Bangladesh Forest Department

Climate Resilient Participatory Afforestation and Reforestation Project

Updating Forestry Master Plan for Bangladesh

BANGLADESH FORESTRY MASTER PLAN 2017-2036

(Draft Final)

December 2016

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Summary for Decision Makers

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- Total value of ecosystem services provided by trees and forests is impossible to measure. Remaining forests and trees outside forests contribute billions of dollars to the national economy in the form of ecosystem goods and services.
- Jobs and livelihoods of nearly 10 million people are dependent on the forest products, and forest product-based industries and occupations.
- Intact Sundarban and a coastal shelterbelt of trees can save hundreds of lives and millions of dollars each year by dampening the sea storms, cyclones and tidal surges.
- Ecosystem services and forest dependent jobs can be enhanced significantly by reforesting vacant forest lands and enhancing tree cover outside forests.
- Forestry sector institutions are weak and neglected. Nearly all the senior officers of Forest Department are retiring without proper replacements in view. 50% of the top posts in Forest Department and all other institutions are vacant. There is a severe shortage of funds even for routine activities, such as duty travel.
- Monitoring and evaluation systems are ineffective for want of staff and IT infrastructure.
- Natural forests, except Sundarban, are under severe pressure from illicit felling, encroachments and shifting cultivation. Most forests are vulnerable to impacts of climate change.
- Wildlife populations are declining due to habitat loss and poaching.
- Nearly 300000 ha forest land requires urgent reforestation/restoration. Most of forest land for reforestation is situated in in the CHT area where working conditions are very difficult.
- Country needs to spend close to BDT. 37500 crores in 20 years to achieve all the targets of the FMP although availability of Tk. 10,000 crores seems to be the more likely scenario.
- Without strengthening the forestry institutions and resolution of the CHT's land tenure issue, no achievements are likely to be possible.

Background

A master plan, in any sector, is meant to set the long term vision and goals for the sectoral institutions and other stakeholders to pursue, and allows them to fit their annual plans or other tactical actions into a strategic framework. Such a tool also helps potential donors and other investors to make investment decisions based on the declared goals and identified needs of the sector and assures them that their intervention fits into the long-term strategic plans of the government. The master plan also guides the government and related institutions to plan long term investments in accordance with the direction and needs identified in the strategic plan.

Bangladesh was one of the first developing counties to prepare a long-term Forestry Master Plan (FMP) which was in force from 1995 to 2015. The country has now decided to update the master plan in order to be able to deal with the emerging environmental and socioeconomic challenges, and capitalise the opportunities thrown up by the emerging global consensus in dealing with environmental issues. The new FMP has been prepared as a part of the Climate Resilient Participatory Afforestation and Reforestation Project (CRPARP), funded by the Bangladesh Climate Change Resilience Fund (BCCRF).

The last FMP had proposed a minimum investment of Tk. 6,024 crores over a period of 20 years but the country could provide only Tk. 2,317 crores during this period. Due to the availability of just 38% of the required investment in the sector, most goals remained unachieved. As a result, the forestry sector suffered tremendous setbacks. According to the latest assessment, only 15% of the plains land sal forest and 11% of the hill forests now have any significant natural tree cover. All other areas, in these forest belts, have been either under plantations or have been encroached or have become severely degraded due to shifting cultivation and illicit felling. Plantations raised in these forests have also failed or have been destroyed by biotic pressure. Social forestry plantations, however, are doing well. Sundarban, the real lungs of Bangladesh, has survived any major recent damage so far and isimproving.

Significance of the Forestry Sector to National Well-Being

Despite the multifarious problems and handicaps that the forestry sector is beset with, forests and trees make a huge contribution to the economy and ecology of the country. Although the total impact of forests and trees on various aspects of national economy and ecology has never been thoroughly assessed, the following examples illustrate the significance of the sector to the national well-being:

- The overall impact of forests on human well-being can be summarised in the form of ecosystem goods and services provided by them to the Bangladesh society. Although the most valuable services provided by the forest ecosystems, like protection, pollination, water regulation, soil formation etc., are intangible and immeasurable, the value of provisioning and measurable services alone runs into several billions of dollars per annum.
- Forests, particularly mangroves and coastal plantations, are the only natural defence for the country against frequent sea storms, cyclones and tidal bores. Bangladesh has been adjudged as one of the countries which are most vulnerable to climate change. With intensifying climate change impacts, especially sea level rise, rise in temperatures and erratic rainfall patterns, the country is going to need much stronger defences against sea borne disasters and floods. In the absence of an extensive tree cover, the losses that the country is likely to suffer are going to be of a much higher magnitude.
- Forests are among the most important tools, if not the only one, for moderating climate change. Climate change is the result of excessive concentration of greenhouse gasses, particularly carbon dioxide, in the atmosphere. While technologies to reduce the rate of release of carbon into the atmosphere are being developed, the only effective way to remove the existing carbon load of the atmosphere is to plant and preserve more and more trees for trapping carbon. Planting and preserving trees to sequester carbon can earn the country millions of dollars through carbon trade, in addition to providing ecosystem services and creating jobs for the local population.
- Wood is the most prominent and significant produce of the forests, although other goods like bamboos and non-timber forest products are no less important. Apart from meeting the needs of the people, for timber, fuel etc. forest products generate a huge amount of employment in the country. Although estimates of the employment in forest products based industries and occupations vary, all estimates indicate a very significant contribution of the forestry sector to employment generation in the country. The total employment in the forestry sector may be as high as 10 million jobs, one of the highest in any sector, as shown below:

Box 1: Contribution of the Forestry Sector to Employment Generation in Bangladesh

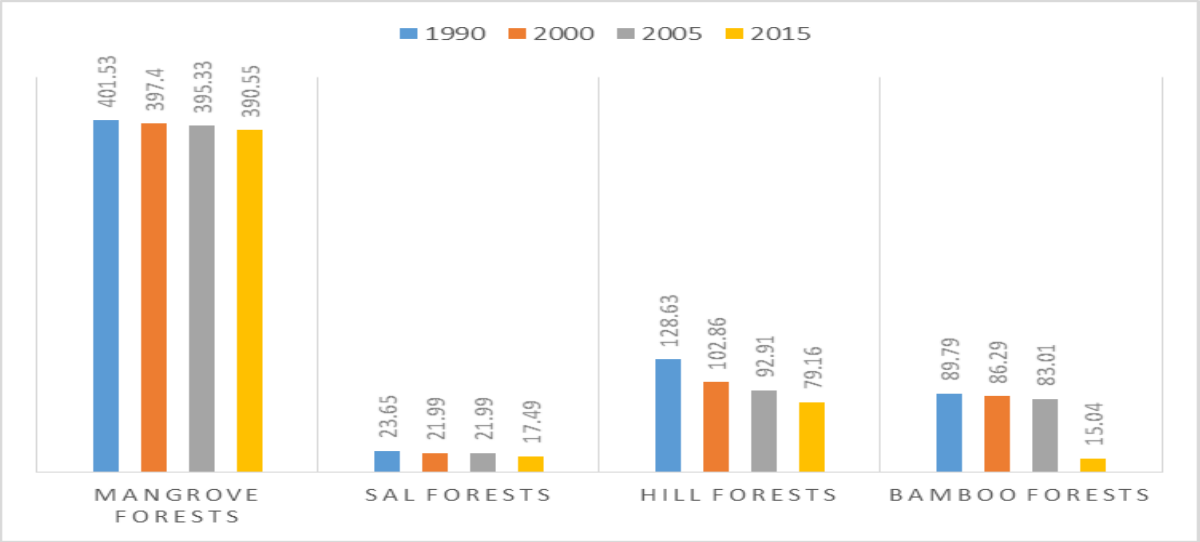
- A study of the furniture sector sponsored by European Union (EU), in 2013 indicates the employment of 1.8 million persons in the furniture industry alone.
- Forest Resources Assessment (2015) indicates a total employment in the forestry sector as equivalent to 1.5 million full time jobs, out of which 40% are women.
- The Statistical Year Book of Bangladesh (2014) provides a list of 33 industries/occupations related to forestry which employ 2.13 million persons, out of which 40% are women.
- The most stunning value of the contribution of the forestry sector to employment generation comes from the "Household Based Forestry Survey 2011-12" of Bangladesh which shows that more than 5.83 million people are employed in operations related to homestead and private plantations and products alone, out of which 2.4 million are employed full time.
- Adding the downstream employment generated by the forestry products in areas like furniture manufacturing, paper and pulp industry, medicinal plants, handicrafts etc. the overall impact may be close to 9-10 million full time or part time jobs.

