Strengthening the Arannayk Foundation
(Bangladesh Tropical Forest Conservation Foundation)
Phase I

Site Selection,
Inventory and Monitoring Report

Task Order under the
Biodiversity & Sustainable Forestry IQC (BIOFOR)

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EXECUTIVE SUMMARY

The Arannayk Foundation (AF) has been established for the purpose of facilitating tropical forest conservation in Bangladesh, involving the full spectrum of stakeholders, and focusing on the development of public-private sector partnerships for developing and implementing conservation activities. The Foundation's strategic plan calls for, inter alia, two activities: (i) an inventory and assessment of tropical forests and their biodiversity and a program of regular and systematic monitoring of remaining natural forest patches throughout Bangladesh; and (ii) further development and integration of data bases related to tropical forests and their biodiversity and measures to ensure they are known current and openly available for use by all levels and types of stakeholders.

The objective of site selection, inventory and monitoring component of the Chemonics International mission was to assist the AF with the above activities by initiating the site selection process and designing a tropical forestry biodiversity inventory and monitoring program for selected sites.

Specific activities included:

Development of site selection criteria. The first step in the site selection process was to establish some criteria with which to evaluate site potential for eventual AF intervention. Criteria included ecological significance (conservation value), management status (threat analysis, protection and management status), leverage potential (ability to affect the largest audience), and feasibility/project potential. These evaluation criteria served as a general guideline when reviewing literature and during site rapid appraisals, emphasizing management and feasibility criteria for the initial pilot phase given that these criteria will likely have the biggest impact on AF success in the short-term.

Site rapid assessment and selection. Based on discussions with key stakeholders and on a detailed literature review, the Chemonics team was able to eliminate certain sites for AF consideration (no remaining forests) while identifying - for rapid appraisal purposes - a number of sites where natural forest remnants were thought to exist. In this context, the Chemonics team was able to briefly visit a total of six sites to be potentially considered for initial AF activities; Lawachara National Park, Satchuri Reserved Forest, Rema Kalenga Wildlife Sanctuary, Madhupur National Park, Chunati Wildlife Sanctuary, Teknaf Game Reserve and the Doolhazara Safari Park. The team was also able to over fly the Chittagong Hill Tracts (CHT) where important areas under closed canopy forest were found to exist.

Based on the selection criteria, Lawachara National Park and Satchuri Reserved Forest were found to have the highest potential for on-the-ground AF activities and a detailed program of work was developed for these two sites. Recommendations for possible AF activities were also made for the other sites, including the development of guidelines for further biological and socio-economic analysis of CHT forests. A summary of site analyses contrasting problems and potential for all sites visited is provided in Annex C.

Identification of cross cutting policy issues. During the course of conducting the rapid site assessments, several cross-cutting issues common to all areas became apparent, including: (i) the Forestry Department's (FD) focus on production forestry rather than on ecosystem integrity; (ii) the proposed creation of a separate Parks Department; (iii) the FD's mutually exclusive roles of policing and extension/community participation; and (iv) no local retention of revenues generated from the parks/reserved forests. A discussion of these issues is provided along with recommendations on how policies might be modified in order to better reflect current protected area/natural forest area needs.

Development of an inventory and monitoring program. There are basically three key criteria regarding the frameworks of successful biodiversity monitoring programs: (i) they must be designed in accordance with specific objectives and to provide the information needed to progress toward the achievement of those objectives; (ii) both spatial and temporal scales of investigation must be considered; and (iii) they must be designed with a sound methodological and statistical foundation.

Given these criteria, and the fact that the design of a program for inventory and monitoring of natural forests in Bangladesh will, of necessity, be a compromise between park/PA management objectives, limited AF resources, and the capacity of local institutions to undertake detailed inventory and periodic monitoring of biodiversity changes, the Habitat Suitability Index Model (HSI), developed by Tecsult under the Forestry Sector Project, was identified as the model which meets all necessary conditions.

The HSI model uses the capped langur as an indicator species for mature natural forest cover and has the following advantages: (i) it can use the FD's RIMS/GIS data base which is the best available descriptor of land units having uniform ecological conditions in Bangladesh – the data base covers all of the protected areas with the exception of CHT and Madhupur; (ii) it provides a relatively low cost mechanism to address changes over time providing updated imagery can be procured and analyzed, and funds are available for some limited ground truthing; and (iii) it can be used in a wide variety of sites.

Detailed guidelines for model development and implementation are provided including development of overall site management objectives, development of management zones (core, buffer and transition) and specific objectives for each zone, development of HSI values for capped langurs for generalized land use types, and the establishment of a baseline and monitoring plan.

Development of a biodiversity data/information collection and exchange system. Much of the information needed to better manage Bangladesh's biodiversity rests with a number of institutions. As data and information are valuable commodities, there is a tendency among many of these institutions not to share information. Better inventory information is needed on the extent and quality of all remaining natural forest remnants and their potential biodiversity value. However, it is important that work of the AF, as an organization actively engaged in promotion of tropical forest conservation and biodiversity protection, not be delayed by the lack of a comprehensive and fully verified data base on remaining natural forest patches, their biodiversity status and value. To this end, it is recommended that the AF encourage the development of a

biodiversity information network and eventually become a repository or clearing house for all biodiversity information by collating, reconciling and synthesizing data and information from all pertinent sources.

Data collection and analysis capabilities are also scattered among several institutions. In general, however, Bangladesh has excellent data collection and analysis on the flora side – particularly with regard to trees and production forestry - with a number of institutions capable of conducting inventories, taxonomic studies, etc. However, there appears to be a weakness on the faunal side. This weakness is not due to a lack of qualified people – over a 1000 wildlife biologists have graduated at BSc level from Dhaka University along with numerous MScs and PhDs, including a number from Cambridge - but the lack of employment and experience opportunities. A summary of some of the data collection and analysis strengths and weaknesses found in selected institutions is provided.

SECTION I

Introduction

The Arannayk Foundation (AF) has been established for the purpose of facilitating tropical forest conservation in Bangladesh, involving the full spectrum of stakeholders, and focusing on the development of public-private sector partnerships for developing and implementing conservation activities. The Foundation's strategic plan calls for, inter alia, two activities: (i) an inventory and assessment of tropical forests and their biodiversity and a program of regular and systematic monitoring of remaining natural forest patches throughout Bangladesh; and (ii) further development and integration of data bases related to tropical forests and their biodiversity and measures to ensure they are known current and openly available for use by all levels and types of stakeholders.

1.1 Terms of Reference

The objective of site selection, inventory and monitoring component of the
The Chemonics International mission is to assist the AF with the above activities by initiating the site selection process and designing a tropical forestry biodiversity inventory and monitoring program for selected sites. Specific tasks include:

- Undertake a rapid appraisal, description of land and biodiversity, and threat analysis of biodiversity of select site(s);
- Recommend potential site(s) for implementation in accordance with a long-term strategy;
- Design a detailed program for inventory and monitoring of tropical forest resources for select sites; and
- Identify potential local institution(s) to undertake detailed inventory and periodic monitoring of biodiversity changes.

1.2 Site Selection Criteria

The first step in the site selection process was to establish some criteria with which to evaluate site potential for eventual Arannayk Foundation intervention. The following evaluation criteria served as a general guideline when reviewing literature and during site rapid appraisals. Specifically, the team chose to emphasize management and feasibility criteria for the initial pilot phase given time and resource constraints and the fact that these criteria will likely have the biggest impact on AF success in the short-term.

The Chemonics team hopes that these criteria (and/or others) may also serve the AF in more detailed future site selection assessments.

Ecological Significance

- What's the site's conservation value?
- What's the site's current biophysical condition?
- Is the site within a priority ecoregion, i.e., a large geographical area distinguished by a complement of species, ecological communities, and ecological systems;
- Is the site and the biodiversity therein especially rare and/or threatened on a national and regional scale?
- How does the conservation value of the site contrast with its commercial value/production value?

Management Status

- What are the threats to biodiversity at each site and the strategies needed to addresses those threats?

- How do site threats fit into the range of threats that must be addressed to conserve the representative biodiversity of the ecoregion?

- What's the current protection status (is the site legally decreed? is it a national park, wildlife sanctuary, game reserve or forest reserve, and how do the national laws protecting these areas differ?)

- Does the site have a management plan which provides for biodiversity and if so, has the plan been implemented?

- Is there a strong, existing conservation effort at the site that does not need AF assistance, but may offer opportunities for collaboration?

Leverage

Sites should have the hope/potential of affecting the broadest possible audience of stakeholders.

- Will a successful conservation effort at the site offer AF the opportunity to affect other sites in the ecoregion or elsewhere?

- If the AF deals effectively with the major threat at this site, will it be able to apply that lesson to other sites?

- Can a conservation success at this site provide additional, local credibility that will attract the attention of managers at other sites (and donors) and give AF an opportunity to work (receive funds from) with them?

Feasibility/Project Potential

Generally funds that focus their goals and objectives on activities selected for strategic impact, feasibility, and ability to be carried out quickly to build a track record, do better than those that start out with an "open door" policy based on reacting to whatever is proposed. In Bangladesh this is particularly important because of the rapid rate of loss of tropical forests and their biodiversity at nearly all sites.

- Is there a strong conservation organization present at the site?
- What's the availability of other partners currently working in the area or are interested in working in the area as facilitators, catalysts, or researchers?
- Is there a current local or other initiative to improve the conservation of the site?
- What's the level of awareness, understanding and interest of the local community(ies) with regard to conservation and their willingness to participate in an eventual project?
- What are other community issues? e.g., level (and form), if any, of conflict among stakeholders; status of devolution policy, including type of decision making rights of community or degree of community rights to manage the resources of the community; degree to which informal rights are perceived and exercised
- Are local conservation authorities particularly interested in forest/biodiversity conservation at this site?
- Are the threats at the site within AF's capacity to address?
- What will the proposing organizations be expected to "bring to the table," e.g., counterpart funding? In general, the success rate of projects is better when there is a requirement for counterpart contributions, which may be in-kind. Even the poorest communities are usually able to contribute labor, for example, if materials are paid for.
- What's the potential for sustainability after AF support?

SECTION II

Site Analysis

2.1 Bangladesh's Protected Area System

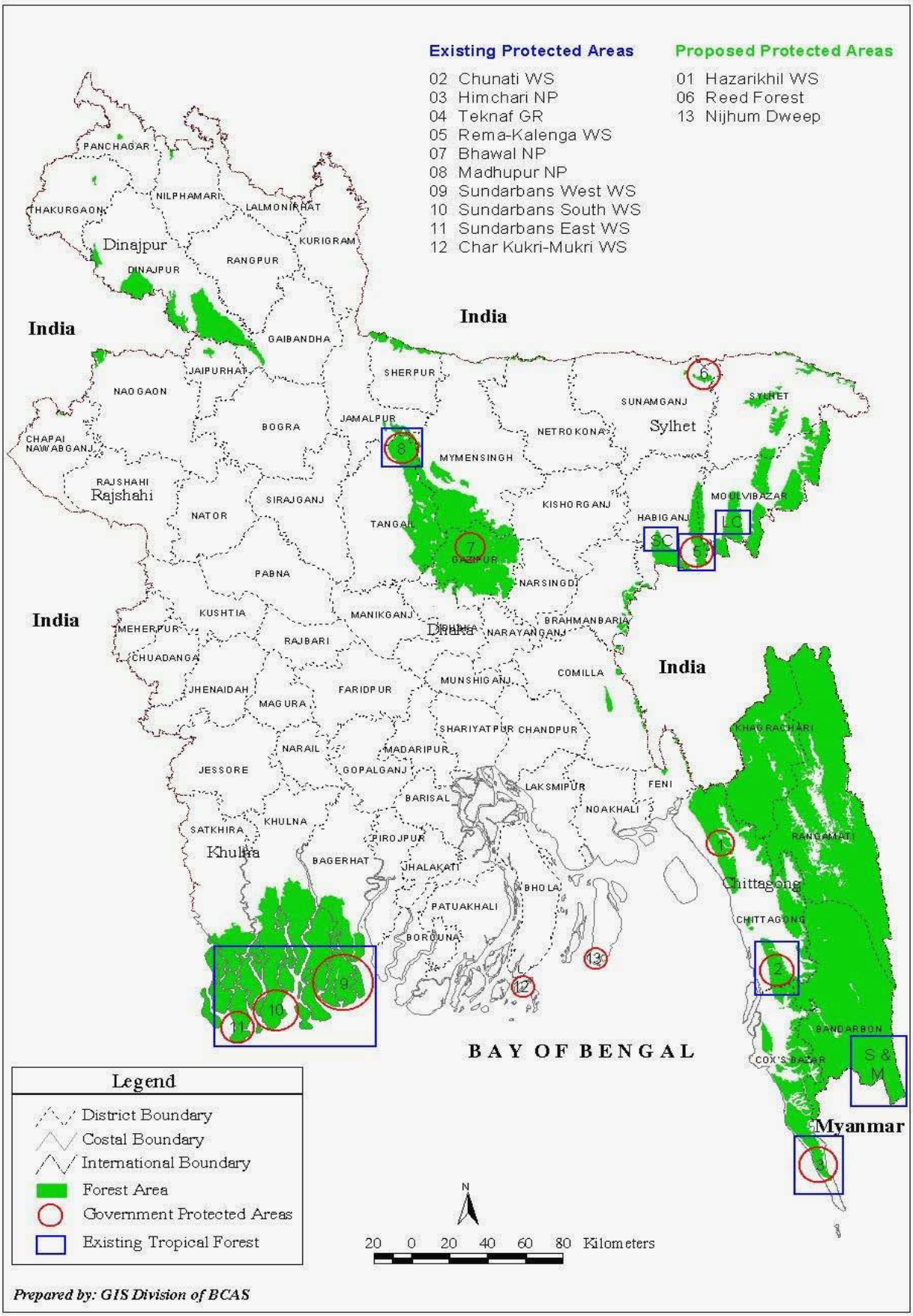
Bangladesh has 16 gazetted protected areas (PA) some with possible natural forest remnants which might be conserved or regenerated. These areas are classified according to their level of protection, i.e., National Parks (NP) have the highest degree of protection, Wildlife Sanctuaries (WS) have a moderate level of protection while Game Reserves have the lowest level of protection. Bangladesh also has a number of Reserved Forests (RF) – a lower level of protection - some with natural forest remnants that might also be conserved or regenerated. A list of Bangladesh's PAs (excluding reserved forests) is presented in Table 1 below, while the location of Bangladesh's primary natural forest areas is presented in Figure 1. Definitions for the various classifications are provided in Annex B.

