back for the development of local communities and the Sanctuary. The program will be focused mainly in the identified interface landscape zone but also in the core zone where local communities are living. Networking with relevant NGOs acting in the area will be established for rendering rural development services to user groups and co-management councils/committees.

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 by CODEC to be implemented mainly in the interface landscape zone of the Sanctuary but also inside the core zone, whenever required:

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, processing and marketing

Integrated Homestead Farming

Many villagers in interface landscape zone 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 provide livelihood security and enhance their income by creating livelihood assets and self-employment opportunities. Diversification of production possibilities will help avert production risks and reduce vulnerability of livelihood during natural calamities. Possible components of such an integrated production technology package may include vegetables (on open fields, machans, 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 more 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 surrounding 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 be grown all year round and so fetch more prices during off-season.

Village Nursery

Many private nurseries have grown up in the towns near Chunoti 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 preferences 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

Poultry and cattle rearing with focus on milch cow rearing are suitable for poor people residing within and outside the Sanctuary. The following livestock rearing technologies are found suitable for their implementation in and around the Sanctuary:

- 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 many 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 mainly 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 and Enterprise Development

5.3.1 Non-Timber Forest Products

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. An important objective of NSP is to create stakes among local stakeholders for biodiversity conservation by ensuring adequate benefits to them from the Sanctuary, and also off-Sanctuary based income generation activities. In the forests being managed for biodiversity conservation in the Sanctuary, this objective can be achieved by facilitating intimate linkages with the livelihoods of local stakeholders and NTFPs development. The backward and forward linkages of NTFPs based production technologies is substantial in the Sanctuary. An exhaustive survey of NTFPs (extent, distribution, threatened species, regeneration and enrichment, collection and use-patterns, illicit removals, present and sustainable level of extraction, local needs and community dependence, processing and value addition opportunities, ethno-botany, indigenous knowledge base, local stakeholders, markets and marketing channels, forward and backward linkages, export and trade) available within the Sanctuary.

The timing of various agricultural operations and NTFPs management and collection activities are generally complementary. This means that appropriate management practices can be locally adopted in order to provide year-round employment and income to local unemployed villagers, thereby reducing the severity of rural poverty, particularly during the agriculture lean season. For example, the agriculture lean season could best be made use by the members of co-management council/committee and user groups for the collection, harvesting, processing and marketing of NTFPs. In addition to the benefits from NTFPs, forest management interventions such as pruning and cleaning would enhance the flow of intermittent benefits. The NTFPs based forest management practices (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. This may hamper an intensive management and collection, particularly in the absence of a designated organization responsible for the collection and marketing of NTFPs.

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 other 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). The 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 sell NTFPs through auctions and leases; instead, the responsibility for primary collection, storage, processing and marketing can be given to user groups and/or co-management council/committee. 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.

5.3.2 Forest-based Enterprise Development

A study of pre-assessment of enterprise development around the 5 pilot PAs completed under an USAID supported project (JOBS) suggested the development of both the primary and secondary sectors. Primary sectors for potential development around the Sanctuary include handicrafts (cane and bamboo), 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, horticulture including orchid

cultivation and floriculture, eco-tourism and nature-based healing homes development. Priority sectors such as bamboo and canes, homegardens, nursery and natural dye processing may initially be taken up for enterprise development. Similarly eco-tourism can be a priority under secondary forests.

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 are essentially local, exhibit seasonal behavioral patterns because NTFPs production is seasonal in character. The quality of NTFPs as raw material is influenced by post harvesting handling, processing and storage conditions.

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 in order to conserve cross-sections of diverse eco-systems having potential for medicinal plants and animal species, and their genetic diversity.

5.4 Biodiversity User Groups

Sustainable use of biodiversity of Chunoti will be determined by its socio-economic and cultural setting. Biodiversity user groups of local participants (comprising 15-25 members/households) shall be organized and mobilized by identifying poor households from neighbouring para or village (located in or around the Sanctuary) and trained by participating NGOs and/or local FD staff. The formation of user groups will be process-oriented, giving due emphasis to target communities including ultra poor, poor, landless, ethnic minorities, widow, destitute, etc. In lieu of project benefits, the user groups will assist FD in the protection of the forests and wildlife in core zone through community patrolling and intelligence information sharing. They will not themselves get involved in illicit removals but will also obstruct others in doing so.

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	<input type="checkbox"/> Conducting reconnaissance surveys and demand-supply assessment <input type="checkbox"/> Identifying a list of feasible production technologies <input type="checkbox"/> Holding discussions with local stakeholders on feasible production technologies <input type="checkbox"/> Finalizing a short list of candidate production technologies <input type="checkbox"/> Identifying and selecting trainers <input type="checkbox"/> Preparing training material on the finalized production technologies <input type="checkbox"/> Designing demonstration centres for proven technologies and arranging funds for demonstration training <input type="checkbox"/> Finalizing preparations for imparting training to local stakeholders <input type="checkbox"/> Finalizing operational guidelines for LDF	Demand-supply situation assessed Feasible production technologies identified Stakeholders' consultations held Short list of production technologies finalized Trainers identified Training materials prepared Design of demonstration centres completed Preparations for training completed LDF operational guidelines finalized	NSP NSP/ Stakeholders NSP/FD/ Stakeholders NSP/FD/ Stakeholders NSP NSP NSP NSP/FD/ Stakeholders NSP/FD/ Stakeholders
2	<input type="checkbox"/> List of feasible production technologies refined based on the first	List of production technologies refined	NSP/ Stakeholders

	<p>year experiences</p> <ul style="list-style-type: none"> <input type="checkbox"/> Continue holding discussions with local stakeholders on feasible production technologies <input type="checkbox"/> Short list of candidate production technologies refined based on the first year experiences <input type="checkbox"/> Finalizing training material on the finalized production technologies <input type="checkbox"/> Establishing demonstration centres for proven technologies and arranging for stakeholders visits <input type="checkbox"/> Imparting training to local stakeholders <input type="checkbox"/> Training in simple storing and processing technologies <input type="checkbox"/> Encouraging low-input small scale and cottage industries <input type="checkbox"/> Conducting enterprise development assessment 	<p>Stakeholders' consultations continued</p> <p>Short list of production technologies refined</p> <p>Training materials finalized</p> <p>Demonstration centres established</p> <p>Training to groups imparted</p> <p>Stakeholders trained</p> <p>Stakeholders encouraged</p> <p>Enterprise development studied</p>	<p>NSP/FD/ Stakeholders</p> <p>NSP/FD/ Stakeholders</p> <p>NSP</p> <p>NSP</p> <p>NSP/FD/ Stakeholders</p> <p>NSP/ Stakeholders</p> <p>NSP/ Stakeholders</p> <p>NSP</p>
3	<ul style="list-style-type: none"> <input type="checkbox"/> Continue holding discussions with local stakeholders on selected production technologies <input type="checkbox"/> Training material on the finalized production technologies reviewed based on the project experiences <input type="checkbox"/> Demonstration centres for proven technologies improved based on the project experiences <input type="checkbox"/> Continue imparting training to local stakeholders <input type="checkbox"/> Helping in developing market linkages <input type="checkbox"/> Training on small enterprise development 	<p>Stakeholders' consultations continued</p> <p>Training materials reviewed</p> <p>Demonstration centres improved</p> <p>Training to groups continued</p> <p>Market linkages established</p> <p>Stakeholders trained</p>	<p>NSP/FD/ Stakeholders</p> <p>NSP</p> <p>NSP</p> <p>NSP/FD/ Stakeholders</p> <p>NSP/Federations</p> <p>NSP/Federations</p>
4	<ul style="list-style-type: none"> <input type="checkbox"/> Continue holding discussions with local stakeholders on selected production technologies <input type="checkbox"/> Continue arranging visits to demonstration centres <input type="checkbox"/> Continue arranging training <input type="checkbox"/> Continue imparting training to local stakeholders <input type="checkbox"/> Helping in enterprise development 	<p>Stakeholders' consultations continued</p> <p>Demonstration centres visited</p> <p>Trained members of user groups</p> <p>Training to groups continued</p> <p>Small enterprises established</p>	<p>NSP/FD/ Stakeholders</p> <p>NSP</p> <p>NSP</p> <p>NSP/FD/ Stakeholders</p> <p>NSP/Federations</p>
5	<ul style="list-style-type: none"> <input type="checkbox"/> Continue holding discussions with local stakeholders on selected production technologies <input type="checkbox"/> Continue arranging visits to demonstration centres <input type="checkbox"/> Continue arranging training in farmers training schools <input type="checkbox"/> Continuing with enterprise development and market assistance 	<p>Stakeholders' consultations continued</p> <p>Demonstration centres visited</p> <p>Training in Farmers training schools continued</p> <p>Enterprise development continued</p>	<p>NSP/FD/ Stakeholders</p> <p>NSP</p> <p>NSP</p> <p>NSP/Federations</p>

	activities		
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6. FACILITIES DEVELOPMENT PROGRAMS

During the Plan implementation the maintenance and development of facilities will be undertaken to support the long-term administration of the Sanctuary. In addition to built facilities, this 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 procure equipments for FD field staff responsible for the Sanctuary management.