National forests are the repository of the unique biodiversity of the country. Sundarban is the only place where the royal Bengal tiger, which is the symbol of the global conservation consciousness, survives in Bangladesh. Hundreds of species of mammals, birds, butterflies and members of other phyla survive because of the forests. If the last remnants of our natural forests disappear, a large number of wild species will disappear too. Sundarban's natural beauty, unique ambience and tigers can make an extremely potent combination for promoting ecotourism which can generate thousands of more jobs.

State of the Forestry Sector

Bangladesh occupies an area of 1,47,57,000 ha. For many years, the country has been aiming to have 20% of its geographical area under forest and tree cover. Although no complete inventory of the current tree cover of the country is available, the estimated tree cover in the country, on the basis of available data, is approximately 24,91,555 ha, including wooded lands outside state forests. This amounts to be nearly 16.88% of the geographical area of the country. If the exiting wetlands and water bodies in the country are excluded, as trees cannot be grown there, the tree covered area of the country exceeds 20% of the available area. Incidentally, all the increase in the tree cover has taken place outside the designated state forests while most of the natural forests, except the Sundarban, have been seriously denuded. Only about 15% of the natural sal forests in the plains and 11% of natural hill forests are now left in the country and these too are under severe biotic pressure.

State of the Natural Forests in Bangladesh (000 ha)



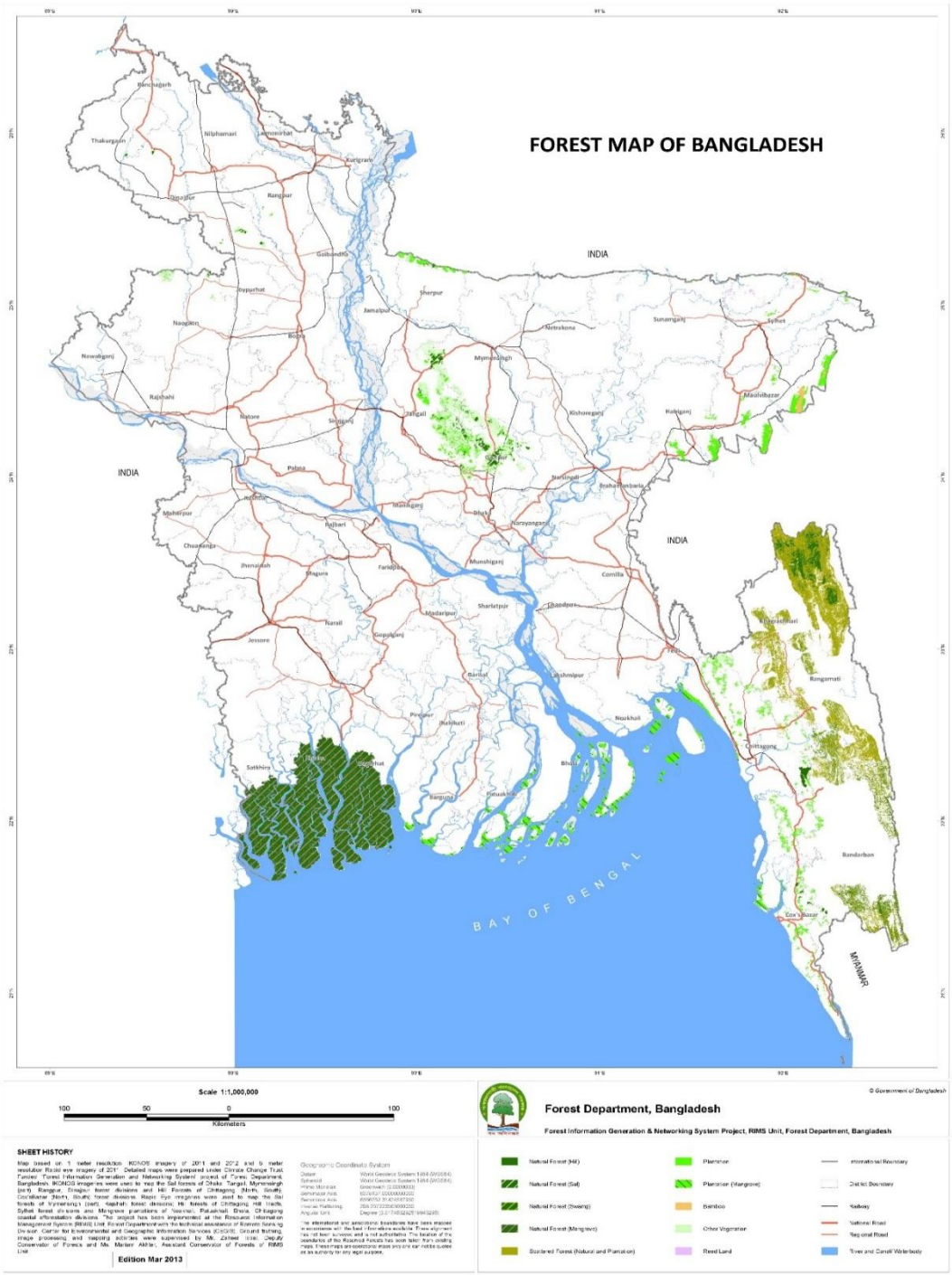
The country has established nearly 209,000 ha of coastal plantations in the last 50 years, but out of these nearly 45,350 ha of the planted area has been transferred back to the revenue department for non-forestry land uses. Bangladesh has also carried out over 71,000 ha of woodlot/agroforestry plantations and 62,329 km of strip plantations, till 2015, under the social forestry programme.

Social forestry and the creation of a coastal shelterbelt of climate resilient species are the two major thrust areas in forestry at present. The country has made significant progress in these areas, but progress is slow due to a paucity of resources.

Sal forests have lost ground to encroachments and illicit felling, while the hill forests have been destroyed mainly by shifting cultivation, and large scale illicit felling, although encroachments are rampant there as well. Forestry operations and forest protection in the CHT are virtually non-existent due to the prevailing law and order situation and land tenure problems.

Forest products

No reliable data on the production of forest products is available in the country. While a 2014 survey of private forests by BBS estimates the production of timber to be nearly one million m^3 per annum, from private forests, in contrast, 15,880 sawmills spread across the country are conservatively estimated to consume nearly 7 million m^3 of sawlogs per annum, mostly produced in homesteads and private plantations. As per FAO estimates, the production and consumption of roundwood (all wood including fuelwood) in the country has been showing a downward trend since 2001 and the current production and consumption of total roundwood is estimated to be nearly 27 million cubic meters per annum. Forest Department produces only about 30,000 cubic meters of roundwood per annum from its social forestry operations.



Most of the roundwood produced in the country is used as fuelwood. The rest goes into construction and industrial consumption. Sawmilling, furniture and paper and pulp industry are the major industries connected with the forestry sector. Only the Government owned Karnafuli Paper Mills gets any significant supply of raw materials from government forests; all other paper and pulp mills are dependent on recycled or imported fibre as raw material, apart from sourcing unspecified quantities from private producers.

While BFD concentrates on coastal plantations and social forestry, most of the afforestation is done by private individuals outside the state forests. Most of the demand for tree seedlings comes from the private sector and is, by and large, met by private nurseries spread all over

the country. Every district has 300 to 500 nurseries which produce horticultural as well as timber species. Although BFD has its social forestry training centres spread all over the country, extension services for improving the planting stock and silvicultural practices in private plantations seem to be very insignificant. But, many of the nursery owners admit to have got their training and motivation from the Forest Department's training programmes of the past.