Table 1: List of protected areas of Bangladesh

Name	Location	Year created	Area (ha)	Present condition
Sundarbans East Wildlife Sanctuary	Southern part of Bagerhat district	1996	31226.938	Management plan prepared/being implemented
Sundarbans South Wildlife Sanctuary	Southern part of Khulna district	1996	36970.454	Management plan prepared/being implemented
Sundarbans West Wildlife Sanctuary	Southern part of Satkhira district	1996	71502.13	Management plan prepared/being implemented
Rema Kalenga Wildlife Sanctuary	Eastern Part of Habiganj district	1996 (Initially gazetted in 1981, expansion gazetted in 1996)	1795.54 (Initially 1095)	Management plan prepared/not implemented
Char Kukri Mukri Wildlife Sanctuary	Southern part of Bhola district	1981	40	Management Plan prepared/not implemented
Pablakhali Wildlife Sanctuary	Khagrachari Hill district	1983	42087	No management plan prepared as yet
Chunati Wildlife Sanctuary	South western part of Chittagong district	1986	7761	Management plan prepared/not implemented
Hazarikhel Wildlife Sanctuary	North eastern part of Chittagong district	1973 (Proposed)	2903	No management plan prepared as yet
Himchari National Park	Northeastern part of Cox's Bazar District	1980	1729	Management Plan prepared/not implemented
Bhawal National Park	Gazipur district	1982	5022	Management plan prepared/not implemented
Madhupur National Park	Tangail district	1982	8436	Management plan prepared/not implemented

Name	Location	Year created	Area (ha)	Present condition
Lawachara National Park	Moulavibazar district	1996	1250	Management plan prepared /not implemented
Kaptai National Park	Rangamati Hill district	1999	5464	No Management plan prepared as yet
Ramsagar National Park	Eastern part of Dinajpur district	2001		No Management plan prepared as yet
Nijhum Dweep National Park	South eastern part of Noakhali district	2001	16352.23	No Management plan prepared as yet
Teknaf game Reserve	South eastern part of Cox's Bazar district	1983	11615	Management plan prepared/not implemented
		TOTAL	**224154.282**	

TROPICAL FOREST AREA OF BANGLADESH



Prepared by: GIS Division of BCAS

2.2 Site Selection

Based on discussions with key stakeholders and on a detailed literature review, the Chemonics team was able to eliminate certain sites for AF consideration (no remaining forests) while identifying - for rapid appraisal purposes - a number of sites where natural forest remnants were thought to exist. It should be noted that the Chemonics team chose not to consider the Sunderbans for AF support at least in the short-term, given the level of ADB support going to the Sunderbans ($80 million). However, there may be a possible niche for the AF in the Sunderbans once the Sunderbans Biodiversity Project gains additional on-the-ground experience.

In this context, the Chemonics team was able to briefly visit a total of six sites to be considered (potentially) for initial AF activities; Lawachara National Park, Satchuri Reserved Forest, Rema Kalenga Wildlife Sanctuary, Madhupur National Park, Chunati Wildlife Sanctuary, Teknaf Game Reserve and the Doolhazara Safari Park. The team was also able to over fly the CHT where important areas under closed canopy forest were found to exist. Although time and resources did not permit a full evaluation of the potential of each site, most of the areas covered in this review have recently been subject to a detailed review and preliminary management planning process (Tecsult 2000a-c, 2001a-c) under the ADB-supported Forestry Sector Project of the FD. This information was verified and updated during site visits and interviews with local FD staff, NGOs, resource users and has been incorporated into this report. The following represents the Chemonics team's recommendations for potential sites for eventual AF implementation, with a summary site analysis matrix provided in Annex C.

2.2.1 Lawachara National Park

2.2.1.1 Location

Lawachara National Park is located approximately 160 km northeast of Dhaka, 60 km south of the city of Sylhet in the civil administrative units of Kamalganj Upazilla, Maulvibazar District – about 10 kilometers from the town of Srimangal. The Park incorporates the southern and eastern parts of West Bhanugach Reserved Forest, within Lawachara, Chautali and Kalachara Beats, Maulvibazar Range, Sylhet Forest Division.

2.2.1.2 Ecological Significance

Although there are some remnant patches of primary forest - including an 8.6 ha unlogged BFRI research plot - most of the original forest cover has been removed or substantially altered; the conservation value of the Park now stems from old plantations (dating back to 1921) of primarily indigenous species which in some areas have developed a tall, multi storied structure, including regrowth of creepers and naturally occurring tree and undergrowth species. Other areas of natural forest cover inside the Park (approximately 130 ha) are utilized for betel leaf cultivation. Although the structure of these forests has been altered by the annual removal of undergrowth and the removal of lower limbs to provide a substrate for the growth of betel vines, the over story composition remains essentially intact. Additionally, an estimated 483 ha of plantations (indigenous and exotics) over 50 years of age are included within the Park representing 40% of

the total gazetted area. Much of the remainder of the area (244 ha. or ~20% of gazetted area) is covered by mixed species (indigenous and exotic) plantations greater than 25 years of age.

Many of the large mammal species have long since disappeared from the Park area (e.g. tigers, leopards, bears, wild dogs, and sambar) probably as a combined result of hunting and habitat fragmentation. However, viable populations of many small and medium sized mammal species that can survive in disturbed or secondary habitats (e.g., jackals, small cats, barking deer, wild pigs) still remain. The Park also supports important populations of; gibbons, langurs and macaques. Two of these (hoolock gibbon and capped langur) could be used as key indicator species for the development and implementation of any conservation measures.

The Park and adjacent Reserved Forest support a documented avifauna of 337 species, one third of the total bird species known from Bangladesh. The avifauna includes a large number of species that are dependent on dense ground cover and undergrowth (47 species) and/or forest cover (175 species).

The Park is also thought to support a rich diversity of other faunal groups (reptiles, invertebrates, some fishes and amphibians). However, very little information on these groups is currently available.

Finally, the Park is drained by a number of small, sandy bedded streams, all of which dry up following the end of the rainy season in October November. Although limited in extent, aquatic habitats and riparian (streamside) vegetation are important elements of overall habitat composition. Both of these elements are thought to harbor specialized plant and animal species although inventories are incomplete.

2.2.1.3 Management Status

Protection Status

The area was formally established as a National Park in 1996, incorporating an area of 1250 ha. Refer to Annex B for the definition of a National Park.

Threat Analysis

Continued FD emphasis on production forestry in the buffer zones surrounding the Park. With the exception of Forest Village areas and small areas of agricultural encroachment virtually all of the Park area and proposed extension have been converted to plantations. The original intention of these plantations was production of timber, cane, bamboo and other forest products, with plantation planning, establishment, management and harvest under the centralized control of the Forest Department. Although logging has been stopped in the Park, FD continues to clear cut (and replant) mature plantations in the reserved forests surrounding the Park. The large clear-cut size (100+ha), the relatively large percentage of organic material removed, the fact that the harvest does not mimic natural disturbance such as a large blow down, all mean that these buffer zones will do little to contribute to the conservation of biodiversity in the Park.

Impact of forest villages inside the Park. Two Forest Villages inhabited by Khasia people are located within the Park area. The largest of those (Magurchara) was established some 48 years ago and currently consists of about 40 households. These villagers grow betel vines in an adjacent area of the Park (110 ha) with the express permission of the Forest Department, and in exchange for participation in plantation management activities and enforcement patrols. (As stated above betel production changes the under story structure of the forest, but leaves the over story intact.) The villagers have also established small paddy fields adjacent to the village. Fuelwood and building materials requirements are reportedly obtained from the betel growing areas, and laborers engaged by the villagers for betel leaf harvest also obtain fuelwood from these areas.

The Second Forest Village (Lawachara) was established in the 1940s and currently consists of about 23 households. These villagers also use forest land for betel leaf production in exchange for providing labor to FD. Fuelwood and building materials requirements of the villagers, and fuelwood requirements of laborers hired for betel leaf harvesting, are reportedly obtained from the betel production areas.

External harvest of timber, fuelwood and other non-timber forest products. In addition to use by resident villagers, the Park area is widely used by the surrounding rural population, residents of neighboring Tea Estates, and marginalized urban dwellers from as far away as Srimongal, for harvest of forest products. The most common and widespread use of the Park appears to be for subsistence harvest of fuelwood. Some fuelwood harvest is permitted by local FD staff in exchange for menial labor such as sweeping, cleaning, nursery work, even though such arrangements are technically illegal and greatly complicate enforcement and control efforts

However, there is also some evidence that fuelwood collection is becoming organized and commercialized based on the team's limited observations of several small groups of women and young children, who primarily harvest sticks and dead branches, and by groups of men and adolescent boys, who harvest standing trees and chop and bundle measured lengths for marketing. Additionally, the fuelwood situation may be exacerbated by the fact the tea estates do not employ all their workers on a year round basis. During the dry season and when the tea market is poor, casual workers – those living both inside and outside the estate - reportedly resort to fuel wood collection to supplement their cash income.

Illicit harvest of mature timber, primarily teak but also including other species, is reportedly widespread. This is carried out at night by large, often armed, gangs.

Bamboos also are widely harvested within the Park area and surrounding reserved forests, primarily, it appears, for subsistence and small-scale commercial use. (Most commercial bamboo comes from the Tea Estates. Other NTFPs harvested in the area are vines (reportedly for mechanical use) and grasses and leaves used for livestock fodder and mulch. Some in situ livestock grazing also occurs but this appears to be limited primarily to the highway margins and (to a lesser extent) to the railway right of way.

2.2.1.4 Leverage

The Chemonics team believes that Lawachara has high leverage potential. Lawachara has threats similar to other PAs but these threats are not at the same scale and would be easier to address. There is excellent potential to apply lessons learned from Lawachara to other sites in the ecoregion (Satchuri and Rema-Kalenga), and elsewhere. There is also good potential for building AF credibility, given Lawachara's ease of access and the high visibility any conservation success would bring.

2.2.1.5 Feasibility/Project Potential

The Chemonics Team believes that there is considerable project potential for the AF at Lawachara in spite of FD's continued focus on production forestry in the reserved forest buffer zones and apparent lack of interest in moving to a more conservation-oriented approach. There are several reasons for this conclusion:

- *Relatively good tourism potential*. The potential for ecotourism and cultural tourism in Lawachara National Park and the surrounding tea estates, wetlands and other remnant forest areas of Maulvibazar District has been long recognized. However, visitor use in the Park area is currently limited to occasional group visits to the Janakichara Nursery and to mostly official visitors to FDs Samoli Resthouse, located adjacent to Lawachara Beat Office. Dolobari Village is occasionally visited by school groups and individual travelers, mostly foreigners. Magurchara Village also receives occasional visitors, both drop-ins and as part of tours arranged by Bangladesh Parjatan Corporation. Lawachara is considered to be the best forest in the country for bird-watching but this use currently involves only very limited numbers of visitors.

- *Additional habitat potential of Tea Estates*. The Park and the extension proposed by the Forestry Sector Project, are bordered on the north, west, south and southeast largely by Tea Estates. These estates contain large areas of unmanaged secondary vegetation which provide additional wildlife and plant habitat. Where adjacent to the Park, these secondary areas provide an important transition zone between mixed forest cover and tea gardens and other monocultures. However, the current trend among the majority of estates is for these secondary vegetations areas to be removed and converted to rubber, pineapple and other plantations monocultures (bamboo), thus indirectly affecting habitat availability for some wildlife species populations centered in the Park. However, Finlay's Tea, the oldest and largest estate owner in Bangladesh, has set aside about 60ha of natural forest as a protected area. Financial incentives such as tax relief and the elimination of royalties paid to the FD for cutting estate-planted shade trees and bamboo, might encourage other estates to follow Finlay's lead.

- *High potential for reconversion to natural forest structure*. In the oldest of the Park's plantation areas, the vegetation cover has taken on the structure of natural forest, and evolution toward a natural structure and species composition is expected to continue with the implementation of protective measures. The other small natural forest

patches in the Park along with the "volunteer" fruit trees represent a seed bank for both enrichment plantings and natural regeneration. The MACH project has also started a nursery for local species in the area. The betel leaf cultivation areas also retain high potential for reconversion to natural forest structure.