6.2 Built Facilities

The renovation and maintenance of built facilities will proceed in a well-planned and phased manner, that is appropriate to a Sanctuary setting, in order to ensure that they do not negatively impact the area's natural resources. Existing FD facilities will be fully utilised and incorporated in Sanctuary management where these can be renovated and maintained on a cost-effective basis. Built facilities are concentrated at Sanctuary Headquarters (incorporating the existing Chunoti Range Office and some other existing facilities) and Jaldi Range including Range Office complex and Banshkhali Eco-Park Complex..

Built facilities requirements during the Management Plan period are summarised in Tables 6.1 and 6.2 as below:

Table 6.1 Built facilities in Chunoti Wildlife Sanctuary: use and maintenance of existing facilities

Location	Facility (current use)	Use during Plan Period	Action Required
Sanctuary Headquarters (Chunoti Range Office Complex)	Forest Rest House with building footprint ~150 m ² .	Rest House	<input type="checkbox"/> Upgrading and regular maintenance
	Range office and staff quarters (3 Range office/quarters, each @ 200 m ²)	Office/Residence for OIC/Range Officer	<input type="checkbox"/> General renovation/repairs <input type="checkbox"/> Installation of water supply and electricity hookup <input type="checkbox"/> Repainting and regular maintenance
	Beat Officer's offices (12 Beat offices, each @ 120 m ²)	Beat Officer's offices	<input type="checkbox"/> Renovations to improve rainwater drainage and cross ventilation <input type="checkbox"/> Installation of water supply and electricity hookup <input type="checkbox"/> Repainting and regular maintenance
	Staff quarters (36 Forester's/Forest Guard's, each @ 80 m ²)	Staff quarters	<input type="checkbox"/> General renovation/repairs <input type="checkbox"/> Installation of water supply, electricity hookup and telephone <input type="checkbox"/> Repainting and regular maintenance <input type="checkbox"/> Construction of walkway from access road
	Two Watch Towers	As Watch Towers	<input type="checkbox"/> Maintenance
Eco-Park (near Jaldi)	Rest House, Cottages, 2 Watch Towers, Rest Sheds, 2 Suspension Bridges, etc.	As such	<input type="checkbox"/> Completion of the on-going works and maintenance

Table 6.2 Built facilities development in Chunoti Wildlife Sanctuary : new facilities

Location	Facility and use during Plan period	Action Required
Sanctuary Headquarters (Chunoti Range Office Complex)	Sanctuary Headquarters and Nature Information Centre (area ~300 m ²)	<input type="checkbox"/> Site selection <input type="checkbox"/> Design and construction <input type="checkbox"/> Installation of water supply and electricity hookup <input type="checkbox"/> Regular maintenance
	ACF's Quarters (1, area ~200 m ²)	as above
	Guard's Quarters (2, each ~60 m ²)	as above
Rest Stop/Picnic Area	Near the two Watch Towers in Chunoti Range	<input type="checkbox"/> Site selection <input type="checkbox"/> Design and construction <input type="checkbox"/> Installation of water supply and electricity hookup <input type="checkbox"/> Regular maintenance
Public Toilets		

All built facility requirements at Sanctuary Headquarters, except for senior staff and Forest Guard's quarters, should be satisfied through the use of existing buildings. 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 implementation. The existing visitor facilities including two Watch Towers will be renovated to provide two covered picnic shelters and adjacent toilets. At each location, design standards for both renovations and new construction will be based on the "Guidelines for Conservation Area Facilities Development" (Tecsult, 2001) as provided in Volume 2. 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 Sanctuary Headquarters as a matter of priority.

6.3 Forest Roads and Trails

Access to the Sanctuary Headquarters is currently provided by all-weather access roads which do not presently require upgrading. Access roads between sites at Sanctuary Headquarters (*i.e.*, between the main office/accommodation complex, the Resthouse and proposed Environmental Education Centre) and the existing Watch Towers will require periodic manual maintenance, but are currently built to sufficient standards for anticipated traffic loads. All other roads within the Sanctuary will be permanently closed to 4-wheeled vehicles. Unsurfaced forest trails (former logging tracks) linking Sanctaury Headquarters/Chunoti Range Office complex with the interior areas need to be maintained and several culverts would need to be replaced to restore easy access. 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 Sanctuary staff is currently and will continue to be by on foot and by motorcycle. Foot patrols are much more effective than vehicle patrols and so the trails linking the Beat Offices will be maintained for foot and motorcycle access (and not for access by vehicles with four wheels).

Numerous other foot trails have been developed throughout the Sanctuary mainly at the time of harvesting of trees and plantation establishment. 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. 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. Reconnaissance 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 as below:

- i) To demonstrate the importance of biodiversity conservation to visitors and policy makers,
- ii) To make outing/hiking for observing the Sanctuary's beauty,
- iii) To learn the things of interest 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 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 equipment and office equipment will be needed to support the management and administration programs for the management of Sanctuary. Double-cab pickups will be provided for the ACF/OIC. In addition, two 100 cc motorcycles will be provided for use at Sanctuary Headquarters, and one each at Range and Beat Offices. Walkie-talkies and/or mobile telephones will be provided for use at Sanctuary Headquarters, Range Offices and Beat Offices. Compasses, binoculars, GPS-units and other field equipments will be provided as required for support of the Sanctuary management programs.

6.5 Office Equipments

Office equipments (telephone, computer), furniture (desks, filing cabinets *etc.*) and supplies will be provided as required for use at Sanctuary Headquarters, Range Offices and the Beat Offices. Similarly all necessary equipments 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 programmes.

6.6 Summary of Main Prescriptions

Main prescriptions outlined under the above-developed protection programs are already summarized in Tables 6.1 and 6.2.

7. VISITOR USE AND VISITOR MANAGEMENT PROGRAMS

7.1 Objectives

Environmentally sound and socio-economically inclusive eco-tourism will be an important goal to be achieved under NSP. Wildlife tourism will help inculcate amongst the visitors a love for PA conservation by providing a communion with nature. Nature 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 eco-tourists. Socio-economic benefits of nature tourism accruing to local people will be catalyzed by establishing forward and backward linkages.

7.2 Nature Tourism

Public support for PA management can be obtained by allowing a regulated and low-impact nature tourism. However, it is important to realize that nature tourism exists for the PAs (and not PAs for tourism) and so nature tourism facilities/demands must be compatible with PA conservation. Regular participatory monitoring of negative impacts and putting up a corrective mechanism may be necessary for mitigating adverse socio-ecological effects of nature tourism on habitats, wildlife and local communities. Although the revenue generated from nature tourism can be an important source of PA development (by investing a certain part of the revenue), maximization of income may not be the main aim of nature tourism. The potential of conservation tourism is good in Chunoti due to its easy accessibility from Chittagong and Cox's Bazar, undulating terrain, remaining biodiversity including Elephants and scenic beauty. So a number of conservation facilities can be developed for visitors' use and promotion of nature tourism.

7.2.1 Nature Tourism Areas

A nature tourism region will be identified in and around the Sanctuary by linking with other local and regional attractions including Banskhali Eco-Park, Rest Houses, Dulahazara Safari Park, undulating/rolling landscapes, wetlands and streams, forest roads and nature trails. For example, the present Eco-park Near Jaldi is only 3 km from the Banskhali Upzila Hq. and so is an important eco-tourism center for the visitors. After the completion of the present bridge under construction, the Park will be less than 50 km from Chittagong and so is expected to attract a large number of visitors. Existing roads and trails will be renovated for easy movement in the identified nature tourism zone.

Elephant ride may be arranged by FD as many tourists may be interested to have a close look of nature from elephant back. Initially Chunoti FRH, and FRH and cottages at Eco-Park near Jaldi, and the Guest Houses maintained by local NGOs (say at Chunoti) will be able to provide accommodation to tourists. But when the number of tourists increase, the local entrepreneurs including user groups on the fringes (in interface landscape zone) of the Sanctuary may be encouraged to set up nature camps, eco-lodges, dormitories, huts and cottages for tourists. Eco-guides as identified under NSP amongst local communities will be helpful for the guidance of eco-tourists. A ceiling on the number of tourists/tourist vehicles permitted to enter the Sanctuary may be laid down in case there is a sharp increase in the number of visitors. Presently the visitors to Banskhali Eco-Park hire local Rickshaws to commute from Jaldi town. A special training on eco-tourism can be organized for the Rickshaw Pollers so that they can act as local eco-tour guides as well.