Honey, nypa leaves, fish, bamboo, cane murta etc. are the most important non-timber forest products (NTFP) of the country although there are several other products, which may be locally important. As natural bamboo forests have shrunk to only about 15,000 ha, homestead plantations meet most of the demand for bamboo in the country. Demand for nypa leaves for thatching purposes is said to be declining due to the availability of better commercial alternatives, such as C.I. sheets. Available information indicates that honey production from the Sundarban varies between 55 and 287 tons per annum, while the production of all other items is going down.

Research and monitoring in the sector is very poor due to the lack of institutional capacities and resources.

Forestry sector institutions are in a very poor shape. Over 50% of the senior posts in BFD and BFRI are vacant. With large-scale retirements taking place in next 2/3 years in BFD and no arrangements for recruitments to replace them, the situation is only getting worse. Facilities and basic amenities available to field staff are poor. Travel bills of the junior staff are never reimbursed for want of funds. Even criminals are not arrested and sent to the court for prosecution for the same reason.

Future demand for timber and firewood

Demand for wood products is likely to grow due to the increase in population, although the developing demographic and socioeconomic changes are likely to influence these trends significantly. According to BBS (2014) the proportion of the population using firewood as the principal cooking fuel has dropped from nearly 44.27% to 34.80% between 1991 and 2011. If this trend continues, the demand for fuel wood is likely to come down sharply in future while the demand for industrial roundwood (timber) may continue to rise in tandem with the growth in population and prosperity of the country.. Accordingly, the demand for timber is likely to rise to 9.77 million m^3 by 2030 and 10.62 million m^3 by 2050, from current consumption of approximately 8.57 million m^3. However the demand for firewood is likely to decline to 17.67 m^3 and 11.5 m^3, over the same periods, respectively, from the current consumption of nearly 19.76 million m^3 per annum.

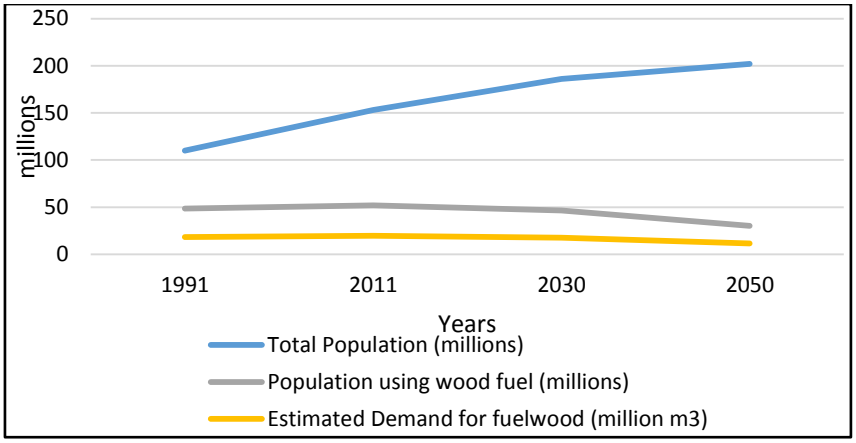


Figure 1-1: Projected fuelwood demand in Bangladesh

There is a complete moratorium on the exploitation of natural forests in the country. Therefore, most of the needs of the country for timber and fuel wood are met by the private tree growers, although some contribution is made by the social forestry plantations and illicit felling in other areas, as mentioned before.

Biodiversity and wildlife

Country has established protected areas for wildlife and biodiversity conservation over nearly 2,85,000 ha of forest land. In addition to a marine national park and 3 dolphin sanctuaries in the Padma river have also been established. But wildlife is depleting due to loss of habitats due to the decimation of forests, heavy poaching and illegal trade. Tiger population in the Sundarbans was last estimated to be only 106. Although most of the poaching of wildlife is happening for local consumption and pet trade, Bangladesh is believed to be an important transit route for illegal wildlife products originating in South Asia and destined for China and other East Asian countries. 31 species of mammals, birds and reptiles have been adjudged as regionally extinct in Bangladesh while another 480 species, of various phyla, are threatened with extinction (IUCN 2016).

Challenges for the Forestry Sector

The key challenge for the forestry sector is to preserve, preferably enhance, the forest and tree cover for ecological and environmental purposes, and as a defence against the impacts of impending climate change, while meeting the needs of the public for wood and non-wood products generated by forests. In view of the huge demand for forest products, land hunger, poverty and shortage of funds, the country has not been able to meet this challenge successfully, so far.

Although tree cover outside state forests has increased significantly over the last few decades, the natural forests have come under severe strain due to illegal felling, shifting cultivation and encroachments.

Most of the sal forests of the country have been converted into agricultural land, illegally, or are under monocultures of akashmoni, planted under the social forestry programme. Only about 17,500 ha of the original 125,000 ha of sal forest has some sort of natural tree cover now.

The hill forests, which were a part of the global biodiversity hotspot spanning India, Bangladesh, Myanmar and adjoining countries, have been severely degraded under the impact of progressively reducing cycles of shifting cultivation. Only about 1,00,000 ha hill forest land, out of over 7,00,000 ha has any natural tree/bamboo cover at present.

Management and conservation of the hill forests are the most serious challenge for the forestry sector, in view of the difficult socioeconomic and law and order situation in the CHT belt. Hill forests are the only region in the country where significant land is available for reforestation but working conditions in the region are also the most difficult due to the prevailing situation and the unsettled land tenure issue.

Apart from the land hunger amongst the public, for agriculture and habitation, forest lands are also under pressure from the developmental and security needs of the country. More than 1,25,000 ha of the forest land, including coastal plantations, have been disforested for conversion to other land uses.

Conservation of natural resources needs strong public participation and ownership. Although the Forest Department has made significant progress in social forestry, the country needs a complete reorientation of foresters from being primarily a law enforcement force to being an extension force. The conversion of the forester, from a soldier to a teacher and a communicator, is a big challenge for the sector.

Forestry sector has chronically suffered from acute shortage of resources. Resurrection of the tree cover in the country requires a two pronged strategy: a massive reforestation drive for the state forests and even bigger thrust to encourage tree planting outside forests through extension and marketing support to the public. Both these strategies have not made any significant headway in the past due to an acute shortage of funds. While the extension activities of the Forest Department are virtually non-existent, the pace of reforestation of degraded forests is too slow to match the prevailing rate of degradation. Finding adequate funds and organisational capacity to support these strategies is the key challenge for the forestry sector.

However, the biggest challenge to the forestry sector is the health and lack of vitality of the key organisations. While all the organisations are suffering from huge shortages of staff and infrastructure, BFD is heading into a special crisis due to the impending retirement of nearly all the senior officers and no one qualified to take over from them. This has happened as a result of the erratic recruitment patterns of the past, as no cadre officers were recruited between 1986 and 2003.Very few officers have been recruited since 2003 again, until 2016 when 7 more joined the cadre.

The conflict between the cadre and non-cadre officers is another issue which BFD has not been able to sort out so far. While the department is going to have to rely heavily on non-cadre officers in the near future to fill up vacant positions, according to the current Service Rules, they are not qualified to take up senior positions. Therefore, it has not been possible to properly integrate them into the departmental mainstream so far.

The same is the case of another key level, the Forest Rangers. As the direct recruitment of Forest Rangers has been discontinued since 1994, almost 80% of the existing rangers are nearing retirement in the next 3/4 years. A Forest Department without young and agile rangers will never be able to meet the challenges of the future. It will be a huge challenge for BFD to accept any major responsibility while such a shortage of senior officers and rangers prevails.