- *Good forest/vegetation monitoring potential*. BFRI has an office and staff at Lawachara, and has established permanent sample plots to monitor the growth and performance of natural forest species in previously cleared areas. Other activities include under planting trials of locally dominant forest species and a small nursery with predominantly local species, including fruit trees. On the wildlife side, the capped langur could be relatively easily used as key indicator species for the development and implementation of any conservation measures.

- *Relatively limited illegal harvest of Park resources*. Being surrounded by tea estates, Lawachara is not as subject to the open access resource syndrome common in other areas of Bangladesh.

2.2.1.6 Possible AF Activities

The approach the AF should try to use is to negotiate with the FD to manage Lawachara and the surrounding reserves on a conservation basis rather than a production basis. Negotiations could include (but would not necessarily be limited to) the following:

- Convince FD to include a 281 ha extension to the north of the currently gazetted area. The extension would incorporate most of the remaining plantations in West Bhanugach Reserve Forest that are greater than 25 years of age. The addition of this area would add habitat used by important forest dwelling wildlife species, thus improving their population viability and maximizing the area of primary biodiversity value under conservation management.

- Drawing on the existing management plan developed under the Forestry Sector Project, and drawing on the delineation principles for core areas, buffer zones and fringe areas for biosphere reserves provided in Annex E, define and agree on management zones and actions to be undertaken in each zone, e.g.,

Zone	Management Objective	Possible Partner
Ecosystem management zone (Core area)	Long term protection and rehabilitation of remaining forest cover (all existing high forest and selected areas that can be restored to natural forest cover)	BFRI Ecotourism NGO for interpretive center, etc.
Habitat Management Zone (Buffer zone)	Restoration and/or manipulation of habitat for selected wildlife species (e.g., gibbons and langurs). These zones are likely to be areas converted to agricultural land by the Forest Villages; encroached areas along the periphery; and long term plantations	BFRI for restoration guidance, NGO for facilitation with forest villages
Sustainable use zone (Outer transition area)	Sustainable use of plantations using uneven aged or selective management techniques, or other silvicultural techniques consistent with biodiversity conservation.	BFRI for uneven aged management, NGO for better management of ag/forest village lands and related buffer

	Better management of agricultural areas and habitation including reclamation of certain village betel areas and establishment of participatory plantations and natural forest cover in peripheral areas	zones.

- Provide support to BFRI to conduct literature reviews on uneven aged/selective plantation management, and on natural forest restoration. Have BFRI develop research protocols for these areas and support actual research.
- Identify NGO (preferably local) to work with stakeholders in the sustainable use zone (participatory plantation development, agroforestry, sustainable fuelwood harvest from natural forest areas, etc.)
- Identify NGO to begin development of basic interpretive facilities for the Park (nature trails, sign boards, etc.). Peace Corps Volunteers might be a valuable resource to assist the NGO(s) and FD engaged in this activity. Consider turning management of the guest house over to the private sector on a concession basis, as a means of income generation.
- Negotiate with the GOB (Treasury, MOEF and FD) the possibility of having a portion of the revenues generated by the Park and surrounding reserves be retained locally for Park management purposes and for the possible creation of a Community Conservation Fund which would support community efforts in biodiversity conservation (and perhaps some social works activities such as schools, dispensaries, etc.)
- Independent of the above activities, develop a Tea Estate Program which would target estate managers and encourage them to set aside areas in natural forest. Specific activities could include dialogue with the Tea Board, promotion of site visits from other estate managers to Finlays, and policy dialogue on possible financial incentives such as tax relief and the elimination of royalties paid to the FD for cutting estate-planted shade trees, to encourage other estates to follow Finlay's lead. This program could also explore alternative income sources and/or incentives for estate owners to maintain workers on a year round basis.

2.2.2 Satchuri Reserved Forest

2.2.2.1 Location

Satchuri reserved forest is located on the Dhaka-Sylhet Highway, between Teliapara and Srimangal, in Habiganj District. The forest is about130 km northeast of Dhaka and is one of the most easily accessible reserved forests in the country.

2.2.2.2 Ecological Significance

The reserve comprises an area of about 1760 ha of which about 200 ha are in natural forest and the remainder in long-term rotations (primarily teak and mahogany) and short term rotations (primarily Acacia mangium). Conversion of the natural forest to plantations began in the 1950's.

The condition of the natural forest appears relatively good (primarily closed canopy), the only exception being in areas where the FD has cut under story vegetation to plant cane and bamboo. Although there is a moratorium on logging within the natural forest, there was some evidence of illegal felling of relatively large trees (40 cm diameter).

As with Lawachara, many of the large mammal species have long since disappeared from the Reserve area (e.g. tigers, leopards, bears, wild dogs, sambar) probably as a combined result of hunting and habitat fragmentation. However, the headman from the Forest Village located inside the Reserve reported seeing a black bear about three months ago. In spite of this loss, viable populations of many small and medium sized mammal species that can survive in disturbed or secondary habitats (e.g., jackals, small cats, barking deer, wild pigs) still remain. The Reserve also supports important populations of langurs and macaques. The capped langur could be used as key indicator species for the development and implementation of any conservation measures.

There is very little information on the status of the avifauna although species found there are thought to be similar to those in Lawachara. The Reserve is also thought to support a rich diversity of other faunal groups (reptiles, invertebrates, some fishes and amphibians). However, very little information on these groups is currently available.

Finally, the Reserve is drained by a number of small, sandy bedded streams, all of which dry up following the end of the rainy season in October November and are subject to intensive commercial harvesting of sand during the dry season.

Although limited in extent, aquatic habitats and riparian (streamside) vegetation are important elements of overall habitat composition. Both of these elements are thought to harbor specialized plant and animal although inventories are incomplete.

2.2.2.3 Management Status

Protection Status

Reserved Forests are basically governed by the Forest Act 1927 (with subsequent amendments). Refer to Annex B for the definition of a Reserved Forest.

Threat Analysis

Continued FD emphasis on production forestry. As noted above, a major portion of the Reserve has been converted to plantations. The original (and current) intention of these plantations was production of timber, cane, bamboo and other forest products, with plantation planning, establishment, management and harvest under the centralized control of the Forest Department. Although logging has been stopped in the natural forest, FD continues to clear cut (and replant) mature plantations both inside the Reserve and in bordering reserves. The large clear-cut size, the relatively large percentage of organic material removed, the fact that the harvest does not mimic natural disturbance such as a large blow down, all mean that these buffer zones will do little to contribute to the conservation of biodiversity in the Reserve.

The FD also continues to cut under story vegetation in the natural forest in order to plant cane and bamboo. Although not quantified, this practice has a significant negative impact on natural regeneration and forest succession.

Changing these practices may be difficult given the amount revenue generated. Average revenue for cane and bamboo sales amounts to about taka 600,000 per month. The Reserve will generate about taka 100,000,000 from teak harvest this year alone, and the beat office estimates a yearly income of about taka 20 million from both the long and short term rotations. All revenues from the reserve go to the central treasury with no local income retention. Revenue generated by the Reserve far exceeds its budget allocation estimated to be taka 300,000 per year.

Impact of forest villages inside the Reserve. There is one forest village located within the reserve area with about 20 families (5-6 people per family). These villagers grow betel vines in the natural forest part of the Reserve with the express permission of the Forest Department, and in exchange for participation in plantation management activities and enforcement patrols. (As stated above betel production changes the under story structure of the forest, but leaves the over story intact.) The villagers have also established small paddy fields adjacent to the village. Fuelwood and building materials requirements are reportedly obtained from the betel growing areas, and laborers engaged by the villagers for betel leaf harvest also obtain fuelwood from these areas.

External harvest of timber, fuelwood and other non-timber forest products. In addition to use by resident villagers, the Reserve area is widely used by the surrounding rural population, residents of neighboring Tea Estates, and marginalized urban dwellers for harvest of forest products. The most common and widespread use of the Reserve appears to be for subsistence harvest of fuelwood. The beat officer estimated that there are about 150-200 people/day collecting fuelwood, with each carrying an average of about 40 kilo per day (more for men, less for women). This represents about 6 tons of fuelwood being extracted from the forest each day. Fuelwood harvesters commonly pay the FD 10-15 taka per day for this privilege. In some cases, fuelwood harvest is permitted by local FD staff in exchange for menial labor such as sweeping, cleaning, nursery work, even though such arrangements are technically illegal and greatly complicate enforcement and control efforts. In theory, harvesters are only permitted to collect dead wood. However, the common practice is for trees to be girdled and or felled, left to dry, and then harvested as dead wood. The extent to which fuelwood harvesting has become organized and commercialized in Satchuri is unclear, although the volume collected would appear to exceed local subsistence needs.

As with Lawachara, there is some illicit harvest of mature timber, primarily teak but also including other species, with the beat officer reporting that most of the problems are coming from the Indian side.

Bamboos also are widely harvested within the Reserve and surrounding reserve forests, primarily it appears, for subsistence. (Most commercial bamboo comes from the Tea Estates.) Other NTFPs harvested in the area are vines and grasses and leaves used for livestock fodder and mulch.

Sand harvesting. Satchuri is subjected to intensive commercial harvesting of sand during the dry season.

2.2.2.4 Feasibility/Project Potential

The Chemonics Team believes that there is considerable project potential for the AF at Satchuri in spite of FD's continued focus on production forestry. There are several reasons for this conclusion:

- *Relatively good tourism potential*. Although not as great as Lawachara, there appears to be good potential for ecotourism and cultural tourism in the Reserve and the surrounding tea estates, wetlands and other remnant forest areas of Maulvibazar District. To date, however, visitor use has been limited to student groups, day picnickers and the occasional forester. Both the Forest Village headman and d the beat officer reported that they have been asked on several occasions to act as guides for various groups and individuals.

- *Additional habitat potential of Tea Estates*. The reserve is also bordered by Tea Estates containing large areas of unmanaged secondary vegetation that provide additional wildlife and plant habitat. Where adjacent to the Reserve, these secondary areas provide an important transition zone between mixed forest cover and tea gardens and other monocultures. However, the current trend among the majority of estates is for these secondary vegetations areas to be removed and converted to rubber, pineapple and other plantations monocultures (bamboo), thus indirectly affecting habitat availability for some wildlife species populations centered in the Reserve. However, as noted for Lawachara, at least one estate – Finlay's - has set aside about 60ha of natural forest as a protected area. Financial incentives such as tax relief and the elimination of royalties paid to the FD for cutting estate-planted shade trees, might encourage other estates around both Lawachara and Satchuri to follow Finlay's lead.

- *High potential for reconversion to natural forest structure*. Although the impact of under story cutting and planting of cane and bamboo on natural regeneration has not as yet been determined, the general consensus is that if the practice is stopped, the forest would revert to its original state. (Some FD employees argue that the presence of cane acts as a deterrent to illegal logging.) The betel leaf cultivation areas also retain high potential for reconversion to natural forest structure.

- *Good forest/vegetation monitoring potential*. BFRI has an office and staff at Lawachara, only 30 kilometers distant and could conceivably be called upon to establish a vegetation monitoring program as well as provide advice/research assistance on alternative, more conservation oriented management practices. On the wildlife side, the capped langur could be relatively easily used as key indicator species for the development and implementation of any conservation measures.

- *Relatively limited illegal harvest of Reserve resources*. Being surrounded by tea estates, Satchuri, like Lawachara, is not as subject to the "open resource" syndrome common in other areas of Bangladesh.

2.2.2.5 Leverage

The Chemonics team believes that Satchuri has high leverage potential. Like Lawachara, Satchuri has threats similar to other PAs but these threats not at the same scale and would be easier to address. There is also excellent potential to apply lessons learned from Satchuri to other sites in the ecoregion (Satchuri and Rema-Kalenga), and elsewhere. There is also good potential for building AF credibility, given Satchuri's ease of access and the high visibility any conservation success would bring.

2.2.2.6 Possible AF activities

- Possible AF activities would be the same as for Lawachara; working through local NGOs, the development of a zoning system permitting controlled harvest sustainable use in certain areas by local people who currently rely on forest resources from the area, while restricting use in others would be relatively simple to implement.

- Additionally, negotiations with the FD should include upgrading of the status of the Reserve to that of Park, which would; (1) better ensure its protection; and 2) enable the AF to focus resources on a collection of sites that captures the range of biodiversity of the ecoregion. However, any upgrade must be complemented by commitment by the FD and local stakeholders to actually implement the protection provisions, even though the area may generate fewer benefits in the short term.

2.2.3 Rema-Kalenga Wildlife Sanctuary

2.2.3.1 Location

Rema Kalenga Wildlife Sanctuary is located approximately 130 km east northeast of Dhaka and 80 km south southwest of the city of Sylhet in the civil administrative units of Chunartighat Upazilla I labiganj District. The Sanctuary comprises the southern and eastern parts of Tarap Hill Reserved Forest, incorporating parts of Kalenga, Chonburi and Rema Beats, Habiganj 2 Range, Sylhet Forest Division. The Sanctuary is bordered on the east and south by the Indian state of Tripura.