Relevant brochures, pamphlets, guide maps, hand outs, audiovisual aids and display boards will be developed at convenient points. Mass Communication Officer of FD and Communication Specialists of NSP will provide help in launching publicity program including adequate coverage in electronic and print media. Local youths/naturalists, preferably from the local 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 developing tools for spreading conservation awareness among the visitors. Binoculars and guide books on ornithology may be made available at tourist accommodation places. Nature camps (say of -2 days duration) may be organized (at places of interest within the Sanctuary) for students, scouts 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 and eco-lodges.

7.2.2 Facility Development

Tourism facilities that are sustainable, durable, environment friendly, moderately priced, clean and self-sufficient need to be promoted in and around the PAs. The proposed visitor facilities to be developed in the Sanctuary are described in detail as below:

7.2.2.1 Use Types and Facilities

Chunoti FRH and FRH, and cottages at Banskhali Eco-Park are available for making night halts inside the Sanctuary. The use of these FD facilities for general visitors is restricted as its upkeep is not regular. However, longer-term visitors can get accommodation outside the Sanctuary area in the Guest Houses maintained by local NGOs. In addition, hotel accommodation is available at Chittagong and Cox's Bazar from where a day journey can be performed. Publicity and information materials having basic information about the Sanctuary 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 Sanctuary Hqs. will serve as a nature interpretation centre (NIC) with updated information. Suitably trained staff will be posted at all of these locations with adequate information and publicity material about the Sanctuary's importance and facilities. Additional training on public relations and visitors management will be provided to the Sanctuary staff.

7.2.2.2 Nature and Hiking Trails

A network of nature trails will be developed/renovated for visitors movement on foot and bicycle in traversing key natural and cultural features of interest (e.g. patches of high forests, watch towers, cultural remnants, natural streams/cheras, religious places). The FRH will be connected with nature/hiking trails as far as possible. 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 such trails for visitor access.

The following three existing nature trails have been initially identified and mapped (Figure 8):

4. **Short Trail (about 1 km with half an hour walk):** The undulating trail, with elevated hills, starts from the road near Bon Pukur (Baitussalam Mosque) to the west through the garjan forest, returning to the main road near Euro Asia Poultry Hatchery. The trail covers many big trees of garjan and other species, and the visitors may encounter birds such as *myna*, *bulbuli* and *tia*.
5. **Medium Trail (nearly 2.5 km with one hour walk):** The trail starts from the Arakan road, near a signboard posted at about 1 km to the south of Chunoti Range Office. It goes through plantations and one of the two watch towers and ends about 20 m north from the starting point. If fortunate, the visitors may encounter elephant and other wildlife including fox, civet, squirrels, wild boar, jingle fowl and birds.
6. **Long Trail (around 7 km with three hours walk):** The trail starts at the Chunoti Forest Rest House and ends at the same FRH after traversing a long loop through the watch towers and a number of elevated hills. In addition to tall trees of garjan, a number of plantation areas are worth noticing during the trail journey. Important wildlife including elephant, monkey, honuman, and birds may be observed while walking along the trail.

The following guidelines/standards will be followed while designing, developing and maintaining the nature trails in future.

- ▣ 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 existing trails will be done by maintaining minimum necessary surface area and vegetation clearances required for easy access will be limited, wherever possible;
- ▣ Sign-posts with adequate information will be provided at main trail heads and printed materials will be distributed by the staff to interested visitors for their education and awareness. A list of do's and don'ts for the visitors will be made available at visit places;
- ▣ Hygienic 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, the 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. Basic picnic facilities including sheltered and outdoor tables, simple toilets and litter disposal buckets/boxes will be provided (for visitors in small groups), particularly near the Watch Towers. 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 Sanctuary.

7.2.2.3 Community-Based Tourism

Eco-tourism must involve and benefit local communities and so the first benefits (e.g. local employment and income generation activities) of tourism activities should flow to the local people. Guided tourism will be developed over a period of time by involving unemployed youth members/naturalists from local communities 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 user groups and co-management council/committee will be sought in developing community-based tourism. Local people will gainfully be involved in energy conservation and waste disposal activities. The movement of vehicles and tourists will be regulated within the identified tourists 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. No night driving will be allowed and entry hours will be specified. Slow driving (say 25 km/hour) will be allowed for motor vehicles and blowing of horns will not be permitted. Wildlife will not be chased and food from outside will not be allowed. Litting of fire will not be allowed during excursions, and empty cans, tins and polythene will not be used. Dogs and pets will not be allowed. The ACF in-charge of the Sanctuary will regularly get feed back from his field staff about the tourists through periodic reports and briefings.

7.3 Biodiversity Conservation Awareness, Education and Interpretation

The publicity of the Sanctuary 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 local schools as a part of publicity campaign. Sabuja Vahinis (Green Brigades) and Youth Clubs will be formed and trained in nearby schools and madarasas. Professional publicity and communication personnel will be invited for such tasks. Communication strategy as developed under NSP will be implemented, and efforts will be undertaken to improve relations and communications between the FD field staff and the media.

7.3.1 Biodiversity Awareness

Nature interpretation will, as an educational activity, focus on revealing meaning and relationships of complex ecosystems, biodiversity and landscapes. 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 least one) in the Sanctuary at accessible place (say at the Sanctuary HQ); landscape features will 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 may be added with proper leveling and description.

Appropriate signages will be used for the guidance of tourists in finding their ways without any enquiry. These signages may be as below:

- 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 Nature Education

The proposed Environmental Education Centre will be developed at the Sanctuary Headquarters 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-visuials, explanatory 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 Sanctuary, 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

Land-based sectors have profound effects (both negative and positive) on the Sanctuary 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 and community-private partnerships will be applied in soliciting the required inputs/contributions from private sector for facilities development in Chunoti. The nature conservation will progress 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 biodiversity 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 conservation partnership program may be implemented as below:

1. It may help improve livelihoods of local people around the Sanctuary 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 Sanctuary or provided under NSP (e.g. alternative income generation activities). 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 Sanctuary level to attest to their contribution.
3. Contributors may support/co-finance NSP's communication and outreach efforts by providing help in 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 pictures of local wildlife. The receipts from the licensing program may be ploughed back either for local community development and/or improved Sanctuary management.
5. Private businesses located in the interface landscape zone will be rewarded for their Sanctuary-friendly behaviour/activities. For example, those businesses supporting Sanctuary 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	<input type="checkbox"/> Identifying tourism areas within the Sanctuary	Possible tourism areas identified	FD
	<input type="checkbox"/> Designing and developing basic picnic facilities for tourists	Minimum tourist facilities are in place	FD/NSP
	<input type="checkbox"/> Identifying suitable sites for nature camps	Possible sites for 1-2 days nature camps identified	FD/NSP
	<input type="checkbox"/> Designing and preparing publicity materials including pamphlets, brochures and maps	Publicity material developed	NSP/FD
	<input type="checkbox"/> Identifying and training eco-guides	Eco-guides identified and trained	NSP
	<input type="checkbox"/> Developing and propagating conservation awareness and education through electronic and print media	Conservation awareness program developed	NSP/FD
	<input type="checkbox"/> Identifying and motivating students and volunteers (Sabuj Vahini) for biodiversity conservation	Number of schools identified and students motivated	NSP/FD

	<input type="checkbox"/> Identifying an existing building for establishing Nature Interpretation Centre <input type="checkbox"/> Identifying and mapping existing nature and hiking trails <input type="checkbox"/> Establishing regular contacts with relevant ministries and departments for inter-sectoral conservation planning <input type="checkbox"/> Developing a policy on public-private conservation partnership	Building for NIC selected Existing trails mapped Relevant ministries and departments contacted Public-Private partnership policy drafted	FD FD/NSP FD NSP
2	<input type="checkbox"/> Tourism areas shown on maps and brochures <input type="checkbox"/> Regulating tourism within the Park <input type="checkbox"/> Developing basic picnic facilities for tourists <input type="checkbox"/> Developing suitable sites for nature camps <input type="checkbox"/> Preparing publicity materials including pamphlets, brochures and maps <input type="checkbox"/> Training eco-guides <input type="checkbox"/> Propagating conservation awareness and education through electronic and print media <input type="checkbox"/> Motivating students and volunteers (Sabuj Vahini) for biodiversity conservation <input type="checkbox"/> Establishing Nature Interpretation Centre <input type="checkbox"/> Developing existing nature and hiking trails <input type="checkbox"/> Holding meetings with relevant ministries and departments for integrating Nishorgo Program with other sectoral programs <input type="checkbox"/> Approving a policy on public-private conservation partnership	Tourism areas notified Tourism regulated Tourist facilities are developed Possible sites for 1-2 days nature camps developed Publicity material development completed Panel of possible Eco-guides trained Conservation awareness propagated Number of students motivated NIC established Existing trails developed Relevant ministries and departments pursued Public-Private partnership policy approved	FD FD FD/NSP FD/NSP NSP/FD NSP NSP/FD FD FD/NSP FD FD/MOEF/ NSP
3, 4 and 5	<input type="checkbox"/> Regulating tourism within the Park <input type="checkbox"/> Continuing to develop picnic facilities for tourists <input type="checkbox"/> Maintaining suitable sites for nature camps <input type="checkbox"/> Continuing to distribute publicity materials including pamphlets, brochures and maps <input type="checkbox"/> Maintaining the panel on eco-guides <input type="checkbox"/> Continue propagating conservation awareness and education through electronic and print media <input type="checkbox"/> Continue motivating students and volunteers (Sabuj Vahini) for biodiversity conservation	Tourism regulated Tourist facilities are developed Possible sites for 1-2 days nature camps maintained Publicity material development distributed Panel of possible Eco-guides maintained Conservation awareness propagated Number of students motivated	FD FD FD/NSP FD/NSP NSP NSP/FD NSP/FD