Apart from the depleting forests and weak institutions, another core problem is that the forestry sector is chronically short of resources required to rectify the situation. The rate of afforestation/reforestation in the country has all along been far below the rate at which the forests have depleted, while BFD has never been able to pay even the travel bills of the field staff due to shortage of funds. There is often no money for fuel for official vehicles. Departmental infrastructure, vehicles and equipment are not properly maintained due to the perennial shortage of funds. Criminals are often not arrested because there is no money to feed or transport them.

This is despite the common realisation that healthy forests can make a huge contribution in protecting the country against the ravages and impacts of impending climate change. Situation is more or less similar in all other organisations

Securing funds, not only for development work, but also for mere routine maintenance of the department, is the most serious challenge the forestry sector faces.

Bangladesh and climate change

Bangladesh has been rated as among the most climate vulnerable country in the world, due to its low lying deltaic position, poverty, poor infrastructure and low ability to respond to extreme weather events. Global warming and the resultant changes in global climate in the form of rising temperatures, changes in rainfall patterns, sea level rise and a rise in the frequency of extreme weather events, like storms surges and cyclones, are likely to have a serious impact on the people and economy of the country. The country is likely to experience warmer winters, more rainfall over a shorter monsoon, more saline seas and salinity intrusion, and large parts of coastal areas, particularly mangroves, are likely to be submerged under water due to rising sea level. Although productivity of forest ecosystems is likely to go up due to increased photosynthesis in a warmer world, many existing forests may become unsuitable for some current species due to changes in local conditions. Poor condition of the hill forests, due to excessive human pressure makes them more vulnerable to the impacts of climate change.

As Bangladesh is a low carbon emitting country, its role in global warming is negligible while it is among the worst affected. Although the country is participating whole-heartedly in the global effort to combat climate change, the country needs to develop adequate adaptive and mitigative capacity in order to protect her people and economy against the impacts of climate change.

Forestry Sector Aim and Objectives

The long-term aim of the forestry sector is defined in the new National Forest Policy (draft) as follows:

The main aim of the policy is to manage all existing forests, wildlife and other forestry resources, adhering to the principles of sustainable management and climate resilience; enrich degraded forest areas; and enhance land areas under forest/tree cover; to produce a wide array of goods and ecosystem services for the benefit of Bangladesh's present and future generations

The FMP shall endeavour to direct sectoral progress in the direction of the achievement of this larger aim. Within this overall direction, the FMP shall develop strategies and programmes to achieve the following objectives, as defined in the new draft of the National Forest Policy:

1. To arrest deforestation, and degradation of forest resources, enrich and extend areas under tree cover, through appropriate programmes and projects, to ensure that at least 20% of the country comes under tree cover by 2035, with at least a canopy density of 50%.
2. To ensure strict conservation, growth, increased ecosystem services and sustainable management of state forests. Introduce Forest Certification as a tool to improve forest management through market influence.
3. To significantly increase tree cover outside state forest, through appropriate mechanisms, in both public and private land including urban areas.
4. To encourage all types of participatory forestry activities and creation of off-forest job opportunities to reduce dependence of forest-dependent communities on forests.
5. To improve management and conservation practices of wildlife in Protected Areas and other important habitats.
6. To incorporate measures to deal with climate change impacts on forest ecosystems.
7. To delineate and designate catchments of rivers, lakes and other wetlands as strict nature reserves.
8. To ensure enhanced groundwater recharge and perennial stream flow, extend the coverage under Protected Areas to 30% of all notified forest land.
9. To strengthen the research, education and capacity building in forest ecosystem management practices to cope with the existing and emerging challenges including impacts of climate change, population pressure, and urbanization.
10. To include valuation and payment for ecosystem services in the planning and management of forest ecosystems.
11. To ensure effective implementation of the relevant programmes identified by the Bangladesh Climate Change Strategy and Action Plan, 2009.

12. To ensure that the policies prescribed herein, and the formulated programmes there under are properly implemented, and to establish a strong information management, monitoring and evaluation set up.
13. To facilitate the establishment of efficient wood and wood substitute-based industries, together with capacity building of rural communities and entrepreneurs, to enable them to setup wood and wood-based production facilities, small and large.
14. To ensure fulfilment of the country's commitments under different Multilateral Environmental Agreements like CITES, CBD, UNCED, Ramsar etc.
15. To encourage community involvement, particularly, women's involvement in forestry activities, wherever feasible.
16. To make plans for converting the policies outlined herein into actions by developing appropriate interventions backed by commensurate financial provisions and proper accountability.

Goals for the Forestry Master Plan

Within the overall mandate of the forestry sector as enunciated in the draft forestry policy, the FMP shall pursue the following overarching goals:

1. To bring 20% of the geographical area of the country under forest and tree cover with minimum canopy density of 50%.
2. To conserve the remaining natural sal, hill and mangrove forests and to prevent further degradation or deforestation.
3. Strengthen the conservation of wildlife and biodiversity
4. Creation of a strong coastal shelterbelt of climate resilient plantations on newly accreted charlands and other unused public lands.
5. To improve the socioeconomic condition of the forest dependent communities.
6. To develop forest products industries and occupations in order to generate more employment opportunities.
7. To strengthen applied forestry research including on current and emerging issues like impacts of climate change, so that informed interventions can be planned and implemented
8. To strengthen the forestry sector institutions in order to enable them to deliver on all the goals.

Major Strategies and Programmes

Achievement of the goals and objectives of the FMP requires a multipronged, crosscutting, approach, ranging from afforestation / reforestation on government lands, strengthening of protected area system and wildlife conservation, people's participation in forestry and conservation, enhanced well-being of forest dependent communities, boosting of private tree planting activity, control on encroachments and other drivers of deforestation/degradation, improvement of forest based industries, and so on. In view of the looming dangers of climate change, all activities have to focus on achieving climate change resilient results. Improvement of the diversity and connectivity of forests is of paramount importance in this regard. Monocultures need to be multi-layered plantations. As, the survival of state forests largely depends on their sense of ownership by local communities, all forestry programmes must generate tangible benefits for neighbouring communities. People's participation and sustainable forest management shall be the cornerstone of the forestry of the future.

The strategic programs, each of which can help in achieving multiple objectives, and can fit into multiple vision statements, proposed under the FMP, are listed below, along with their key features:

Field programmes

1. **Forest Management Plans:** All state forests shall be brought under planned management by reintroducing the lost system of forest working plans. These plans will also include management strategies for homestead forests and other TOF categories.
2. **Conservation of remaining natural forests:** All state forest land shall be mapped and demarcated. Site specific protection plans shall be prepared to protect the remaining fragments of sal and hill forests. Enrichment plantations shall be carried out where necessary. Information, education and communication (IEC) campaigns shall be carried out. Legal provisions relevant to forest protection shall be reviewed and improved. Local communities shall be actively involved in conserving natural forests through benefit sharing. Professionally run but community based ecotourism shall be encouraged. Forest certification for strengthening SFM shall be introduced. Protection and management of Sundarban shall be particularly strengthened and navigation of ships in Sundarban shall be strictly regulated to minimise chances of oil spills.
3. **Reforestation/restoration of degraded state forests:** Reforestation of 2,83,930 ha degraded/denuded state forests, mostly in hill areas, is the urgent need of the country. This shall be attempted through assisted natural regeneration (ANR) and plantations, depending upon site and situation-specific requirements. Extent of land needing reforestation or restoration shall be reassessed. A watershed management approach to reforestation shall be adopted and soil and moisture conservation measures shall be included in plantation or ANR projects. Joint forest management shall be introduced where communities are willing and motivated. Support of credible NGOs shall be sought. Ban on eucalyptus shall be re-examined in the light of latest available scientific evidence. Other fast growing species shall also be evaluated to reduce dependence on just one species (akashmoni) to improve climate resilience. Forest rehabilitation programmes shall be linked with REDD+, CDM, NAMAs, INDCs

and other programmes that can bring financial returns along with environmental benefits.