2.2.3.2 Ecological Significance

The natural vegetation cover of the Sanctuary area is mixed tropical evergreen forest. Degraded by prolonged human use, high, closed canopy forest is very rare, at least in the northern portion of the Sanctuary visited by the Chemonics team. Forest condition and contiguity are reported to be better in the south. A small part of the Sanctuary area has been converted to mixed species, long rotation plantations; the older of these areas show signs of developing a tall, closed canopy structure with an understory of naturally occurring tree and undergrowth species.

A number of large mammal species have long since disappeared from the Sanctuary area as a combined result of hunting and habitat fragmentation (e.g., tigers, bears, elephants, and probably wild dogs, and leopards), and others (e.g., hoolock gibbons, sambar) are likely on the verge of extinction. However, viable populations of many small and medium sized mammal species that can survive in limited forest areas and/or disturbed or secondary habitats still remain (e.g., jackals, small cats, barking deer, wild pigs). The Sanctuary also supports important populations of langurs and macaques. One of these (capped langur) could be used as a key monitoring species. The total of 35 mammal species documented in the area to date includes at least 23 species which are at a high to extremely high risk of extinction in Bangladesh.

The avifauna of the area has not been fully documented, but includes a mix of forest dwelling and wetland associated species. The (incomplete) total of 167 species documented in the area to date includes at least 10 species that are at high to extremely high risk of extinction in Bangladesh.

Although incompletely documented, the Rema Kalenga area also supports an important herpetofauna, including seven frogs and toads, two turtles, six lizards, and 10 snakes among the total 25 species documented to date. Two of the amphibians and 14 of the reptiles are rated as being at high to extremely high risk of extinction in Bangladesh.

The Sanctuary is also expected to support a rich diversity of other faunal groups (invertebrates, some fishes). However, very little information on these groups is currently available.

The Sanctuary is drained by a number of small, sandy bedded streams, which largely dry up following the end of the rainy season in October November. Although limited in extent, aquatic habitats associated with forest cover and riparian (streamside) vegetation are important elements of overall habitat composition. Both of these elements are expected to harbor specialized plant and animal species, although inventories are incomplete

2.2.3.3 Management Status

Protection Status

The original Sanctuary area of 1095 ha was gazetted in 1981 and was expanded to 1795 ha in 1996, and now includes 85% of the high forest remaining in Tarap Hill Reserved Forest. Refer to Annex B for the definition of a Wildlife Sanctuary.

Threat Analysis

Continued FD emphasis on production forestry in the buffer zone. Although logging has stopped on the plantations within the Sanctuary, production forestry, focusing on long rotation plantations and to a lesser extent on plantations of other species, is the primary land use in Tarap Hill reserved forest. A much larger proportion of Reserved Forest land outside of the Sanctuary has been converted. Plantation establishment has been at least partially at the expense of natural forest, 785 ha of which were clear felled by the Forest Department during 1984/85 90/91 and

replaced by plantations. Plantation planning, establishment, management and harvest are currently under the centralized control of the Forest Department.

The management plan developed for Rema-Kalenga under the Forestry Sector Project proposed conservation-oriented management prescriptions for Reserved Forest land contiguous with the Sanctuary's western and northern boundaries. The proposed 1 km wide buffer zone includes an additional 249 ha of high forest, which in combination with the Sanctuary area brings virtually all (99.9%) of the existing high forest within Tarap Hill RF under conservation management. In addition, the buffer zone would include nearly 700 ha of primarily long rotation plantations, which would: 1) make important contributions to biodiversity conservation, at least in older (pre 1970s), mixed stands; 2) provide additional habitat for some forest dwelling wildlife species; and 3) be used in part to involve existing users in participatory management, thus shifting fuelwood and other NTFP harvest pressures away from natural forest areas. However, to the Chemonics team's knowledge, the plan has never been implemented.

Impact of forest villages inside the Sanctuary. According to the Rema Beat Officer, there is one Forest Village within the Kalenga Beat with about 95 families (5-6/family). The impact of these families was highly visible, as a large area of the Beat is under cultivation (rice paddies for the most part), and forest clearing for new paddies appears to be continuing unabated. This problem is exacerbated by the presence of 400+ cattle and goats whose impact on the forest is highly visible. Additionally, there are 33 households in Rashidpur Beat, 50 in Chonbari Beat and 13 in Rema Beat, but actual household numbers may be much higher due to natural population increase. Although the Chemonics team was not able to ascertain the impact of these other villages, it is expected that land use patterns and level of degradation in the other beats are similar to those in Kalenga.

The Forest Villager system is a long standing arrangement whereby these people are permitted to live on FD land and to cultivate all level areas within the forest, in return for providing assistance with plantation management and forest protection. They also harvest fuelwood and building materials from the forest, and although not officially permitted this practice is tolerated by FD staff as a de facto part of the arrangement. However, the Management Plan for Rema-Kalenga notes that:

- Many of the people currently living in or using the Sanctuary are not registered Forest Villagers, although they may be descendants;

- Forest Villagers (and others) living in the Sanctuary are using more than the agreed allotment of 1.2 ha per household, including paddy lands vacated when people who were not registered as Forest Villagers were removed in 1982;

- An estimated 50% of paddy lands in the Sanctuary are used by people from outside.

Impact from the Bangladesh Rifles Camp. The two Bangladesh Rifles (BDR) Camps in or near the Sanctuary represent a major human presence resulting in a limited impact on the Sanctuary from firewood collection. However, the BDR cooperates with the FD in controlling illicit fellers

who enter the Sanctuary from India, and can officially prosecute forest related offences independently.

Absence of conservation or other forest management programs applicable to the Sanctuary. The Sanctuary and the adjacent remaining portion of Tarap Hill Reserved Forest currently are managed under the territorial system of the Forest Department, with the Range Officer (Habigonj 2 Range) as the senior field officer responsible for the area, reporting to the DFO Sylhet. Five staff were posted to the Sanctuary under FD's Wildlife Conservation and Management Project during the mid 1990s but have since been withdrawn. Although a management plan for Rema-Kalenga was developed under the Forestry Sector Project, the FD appears to have no intention of implementing it.

Illegal logging. Theft of timber trees (primarily teak) from plantations in Tarap Hill RF is a major ongoing problem. FD plantations bordering the Sanctuary on the north and west are extensively used by illicit timber harvesters, but these plantations also appear to provide a largely effective buffer against penetration of illicit fellers into the interior of the Sanctuary from these directions. Illicit timber harvesters have relatively easier access to the eastern and southern sides of the Sanctuary from India. Illicit harvesters also enter the northeastern part of the Sanctuary via adjacent khas and Tea Estate land in Bangladesh, and float logs out down the Kalenga Chara during the rainy season. Medium sized trees appear to be targeted as these can most easily be cut up into manageable lengths for rapid transport out of the Sanctuary.

Pressure on NTFPs. There is also heavy harvesting pressure on some NTFPs destined for outside/urban markets (e.g., creepers used for making baskets), to the extent that some of the Sanctuary's NTFP resources are becoming severely depleted.

Land adjacent to the Sanctuary in India has been extensively converted to rubber plantations and paddy fields. Little or no natural forest borders the Sanctuary on the east or south, although some scrub vegetation remains. Khas lands adjacent to the Sanctuary in the northeast have been partially converted to citrus and banana plantations, which may encroach on FD lands. The leaseholder also has felled scattered natural tree cover in this area.

Although the Sanctuary area was previously used for hunting by government personnel and local elites, this practice has long since ceased. However, some hunting may still be carried out by illicit tree fellers, and wild pigs and jungle fowl are hunted by some Forest Villagers. Hunting by villagers may cause collateral damage to under story vegetation, as burning of the under story is used as a method of driving wild pigs.

2.2.3.4 Leverage

The Chemonics team believes that Rema-Kalenga has relatively low leverage potential, and a "conservation success" there will be difficult in the short term. We feel that it would be better for the AF to initiate activities in Lawachara and/or Satchuri and then apply lessons learned there to Rema-Kalenga, in order to better resolve local credibility issues. Additionally, the isolated nature of the site makes attracting the attention of other PA managers, donors, etc., all the more difficult.

2.2.3.5 Feasibility/Project Potential

Keeping in mind the objective of selecting initial activities based on strategic impact, feasibility, and ability to be carried out quickly to build a track record, the Chemonics team believes that this would be a difficult site (at least the northern section) for the AF to "start" with. The reasons for this are threefold:

- *Difficult resolution of settlement problems*. Resolution of settlement problems will require comprehensive socio economic surveys of current users, rationalization of the list of Forest Villagers, including development of a mechanism to take account of population increases, and development of land use agreements. All of this would take considerable time and resources and would need to be done prior to undertaking any remedial actions in the Sanctuary.

- *Limited tourism potential*. Due to its isolated location the Sanctuary receives little or no visitor use, and the potential for such use (and resulting income potential) in the near term is considered to be limited. Visitor accommodation is limited to the FD rest house at Kalenga Beat Office (recently upgraded to three bedrooms), and to a rest house at Chonbari Beat Office constructed under the Wildlife Conservation and Management Project, and current being used as a residence. There are currently no other visitor facilities. The wildlife-viewing tower that was built when the Wildlife Sanctuary was established now seems to have been abandoned. It overlooks a small lake in one direction but is mostly surrounded by paddy fields and agricultural lands.

- *Apparent tendency to open access*. Of the three sites visited in Syhlet Forest District, Rema Kalenga – at least the northern section - was by far the most degraded and showed the most signs of human use. The Chemonics team believes that it will be difficult to change land/Sanctuary use patterns, at least in the short-term. Paddy cultivation and subsistence use of forest resources (fuelwood, bamboos) are well established, authorized (in the case of Forest Villagers) forms of land use which will be difficult to change without alienating local residents and negatively affecting overall management effectiveness in the Sanctuary.

2.2.3.6 Possible AF activities

- Tea estate lands adjacent to the Sanctuary cover a total area of 850 ha, of which 144 ha are under tea, 40 ha under rubber, and the remainder under scrub and natural forest. The latter areas represent an important timber and fuelwood resource to the 1200 people living on the estate (60% of whom are employed as workers), and provide wildlife habitat additional to that included in the Sanctuary. The tea estate program proposed for the Lawachara and Satchuri could easily be expanded to include Rema Kalenga.

- Additionally, as noted above, forest condition is reported to be better in the south. Thus, AF should consider verifying this assertion prior to making any final decision on Rema-Kalenga as a possible site.

2.2.4 Madhupur National Park

2.2.4.1 Location

The Park is located in the northeastern part of Tangail Forest Division, along the boundary with and extending marginally into Mymensingh Division. Of the 8,437 ha of gazetted area, 8,197 ha (97%) are located in Tangail and 240 ha (3%) in Mymensingh. The Park is located ~50 km by road from Tangail city and ~30 km from Mymensingh.

2.2.4.2 Ecological Significance

Madhupur National Park is a remnant of the very extensive deciduous forest that once covered the central plains of Bangladesh. In its natural state this forest has a canopy of tall sal (*Shorea robusta*) trees and a number of fire resistant associates, and a rich multi species under story. Currently, the present extent of forest cover within Madhupur National Park and immediately adjacent areas is estimated to be less than 4000 ha. As elsewhere in the country, human population growth and conversion of forest lands to agriculture have severely affected the extent and condition of Madhupur's forests. Other factors have been extensive conversion to plantations (primarily rubber, Acacia and Eucalyptus) under various government initiatives; removal of forest undergrowth and under planting with rattan, also under government programs; uncontrolled livestock grazing; widespread illicit felling and collection of fuelwood and other forest products; and widespread uncontrolled ground fires with consequent damage to forest undergrowth and soils.

Most of the low lying (*baid*) areas of the Park have long been converted to paddy cultivation, and little or no natural vegetation cover remains in these areas. The slightly elevated but largely flat upland (*chala*) areas of the Park support a natural vegetation cover of sal forest. Much of this has been converted to village lands, cultivation (primarily pineapple and fruit tree plantations), rubber plantations established by Bangladesh Forest Industries Development Corporation, and plantations established by the Forest Department. The FD plantations include rattan (under planted in *sal* forest), bamboo, teak, *dipterocarps*, and short rotation species such as *Acacia auriculiformis*, *A. mangium* and *Eucalyptus camaldulensis*.

The current condition of remaining sal forest cover is highly variable, ranging from patches of tall forest (canopy height 15+ m) around the FD buildings at Rasulpur and Dokhola, to scrub forest in which the tallest trees are only 6 8 m in height. All areas have been subjected to a varying degree of disturbance, including clear felling followed by silvicultural treatment (coppice management or artificial regeneration); illicit felling of the largest and/or most valuable trees for commercial use; subsistence harvesting for construction timber, poles and fuelwood; grazing; burning; and harvesting of non timber forest products (fruits, tubers, etc.).

Although all areas have been subjected to some degree of use, and the larger wildlife species (elephants, tiger, leopards, sloth bears, spotted deer) have been extirpated, it is noteworthy that recent surveys have shown that most of the plant biodiversity still remains. Current vascular plant diversity is estimated at 176 species, 73 of which are trees. Bird diversity has been estimated as 140 species, mammal diversity as 19 species, reptile diversity as 28 species and amphibian diversity as 4 species. Madhupur was thought to be the main center of abundance for capped langurs (548) but there is recent evidence of population declines with some estimates suggesting that there may be less than 100 individuals remaining. Team observations of langurs feeding in Acacia plantations and in orchards/homestead plantations could be indicative of a lack of food in degraded forest areas.