	<input type="checkbox"/> Maintaining NIC	NIC maintained	FD/NSP
	<input type="checkbox"/> Developing new nature and hiking trails	New nature trails developed	FD
	<input type="checkbox"/> Continue liaisoning with relevant ministries and departments for integrating Nishorgo Program with other sectoral programs	Relevant ministries and departments pursued	FD/MOEF/NSP
	<input type="checkbox"/> 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

Conservation research, monitoring and capacity building are tools/mechanisms for a better understanding of the Sanctuary and its functions in order to sustainably manage constituent forests and biodiversity. An appropriate conservation research, conservation monitoring and conservation capacity building program will be developed with the following main objectives:

- i) To better understand the biodiversity resources, ecosystem and landscape environment of Chunoti WS,
- 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 selected key species, 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 Sanctuary's management program, and
- vi) To gradually reduce the extent and degree of uncertainty while taking the management decisions for the Sanctuary.

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 linkages with other related research organizations such as FRI, BARC, and relevant Universities and NGOs. In view of scarcity of funds 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, socio-economic issues, livelihood opportunities, silvicultural aspects, man-animal conflicts, impact of anthropogenic pressures on natural eco-systems, etc. Applied research relating to management aspects of the Sanctuary will be given priority by FD over academic studies, which may be conducted by Universities and research institutes separately.

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 council/committee and user groups formed at different levels, impacts and dependence of local people on the Sanctuary habitat, ethnic knowledge about local biodiversity, impacts of human activities on natural habitats, forward and backward linkages of nature tourism, sustainable collection, harvesting, storage and processing and marketing of NTFPs and suitable means of their multiplication, impacts of NTFPs on local economy, collection of NTFPs by the members of co-management council/committee and user groups. Many of these studies will be carried out through action research and by associating local stakeholders. Prioritization of research topics will be decided in a Workshop in which key persons from FD and other relevant stakeholders will participate. A computerized data base and retrieval system will be established.

8.2.2 Applied Biological Research

Suitable benchmarks are needed for measuring diversity and to monitor the status of indicator/flagship/threatened species of flora and fauna. Some relevant topics of biological research may include wildlife-population viability analyses, population dynamics and feeding behaviour, wildlife habitat/niche use behaviour, wildlife distribution patterns, wildlife seasonal variability and movements, and wildlife health and diseases.

Population viability analyses may be taken up to ensure that considerations of minimum population size and population dynamics are taken into account while formulating appropriate Sanctuary 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 in the Sanctuary and illegal wildlife trade will be studied.

8.2.3 Silvicultural Research

Main topics of silvicultural research may include impacts of forest grazing and fires on forest regeneration and wildlife (e.g. grazing intensity), 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 BFRl will be reviewed in order to draw relevant inferences and develop appropriate recommendations for managing forests in core and landscape 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, and 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 body studies, assessment of the contribution of the Sanctuary in water yield and conservation, impacts of forest grazing and forest fires on natural regeneration and wildlife, and 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 conservation 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. Main species considered for purposes of macro-level habitat management while implementing this Management Plan for the Sanctuary is the elephant, requiring regenerating forest areas with grasses and bamboo for food and shelter, and water bodies for drinking and bathing. The long-term aim will be to maximize gains in quantity and quality of habitat, and quality of associated species.

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 forests of Sanctuary
- ▣ Indicator 6b : Increased production of natural resources in targeted areas of the Sanctuary
- ▣ Indicator 6c : Increased biodiversity in targeted areas of the Sanctuary

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 in the Sanctuary. A survey of natural regeneration (density of seedlings and saplings per ha) in the forests may 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 may 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 species including elephant 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; the Sanctuary 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 and 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), East-West Centre (USA), 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. There is a great necessity of imparting conservation training to the FD field staff responsible for managing the Sanctuary. FD does not have any specialized capacity for imparting PA management training. Of 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 have undergone overseas training on wildlife and PA management. Unfortunately many of them are working outside Wildlife and Nature Conservation Circle (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 when senior FD officers and local stakeholders were sent to India for short-term training; 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 circumstances (cumbersome appointment procedures), it may not be possible to recruit permanent staff for 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 skills 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 Conservations Acts and International Conventions

The existing Wildlife (Preservation) (Amendment) Act, 1974 is now under revision process by a committee of FD officers with technical help being provided under NSP. The revision process should be expedited and completed after taking inputs from renowned legal experts and relevant stakeholders. This means that the

draft Act will be subject to public scrutiny before it is finalized and finally gazetted. It should be ensured that the revised Act is compatible with relevant international conventions and agreements signed by the Government of Bangladesh.

8.7 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	<ul style="list-style-type: none"> <input type="checkbox"/> Identifying possible conservation topics for taking up applied research studies <input type="checkbox"/> Holding stakeholders consultations on the proposed list of identified applied research topics <input type="checkbox"/> Identifying and networking with interested national organizations such as Chittagong University for conducting selected research studies <input type="checkbox"/> Developing a set of indicators for conservation monitoring <input type="checkbox"/> Collecting and developing benchmark data/information base with respect to core indicators <input type="checkbox"/> Identifying regional and international organizations for networking and cross-learning <input type="checkbox"/> Preparing an overseas and in-country training plan for imparting training to all stakeholders <input type="checkbox"/> Finalizing the draft Wildlife Act 	<ul style="list-style-type: none"> A list of research topics prepared A short list prepared after stakeholders consultations Interested research organizations contacted A set of indicators selected after consultations Benchmark surveys completed Relevant regional organizations identified & contacted Conservation training plan finalized Draft Wildlife Act finalized by FD and submitted to MOEF 	<ul style="list-style-type: none"> NSP/FD NSP/FD/ Stakeholders NSP/FD NSP/FD NSP NSP/FD NSP/FD FD/NSP
2	<ul style="list-style-type: none"> <input type="checkbox"/> Prioritizing the identified research topics <input type="checkbox"/> Developing ToRs and arranging budget for conducting priority research studies <input type="checkbox"/> Contracting interested national organizations for conducting selected research studies <input type="checkbox"/> Collecting and developing follow up data/information base with respect to core indicators <input type="checkbox"/> Maintaining regular contacts with regional and international organizations for networking and cross-learning <input type="checkbox"/> Implementing overseas and in-country training plan for imparting training to all stakeholders <input type="checkbox"/> Approving the draft Wildlife Act 	<ul style="list-style-type: none"> Priority list finalized after stakeholders consultations ToRs ready with required budget Interested research organizations contracted Follow up surveys completed Contacts with regional organizations maintained Training plan implemented Draft Wildlife Act submitted by MOEF to Ministry of Law and other related ministries 	<ul style="list-style-type: none"> NSP/FD/ Stakeholders FD/NSP NSP/FD NSP NSP/FD NSP/FD FD
3, 4 and 5	<ul style="list-style-type: none"> <input type="checkbox"/> Implementing conservation research studies on the identified research topics <input type="checkbox"/> Disseminating and using research findings 	<ul style="list-style-type: none"> Priority research studies completed FD and NSP staff use research findings 	<ul style="list-style-type: none"> NSP/FD FD/NSP

	<input type="checkbox"/> Continue follow up data/information base with respect to core indicators <input type="checkbox"/> Maintaining regular contacts with regional and international organizations for networking and cross-learning <input type="checkbox"/> Implementing overseas and in-country training plan for imparting training to all stakeholders <input type="checkbox"/> Approving the draft Wildlife Act	Follow up surveys completed Contacts with regional organizations maintained Training plan implemented Draft Wildlife Act gazetted after Parliament approval	NSP/FD NSP/FD FD FD
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9. ADMINISTRATION AND BUDGET PROGRAMS

9.1 Objectives

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

9.2 Administrative Set Up

As per the approved organogram a Wildlife Management and Nature Conservation Division is to manage the PAs within an overall supervision of Wildlife and Nature Conservation Circle (with a total of 378 staff). Each PA will be managed by an ACF/RO, who will be assisted by 1 DR/Fr and 3 FG/Boatman. As per the approved organogram a Wildlife Management and Nature Conservation Division is functioning at Chittagong for managing Chunoti WS.