4. **Afforestation/reforestation outside state forests including USF:** Continuous boost to private tree growing activity in homesteads and agroforestry shall be given through vigorous extension and marketing services. NGOs, DAE and other suitable organisations shall be roped in to strengthen the extension efforts. A full assessment of the status of TOF and related issues shall be carried out at the outset, and periodically later. Innovative models of reforestation of barren hills, acceptable to all stakeholders in CHT, will be implemented. The feasibility of a new Department of Forestry Extension *vis a vis* a strong extension wing within BFD shall be examined. Mass communication campaigns shall be launched. Forest extension staff shall be spread down to the upazila level. A network of timber markets, to ensure competitive pricing of wood produced in homestead forests shall be created. New agroforestry models shall be evaluated. Forest regulations, such as forest transit rules, that militate against the interest of tree growers shall be reviewed. Proportion of tree growing fund (TFF) in social forestry plantations shall be enhanced by reducing government share.
5. **Coastal afforestation and creation of a coastal greenbelt:** Creation of a coastal green belt shall be a high priority activity. Approximately 100,000 ha of coastal plantations of climate resilient mangrove and other species on unused public lands and charlands shall be carried out. Land may be acquired for coastal plantations if suitable public land is not available. Institutional areas, roadsides, embankments, dykes and all available land shall be planted to complete the greenbelt.
6. **Management of protected areas and protection of wildlife:** Conservation of wildlife and biodiversity shall be carried out in accordance with the Wildlife Master Plan 2015. PA management including co-management shall be strengthened, expansion of PA network upto 30% of state forests. Role and structure of Wildlife Divisions shall be reviewed. Wildlife circle shall be upgraded to the level of a wing of the department. The newly created Wildlife Centre, the Wildlife Crime Control Unit and the forensics laboratory shall be strengthened, among other things. Control on poaching of wildlife outside forests and PAs shall be given special attention.
7. **Management and protection of existing plantations:** All coastal plantations shall be given protection support as long as they stand. Degraded teak and other plantations in the hills shall be revived through protection and benefit sharing with local people. The current practice of jot permits shall be reviewed to minimise its misuse.
8. **Promotion of fuelwood saving devices and technologies:** Fuelwood amounts to more than 80% of all wood consumed in the country and is a major demand on natural forests. Networking with relevant government agencies and NGOs promoting renewable energy shall be strengthened and subsidies for adoption of improved cook stoves, solar cookers, biogas etc. shall be provided among forest dependent communities. Possibilities of linking this programme with CDM, NAMA and NAPA etc. shall be explored. BFRI shall conduct research on cost effective technologies.

9. **Development of NTFP plantations and related industries and occupations:** A comprehensive assessment of the status and related issues of various NTFP items shall be conducted on a priority basis. Plantations of bamboo, cane, Murta, golpata etc. shall be taken up. Plantation of medicinal plants, which are usually found in the wild, shall be encouraged through subsidies and technical support. Development of handicrafts based on bamboo, Murta etc. shall be promoted. Sustainability of current levels of extraction of NTFPs from the Sundarban shall be reviewed. Establishment of commercial wood seasoning plants shall be encouraged.

10. **Promotion of forest products based industries:** A detailed assessment of the state of forest industries shall be conducted as early as possible. Issues and concerns of the forest based industries, such as raw materials, technology, skilled manpower, regulation, taxation etc. shall be identified and resolved. A public body (e.g. BFIDC) shall be made responsible for championing the cause of forest based industries. Industries shall be encouraged to raise their own plantations. Establishment of commercial wood seasoning plants shall be encouraged.

11. **Strengthening Forestry Research:** BFRI, BNH and other institutions or universities involved in forestry research shall be modernised and shall be supported through regular research grants. Institutional issues, such as staff shortages, recruitment rules, IT infrastructure, library etc. faced by BFRI shall be resolved at the earliest. Annual forestry research seminar shall be organised by BFRI. Foreign travel to participate in technical programmes shall be made easier. BFRI shall be encouraged to undertake research on climate resilient species.

12. **Livelihood support to forest dependent communities (Ecodevelopment):** Ecodevelopment committees shall be constituted in forest dependent communities and their livelihood needs shall be assessed through participatory appraisal techniques. Relavant NGOs and other rural development agencies shall be encouraged to participate in these exercises in order to link identified needy and vulnerable individuals with government's livelihoods programmes. A suitable percentage of project cost shall be reserved for improving livelihoods of forest dependent communities.

13. **Control on forest encroachments:** Using modern tools and techniques, the boundaries of all forest land shall be demarcated and mapped and detailed records shall be prepared. All existing forest encroachments shall be mapped and demarcated. All fresh encroachments shall be evicted immediately. Patrolling in sensitive areas shall be strengthened. Forest boundaries shall be clearly delineated and demarcated, to prevent further encroachments. All encroachments in the interior of forest blocks shall be evicted or relocated. A government policy on forest encroachments, both old and new shall be developed.

14. **Climate Change (Supporting REDD+ programme):** Country has already decided to implement REDD+ programme of the UNFCCC in the country. All conservation and development programmes of BFD shall be linked with REDD+ or other climate change finance programmes such as CDM, NAMA, NAPA etc. to generate funds for supporting forestry programmes and community development. Apart from these, research and monitoring programmes, afforestation and reforestation programmes

and livelihoods programmes aimed at climate change mitigation and adaptation shall be taken up.

Supportive Strategies

1. **Institutional reforms and capacity building:** Institutional strengthening shall be undertaken in all forestry sector organisations. All vacant posts shall be filled. An assessment of workload shall be carried out to determine future structure of cadres. An HRD plan shall be developed within two years to meet the future manpower needs of the sector. A system for regular recruitment of staff and officers shall be developed. A parallel cadre of non-cadre officers in BFD shall be created to make the best use of available manpower to tide over cadre shortage and contractual recruitment of officers to fill the large number of officer vacancies in BFD shall be carried out. Service rules shall be amended to allow the promotion of cadre officers to occupy higher positions. All new recruitments in the forestry cadre shall be on the basis of forestry related degrees. Training institutions shall be strengthened and travel bills of subordinate staff shall be regularly reimbursed. A high powered committee shall be constituted to resolve the cadre vs. non-cadre issues of the BFD. Information and communication technology (ICT) shall be developed down to the range and beat levels and shall be regularly updated through replacements. Forest and wildlife laws and relevant rules and notifications shall be reviewed and strengthened. The possibility of introducing time scales for the scientists of BFRI and BNH shall be examined. RIMS and wildlife circle shall be upgraded to the level of a wing. Monitoring and evaluation set up in the BFD shall be substantially strengthened. Feasibility of an independent Department of Forestry Extension shall be explored. High priority shall be given to develop the ICT infrastructure and related manpower training.
2. **Strengthening community participation:** Selection of social forestry participants shall be made more transparent. All new coastal plantations shall have funds for (alternative income generating activities (AIGAs) co-management of PAs shall be strengthened. Land tenure issues in CHT shall be resolved on a priority and the relevant experience of neighbouring countries in resolving issues forest land tenure issues shall be examined. Rural livelihoods shall be made a strong component of forestry programmes. Credible NGOs shall be encouraged to take up social forestry programmes. Mass awareness programme for informing the people of the state of their forests shall be taken up.
3. **Promotion of PPP for reforestation:** Government of Bangladesh has created the institutional and legal framework for developing public private partnership (PPP) projects to develop cost intensive infrastructure. BFD shall explore the possibility of using the PPP model for accelerating the reforestation of degraded forests of the hill districts. A public sector corporate body may be constituted to lead the programme, if found viable.
4. **Strengthening of monitoring, evaluation and database facilities:** Status of RIMS shall be upgraded to the level of a wing of the department and shall be made responsible for regular assessment and monitoring of forest resources and management indicators in the BFD. Forest Resources Monitoring and Assessment

(FRMA) system and Forest Resources Management Information System (FRMIS) as proposed by the CRPARP shall be implemented all across BFD for generating a seamless flow and storage of resource and management data. RIMS shall lead the development of IT infrastructure in BFD and shall maintain it. General monitoring of forestry activities will be strengthened.