2.2.4.3 Management Status

Protection Status

The Park was formally established in 1982, incorporating an area of 8437 ha. Refer to Annex B for the definition of a National Park.

Threat Analysis

Madhupur National Park represents the most complicated set of protected area management problems in Bangladesh. A number of inter related factors/threats determine how realistically the AF could intervene.

Unclear land tenure. Land ownership is a major issue in the Park and surrounding areas, with occupation/control of specific areas being based on registered title, right of record (contested by the Forest Department), encroachment on government land by local residents, and uncontested ownership by government with management by the Forest Department. The Garo indigenous communities have contested the claims of the Government ever since the Madhupur tracts were first claimed as State Lands. Many people, mainly from outside the area, also bought out rights to land from departing Zamindars, some back-dated to support claims of occupancy prior to Government declaration of the entire area as State Forest lands. The land tenure situation has been made even more complex by the influx of many Bangladeshi immigrants in search of agricultural land to work or other gainful employment as a basis of livelihood. The increased population pressure on the land has made the Jhum practices of the Garo communities unviable; there is insufficient land to permit long (10-12 year or longer) fallow periods following jhum cultivation, in order to allow natural recovery of soils and sustainability of the system.

The declaration of a National Park, still with ill-defined boundaries, further exacerbated the situation, although did provide release of the claims of the government to a large section of the Western Madhupur tracts, formerly all under sal forest cover.

Given this situation, the FD currently spends a lot of time and effort in trying to regain/maintain control of forest land that has long been completely converted to cropland, and this focus takes time and resources away from the management of remaining natural forest areas while contributing little if anything to the conservation of biodiversity.

Inadequate FD capacity and resources for effective park/biodiversity management

- Attempts by the FD during the 1970s to reforest recovered encroached lands with moderately fast growing indigenous species were largely unsuccessful due to destruction by the local population. Additional animosity arose over the razing of large areas of sal coppice forest during the late 1980s and early 1990s for the establishment of rubber plantations in the western half of the Park.

- There has been a long history of animosity between the Forest Department and people who live in the Park and surrounding/adjacent areas arising from disputes over harvest of forest resources and land ownership. The Garos (and the recent settlers who have acquired Garo lands) claim right of ownership and use over much of the land base, but the Forest Department views harvest of forest resources as illegal and conversion of forest to agricultural land as encroachment.

- The Thana Banayan and Nursery Project (1987 95) introduced participatory agroforestry and woodlot plantations covering >1800 ha in the Madhupur forest area, but this too resulted in animosity as the Forest Department failed to uphold harvest agreements and to adhere to the agreed schedule of benefit sharing, and even arrested participants who harvested what they perceived to be their share of plantation production. The mature plantations have now virtually all been felled illegally. The continuing animosity and distrust arising from this situation is a very serious problem as it increases the difficulty of agreeing on and implementing participatory approaches to forest management and conservation.

- There is a widely held view of National Park residents that the FD, police and other enforcement personnel act in collusion with illicit fellers from outside of the Park area adds to the climate of animosity and distrust.

- FD has not developed specialized, protected area management activities within the Park. On the contrary, the Park has been managed much like any other forest area under FD control, and has been subjected to various management interventions (extensive establishment of exotic and/or monoculture plantations, including clear cutting and burning; development of a zoo) that would not normally be considered appropriate in a protected area.

- The FD has filed numerous cases of illegal cutting of Forest reserve trees against local inhabitants; the FD beat officers claim –and some of the local communities concede that they depend heavily on the extraction of firewood, even some logs that they sell to local brick kiln operators and saw-mill operators. However, many of the cases may well be without validity and often drag on for years, with few coming to settlement. In fact, some people interviewed suggested that many cases represent a means for the FD to have leverage over local residents to ensure their compliance with FD strategies for forest management and use of the productive forest resources.

- The Forest Department is currently implementing a GoB funded project for the development of Madhupur National Park (initiated in mid 2000, with funding to the 2003 4 fiscal year). The primary component of this project is the establishment of an approximately 1200 ha core area in the National Park Sadar Range, to be protected by a 2 m high boundary wall and by additional enforcement staff to be hired under the project. However, there is a very real danger that with construction of the wall the included area will be viewed as "the National Park", with the remaining forest outside being treated as a free resource; this would lead to rapid loss of forest cover remaining outside of the wall unless FD redoubles its management and forest protection efforts.

Population pressure. The current total population living within the Park is estimated to be more than 20,000. This does not include people who harvest Park resources, but live outside. It is known that people travel up to 5 km or more to harvest fuelwood from the Park, but there are no reliable estimates of the total numbers of people involved or the volume of resource harvest. As a result, virtually all large trees have been removed and little or no mature sal forest remains, and some areas have recently been virtually clear felled by woodcutters. Large contiguous areas encroached for pineapple plantations and other agricultural uses continue to be expanded incrementally into (former) sal forest areas.

Shift from Garo to Bengali settlers. The Park was previously inhabited primarily by a relatively small number of tribal (Garo) people, but the population demographics are changing due to an influx of Bengali settlers. The Garos are selling off their lands, either remaining in the area in a landless state (and thus presumably relying more on forest resources), or moving out of the area, primarily northward toward northern Mymensingh District and the Garo Hills in India. At present non tribals greatly outnumber the Garo population and are believed to have encroached on a much larger area of forest. This is an important development as the Garos have a long standing relationship with the forest, including a store of traditional knowledge and the development of sustainable harvesting practices, which may or may not be shared by recent settlers.

2.2.4.4 Leverage

In spite of its many problems, the Chemonics team believes that Madhupur has considerable leverage potential. An AF “conservation success” in Madhupur, albeit difficult to achieve, would have a significant positive impact on local credibility and substantially increase the visibility of the AF, and perhaps even gain the confidence of the FD.

2.2.4.5 Project Potential

As stated above, Madhupur National Park represents the most complicated set of protected area management/biodiversity conservation problems in Bangladesh. Yet In spite of these problems, sal forests have certain advantages, including:

- *Good regeneration potential*. Sal forest is well known for its persistence and regenerative capabilities. Reconnaissance surveys undertaken during the preparation

of the management plan under the Forestry Sector Project in April 1999 revealed that the full complement of associated plant species remains even in degraded areas. These include canopy species (e.g., *Adina cordifolia*, *Albizia procera*, *A. chinensis*, *Butea monosperma*, *Dillenia pentagyna*, *Careya arborea*, *Garuga pinnata*, *Hymenodictyon orixensis*, *Lagerstroemia parviflora*, *Schleichera oleosa*, *Terminalia bellirica*, *Litsea monopetala*, *Zanthoxylum Theta*), mid stratum species (e.g., *Flacourtia indica*, *Bauhinia spp.*, *Mallotus philippensis*, *Microcos paniculata*, *Randia uliginosa*), climbers (e.g., *Bridelia sp*., *Ziziphus oenoplia*, *Vitis spp*.) and ground cover (e.g., *Clerodendrum viscosum*, *Glycosmis arborea*, *Eupatorium odoratum*, grasses, sedges).

- *Local preference for sal forest*. According to Forestry Sector Project studies and team interviews with local residents, there is a clear preference of local resource users for sal forest over exotic monocultures. The primary rationale for establishment of extensive plantations of fast growing exotics - sal takes too long to mature, but that exotics provide a harvestable crop after as little as seven years as well as intermediary products - needs to be reexamined. It can also be argued that protection and regeneration of sal forest requires much less initial investment, that well managed sal forest provides earlier and more consistent benefits (including leaves and shoots starting from the first year of management), and that net benefits are greater even in young stands. Moreover, sustained yield management of sal forest contributes positively to biodiversity conservation, whereas establishment of exotic plantations does not. Plantations of fast growing species will continue to play a role, however, in situations where sal forest cannot be re established, and particularly where they can demonstrably alleviate use pressures on remaining natural sal forest areas.

- *High tourism (and local income potential)*. Madhupur National Park provides significant potential for visitor use. The Park is easily accessible by road from both Mymensingh and Tangail (and hence from Dhaka). The Park currently attracts large numbers of visitors (18747 in FY 1997/98) even though facilities are very limited. According to the ACF, there appears to be considerable tourist demand for interpretative information on plants and animals, and for better facilities.

- *Good potential for improved management of areas outside the Park*. There are important sal forest areas remain outside of the gazetted boundaries of the Park, south of the Tangail to Mymensingh Highway between Jalachatra Village and the Park headquarters at Rasulpur. Recent satellite imagery (March 1999) and sal forest inventory data (January February 2000) indicate that this block is relatively contiguous and remains predominantly covered by sal forest, albeit in a degraded state and reduced in area.

2.2.4.6 Possible AF Activities

Given the problems and potential noted above, the Chemonics team believes that some AF intervention in Madhupur is required, but recognizes that any AF efforts to resolve the above problems will take considerable time and resources, perhaps beyond the AF's initial means.

Thus, the Chemonics team proposes both a short and a longer term strategy for the AF to begin to address some of the key issues in sal forest conservation. In the short term, the Chemonics team would recommend that the AF consider:

- *Support a study that documents the extent of sal forests in the Madhupur area (both classified and unclassified), their level of degradation and their potential for regeneration and restoration*;

- *Support activities to settle /resolve/ or otherwise clear the many outstanding forest cases filed against the local population*. Previous initiatives by local Forest Officers and forest communities to develop community management to conserve natural forests have been threatened and thwarted by powerful elites and even some FD officials, with personal vested interests in maintaining the status quo with respect to protected forest area management. Cases –some without foundation- are filed against community, local NGOs and cooperating FD staff. The Chemonics team recommends that AF identify some environmental law NGO to monitor such developments and where necessary to provide legal aid to ensure that due process with respect to the forest laws and rules are followed.

- *Address and clear as many as possible of the informal charges made against the FD regarding collusion and direct involvement in illegal activities*.

All of these activities are likely to be successful as long as FD and local communities commit to changing the present untenable situation. Moreover, these activities will provide the groundwork and climate to initiate a model of joint FD and community (assisted by NGOs) conservation management of a significant area of sal forest.

Thus, as part of its longer term strategy for Madhupur, the AF may want to consider negotiating with the FD to transfer management responsibilities for certain areas outside the Park to local – particularly Garo – communities. This would be considered as a pilot initiative whose aim would be to: (i) demonstrate that joint FD - community forest management can conserve or regenerate natural forests, generate income and protect biodiversity better than FD management alone; and (ii) show that the biodiversity values of the natural forest patches provide all parties- community, FD and other stakeholders with incentives to conserve forests and protect its biodiversity on a sustainable basis. Such a pilot initiative would include but not necessarily be limited to the following elements:

- Selection of an implementing NGO given local hostility to the FD. The present roles of NGOs and community based organizations working in the area with local communities would have to be identified and their potential role as forest community partners analyzed. Particular care and attention would have to be given to micro-credit programs that they operate among communities they organize, to ensure that these activities are not incompatible with the forest conservation and biodiversity protection objectives of the pilot.

- For the selected site it would be necessary to develop a participatory biodiversity management plan involving and agreed to by all the key stakeholders.

- Roles for each of the partners would have to be specified. It is essential that there be clear guidelines as to what is acceptable under the special rules applying in the pilot area.

- Major management responsibilities presently taken on exclusively by the Forest Department would have to be transferred to local forest communities, with the support of local NGOs.

- Care will have to be taken to analyze the economics of participation for forest communities, NGOs and FD participation to ensure that all stakeholders have strong and demonstrated incentives to participate in the pilot scheme activities. In the long term it is hoped that the biodiversity values that can be generated will be sufficient to give partners incentives to manage and conserve the forest on a sustainable basis. If earnings are sufficient then in addition to supporting forest development, some part of them could be deposited in a specially established Community Conservation Fund which could support community development and social services.

The Chemonics team recognizes that getting commitments for co- management of a sal forest will be difficult. The major advantage of considering Madhupur as a site is that both the communities and the FD recognize that the forest resources are being lost because of patently illegal activities. However, both parties need to effectively put the past aside and look to the future. In particular, the FD needs to undertake two steps that it has been unwilling to do up until now. First, the FD needs to recognize that it cannot now or in the foreseeable future control illegal activities carried out by local communities (Garo or in-migrant Bengali communities). Second, even if the FD has local communities on their side, illegal commercial activities by resource using enterprises (brick-kilns, saw mills, furniture makers) will have to be halted.

2.2.5 Chunati Wildlife Sanctuary

2.2.5.1 Location

The Chunati WS comprises a range of low hills in the extreme southern part of Chittagong Forest Division. The area is easily accessible from Chittagong City via the national highway to Cox's Bazar, which directly borders its eastern boundary over a distance of about 15 km.

2.2.5.2 Ecological Significance

Chunati includes three of the hill forest subtypes, mixed evergreen, moist deciduous and bamboo. However, the quality and extent of forest cover has degraded significantly since the Sanctuary was gazetted in the mid 1980s. A 1985 forest inventory classified the area as 2000 ha of natural forest, 2300 ha of scattered trees, 1300 ha of plantations, 1300 ha of denuded areas and 800 ha of paddy fields. At that time, some good natural high forest remained in the central core of the Sanctuary, which is characterized by deep gullies and steep slopes. In 1999, FD staff

estimated that less than 50% of the Sanctuary was covered by dense (albeit degraded) woody vegetation, with the remainder in open scrub/herbaceous vegetation (30-40%), plantations (~20%) and agriculture (~10%). Contiguous closed canopy forest was confined to small pockets on steep inaccessible terrain. Extensive plantation establishment continued under the Forest Resources Management Project until 2001 that contributed to the destruction of natural vegetation.