9.3 Staffing Pattern

A staff strength of 34 is approved for the division, including technical staff (one ACF, one DR/Fr and three FG/Boatman). The Sanctuary will function as an independent management and administrative unit, headed by an ACF/RO, who will have all the required administrative and financial powers. Deputy Range Officer, as provided in the approved organogram will be posted to function as an attached officer to the ACF/RO, providing assistance as and when required. FD staff and participants will have greater role in interface landscape zone.

9.4 Duties and Responsibilities

The Sanctuary is managed by an ACF/RO under the overall charge of DFO, who works under the guidance of Conservator of Forest, WNCC.

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 program for *ex-situ* and *in-situ* conservation for botanical/baldha gardens and PAs; vii) be responsible for taking program 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; ixix) 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 xix) 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/RO as officer in-Charge for the Sanctuary 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 Lawachara Park. He will maintain liaison with other related government departments and local NGOs for smooth implementation of co-management activities. He will maintain a close liaison with the territorial staff of Chittagong (South) Forest Division particularly in protection of forests and wildlife of the PA.

The following responsibilities for ACF/RO as officer in Charge are as per the approved organogram; he/she will i) be responsible for over all administration of the PAs, 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; x) facilitating and catalyzing linkages for livelihood programs in the identified landscape zones; xi) maintain close liaison with FD staff responsible for the management of neighbouring forests and social forestry plantations; 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, budget and protection. He will reside at Sanctuary HQ and be de facto Deputy Officer-in-Charge responsible for all Sanctuary 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 FG 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 co-management council/committee will have defined functions in the Sanctuary management.

9.5 Protected Area Code of Conduct for Forest Officials

1. Have a clear understanding of the Ministry of Environment and Forest approved Nishorgo Vision-2010.
2. Develop awareness about Nishorgo Program among community people living in and around the Protected Areas (PA).
3. Help people living in and around the PAs to get involved in alternative income generating activities and other such community development initiatives on education, health, drinking water, sanitation, etc.
4. Facilitate smooth functioning of Co-management Councils/Committees.
5. Create scope for women and ethnic people in PA management and show proper respect to them.
6. Develop gainful partnership with local people and ensure their participation in regeneration, conservation and development of the forests and biodiversity.
7. Develop close working relationships with people living within a defined landscape and provide support to them in getting involved in development initiatives.

8. Ensure Nishorgo conservation and the co-management of PAs with the help and participation of the members of the local government, local administration, NGOs and voluntary initiatives/institutions.
9. Achieve main objectives of Nishorgo Support Project by maintaining close relationships with program implementing agencies.
10. Maintain professional integrity and honesty while discharging official duties.

9.6 Staff Amenities

The existing Chunoti Range Office will be the HQ of ACF/RO to be posted exclusively for managing the Sanctuary. He will be provided official residence at Chunoti HQ along with other technical staff and facilities.

9.7 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 much earlier) 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 the Sanctuary management need to be augmented by retaining and ploughing back a part (say 20%) of the total revenues generated from the WS. Eco-tourism activities and entry fees for the Sanctuary will be a good source of revenue in future.

10. THE BUDGET

The budget requirements for the implementation of the Management Plan for Chunoti WS 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	20000					20000		1000	note 1
1.2 Boundary Demarcation										
1.2.1 signboards	nos	15	15	10			40	3	120	note 2
1.2.2 outer and zonal boundary posts	km	50	100	50			200	5	1000	note 3
1.3 Formation of groups and signing of participatory conservation and benefit sharing agreements by user groups	User groups (@20 participants/group)	25	30	30			85	2	170	
1.4 Formalization of co-management councils/committees	lump sum	lump sum							50	
1.5 Control of illicit felling, poaching, encroachment, forest fires and grazing by user groups and community patrol groups	lump sum	lump sum							900	note 4
1.6 Communication networks : mobile telephones, etc.	lump sum	lump sum							50	
1.7 Arms and ammunition for control of organized smugglers	lump sum	lump sum							300	
1.8 Rewards/Incentives for biodiversity protection efforts	lump sum	lump sum							100	
1.9 Resolution of forest conflicts	no. of meetings	40	50	50	40	20	200	1	200	note 5
2. Management Programs										
2.1 Landscape Management Zoning										note 6
2.2 Core Zones Management										
2.2.1 Protecting forests and biodiversity	ha	7764	7764	7764	7764	7764	7764			note 7
2.2.2 Enrichment planting in better stocked areas	ha	140	160	150	150	100	700	8.8	6160	note 8
2.2.3 Plantations of framework species	ha	100	150	150	150	100	650	24	15600	note 9
2.2.4 Short-rotation plantation (woodlot) management	ha	50	150	100	50	50	400	24	9600	note 10
2.2.5 Habitat improvement works	ha	50	50	100	50	50	300	15	4500	note 11

Strategic Programs	Unit	Quantity / Year						Unit Cost '000 Taka	Total Cost '000 Taka	Notes
		Y1	Y2	Y3	Y4	Y5	Total			
2.2.6 Habitat restoration works	ha	50	50	100	50	50	300	10	3000	note 12
2.2.7 Renovations of existing Water bodies	No.	2	5	5	2	1	15	100	1500	note 13
2.2.8 Grass development in the identified elephant movement corridor	ha	100	150	150	100	50	550	10	5500	
2.3 Interface Landscape Zones Management										
2.3.1 Proposed Core Area Sub-zone	ha						5000			
2.3.1.1 Protection of forests	ha	5000	5000	5000	5000	5000	5000			note 7
2.3.1.2 Enrichment planting in better stocked forest areas	ha	100	100	150	100	50	500	8.8	4400	note 8
2.3.1.3 Planting framework species	ha	50	75	75	50	50	300	24	7200	note 9
2.3.1.4 Signing PCBSAs and raising woodlots of short rotation tree species	Ha	40	60	60	50	40	250	24	6000	note 10
2.3.2 Buffer Reserve Sub-zone										
2.3.2.1 Woodlots of short rotation species	ha	50	50	50	25	25	200	24	4800	
2.2.7 Renovations of existing Water bodies	No.	2	2	3	2	1	10	100	1000	note 13
2.3.3 Elephant Movement Corridor Sub-zone										
2.3.3.1 Grass development in the identified elephant movement corridor	ha	50	100	100	100	50	400	10	4000	
2.3.3.2 Checking encroachment for maintaining the corridor connectivity	lump sum								1000	
2.3.4 Assisted Biomass Production Area Sub-zone										
2.3.4.1 Establishing agroforestry systems	ha	50	50	50	25	25	200	24	4800	
2.3.4.2 Distribution of quality seedlings	No. (in '000)	10	20	20	20	10	80	3	240	
2.3.5 Skill development and implementing livelihood programs for workers' user groups	No. of villages									note 14
3. Livelihoods Programs										
3.1 Selecting priority production technologies										
3.1.1 Conducting reconnaissance surveys and demand-supply assessment	lump sum								40	
3.1.2 Identifying a list of feasible production technologies	do								5	
3.1.3 Stakeholders' Consultations on the proposed production technologies	do								20	
3.1.4 Agreeing on priority production technologies	do								5	

Strategic Programs	Unit	Quantity / Year						Unit Cost '000 Taka	Total Cost '000 Taka	Notes
		Y1	Y2	Y3	Y4	Y5	Total			
3.2 Developing skills for alternative income generation										
3.2.1 Identifying participants for skill demonstrations	do								75	
3.2.2 Developing demonstration centers/schools	do								1500	
4. Facility Development Programs										
4.1 Facilities and Infrastructure										
Renovation of FRH	m ²	60					60		420	
4.1.1 Maintenance of FRH	m ²						150	7	1050	
4.1.2 Repair of 3 Range office/quarters (each @ 200 m ²)	m ²						600	7	4200	
4.1.3 Renovations of 6 Beat Officers' quarters (each @ 120 m ²)	m ²						1220	7	1200	
4.1.4 Renovations of 20 FG/Foresters quarters (each @ 80 m ²)	m ²						1600	7	11200	
4.1.4 Maintenance of the existing 2 Watch Towers	nos						2	10	20	
4.1.5 Construction of Sanctuary HQ and Nature Interpretation Centre	m ²	350					350	12.5	475	
Animal recovery shed	m ²	100					100	5	500	
Student Hut / Dormitory	m ²	150					150	12.5	1875	
Dormitory / Barrack for staff	m ²	300					300	7	2100	
4.1.6 Construction of OIC/ACF's Quarters	m ²	100					100	7	7000	
4.1.7 Construction of 2 Quarters for FG (each @ 60 m ²)	m ²	120					120	12.5	1500	
4.1.8 Construction of Rest Stop/Picnic Area	m ²	50					50	12.5	625	
4.3 Vehicles										
4.3.1 Double-cab pickups	nos	2					2	2500	5000	
4.3.2 100 cc motorcycles	nos	10					10	130	1300	
4.4 Equipment										
4.4.1 Office equipment	misc	40%	60%				100%	100	100	
4.4.2 Field equipment	misc	40%	60%				100%	200	200	
5. Visitor Use and Visitor Management Programs										
5.1 Nature Interpretation Centre										Note 15
5.2 Nature trails	no.	1	2	2	2	1	8	10	80	
5.3 Identifying suitable sites for Nature Camps	no.	2					2	2	4	
5.4 Toilets/Restrooms	no.	1	1	1			3	75	225	
5.5 Resting Facility	no.		1				1	100	100	
5.6 Trash cans	no.	5	3	2			10	1.5	15	
5.7 Identifying & training eco-guides	no.	3	2	2	2	1	10	5	50	
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										