5. **Basic amenities and logistics (Civil works, vehicles, boats etc.):** The need for staff housing in the field along with offices, vehicles, boats, other basic amenities office equipment shall be reviewed within one year and arrangements for regular replacements and maintenance shall be made. The assessment shall be reviewed every three years.

Sustainable forest management and people's participation shall be the two cornerstones of the FMP implementation. Obviously, progress on the above programmes shall contribute to the achievement of several objectives such as improving carbon sequestration, meeting subsistence and commercial demands for forest products, enhancing resilience of forests and communities against the impacts of climate change, improving rural livelihoods, poverty alleviation etc. Special emphasis shall be given on the participation of women and weaker sections of the society.

Potential Financial Scenarios and Sources of Funds

Nearly all the development work in the forestry sector in Bangladesh has so far been accomplished under projects funded by bilateral or multilateral development partners (DPs) and the trend is likely to continue in future. The availability of funds to the sector has been fluctuating from year to year, depending on the interest of the DPs. It is difficult to objectively and accurately assess the requirement and availability of resources as far into the future as 20 years, in view of the involved uncertainties. However, some projections for future can be made on the basis of trends observed in the recent past.

The average development funding available to BFD in the last five years (2011-12 and 2015-16) has been to the tune of Tk. 247 crore per annum. This allocation contains nearly 62% external aid or project assistance. In the light of this experience, FMP targets have been developed under the following potential scenarios:

Scenario 1: Investments based on GoB's own fiscal resources and current level of institutional capacity i.e. Tk. 93 cr. per annum. As per this scenario, total amount available during the plan period is likely to be nearly Tk. 3600 crore.

Scenario 2: Investments based on current level of donor support and current level of institutional capacity i.e. Tk. 247 crores per annum, with some additional availability of resources due to the unique (though unenviable) position of Bangladesh as the most climate vulnerable country in the world. Thus, expected availability of funds during the FMP period, adjusted for potential inflation, is presumed to be Tk. 9631 crores. However, we can plan for an estimated availability of Tk 100,00 crores.

Scenario 3: Investments without any resource or capacity constraints depending on estimated requirements. This scenario will incorporate the possibility of tapping non-traditional sources of funding, such as public private partnerships (PPP) or institutional finance.

Under these three potential financial scenarios, the allocation of funds to different programmes is seen as follows:

Table 1: Indicative financial allocations under different scenarios

Sr. No.	Programmes	Financial Targets (crore Taka)		
		Scenario 1	Scenario 2	Scenario 3
1	Preparation of forest management plans	208.8	580	580
2	Conservation of Natural Forest: Sal	21.6	60	60
3	Conservation of Natural Forest: Hill	108	300	300
4	Conservation of Natural Forest: SRF	180	500	572
5	New Plantations: All types	1728	4800	16896

Sr. No.	Programmes	Financial Targets (crore Taka)		
		Scenario 1	Scenario 2	Scenario 3
7	Promotion of TOF sector (Forestry Extension)	180	500	714
8	Protected areas and wildlife management	198	550	2985
9	Management and Protection of existing plantations	39.6	110	125
10	Promotion of Firewood saving devices and technologies	10.8	30	357
11	NTFP Development	54	150	179
12	Development of Forest industries	7.2	20	242
13	Strengthening forestry research	223.2	620	680
14	Strengthening community participation and rural livelihoods	180	500	640
15	Management of forest encroachments	43.2	120	120
16	Supporting REDD+ Programme	18	50	100
17	Institutional reforms and capacity building	180	500	11136
18	Promotion of PPP for reforestation	3.6	10	410
19	Strengthening of monitoring and evaluation (Development of FRMA/FRMIS)	144	400	400
20	Civil works, vehicles, boats etc.	72	200	1000
	Total	3600	10000	37495

In view of the fact that scenario 1 and scenario 3 are rather unlikely to materialise, further details were developed only for scenario 2 which is clearly in the realm of possibility. The phasing of expenditure in alignment with various Five Year Plans (FYPs) under scenario 2 is as follows:

Table 2: Phasing of FMP expenditure in scenario 2

Sr. No.	Programme	Total Allocation	FYP 7	FYP8	FYP9	FYP10	FYP11
			2017-2020	2021-2025	2026-2030	2031-2035	2036
1	Preparation of management plans	580	69	112	150	201	48
2	Conservation of Natural Forest: Sal	60	7	12	16	21	5
3	Conservation of Natural Forest: Hill	300	36	58	78	104	25
4	Conservation of Natural Forest: SRF	500	59	97	129	173	41
5	New Plantations: All	4800	571	929	1243	1663	395
7	Promotion of TOF (Extension)	500	59	97	129	173	41
8	PAs and wildlife management	550	65	106	142	191	45
9	Protection of existing plantations	110	13	21	28	38	9
10	Firewood saving devices and technologies	30	4	6	8	10	2
11	NTFP Development	150	18	29	39	52	12
12	Forest industries	20	2	4	5	7	2
13	Strengthening forestry research	620	74	120	161	215	51
14	Strengthening community participation and rural livelihoods	500	59	97	129	173	41
15	Management of Encroachments	120	14	23	31	42	10
16	Supporting REDD+ Programme	50	6	10	13	17	4
17	Institutional reforms and capacity building	500	59	97	129	173	41
18	Dev. Of PPP for reforestation	10	1	2	3	3	1
19	Strengthening of M&E (FRMA/FRMIS)	400	48	77	104	139	33
20	Civil works, vehicles, boats etc.	200	24	39	52	69	16
	Total	10000	1189	1935	2589	3465	822

Targets for various types of plantations, proposed under the likeliest scenario, i.e. scenario 2, are as follows:

Table 3: Plantation targets under various financial scenarios.

Plantation Type	Target Scenario 1 (ha, km)	Target Scenario 2 (ha, km)	Target Scenario 3 (ha, km)
Hill Forest (including reed land)	30387	84408	300000
Plain land sal forest	310	861	1200
Agroforestry on encroached lands	2707	7520	20000
Enrichment plantations with Assisted Natural Regeneration (hills and sal)	12674	35206	50000
Agor Plantation	3042	8449	10000
Bamboo, cane and Murta plantations (overlapping)	2582	7171	10000
Strip plantations (Seedling kilometres)	2219	6164	100000
Mangrove plantation- ha.	17887	49686	68000
Enrichment planting, coastal- ha.	241	670	5000
Non-mangrove coastal plantations	4873	13535	27000
Casuarina, palms along sandy beaches	1199	3331	5000
Golpata plantation- km.	1021	2836	4000
Plantation along Road/embankment sides, Homestead/institutional planting- seedling km/ha	2219	6164	20000
Inland char plantations	1291	3586	5000
Seedling sale/distribution (million)	119	332	500
Total plantation area	82652	229588	620200

Potential Sources of Funds for FMP

As mentioned before, forestry sector in Bangladesh has been heavily dependent on external aid. The normal or revenue budget provides only a very small component for capital expenditure. With the advent of climate change financial mechanisms, the options for financing forestry projects have gone up significantly, although the technical and administrative requirements for most international funding avenues are quite complex. A list of various national and international avenues of funding is given below:

- **National Sources:** Government, Bangladesh Climate Change Trust Fund (BCCTF), Public Private Partnership (PPP) projects, institutional finance (bank loans), corporate social responsibility (CSR) funds. The last three avenues are new to the forestry sector and the systems to access these sources are still to be developed.
- **Development Partners:** Several bilateral and multilateral development partners such as the World Bank, Asian Development Bank, USAID, European Union, DFID, GIZ have been active in Bangladesh. These countries can provide grants to Bangladesh in future as well through various vehicles such as the Bangladesh Climate Change Resilience Fund (BCCRF), Norway International Climate and Forest Initiative (NICFI), Germany REDD Early Movers Program, Forest Service and Tropical Forest Alliance 2020 (TFA), Global Climate Change Alliance (GCCA), Forest Carbon Partnership Facility (FCPF) etc.
- **Climate Change Finance through United Nations Framework Convention on Climate Change (UNFCCC):** UNFCCC can provide funds for developing projects as well as for results based funding out of the Global Climate Fund (GCF), Special Climate Change Fund (SCCF), Adaptation Fund and the Least Developed Countries Fund (LCDF). The national programmes/projects which can access these funds include Reducing Emissions from Deforestation and Forest Degradation (REDD+), Nationally Appropriate Mitigation Actions (NAMAs), Intended Nationally Determined Contributions (INDCs), and National Adaptation Programmes of Action (NAPAs).
- **Climate Finance Options through international financial institutions (IFIs):** This category includes funds like Forest Investment Program (FIP), Pilot Program for Climate Resilience (PPCR) of the Climate Investment Funds (CIF).
- **Voluntary Carbon Market (VCM):** Countries can register and trade their carbon credits, earned through programmes such as REDD+ Clean Development Mechanism (CDM) etc. through bodies like Voluntary Carbon Standards (VCS), although current price for carbon is quite low due to over-supply of certified carbon emissions (CERs).