A fly over of the area by the Chemonics team in March 2002, suggests that agriculture lands have increased significantly in Chunati as has the area in scrub/herbaceous vegetation. Small pockets of high forest continue to exist only on the steep slopes.

The biodiversity of Chunati is reasonably well known having been the subject of FRI research and other flora and faunal inventories. The number of plant species is estimated at 500, birds at 160, mammals at 40, reptiles at 8 and amphibians at 6, although some loss of species has more than likely occurred since the last faunal inventory in 1992. In particular, species which rely on high forest or extensive undisturbed habitat such as the capped langur and hoolock gibbon are on the verge of extirpation if not already gone. In fact, the range officer for Chunati reported that capped langurs, once frequent visitors to the Chunati FD office compound, have become increasingly rare over the past two years. This is in contrast to Satchuri and Madhupur where capped langurs were readily observed by the team in spite of the short visits.

The Sanctuary still supports an important elephant population, with population estimates ranging from 10-40. IUCN is currently conducting an elephant census in the area to determine actual numbers and this information is expected to be available within the next few months. Regardless of the numbers, elephant sightings and elephant related problems (damage to paddies, deaths and injuries to wood cutters) appear to be very common in the area according to people interviewed. The elephant population is (or was) part of a larger population scattered over the CHT and down through the Teknaf peninsula and contiguous with populations in the adjacent parts of India and Myanmar. However, movement routes/corridors in and out of the Sanctuary may have been cut off.

Although its occurrence has never been confirmed, the Sanctuary also reportedly supports a population of serow that is considered vulnerable within their total range in Asia. The Chunati population is though to be confined to the deep gullies in the northern corner of the Jaldi beat although its current status is unknown.

2.2.5.3 Management Status

Protection Status

The original Sanctuary area of 7761 ha was gazetted in 1986. Refer to Annex B for the definition of a Wildlife Sanctuary.

Threat analysis

Uncontrolled harvesting of fuelwood, poles, bamboo, sungrass and other resources from the sanctuary combined with extensive livestock grazing. The fundamental problem is that Chunati is treated as an open access resource by the local population do to a number of inter-related factors:

- The Sanctuary was established unilaterally by the FD without consultation with local residents and without adequate knowledge or consideration of existing land uses. This has resulted in continued land use conflicts and intensive harvesting of forest resources that the FD is unable to control.

- The gazetted area includes deeded agricultural land as well as forest villages that from the time of Sanctuary establishment have been focal points for management conflicts and have made it impossible for the FD to control access and resource harvesting.

- Several brick fields near the Chunati range office openly use wood from the Sanctuary as a fuel source adding to the demand and resource depletion problem.

- There is a long history of animosity between the FD and the people who live in or harvest resources from the Sanctuary. At present, patrols into the interior of the Sanctuary are rare due to the very real threat of physical danger from armed gangs and large groups of villagers.

- There is also a widely held view that some FD staff are corrupt and act in collusion with local resource harvesters, particularly the local "influentials". In fact, the general consensus is that given the scale of resource extraction and the well-organized transport of products, these influentials act as middlemen with most of the benefits accruing to them.

Absence of any specific FD protected area management activities. Although the GOB-funded Wildlife Project supported the development of some infrastructural facilities, the infrastructure was never used for its intended purpose. The Forestry Sector Project developed a management plan for the area which would involve local villagers in management of the Sanctuary and help to relieve dependence on Sanctuary resources, but the plan has never been implemented. As a result, Chunati has been managed for production purposes much like any other reserved forest, i.e., extensive establishment of exotic and/or mono culture plantations using clear cutting and burning, harvesting of cyclone damaged timber, etc., which are not appropriate for management of a wildlife sanctuary.

2.2.5.4 Leverage

In spite of its many problems, the Chemonics team believes that Chunati has considerable leverage potential. An AF "conservation success" here, albeit difficult to achieve, would have a significant positive impact on local credibility and substantially increase the visibility of the AF, and perhaps even gain the confidence of the FD. Results from any success would be directly applicable to Teknaf. Moreover, the site is highly visible and has a substantial elephant population. A success here would attract the attention of nearly everyone.

2.2.5.5 Feasibility/Project Potential

Given the current open access nature of Chunati and all of the time and resources it would take to deal with this problem, the Chemonics team believes that Chunati would not be a good first choice for "on-the-ground" type activities.

2.2.5.6 Possible AF Activities

In spite of the above assessment, the AF could in the short term seek to intervene/negotiate with the FD on the following:

- *Expansion of the Sanctuary to the north and south*. The Sanctuary could potentially be expanded to include reserved forests in both the north and south to include additional 5162 ha under conservation management. This would increase the area of elephant habitat under conservation management and would contribute to the viability of the existing elephant population. This would also improve the viability of other plant and animal species, including potentially the serow.

- *Expansion of the Sanctuary to the east to include the elephant movement corridor located at Harbang, and establishment of linkages to the Doolharza Safari Park*. Although the Sanctuary itself probably does not have sufficient attractions to be a primary tourist destination on its own, its proximity to the heavily traveled national road provides an opportunity to capture passing traffic for nature walks, visits to interpretive centers, and other day use activities. Support might be given to a local NGO to assist the FD in establishing such interpretive activities.

  Additionally, the Chunati Range Office is located about 7 miles from the Doolharza Safari Park which receives over 7000 visitors per day during the January – March tourist season. The Safari Park currently covers an area of about 1900 ha (~130 ha fenced) but directly borders a reserve forest on the east which appears to be an important elephant corridor. Linking Chunati with the Safari Park and its adjacent reserved forest would appear to make sound conservation sense while increasing the area's tourism potential. Again, a local NGO could assist the Safari Park in developing much needed and demanded interpretive facilities for the Park and for the proposed extension. Should Peace Corps re-establish itself in Bangladesh, the posting of a PCV with interpretive experience to the area would also be a very viable option and one that has been used with great success in other countries.

2.2.6 Teknaf Game Reserve

2.2.6.1 Location

The Teknaf Game Reserve as currently gazetted occupies the middle part of the Teknaf peninsula from Ukhia south to the thana town of Teknaf. The gazetted area is all reserve forest land, located within Whykheong and Teknaf ranges and subdivided into 10 forest blocks, and two Forest Divisions, north and south. The Reserve consists of gently sloping to rugged hills and

cliffs running down the central part of the peninsula with a north-south length of 30 km and an east-west width of 2-6 km. The Reserve is accessible from Cox's Bazar along its entire eastern edge by an all weather road, and from the western side along an unbroken stretch of beach from Cox's Bazar to Teknaf, which is used as a road by light four wheel drive vehicles during low tide.

2.2.6.2 Ecological Significance

The Teknaf Game Reserve is one of Bangladesh's largest protected areas, surpassed in size only by the Sundarbans Wildlife Sanctuary and the Pablakhali Wildlife Sanctuary in the CHT.

The Reserve and adjacent coastal area comprise a broad variety of habitats within a relatively compact area, including representative but extremely fragmented and degraded examples of evergreen and semi-evergreen hill forests within the Reserve and mangrove vegetation along the Naf River to the east. These habitats in the past supported what was considered to be the highest biodiversity in Bangladesh – a documented total of 290 species of plants, 55 species of mammals, 286 species of birds, 56 species of reptiles and 13 species of amphibians. However, intensive human use of the area has resulted in rapid degradation of all vegetation types and, and although the impact of this degradation has not been documented, some loss of species is probably occurring or has already occurred.

Much of the original wet evergreen and semi-evergreen forest in the Reserve has been severely degraded, and now high, closed canopy forest is limited to steep, inaccessible slopes. The overall trend in the area is a downward spiral from high forest to low forest to scattered trees and shrubs, with the latter being most in evidence. Some sites are so severely degraded that they would require enrichment plantings in order to reestablish the original vegetation.

The Reserve area has long been known for its elephants and was established in 1983 specifically for their protection. Elephants are still widely distributed in the area, and although numbers have likely declined, total numbers are estimated to be between 15 and 100, with actual numbers more likely somewhere in the middle. (IUCN is conducting an elephant census and data on actual numbers should be available within the next few months.) As in Chunati, elephant sightings and elephant related problems (damage to paddies, deaths and injuries to wood cutters) appear to be very common in the area according to people interviewed. These elephants are part of a larger population scattered over the CHT and down through the Teknaf peninsula, and contiguous with populations in adjacent parts of India and Myanmar, although movement routes in and out of the Reserve may have been cut off.

2.2.6.3 Management Status

Protection Status

The original Game Reserve area of 11615 ha was gazetted in 1983. Please see Annex B for a definition of a Game Reserve.

Threat Analysis

High level of timber, fuelwood and bamboo harvest from the Reserve. There has long been an extremely high level of resource use from the Reserve, partly for subsistence use by surrounding villages, but largely for sale in Teknaf town and other urban markets. The area is also exposed to heavy livestock grazing and periodic fires. Like Chunati, much of the Reserve is considered to be open access and the FD has not been effective in controlling use and access. There are also a number of brick fields along the eastern periphery which openly use illegally harvested wood from the Reserve. Limited FD staff, the fact that licensing and control of brick fields is under the Deputy Commissioner, combined with the relative ease of access from both sides of the Reserve, have exacerbated the situation.

Absence of any specific FD protected area management activities. Teknaf, like most other protected areas in Bangladesh, is managed for production purposes much like any other reserved forest. Although a conservation management action plan was developed for Teknaf under the Forestry Sector Project, it has never been implemented. As a result, much of the FD's time is spent on plantation establishment (clear felling of extensive areas, burning of slash, and planting of exotics or other commercial species), which are unsuitable for protected area management. The Chemonics team witnessed this practice first hand in a reserve forest on the northern boundary of the Reserve, where a large area of what appeared to be closed canopy natural forest was clear-cut, burned and planted with a mix of local and exotic commercial species. Additionally, the FD appears to be using the plantation model as a means of maintaining tenure over forest lands, with the argument being that plantations are easier to protect than natural forest.

2.2.6.4 Leverage

In spite of its many problems, the Chemonics team believes that Teknaf has considerable leverage potential. An AF "conservation success" in here, albeit difficult to achieve, would have a significant positive impact on local credibility and substantially increase the visibility of the AF, and perhaps even gain the confidence of the FD by helping them to resolve the many socio-economic issues. Moreover, the site is highly visible and has a substantial elephant population. A success here would attract the attention of nearly everyone.

2.2.6.5 Feasibility/Project Potential

As in the case of Chunati, the current open access nature of Teknaf and all of the time and resources it would take to deal with this problem, the Chemonics team believes that Teknaf would not be a good first choice for "on-the-ground" type activities.

2.2.6.6 Possible AF Activities

As with Chunati, the AF could in the short term seek to intervene/negotiate with the FD on the following:

- *Upgrading the status of Teknaf (and the proposed extension) from Game Reserve to Wildlife Sanctuary*. The current designation of Teknaf as a Game Reserve does not

provide adequate protection for either wildlife populations or habitat. Redesignation of Teknaf as a Wildlife Sanctuary would at the least provide more scope for protection although enforcement would continue to be a problem.

- *Expansion of the Reserve to include the remaining portion of the Whykheong Range and parts of the Ukhia and Inoni range/reserved forests*. The vegetation of the currently gazetted area is primarily scattered trees and other degraded vegetation and plantations with only a very limited area of high forest remaining. The addition of the above extension would more than quadruple the area of high forest under conservation management and would also incorporate a very large area of low forest, which presumably retains much of its conservation value.

2.2.2.7 Chittagong Hill Tracts

The location and condition of the CHT forests were very much unknown but thought by some to have significant biodiversity potential. In order to verify the status of CHT forests, the Chemonics team in collaboration with USAID and MACH, was able to arrange an over flight of the region. Accompanied by the Deputy Secretary MOEF, Mr.Mahfuzul Haque, Mr. Golam Mowla, ACF, FD/Dhaka, Prof. Haroun Er Rashid, Independent University of Bangladesh (and AF Board member), Bill Collis from MACH, the DFO for Banderbans, Mr. Abani Bhusahan, the DFO from Chittagong, Mr. Jafrul Hasan Choudhury, and the Chemonics natural resource management specialist over flew the CHT in order to ascertain the status of any remaining forests in the area. The over flight was undertaken in two segments.

Southern segment:

Chittagong airport to:
21°50’, 92005’ (Chunati) to
21°30’, 92015’, to
21°20’, 92037’ to
Chittagong Airport

Northern segment:

Chittagong airport to:
23°00’, 92015’ to
23°35’, 92015’ to
Chittagong airport

In the south, significant areas of what appeared to be untouched high, closed canopy forest were found between 21°18’, 92°37’ and 21°23’, 92°34’, with some good patches located at 21030’, 92015’, essentially in the small area of the country in the South surrounded by Myanmar on the South, East and West. Although size was difficult to assess accurately from the air, a conservative estimate would place it over 25 square kilometers.

In the north, significant areas of high, closed canopy forests were found between 23°16'E, 92°16'N and 23°19'E, 92°15'N, or about 50 km directly north of Lake Kaptai. The group estimated the size of the area to be in the neighborhood of 25 square kilometers. Unlike the area in the South, however, this area showed significant signs of human use around the periphery mainly in the form of shifting cultivation combined with some logging, more than likely a result of the former. The center of the forest appeared to be completely intact.