Strategic Programs	Unit	Quantity / Year						Unit Cost '000 Taka	Total Cost '000 Taka	Notes
		Y1	Y2	Y3	Y4	Y5	Total			
6.1.1 Floral and faunal inventories	m-m	3	2	2	1		10	30	300	
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	10	4	4	2	2	22	30	660	
6.2.2 Socio-economic monitoring	m-m	8	2	1	1		12	30	360	
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 16
6.3.4 In-country training (ACF (1), Forest Ranger (1), Deputy Forest Ranger (1), Foresters (8), Forest Guards (12), NGO staff (4))	m-m	11					11	12	132	note 17
6.3.5 In-country training of members of user groups and co-management councils / committees	no.	50	150	100	75	50	425	1	425	
6.3.6 Overseas tour of user groups	no.	50	25	25			100	20	2000	note 18
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	
-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 an area of 7,764 ha for the Sanctuary, proposed extension (5,000 ha) and a 5-km wide landscape zone. Mapping to be produced by RIMS based on satellite imagery and IRS data (more recent imagery, if available), updated Forest Department plantation records, ground-truthing by Sanctuary staff, and socio-economic surveys.
- 2 based on number of signboards to be placed at main access points and elsewhere along the Sanctuary boundary (estimated 30) and to designate participatory use areas (estimated 10).
- 3 calculated based on approximate 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 landscape management zoning is covered under item 1.1
- 7 cost of protection is covered under item 1
- 8 based on 700 ha in Core Zone that may be subject to silvicultural treatment and enrichment planting.
- 9 based on an area of 65 ha of long-rotation plantations with native framework species and managed for a rapid return to forest cover.
- 10 based on suitable area for plantations in the Core Zone that are currently encroached and can be brought under Participatory Conservation and Benefit Sharing Agreements.
- 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 this item is already covered under

- 16 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).
- 17 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
- 18 members of user groups will visit nearby West Bengal by making bus journeys from Dhaka to Kolkata to north Bengal.

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.

10.2 Possible Financing Mechanisms for the Plan Implementation

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

10.2.1. 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.

10.2.2. 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.

10.2.3. 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.

10.2.4. 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 activities. 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

The following is an unofficial translation of the original notification in Bangla.

**Government of the People's Republic of Bangladesh
Ministry of Environment and Forests**

No. XII/For-1/84/174

Dhaka, the 18th March, 1986

Notification

In exercise of the powers conferred by Article 23(1) of the Bangladesh Wild Life (Preservation) Order, 1973 (President's Order No. 23 of 1973), as amended by the Wild Life (Preservation) (Amendment) Act, 1974, (Act XVII of 1974), the Government is pleased to declare the following area of Reserved Forests under Chittagong Forest Division to be Wildlife Sanctuary with effect from the date of publication of this notification in the Gazette.

Compartment	Legal status of the proposed Sanctuary	Area (in acres)	Total Area
1. Chunoti (portion on West of Chittagong-Cox's Bazar Road)	Reserved Forests	2004	
2. Satgarh (portion on the West of Chittagong-Cox's Bazar Road)	do	839	
3. Goyalmara	do	3585	
4. Puichari	do	3346	
5. Napura	do	3975	
6. Jaldi	do	2837	
7. Chambal	do	2571	19,157

BY ORDER OF THE PRESIDENT

Sd/ - S.A. Mahmood
Secretary

No. XII/For-1/84/174

Copy forwarded for information and necessary action to:

1. Secretary, Ministry of L.A. & L.R. Dhaka
2. Commissioner, Chittagong Division
3. Chief Conservator of Forest, Ban Bhavan, Mohakhali, Dhaka
4. Conservator of Forest, Eastern Circle, Chittagong
5. Deputy Commissioner, Chittagong
6. Sd. of B.G. Press, Tejgaon, Dhaka. He is requested to kindly publish the notification in the next issue of the Bangladesh Gazette and supply 50 copies to the Ministry for official use.

Sd/- A.K.M. Serajul Islam
Section Officer

No. CCF (WL)/2M-240/86/124

Dated 1-4-86

Copy forwarded to the Divisional Forest Officer, Chittagong Division for information and necessary action. He is requested to engage his staff to protect the wildlife sanctuary.

(S.M. Sarker)
Conservator of forests
General Administration & Wildlife

For Chief Conservator of Forests

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

A number of flora and fauna inventories have been completed for Chunoti forests. Although Hussain's (1991) floral inventory is the most exhaustive, other recent studies give updated flora situation in Chunoti.

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

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

Scientific name	Family name	Common name
<i>Spilornis cheela</i>	<i>Accipitridae</i>	Crested Serpent-Eagle
<i>Alcedo atthis</i>	Alcedinidae	Common Kingfisher
<i>Halcyon amyrrnesis</i>	Alcedinidae	White-throated Kingfisher
<i>Cypsiurus parvus</i>	Apodidae	Palm Swift
<i>Ardeola grayii</i>	Ardeidae	Indian Pond-Heron
<i>Bubulcus ibis</i>	Ardeidae	Cattle Egret
<i>Egretta garzetta</i>	Ardeidae	Little Egret
<i>Bufo melanostictus</i>	Bufoidae	Common Toad
<i>Pericrocotus cinnamomeus</i>	Campephagidae	Small Minivet
<i>Cuon alpinus</i>	Canidae	Red Dog, Wild Dog, Dhole
<i>Megalaima lineate</i>	Capitonidae	Lineated Barbet
<i>Macaca mulatta</i>	<i>Cercopithecidae</i>	Rhesus Macaque (Banor)
<i>Ptyas mucosus</i>	Columbidae	Common Rat Snake
<i>Columba livia</i>	Columbidae	Rock Pigeon
<i>Streptopelia chinensis</i>	Columbidae	Spotted Dove
<i>Streptopelia orientalis</i>	Columbidae	Rufous Turtle Dove
<i>Streptopelia tranquebarica</i>	Columbidae	Red Collared-Dove
<i>Coracias benghalensis</i>	Coraciidae	Indian Roller
<i>Corvus macrorhynchus</i>	Corvidae	Large-billed Crow
<i>Corvus splendens</i>	Corvidae	House Crow
<i>Dendrocitta vagabunda</i>	Corvidae	Rufous Treepie
<i>Centropus sinensis</i>	Cuculidae	Greater Coucal
<i>Rhopodytes tristis</i>	Cuculidae	Malkoha, Greenbilled
<i>Dicrurus adsimilis</i>	Dicruridae	Black Drongo
<i>Dicrurus aeneus</i>	Dicruridae	Bronzed Drongo
<i>Dicrurus leucophaeus</i>	Dicruridae	Ashy Drongo
<i>Elephas maximus</i>	Elephantidae	Indian Elephant
<i>Hirundo rustica</i>	Hirundinidae	Barn Swallow
<i>Aegithinia tiphia</i>	Irenidae	Common Iora
<i>Sterna aurantica</i>	<i>Laridae</i>	River Tern
<i>Anthus novaeseelandiae</i>	Motacillidae	Australasian Pipit
<i>Motacilla alba</i>	Motacillidae	White Wagtail
<i>Acrocephalus agricola</i>	<i>Muscicapidae</i>	Paddyfield Warbler
<i>Acrocephalus dumetorum</i>	Muscicapidae	Blyth's Reed-Warbler
<i>Capsychus saularis</i>	Muscicapidae	Oriental Magpie-Robin
<i>Orthotomus sutorius</i>	Muscicapidae	Tailor Bird
<i>Rhabdophis submunata</i>	Natricidae	Rednecked Keelbeck
<i>Nectarinia zeylonica</i>	Nectariniidae	Purple-rumped Sunbird
<i>Oriolus xanthornus</i>	Oriolidae	Black-hooded Oriole

Scientific name	Family name	Common name
<i>Dinopium benghalense</i>	Picidae	Woodpecker, Red-backed
<i>Psittacula alexandri</i>	Psittacidae	Red-breasted Parakeet
<i>Pycnonotus cafer</i>	Pycnonotidae	Red-vented Bulbul
<i>Pycnonotus jocosus</i>	Pycnonotidae	Red-whiskered Bulbul
<i>Rana cyanophlyctis</i>	Ranidae	Skipper Frog
<i>Rana limnocharis</i>	Ranidae	Cricket Frog
<i>Mabuya carinata</i>	Sciuridae	Common Skink
<i>Callosciurus pygerythrus</i>	Sciuridae	Irrawaddy Squirrel
<i>Acridotheres fuscus</i>	Sciuridae	Orange-bellied Squirrel
<i>Acridotheres tristis</i>	Sciuridae	Jungle Myna
<i>Sturnus contra</i>	Sciuridae	Common Myna
<i>Sus scrofa</i>	Suidae	Indian Wild Pig
<i>Zosterops palpebrosa</i>	Zosteropidae	White Eye Indian Small

Hussain, KZ (1991) *The Fauna of Chunoti Wildlife Sanctuary*. Multidisciplinary Action Research Centre (MARC), Dhaka.