Concluding remarks

This master plan document clearly indicates that all institutions in the forestry sector are suffering from serious shortcomings and deficiencies, which include shortage of resources, manpower, lack of knowledge and access to modern technologies, inadequate legal cover and poor enforcement, large scale decimation of forest resources and encroachment of forest land, little ability of addressing new challenges like climate induced factors and many other anomalies. These need immediate elaborate reviews to identify the causes and possible remedies. A revision of the National Forestry Policy has been completed addressing all the aforementioned issues and other important matters and submitted to the Ministry of Environment and Forests for necessary approval and follow up actions.

The sector does not have the required financial resources or the required and qualified manpower and other necessary tools to implement the plan and given the annual budgetary allocations, will require massive infusion of funds from external sources to implement the recommended programmatic interventions.. However, the whole sector is currently in a catch 22 situation, where donors will only extend support when they feel that their resources will be efficiently utilised in a timely manner. So, a comprehensive programme for institutional development covering manpower recruitment and development, innovate approaches to it, at least in the short run will have to be initiated immediately, legal and regulatory tolls including revisions of laws, legal and administrative rules will have to be revised and updated.

The recruitment of a large number of ACFs and field staff against projects and their retention after the project periods were over and failure to clarify their status in the Forest department has created an unique anomaly, which the Department has failed to resolve completely over the last two decades or so. Litigations, injunctions and other related issues have led to a situation, where no recruitment of cadre ACFs has taken place since 2004. The situation has deteriorated so much that in the next three years, there will not be enough officials available to hold even 20% of the currently approved positions. The consequences for the Forest Department will be very serious unless this issue is completely resolved, which will require an intervention from the highest level overriding all other considerations. The recruitment at the Forest Ranger's level has been discontinued for the last two decades and the number of incumbents for placement will be reduced to less than 20% of the sanctioned positions in less than four years from now.

Bangladesh Forest research Institute and the Bangladesh National Herbarium are suffering from an acute shortage of manpower, equipment and resources necessary to undertake regular and needed research programmes. Recruitment rules are outdated and processes highly bureaucratic. Promotions are slow and there is very little other incentive to work at these institutions. Forestry programmes in the universities in Chittagong, Khulna and Sylhet have a large number of highly qualified faculty and have been undertaking impressive forestry research with assistance from their students and have made several publications in international journals. Some of the other government run universities have well qualified faculty who have been conducting research in various aspects of flora and fauna, as well as social and economic issues associated with forestry sector. These need to be promoted.

Forest Industries Development Corporation is suffering from an array of serious problems. It is losing money every year and some of their major enterprises are regularly in the red! The performance of different enterprises run by BFIDC need to be reviewed immediately and drastic decisions about the regularly non-performing enterprises need to be taken. In addition as a forest industries development corporation, it has no role in the development forest industries in the country. The organisation needs to reorient its activities and include promotion of forest industries in the private sector as a major focus of its programme. Private sector industries need attention and incentives and these need to be looked into.

The forestry sector institutions are on the verge of collapse and need immediate attention from the concerned authorities. Without which, most of the sector organisations will crash within a few years!

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Abbreviations

ACF	Assistant Conservator of Forests
AD	Activity Data
ADB	Asian Development Bank
AF	Arannayk Foundation
AGB	Above-ground biomass
AIGA	Alternative Income Generation Activity
ANR	Assisted natural regeneration
BAU	Bangladesh Agricultural University
BBS	Bangladesh Bureau of Statistics
BCCRF	Bangladesh Climate Change Resilience Fund
BFD	Bangladesh Forest Department
BFI	Bangladesh Forest Inventory
BFIDC	Bangladesh Forest Industries Development Corporation
BFRI	Bangladesh Forest Research Institute
BFRI	Bangladesh Forest Research Institute
BNCC	Bangladesh National Cadet Core
BNH	Bangladesh National Herbarium
BUR	Biennial Update Report
C&I	Criteria and Indicators
CBD	United Nations Conventions on Biological Diversity
CBO	Community Based Organization
CCF	Chief Conservator of Forests
CDM	Clean Development Mechanism
CDVI	Climate and Disaster Vulnerability Index
CEGIS	Centre for Environmental and Geographic Systems (of MoWR)
CERs	Certified Emission Reduction
CHT	Chittagong Hill Tracts
CIF	Climate Investment Funds
CIFOR	Center for International Forestry Research
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
cm	centimetre
CMP	
CO_2	Carbon di-oxide
COP	Conference of the Parties to the UNFCCC
CPG	Community Patrol Groups
CREL	Climate-Resilient Ecosystems and Livelihoods
CRiSTAL	Community-based Risk Screening Tool – Adaptation & Livelihoods
CRPARP	Climate Resilient Participatory Afforestation and Reforestation Project
CSO	Civil Society Organization
CSR	Corporate Social Responsibility
CVCA	Climate Vulnerability and Capacity Analysis
DAE	Department of Agricultural Extension
DBH	Diameter at breast height
DFO	Divisional Forest Office
DoE	Department of Environment of MoEF
EF	Emission Factor
EGS	Ecosystem goods and services
FAO	Food and Agriculture Organization of the United Nations
FIGNSP	Forest Information Generation and Networking Support Project
FIP	Forest Investment Programme
FMP	Forestry Master Plan
FRA	Forest Resources Assessment (of FAO)

FRMA	Forest and tree Resources Monitoring and Assessment programme
FRMIS)	Forest Resources Management Information System
FSTI	Forestry Science and Technology Institute
FYPs	Five Year Plans
GHG	Greenhouse gas
GIS	Geographic Information System
GoB	Government of Bangladesh
GPS	Global Positioning System
ha	hectare (also Mha – millions of …)
HQ	Headquarters
ICT	Information and communication technology
IFESCU	Institute of Forestry and Environmental Sciences, Chittagong University
IFI	International Finance Institution
IFM	Improved Forest Management
IISD	International Institute for Sustainable Development
INDCs	Intended Nationally Determined Commitments
IPAC)	Integrated Protected Area Co-management
IPCC	Inter-governmental Panel on Climate Change
IUCN	International Union for the Conservation of Nature
JJAS	June July August September
km^2	square kilometre
LC	Land cover
LCCS	Land Cover Classification System
LMS	Land Monitoring System
LULUCF	Land Use, Land Use Change and Forestry
M	million (prefix for unit: ha, tCO_2e)
M&E	Monitoring & evaluation
m, m^2, m^3	metre, square metre, cubic metre
MAI	Mean Annual Increment
MIS	Management Information System
MoEF	Ministry of Environment and Forests
MoWR	Ministry of Water Resources
MRV	Measurement, reporting and verification
NAMAs	Nationally Appropriate Mitigation Actions
NAPA	National Adaptation Program of Action
NBSAP	National Biodiversity Conservation Strategy and Action Plan
NC	National Communication to the UNFCCC
NDVI	Normalized Differential Vegetation Index
NFA	National Forest Assessment
NFMS	National Forest Monitoring System
NGO	Non-governmental organization
NICFI	Norway International Climate and Forest Initiative
NPP	Net Primary Productivity
NPV	Net Present Value
NTFP	Non-timber forest product
PA	Protected Area
PAs	Protected Areas
PCVA	Participating Climate Vulnerability Assessment
PoWPA	Programme of Work on Protected Areas of the CBD
PPCR	Pilot Program for Climate Resilience
PPP	Public Private Partnerships
PSP	Permanent Sample Plot
RCP	Representative Concentration Pathways
REDD+	Reducing emissions from deforestation and forest degradation in developing countries, and the role of conservation, sustainable management of forests, and