Project/Biodiversity Potential

Together, these two areas appear to represent Bangladesh's largest and perhaps highest concentration of forest biodiversity, perhaps equal to or greater than the Sunderbans. Providing the renewed political uncertainty and lawless conditions in the CHT are resolved and the GOB grants easier access, the Chemonics team recommends that the AF accord these areas the highest priority in terms of intervention. Specific short-term actions which need to be undertaken as soon as possible include:

- Procurement of high-resolution (SPOT or ICONOS) imagery from January 2002. Provide this imagery to either RIMS/GIS or EGIS for analysis (EGIS probably has better analytical capabilities but RIMS/GIS has the data base.) Analysis may require someone present from the flight to work with either or both institutions to determine the best color/infrared combination to distinguish actual limits of the forests and any encroachment;

- Compare the boundaries of the forests obtained from the imagery with the boundaries of any reserved forests in the area or any other unclassified state forests appearing in FD maps or management plans;

- Conduct land use classification of the forest and surrounding areas according to RIMS/GIS criteria;

- Although both areas are apparently located in reserved forests, this needs to be confirmed and boundaries redrawn as required. "Push" with the GOB and FD to have these areas classified (or reclassified) as National Parks, or alternatively as "Ecologically Critical Areas" under the Department of Environment;

- Support either or both the Institute of Forestry at Chittagong (who has tribal students from the area) and the Bird Watchers Club (Enam Ul Hauke) to undertake preliminary (rapid) assessments of the biodiversity (and threats) in each of the areas, including recommendations for key indicator species;

- Based on the preliminary assessment, develop a plan for baseline flora/fauna and socio-economic surveys.

On the flora/fauna side

- using secondary data, establish a baseline listing of all flora and fauna species present and develop an assessment of their current abundance and distribution. (NB: In the northern area, local anecdotal information can often provide a rapid and cost-effective means of narrowing down the study area for scientific field surveys. However, caution must be taken in the use of anecdotal data, and every opportunity taken to cross-check the data. Farmers, for example, may exaggerate abundance of animals that prey on livestock or damage crops, and under-estimate abundance of economically inconspicuous species. The same local name may apply to more than one species. There is a human tendency to exaggerate past abundance. Informants may simply aim to please the researcher, providing the information he/she thinks the researcher wants to hear, with little regard for the accuracy of the information conveyed. Informants may even have an unconscious or conscious intent to mislead, for various reasons. Anecdotal information should be cross-checked between informants, and confirmed wherever possible through scientific research.)

- Develop quantitative population estimates (census) for selected key species and develop detailed information on their current distribution and habitat use. (NB: The most appropriate biological survey technique to employ would more than likely be Gradient-directed transect (Gradsect) sampling. Transects are deliberately selected to traverse the steepest environmental gradients present in an area, while taking into account access routes. This technique is considered appropriate for rapidly assessing species diversity in natural forests, while minimizing costs, since gradsects capture more biological information than randomly-placed transects of similar length. IUCN has experience in Gradsect sampling for elephants in Chunati and Teknaf, and the AF should consider supporting IUCN for census work in the CHT.)

On the socio-economic side

- Conduct survey to gain a detailed understanding of current land use patterns, including assessments of what natural resources are available, who uses them, how they are used and trends in use;

- Explain purpose of the PA and its value in both ecological and economic terms;

- Gain an understanding of the preferred options of local people for participation in PA management.

- Based on all of the above, develop an HSI model for key indicator specie(s).

Given that shifting cultivation is perhaps the biggest contributor to loss of biodiversity in the CHT, the AF should commission an independent study on the experience of Codec and ADB projects in stabilizing agriculture. An assessment should also be conducted on BFRI's agroforestry research in the CHT. This assessment could be done independently or with BFRI

researchers and might be preceded by a literature review on the subject in order to better target BFRI research.

2.2.2.8 Other Possible Sites

As noted in Section 2.1 above, there may be other National Parks, Wildlife Sanctuaries, Game Reserves and Reserve Forests with possible natural forest remnants that might be conserved /regenerated. The Chemonics team was only able to visit 6 of the more promising ones, and fly over the CHT as noted above, and Hazarikhil - of interest both for wildlife and plant biodiversity - which appears to contain fairly contiguous secondary vegetation. The Team also briefly visited the Bhawal Babhan National Park (sal forest) in Dhaka District, and the Doolhazara Safari Park. These rapid appraisals combined with a detailed review of available literature do not substitute for the much more systematic assessments that AF needs to conduct in the first year of operations of all the sites, nor should it pre-empt the site selection process for initial activities that the Chemonics International mission is developing to assist the AF. Additionally, given possible FD reluctance in collaborating with the AF at some sites, the team recommends that other natural forest remnants in Unclassified State Forests - particularly haor basin and Pleistocene forest ecosystems and privately owned forests in Sylhet, Agunia (Chittagong) and elsewhere - be considered as additional foci for natural forest conservation, restoration and biodiversity protection.

2.3 Cross-Cutting Policy Issues

During the course of conducting the rapid site assessments, several cross-cutting issues common to all areas became apparent;

- *Focus of FD on production forestry rather than on ecosystem integrity*. Bangladesh's forests provide valuable goods and services, including timber for furniture, home building and paper, diverse and extensive wildlife habitat, abundant clean water, and open space for recreation. However, sustaining forestry into the future will require careful maintenance of the ecological system that is the source of these benefits. In turn, this will require the FD to change the way it does business, i.e., moving from a production/plantation focus to one that focuses on ecosystem integrity. Annex C, adapted from the Maine Audobon Society, provides a brief introduction to the concepts of maintaining forest ecosystem integrity and highlights practices that foresters can apply to help ensure the long term viability of Bangladesh's forests. The issue, is however, how to change the FD's attitude. Based on numerous discussions with current and past FD employees, NGOs, University staff and others, the Chemonics team offers the following suggestions:

    - The message to change needs to come from the top down, perhaps from a level even higher than the Minister, MOEF;
    - Work from within the system. There are only 74 conservators in the FD. Arranging study tours for selected conservators to visit countries who practice multiple use forestry in the context of ecosystem integrity would be a good first step. Additionally, the hiring of internally well respected retired FD employees in

projects (and their subsequent training in or familiarization with the concepts of ecosystem management) may also contribute to an overall change in FD attitude.
  - Finally, projects – including the AF – should attempt to negotiate deals with the FD to develop pilot forest conservation activities which demonstrate that forests can be managed for multiple uses and with community involvement without reducing benefit flows and perhaps even increasing them. In turn these pilot activities and on the ground field experience should then drive policy/legislative reform.

- Creation of a separate Parks Department. During the teams work in-country, a number of people interviewed stressed the need to create a separate Parks Department for management of protected areas. While time and resources did not permit a complete analysis of this issue, based on our experience, the team would encourage those eventually responsible for this decision to carefully weigh the pros and cons of such an action. The team's experience in other counties – in particular Turkey – suggests that the creation of a separate Parks Department does not necessarily enhance protected area management; financial and human resources allocated to such a department are usually limited and often in direct competition with the Forestry Department. In the case of Turkey, the Parks Department is always the "poor cousin" to the FD in terms of resources, staffing, policy implementation, etc., and exists largely due to donor support. The same situation may apply to the DOE in terms of the eventual management of "ecologically critical areas" – where will the staff and resources come from to ensure sustainability?

- FD's policing and extension/community participation roles. Throughout this report, the Chemonics team has stressed the importance of community participation in protected areas management. And in fact, many of the FD staff at the sites visited recognize the need for community involvement, extension and outreach. The problem is that the FD's policing and extension outreach roles are mutually exclusive. As a result, there is a tendency for the FD to focus on the former - even using plantation establishment (and clearcutting of natural forest) as a mechanism to control land. There appears to be a clear need for the FD to explore other policing options – either a separate FD police branch or alternative mechanism.

- No local retention of revenues generated from the parks/reserved forests. Currently in Bangladesh, any revenues generated by a park, reserved forest or other protected area, go to the central treasury, which, after FD budget requests, determines budget allocations for the FD HQ and Forest Districts. However, budget allotments for park/reserve management and development are – in most cases - far less than actual revenues, and at best barely cover local salary costs. As a result, there is little money available for park/reserve development or management plan implementation. This situation is quite common in many developing countries. As a result, many Forestry Departments around the world have lobbied for (with International Development Bank and other donor support) the establishment of a "forestry fund" where a certain percentage of revenues (sometimes up to 70%) are retained by the PA for park management and development purposes. Additionally, when local revenues retained

are in excess of PA needs, many PAs in other countries set aside a portion of local revenues in a community conservation fund. Monies from this fund are used to support community activities and projects (not necessarily those related to conservation), in order to gain community support for and participation in conservation activities, including management plan development. The Chemonics team suggests that the AF and FD explore the option/initiate dialogue on the possible creation of a forestry fund with the GOB.

SECTION III

Inventory and Monitoring

3.1 Introduction

Biodiversity inventory and monitoring is generally undertaken in association with ecosystem management. Ecosystem management has been defined as management driven by explicit goals, executed by policies, protocols, and practices, and made adaptable by monitoring and research based on the best understanding of the ecological interactions and processes necessary to sustain ecosystem composition, structure and function. Monitoring provides the information for making appropriate management decisions. Through repeated measurement biodiversity monitoring is usually designed to reveal changes in particular parameters, in particular changes in the variety of living things, and obviously this can be measured at many levels. There are basically three key criteria regarding the frameworks of successful biodiversity monitoring programs:

- An inventory and monitoring program must first and foremost be designed in accordance with specific objectives and to provide the information needed to progress toward the achievement of those objectives. Objectives should describe the desired state of an appropriate indicator that management is intended to meet, and they should also drive what, where and how often measurements should be made;

- Spatial and temporal scales of investigation must be carefully considered when designing a monitoring program, to ensure that monitoring objectives are actually addressed and the program is also operationally feasible;

- Monitoring programs must be designed with a sound methodological and statistical foundation. Standardized and repeatable methods of measurement or assessment will provide the most useful data, by facilitating comparisons with other monitoring undertaken locally or regionally

Given the above criteria, and the fact that the design of a program for inventory and monitoring for Lawachara, Satchuri and eventually CHT forests will, of necessity, be a compromise between park/PA management objectives, limited AF resources, and the capacity of local institutions to undertake detailed inventory and periodic monitoring of biodiversity changes, the Chemonics team believes that the Capped Langur Habitat Suitability Index Model, developed by Tecsult under the Forestry Sector Project for Lawachara, meets all necessary conditions.

Although the Chemonics team considered a number of options for developing an inventory and monitoring program, a key factor in the selection of the HSI model is the presence of the FD's RIMS/GIS data base. This data base is the best available descriptor of land units having uniform ecological conditions in Bangladesh. The data base and associated mapping based on interpretation of SPOT multispectral satellite data, existing forest cover maps and FD plantation records has the following features:

- It covers all of the protected areas with the exception of CHT and Madhupur, and divides the areas into polygons based on current vegetation cover (natural forest, long rotation plantations, short rotation plantations, bamboo, agriculture, etc.

- It provides an identification number and area measurement for each polygon, and for plantation areas;

- It includes information on year of plantation establishment and major species planted.

This type of data lends itself particularly well to HSI modeling, and provides a relatively low cost mechanism to address changes over time providing updated imagery can be procured and analyzed, and funds are available for some limited ground truthing.

Finally, the HSI capped langur model is applicable to a wide variety of sites, including Madhupur and Rema Kalenga. A summary of the model – slightly modified by the Chemonics team - is provided below, along with recommendations for institutional partners for actual implementation.

3.2 The Capped Langur Habitat Suitability Index Model

Overall Management Objectives

As stated above, the first step in developing an inventory and monitoring program is to define management objectives. In the case of Lawachara and Satchuri, these could be:

- In the short term, develop and implement a management approach that will ensure long-term protection of biodiversity while permitting sustainable use in designated zones by local people who currently rely on forest resources from the area;

- In the longer term, maintain, to the maximum extent possible, area under mature, closed canopy natural forest cover, and maintain this forest, and its constituent biodiversity, in the best possible condition.

Management zoning and specific zone objectives

Achievement of overall management objectives is predicated on reaching an agreement on management zoning and actions to be undertaken in each zone. Drawing on the delineation principles for core areas, buffer zones and fringe or transition areas for biosphere reserves provided in Annex E, zones for HSI modeling would include:

Zone	Management Objective
Ecosystem management zone (Core area)	Long term protection and rehabilitation of remaining forest cover (all existing high forest and selected areas that can be restored to natural forest cover
Habitat Management Zone (Buffer zone)	Restoration and/or manipulation of habitat for selected wildlife species (e.g., gibbons and langurs). These zones are likely to be areas converted to agricultural land by the Forest Villages; encroached areas along the periphery; and long term plantations
Sustainable use zone (Transition area)	Sustainable use of plantations using uneven aged or selective management techniques, or other silvicultural techniques consistent with biodiversity conservation. Better management of ag areas and habitation including reclamation of certain village betel areas and establishment of participatory plantations and natural forest cover in peripheral areas

Choice of an indicator species for HSI modeling

Environmental monitoring can be substantially accelerated (and costs reduced) by reducing the comprehensiveness of assessment to just a few key features – indicators. These indicators are simply measurable surrogates for broader environmental conditions. In the context of biodiversity monitoring, the presence or condition of a particular indicator is presumed or demonstrated to reflect some pattern in overall biodiversity. Importantly, indicators do not necessarily bear any direct or cause and effect relationship to the factor of interest; they are simply indicators.