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	Strobilium asper
Myrtaceae	Syzygium fruticosum
	Syzygium grande
Verbenaceae	Vitex spp.
Leguminosae	Xylia dolabriformis

5. LIST OF PLANT SPECIES

A number of flora and fauna inventories have been completed for Chunoti forests. Although Khan's (1990) floral inventory is the most exhaustive, other recent studies give updated flora situation in Chunoti. The following list of plant species reported from the Chunoti Forest area is based on the following source:

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

Scientific Name	Family Name	Common Name
<i>Thunbergia grandiflora</i>	Acanthaceae	Nillata
<i>Lepidagathis incurve</i>	Acanthaceae	Not available (Na)
<i>Achyranthes aspera</i>	Amaranthaceae	Apang, Upatlangra
<i>Swintonia floribunda</i>	Anacardiaceae	Am-Chundal/Civit
<i>Lannea coromandelica</i>	Anacardiaceae	Bhadi/Jiulbandi
<i>Rauvolfia serpentina</i>	Apocynaceae	Swarpagandha
<i>Tabernaemontana</i>	Apocynaceae	Tugarphul, Duduphul
<i>Colocasia esculenta</i>	Araceae	Kachu, Mokaddamkachu
<i>Colocasia nymphaefolia</i>	Araceae	Jangli Kachu, Sarkachu, Kalikachu
<i>Hoya parasitica</i>	Asclepiadaceae	Pargacha
<i>Stereospermum</i>	Bignoniaceae	Paruljata, Dharmara
<i>Burserra serrata</i>	Burseraceae	Chitrica, Hiliabadi
<i>Garuga pinnata</i>	Burseraceae	Kharapata, Ghogar, Kapila
<i>Calycopteris floribunda</i>	Combretaceae	Goachelata
<i>Anogeissus lanceolata</i>	Combretaceae	Hingori, Kosi, Kantakoroi
<i>Anogeissus acuminata</i>	Combretaceae	Kanchoi
<i>Terminalia belirica</i>	Combretaceae	Bahera
<i>Eupatorium odoratum</i>	Compositae	Assamlata, Germanlata
<i>Chromolaena odorata</i>	Compositae	Assamlata, Germanlata
<i>Mikania scandens</i>	Compositae	Assamlata, Taralata
<i>Ageratum conyzoides</i>	Compositae	Ochunti, Fulkuri
<i>Ipomoea batatas</i>	Convolvulaceae	Mistialu
<i>Iplomea alba</i>	Convolvulaceae	Halkalmi, Dudkalmi
<i>Paederia foetida</i>	Convolvulaceae	Gandhabadhuli, Madhulata
<i>Cyperus difformis</i>	Cyperaceae	Behua
<i>Cyperus iria</i>	Cyperaceae	Barachancha
<i>Dillenia pentagyna</i>	Dilleniaceae	Hargaza
<i>Dioscorea bulbifera</i>	Dioscoreaceae	Rataalu, Banalu, Pagaalu
<i>Dioscorea esculenta</i>	Dioscoreaceae	Susni alu, Mou alu
<i>Dioscorea glabra</i>	Dioscoreaceae	Shora alu
<i>Eaeocarpus robustus</i>	Elaeocarpaceae	Jalpai, Chekio
<i>Baccaurea ramiflora</i>	Euphorbiaceae	Latka, Latkan, Dubi
<i>Bridelia tomentosa</i>	Euphorbiaceae	Khoi, Serai
<i>Macaranga denticulate</i>	Euphorbiaceae	Bura, Ratabura, Madla
<i>Phyllanthus reticulatus</i>	Euphorbiaceae	Panseuli, Chitki, Pankushi
<i>Trewia polycarpa</i>	Euphorbiaceae	Bhatam, Pitali
<i>Quercus spicata</i>	Fagaceae	Raibatna, Barabatna, Batna
<i>Rhyncotechum ellipticum</i>	Gesneriaceae	Na
<i>Garcinia cowa</i>	Guttiferae	Cau, Khaglichu
<i>Myriophyllum tetrandrum</i>	Haloragaceae	Na
<i>Hyptis suaveolens</i>	Labiatae	Tokma, Bilatitulsi
<i>Cinnamomum caphora</i>	Lauraceae	Karpur
<i>Entada phaseoloides</i>	Leguminosae	Gilla
<i>Cassia nodosa</i>	Leguminosae	Bandarlatia
<i>Mucuna pruriens</i>	Leguminosae	Kamoch, Alkushi, Banda
<i>Cassia tora</i>	Leguminosae	Chakunda, Galeski
<i>Desmodium alatum</i>	Leguminosae	Na
<i>Mimosa pudica</i>	Leguminosae	Lajjaboti
<i>Tephrosia candida</i>	Leguminosae	Bogamedula
<i>Uraria hamosa</i>	Leguminosae	Kalilata, Felilata, Panlata
<i>Derris trifoliata</i>	Leguminosae	Kalilata, Felilata, Panlata
<i>Smilax macrophylla</i>	Liliaceae	Bulkumia, Kumarilata
<i>Curculigo recurvata</i>	Liliaceae	Bidripata
<i>Sida acuta</i>	Malvaceae	Kureta, Urusia

Scientific Name	Family Name	Common Name
<i>Urena lobata</i>	Malvaceae	Banokra, Atlera
<i>Melastoma malabathrica</i>	Meastomataceae	Dadranga, Lutki, Bantezpata
<i>Aphanamixis polystachya</i>	Meliaceae	Pitraj
<i>Artocarpus chaplasha</i>	Moraceae	Cham/Chapalish
<i>Ficus hispida</i>	Moraceae	Kakdumur, Thuska
<i>Ficus religiosa</i>	Moraceae	Assawath, Pipal, Panbot
<i>Streblus asper</i>	Moraceae	Asshaora, Shaora
<i>Musa ornate</i>	Musaceae	Ramkola, Bamanagikola
<i>Musa paradisica</i>	Moraceae	Kachakola
<i>Maesa ramentacea</i>	Myrsinaceae	Noamricha, Maricha
<i>Syzygium cumini</i>	Myrtaceae	Jam, Jaman, Kalojam
<i>Syzygium fruticosum</i>	Myrtaceae	Banjam, Khudijam
<i>Syzygium grande</i>	Myrtaceae	Dhakijam
<i>Ludwigia hyssopifolia</i>	Onagraceae	Na
<i>Vanda teres</i>	Orchidaceae	Na
<i>Gymbidium aloifolium</i>	Orchidaceae	Orchid
<i>Caryota urens</i>	Palmae	Golsagu, Golmar, Chaur
<i>Passiflora foetida</i>	Passifloraceae	Gorakphal, Jumkalata
<i>Aegialitis rotundifolia</i>	Plumbaginaceae	Nuniagach, Dhalchaka
<i>Bambusa tulda</i>	Poaceae	Kaligoda
<i>Imperata cylindrical</i>	Poaceae	Ulu, Ulukhar, Kash
<i>Melocanna baccifera</i>	Poaceae	Mulibans
<i>Neohouea dulloa</i>	Poaceae	Daloo Bans/Dalu
<i>Oxytenanthera</i>	Poaceae	Kali Bans
<i>Saccharum spontaneum</i>	Poaceae	Kash, Kaicha, Khag
<i>Thysanolaena maxima</i>	Poaceae	Phuljharu, Jharu
<i>Polygonum hydropiper</i>	Polygonaceae	Bishkatalia, Pakurmul, Kukra
<i>Polygonum orientale</i>	Polygonaceae	Barapanimarich, Bishkhatali
<i>Monochoria vaginalis</i>	Pontederiaceae	Sarkachu, Nukha, Bhainsakachu
<i>Zizyphus oenoplia</i>	Rhamnaceae	Banboroi, Gotboroi, Sheakul
<i>Xeromphis spinosa</i>	Rubiaceae	Mankanta, Manphal
<i>Mussaendra roxburghii</i>	Rubiaceae	Silchauri
<i>Anthocephalus chinensis</i>	Rubiaceae	Kadam
<i>Aphania danura</i>	Sapindaceae	Danura, Gothahornia
<i>Physalis minima</i>	Solanaceae	Bantepari, Phuika, Tepari
<i>Solanum torvum</i>	Solanaceae	Gothbegun, Titbegun
<i>Buettneria pilosa</i>	Sterculiaceae	Harjora
<i>Symplocos racemosa</i>	Symplocaceae	Lob, Puidobmator
<i>Brownlowia elata</i>	Tiliaceae	Machjut, Moss, Mus
<i>Triumfetta rhomboidea</i>	Tiliaceae	Banokra
<i>Grewia laevigata</i>	Tiliaceae	Na
<i>Grewia microcosm</i>	Tiliaceae	Assar, Patka
<i>Trema orientalis</i>	Ulmaceae	Jiban, Jinal, Chikun, Sunsuni
<i>Sarchochlamys</i>	Urticaceae	Barihati, Karabi
<i>Clerodendrum viscosum</i>	Verbenaceae	Ghetu, Ghetphul, Bhand
<i>Clerodendrum indicum</i>	Verbenaceae	Bamunhati, Banchat
<i>Callicarpa arborea</i>	Verbenaceae	Bormala, Kojo
<i>Gmelina arborea</i>	Verbenaceae	Gomar/Gomari
<i>Premna esculenta</i>	Verbenaceae	Lolana, Lalong
<i>Tectona grandis</i>	Verbenaceae	Shagwan/Shegun/Teak
<i>Alpinia galangal</i>	Zingiberaceae	Sugandhbach
<i>Costus speciosus</i>	Zingiberaceae	Kushta, Kemak, Keomul