In the case of Lawachara and Satchuri, both areas support a broad diversity of plant and animal species. Clearly, it would not be possible to consider the habitat needs of each individual species. However, given that long term management aim is to maintain to the maximum extent possible area under mature, closed canopy natural forest cover, and to maintain this forest, and its constituent biodiversity, in the best possible condition, selection of a canopy dweller as an indicator species would be the best course of action. The assumption is, of course that if habitat is maintained for canopy dwellers, it will also be maintained for lower levels (mid-story, under story, shrubs and forest floor).

Techsult proposed two species for HSI modeling, the hoolock gibbon and the capped langur. However, given apparently dwindling hoolock gibbon populations due to continued habitat (closed canopy, mature forest with full complement of fruiting trees) destruction, the Chemonics team believes that the capped langur provides the best species for HSI modeling in that:

- It represents mature semi-evergreen forest cover as well as some earlier stages including plantations under assisted regeneration, and some degraded sites;
- It has a restricted world range, is on the IUCN red list as vulnerable, and Bangladesh has populations of high importance;
- Its easily observable and photogenic, there are many published research studies available (Lawachara is a research site), census methodologies are readily available, and groups have fixed home ranges thus facilitating census;

- It perhaps has a better long-term population viability than the hoolock gibbon, although this would need to be verified;

- It is represented in a number of sites (Lawachara, Satchuri, Rema Kalenga, Teknaf, Chunati and Madhupur), and thus the methodology could be easily replicated.

Development of (and Agreement on) HSI Values for Capped Langurs for Generalized Land Use Types

The HSI model developed by Techsult is designed to be applied to the individual polygons listed in the FD's RIMS/GIS data base. Although measures of habitat structure (stand maturity, canopy closure, fruiting tree abundance) are not available for individual polygons, they can be inferred from cover type, species composition and stand age descriptors in the data based, combined with some limited field verification. A judgment of how well these inferred measures match habitat requirements of capped langurs can then be used to assign HIS values to each generalized land use type. This can provide a first approximation of the overall suitability of habitat in any given polygon, on a scale of 0.0 to 1.0, with 1.0 being high quality capped langur habitat (mature closed canopy, moist deciduous or semi-evergreen forest, with gaps and openings providing forest edge habitat; a species mix of fruiting and leaf bearing trees that provide a year round food source; low levels of mechanical and human disturbance; and contiguous areas of habitat sufficiently large to support a genetically viable population.

As a starting point for AF/FD deliberations, Tecsult provided the following estimates of HSI values for various land use types.

Land use type	Inferred value of:			Assigned HIS value
	Stand age	Canopy closure	Fruit tree abundance	
Natural forest (high forest)	Old	closed	High	1.0
Natural forest (low forest)	Mid	Near closed	Moderate-low	0.6
Natural forest/betel garden	Old	closed	Low-nil	0.4
Long rotation plantations				
Pre 1950 mixed species	Old	closed	High	1.0
Pre 1950 mainly teak	Old	closed	moderate	0.8
1950-74 mixed species	Mid	closed	moderate	0.8
1950-74 mostly teak	mid	closed	Moderate-low	0.6
1975-89 mixed species	Young mid	Near closed	Low	0.6
1975-89 mostly teak	Young mid	Near closed	Low	0.4
1990-99 plantations	Young	Open	Nil	0.2
2000-02 plantations	Young	Open	Nil	0.1
Short-rotation plantations				
Pre 1990	Young	Near closed	Low	0.2
1990 – 02	Young	Open	Nil	0.1
Bamboo, scrub, failed plantations	Young	No canopy	Low	0.2
Agriculture	N/A	N/A	Nil	0.1

(**NB:** Given capped langurs sensitivity to human presence (wood cutters, railway lines, etc.), Techsult also suggests that a disturbance factor be incorporated into the calculated habitat value of each polygon (HSI value multiplied by area), and estimates that a 10% reduction in habitat value for Lawachara, with slightly less for Satchuri.)

The Chemonics team assumes that AF/FD would consult a number of individuals and institutions in developing HSI values, from BFRI, to the University of Dhaka.

Establish Baseline

Once HSI values have been agreed upon, the development of a baseline becomes a relatively simple task:

- AF could support RIMS/GIS to superimpose habitat value on all polygons for both Satchuri and Lawachara and surrounding reserves and buffer zones, and generate maps as appropriate. This information could be aggregated up to the management zone level should these have been agreed upon and developed.

- AF could support a baseline census of the capped langur population in both PA's drawing on the expertise of the Zoology Department, Dhaka University. Initial census is critical in order to assess the correlation between forest improvement and the capped langur population over time.

Establish Monitoring Plan

The HSI model assumes that management interventions, once initiated, will increase habitat value over time, although the actual length of time for interventions to have an effect will vary considerably (e.g., conversion of long rotation mixed plantations to uneven aged or selective management instead of clear cutting would have an immediate positive effect on calculated habitat value.) Other management interventions proposed for both Lawachara and Satchuri include:

- Conversion of short term rotation planting areas in the Habitat Management Zone to permanent tree cover using local "framework" species such as figs, legumes and oaks and chestnuts to rehabilitate sites, and provide cover and food for animals. (The framework methodology was initially developed in Queensland, Australia, and is currently being applied on a trial basis in Chiang Mai, Thailand. It consists of planting 20-30 selected "framework" tree species that are: 1) fast-growing, with dense spreading crowns that rapidly shade out competing weeds; 2) attractive to seed-dispersing wildlife, especially birds and bats; and 3) easy to propagate in nurseries. Experience has shown that once the framework of a forest has been re-established, the other components of the ecosystem return naturally, resulting in rapid forest regeneration.)

- Conversion of mostly teak plantations to mixed species, again, using local framework species.

- Elimination or restriction of betel growing

- Conversion of some agriculture lands to participatory short-term plantations

Once specific management plans and actions have been developed for each of the management zones and implementation begun, AF should support RIMS/GIS to procure and analyze satellite data for changes in calculated habitat value on a bi-yearly basis. As part of the monitoring plan, AF should support BFRI to establish and monitor permanent sample plots in selected polygons in each of the management zones in order to better "calibrate" RIMS/GIS land us classification as well as changes in HSI values over time.

AF would then support another capped langur census after three years to determine the correlation between increases in high forest cover and capped langur population and associated biodiversity over time.

3.3 Inventory and Monitoring Program for CHT Forests

The Chemonics team is hesitant to make any recommendations with regard to the development of an inventory and monitoring program for CHT forests identified in the over flight, simply because no one has a really good idea of what exists. Indeed, given the considerable area of untouched closed canopy high forest in the southern part, one might assume that there could still be a viable tiger and elephant population there, which are entirely different indicator species than the capped langur. This being the case, the Chemonics team recommends that AF support the actions indicated in Section 2.2.2.7 under Project/Biodiversity Potential.

3.4 Biodiversity Data/Information Collection and Exchange

Data/information exchange

Much of the information needed to better manage Bangladesh's biodiversity rests with a number of stakeholders; for classified State forests flora information and data are under the control of the Forest Department (RIMS/GIS); Unclassified State Forests are under the control of local government authorities (District Commissioners and others agencies); information on faunal resources is also scattered in a number of places from IUCN, to FD, to the Sunderbans Biodiversity Project. And more than likely, faunal information is not integrated with floral information. Moreover, as data and information are valuable commodities, there is a tendency among many of these institutions not to share information. Better inventory information is needed on the extent and quality of all remaining natural forest remnants and their potential biodiversity value. However, it is important that work of the AF, as an organization actively engaged in promotion of tropical forest conservation and biodiversity protection, not be delayed by the lack of a comprehensive and fully verified data base on remaining natural forest patches, their biodiversity status and value. To this end the Chemonics team recommends that:

- At a minimum, the AF encourages the development of a biodiversity information network. Information networks, which are simply assemblies of individuals, groups and organisations with common information goals, overcome barriers to data access by focusing on the need for cooperation. They range in size from loose associations of individuals based upon personal contacts and historic ties, to actively managed consortia of government agencies, NGOs, scientists and private organisations, all

with shared information goals. The aim is to build trust and confidence between the network's partners, who may include scientists, policy-makers and resource managers, leading to improved uptake of scientific information in mainstream policy and planning.

The rewards of information networking can be great. For example, more reliable access to data can enable organisations to fulfil their core responsibilities more effectively and consider new opportunities and roles. Participation in networks enables information products to be developed with wider support and with greater efficiency. It is a classic 'win-win' situation in which organisations – whether they are providing or receiving data – become empowered through cooperation.

However, it would be naive to assume that active and positive cooperation will happen as a matter of course. Each partner in the network must be able to see some concrete benefits from joining the network, whether this is the ability to improve the quality of a dataset, acquire access to other datasets, or enter a long-term relationship with another organisation. As the network becomes established and recognised, further potential benefits are economies of scale, minimized duplication of effort, and external investment on a scale that could not be attracted by individual partners.

Information networks require substantial effort to establish and further effort to maintain. Benefits must be perceived as exceeding the costs of participation, for example in terms of the time and resources spent coordinating with other partners. Indeed, networks will not succeed unless this fundamental principle is understood.

- Once the above network has been established, the AF should consider becoming a repository or clearing house for all biodiversity information by collating, reconciling and synthesizing data and information from all pertinent sources.

Data collection and analysis

Data collection and analysis capabilities are also scattered among several institutions. The Chemonics team found that in general, Bangladesh has excellent data collection and analysis on the flora side – particularly with regard to trees and production forestry - with a number of institutions capable of conducting inventories, taxonomic studies, etc. However, there does appear to be a weakness on the faunal side; in fact, most people interviewed said that the majority of wildlife or faunal biodiversity censuses, research, studies, etc., was conducted by or under the supervision of external consultants. This weakness is not due to a lack of qualified people – more than 1,000 wildlife biologists have graduated at BSc level from Dhaka University along with numerous MScs and PhDs, including a number from Cambridge - but the lack of employment and experience opportunities.

Although time and resources did not permit a full institutional assessment of data collection and analysis capabilities, the following is a brief summary of some of the strengths and weaknesses found in selected institutions:

Organization	Competency			Comments
	GIS/data base management	Floral inventories/ studies	Faunal inventories/ studies	
Government Agencies/Research Institutes				
Bangladesh Forest Department	High	Moderate to high	low	Good GIS analyses and database management capability; good fores inventory capability; very limited wildlife capability (only one wildlife person in HQ staff)
Bangladesh Forest Research Institute	Low	Moderate to high	Low to moderate	Good plant taxonomy work, plant species inventory and monitoring/floral surveys, and collection, identification and preservation of botanical specimen very limited wildlife capability
Bangladesh National Herbarium	Low	Moderate to high	low	Good plant taxonomy work, plant species inventory and monitoring/floral surveys, and collection, identification and preservation of botanical specimen
Department of Environment	Low	Low	low	Limited to water, air and wastewate information
EGIS	High	Low	low	Good GIS analyses, mapping and data base management capability; state of the art equipment
Universities				
Chittagong University	Low	Moderate	moderate	Fairly good botanical and wildlife/faunal survey capability
Dhaka University	Low	Moderate	high	Very good wildlife/faunal survey, inventory and study capability; good botanical survey capability, particularly with regard to wildlife habitats
Independent University, Bangladesh	Low	Low	low	Some biological survey experience
Jahangirnagar University	Moderate		moderate	moderate
Khulna University	Low	Low	low	Some botanical survey experience the Sunderbans
North-South University	Low	Low	low	Some biological survey experience
Rajshahi University	Low	Low	low	Some biological survey experience
IUCN and IUCN's NGO Members				
IUCN Bangladesh	High	High	high	Access to international experts, da bases, etc.
Bangladesh Center for Advanced Studies (BCAS)	Low	Moderate	moderate	Fairly good experience with forest resource surveys, some faunal surveys and GIS/data base development
Nature Conservation Management (NACOM)	Low	Moderate	moderate	Fairly good capability in wildlife/faunal surveys, botanical surveys threatened species conservation, area-specific biodiversity studies and species monitoring

Organization	Competency			Comments
	GIS/data base management	Floral inventories/ studies	Faunal inventories/ studies	
Center for Natural Resource Studies (CNRS)	Low	Moderate	moderate	Good experience with faunal surveys, aquatic resource surveys and species monitoring
Wildlife and Nature Conservation Society of Bangladesh (WNCSB)	Low	Low	low	Has conducted some natural resources studies
Wildlife Society of Bangladesh (WSB)	Low	Low	low	Has conducted some wildlife surve
Environmental/Biodiversity Networks				
Bangladesh National Biodiversity Group (BNBG)	Low	Low	low	networking with limited capacity for biological surveys
Biodiversity Research Group of Bangladesh (BRBG)	Low	Low	low	networking and communications along with some experience in biological and biodiversity research

high: current capacity sufficient; no additional staff or training required
moderate: some capacity available but upgrading, primarily of existing staff, may be required
low: little or no current capacity; additional staff and/or training required.