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 Chunoti 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
<ul style="list-style-type: none"> ➤ 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 	<ul style="list-style-type: none"> ➤ 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
<ul style="list-style-type: none"> ➤ Use natural surfacing (herringbone brick, crushed gravel, earth), as appropriate to traffic levels, on interior access roads ➤ Limit public access (using gates, barriers <i>etc.</i>) 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 	<ul style="list-style-type: none"> ➤ 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
<ul style="list-style-type: none"> ➤ 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 	<ul style="list-style-type: none"> ➤ Overdesign (<i>e.g.</i>, 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 (<i>e.g.</i>, 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
<ul style="list-style-type: none"> ➤ 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 	<ul style="list-style-type: none"> ➤ ermit occupation of staff quarters by other than assigned staff and immediate family members ➤ permit unauthorised construction of outbuildings or other structures

<p>Suggested minimum area standards for staff accommodation: ACFs, Forest Ecologists, Social Scientists: 120 m² Range Officers: 100 m² (200 m² when combined with office) Beat Officers: 80 m² (120 m² when combined with office) Forest Guards: 60 m² Plantation Malis: 40 m²</p>
<p>All staff housing should include adequate living space, kitchen and toilet facilities, and access to clean water</p>

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
<ul style="list-style-type: none"> ➤ 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 	<ul style="list-style-type: none"> ➤ 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
<ul style="list-style-type: none"> ➤ 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 	<ul style="list-style-type: none"> ➤ 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
<ul style="list-style-type: none"> ➤ 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 	<ul style="list-style-type: none"> ➤ 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
<ul style="list-style-type: none"> ➤ For maximum field of view, locate observation towers and platforms 	<ul style="list-style-type: none"> ➤ Locate towers and platforms where

Do	Don't
<p>on hilltops, or in open habitats (wetlands, meadows, forest edges) when in flat terrain</p> <ul style="list-style-type: none"> ➤ 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 	<p>public use will result in negative impacts on wildlife</p> <ul style="list-style-type: none"> ➤ 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
<ul style="list-style-type: none"> ➤ 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 ➤ 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 	<ul style="list-style-type: none"> ➤ use security fencing; this gives the wrong message to the public ➤ initiate construction unless adequate capital and maintenance funds are available

Do	Don't
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 ➤ 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)	➤ 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
<ul style="list-style-type: none"> ➤ 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
<ul style="list-style-type: none"> ➤ 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 	<ul style="list-style-type: none"> ➤ 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
<ul style="list-style-type: none"> ➤ 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 	<ul style="list-style-type: none"> ➤ Create wide cleared corridors along boundaries ➤ Blaze trees along boundaries unless no other boundary marking option is feasible

Do	Don't
<ul style="list-style-type: none"> ➤ 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 	

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
<ul style="list-style-type: none"> ➤ 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 	<ul style="list-style-type: none"> ➤ 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
<ul style="list-style-type: none"> ➤ 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 	<ul style="list-style-type: none"> ➤ 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
<ul style="list-style-type: none"> ➤ 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 	<ul style="list-style-type: none"> ➤ 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
<ul style="list-style-type: none"> ➤ 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 	<ul style="list-style-type: none"> ➤ 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
<ul style="list-style-type: none"> ➤ 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 	<ul style="list-style-type: none"> ➤ Develop trails through key wildlife habitats, including natural wetlands

<ul style="list-style-type: none"> ➤ 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 	
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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
<ul style="list-style-type: none"> ➤ 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 	<ul style="list-style-type: none"> ➤ 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 significance. 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 a 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 its 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 track 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.

8. Guidelines for establishing enrichment and buffer plantations

The following simple guidelines are prepared for the use of field staff while raising enrichment and buffer plantations:

Enrichment Plantations Guidelines:

The enrichment plantations can be taken up in identified areas of the core zone as discussed below:

- Identification of suitable areas for enrichment planting
- Advance closure (suitable protection measures against hacking, grazing and forest fires) of identified areas
- Collection and treatment of seeds, development and maintenance of nursery
- Cutting of unwanted bushes (say around 1 m radius of the pits in which seedlings are to be planted in identified gaps), climbers and tall weeds (bushes not hindering natural regeneration will be retained as biodiversity but also for creating moist conditions locally)
- Cutting back of old, high and malformed stumps, and faulty coppice shoots
- On an average 360 seedlings per ha mainly of indigenous species (multi-species plantations to optimize species and habitat heterogeneity) will be planted in the identified gaps (of more than 0.5 ha).
- In the pits of size 45m x 45m x 45m (dug in the month of Feb. – March) 1 kg of cowdung and/or fertilizer (application of fertilizer as 50 gms per seedling – 20 gms TSP, 20 gms MP and 10 gms Urea) will be applied.
- No burning and clear cutting of existing vegetation will be taken up. In case of weeds a circular area of 1 m radius around the pit can be cleared before taking up planting on the onset of monsoon rains (in the month of June-July).
- The dead and hollow trees suitable for wildlife will not be removed.
- Half-moon trenches around the planted seedlings are suggested in the slopes as an integral part to conserve and trap soil, and retain soil moisture.
- Weeding, beating up and cleaning will be taken up as and when required. Normally 3 weeding are taken up in the 2nd financial year and 2 weeding in the 3rd financial year. Vacancy filling, if required, will be done along with weeding. Singling of coppice shoots leaving 2-3 shoots per stool will be taken during 2nd year for the regenerating coppice stumps dressed during the first year.
- Suitable species for enrichment plantations are mainly indigenous species that (in mixture) may include siris, sisoo, simul, chikrasi, jarul, gamar, garjan, telsur, koroi, champa, mahogany, kadam, arjun, haritoki, pitali, chapalish, boilam, agar, hargoja, padauk, jam, dhakijam, toon, bazna, jalpai, chalta, amla, bahera, ficus species, bamboo, etc. Monoculture will not be allowed and canes will be not be planted.
- Exotic species such as acacia, eucalyptus and mangium will not be planted inside the core zone.
- Palatable grasses for fodder plantations may 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*. These grasses may also be used for gully plugging in case soil erosion takes place due to gradient and run off.
- Planting of fruit bearing and wide crown tree species such as chapalish and artocarpus will particularly be suitable for arboreal fauna such as hoolock.
- Plantation of shrubs and vegetables may be taken up around waterbodies (e.g. *charas*, ponds) by involving local stakeholders.
- Subsidiary silvicultural operations such as cleaning of weeds, climber cutting and freeing of natural regeneration from suppression will be taken up for encouraging natural regeneration. In coppicing species stump dressing and stool thinning (retaining 2-3 shoots per stool) will be carried out. Bamboo clumps will be decongested.

Buffer Plantation Guidelines :

The following guidelines will be adopted while raising buffer plantations in support (or buffer reserve) sub-zone of interface landscape zone based on participatory conservation benefits sharing agreements :

- Block plantations of both indigenous (list as in case of enrichment plantations) and fast growing species such as acacia will be taken in mixture at 2m x 2m (2500 seedlings/ha) by associating local stakeholders (e.g. members of community patrolling groups and user groups).
- The rotation age for the fast growing species would be 10 years (two thinning at 4th and 7th year) and 30 years (two thinning at 10th and 20th year) for long rotation species. The fruit bearing trees suitable for wildlife will be planted and retained at the time of felling.
- The usufructury benefits from 2nd thinning and final felling will be shared by following the FSP guidelines (45% of the total proceeds to FD, 45% to participants and 10% to co-management committee by establishing Tree Farming Fund as under FSP).
- Other guidelines will be applicable as described above for enrichment plantations based on site specific characteristics.

By adopting FSP guidelines, strip plantations will be raised along the linear corridors including roads maintained by Union Parishads.