	enhancement of forest carbon stocks in developing countries
REL	Reference emission level
RF	Reserve Forest
RIMS	Resource Information and Monitoring System
RL	Reference level
RLF	Revolving Loan Fund
ROR	Record of Rights
RS	Remote sensing
SCCF	Special Climate Change Fund
SEALS	Sundarbans Environment and Livelihoods Project
SEI	Stockholm Environment Institute
SFM	Sustainable Forest Management
SLR	Sea Level Rise
SMART	Specific, Measurable, Achievable, Relevant, Time-bound
SMF	Social Management Framework
SRF	Sundarbans Reserve Forest
tCO_2e	ton of CO_2-equivalent emissions of greenhouse gases (also $MtCO_2e$ – millions of …)
TFA	Tropical Forest Alliance
TFF	Tree Farming Fund
TOF	Trees Outside Forests
UCF	Union level Forest Conservation Forums
UDOR	Undetected Offence Report
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Conference on Climate Change
UNFF	United Nations Forum on Forests
UN-REDD	United Nations REDD+ Programme
USAID	United States Agency for International Development
USF	Unclassed State Forests
VCS	Village Common Forests
VH	Village homestead forest
VU	Vulnerable
WB	World Bank
WTP	Wood Treatment Plant

1 Background

1.1 Country context

Bangladesh is a country of 159.9 million people, living over an area of 14.75 million ha, in the deltaic plains of the great rivers Padma, Jamuna and Meghna and their myriad tributaries and distributaries. Majority of the population of the country is Bengali Muslims while Hindus, Christians and Buddhists are significant minorities. Hill districts on the east of the country and some parts of the Madhupur plains are inhabited by ethnic communities, such as Khasis, Garos, Chakmas etc. having racial affinities with the tribals of the North-eastern India and Myanmar.

There are three distinct seasons in Bangladesh: a hot and humid summer from March to June; a rainy monsoon season from June to October; and a cool, dry winter from October to March. In general, maximum summer temperatures range between 30°C and 40°C. April is the warmest month in most parts of the country. January is the coldest month, when the average temperature for most of the country is about 10°C. Most parts of the country receive at least 2000 mm of rainfall per year. Because of its location just south of the foothills of the Himalayas, where monsoon winds turn west and northwest, the regions in northeastern Bangladesh receive the greatest average precipitation, sometimes over 4000 mm per year. About 80 percent of Bangladesh's rain falls during the monsoon season.

Figure below shows the extent of various land use categories in Bangladesh in 2011. Nearly 65% of the area of the country is arable cropland while 15.7% area is forest and wilderness (including permanent meadows).

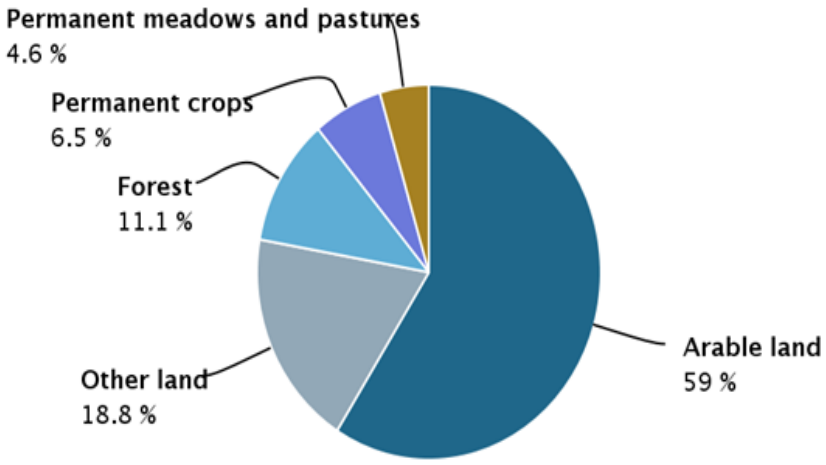


Figure 1-1: Land use proportions in 2011 (FAOstat 2015).

Bangladesh is one of the poorest countries in the world, with the per capita gross domestic product (GDP) of USD 1236, although the economy has been growing at a healthy rate of more than 6% per annum for the last few years (ADB 2016). Annual rate of growth of population in 2016 has come down to 1.3 %. The socioeconomic indicators of the country have been improving continuously, despite serious setbacks caused by natural disasters

from time to time. Life expectancy at birth has improved from 56 in 1990 to 70.9 in 2015, while adult literacy rate has improved from 37% to 64.6% over the same period. Bangladesh is determined to reach middle income group of nations by 2020, as the population below poverty has dropped from 56.6% in 1992 to 23.6% in 2016. There is a growing trend towards the urbanization of the population as the people living in urban areas grew from 14% in 1990 to 26.9% in 2012. This has a major significance for forestry and environment. Bangladesh is a low carbon emitting country, with a total emission of 57.1 million tons and a per capita emission of just 0.4 tons only (2011).

1.2 Forestry context

Bangladesh has a notified forest area of nearly 1.90 million ha, including over 400000 ha of land expected to accrete from the sea in near future. Out of the remaining 1.5 million ha of forest land, only about half the area is under natural forests, mostly in Sundarbans, while the rest is either degraded or deforested due to tremendous socioeconomic pressure, or is under various kinds of plantations (334093 ha in 2013). Forest areas of the country are mainly concentrated in the south-western (Sundarbans) eastern and northeaster flanks (hill forests) of the country, apart from small patches of sal forest in the central and northern parts. Natural forests of the country are on a sharply declining trend under pressure from illicit felling, encroachments, shifting cultivation and official conversion to other land uses.

Apart from the notified forest in the custody of the Bangladesh Forest Department (BFD), there is nearly 695000 ha of unclassed state forest (USF) in the Chittagong Hill Tracts (CHT) districts which is mostly degraded under the impact of shifting cultivation and other factors. Use of the USF area is regulated by the district administration. Large parts of the USF have been leased out for various purposes.

However, Bangladesh has a booming trees outside forests (TOF) sector which meets most of the timber and fuelwood needs of the country. The area under TOF, mostly in the form of homestead forests and cultivated lands was estimated to be nearly 1.7 million ha in 2005 (NFA 2005-07) and is believed to be growing further.

1.3 Biodiversity (conservation status, endangered & extinct species and habitats including PAs,)

Bangladesh is a part of one of the global biodiversity hotspots and is richly endowed with biological diversity, relative to her small size. Her biodiversity is estimated to have nearly 7000 endemic plant species, 113 mammals, 628 birds, 126 reptiles, 22 amphibians, 708 species of fish and 2493 species of insects. Royal Bengal Tiger is the most well-known biological heritage of the country.

However, the biodiversity of the country is under serious threat from anthropogenic pressures. As per IUCN (2016), out of 1619 assessed species, 2% are Regionally Extinct (RE), 3% as Critically Endangered (CR), 11% are Endangered (EN), 9% are Vulnerable (VU), and 6% are Near Threatened (NT). Thirty one species are categorised as extinct from the country, while 390 species (29% of the total species assessed) are under the threatened categories (CR, EN and VU).

Due to the degradation of forests, and deforestation, most species have lost their natural habitat. Apart from the Sundarbans, and a few large water bodies, no biome provides

adequate habitat to the native species of wildlife. However, the country has created a network of protected areas (PAs) for preserving her wildlife. The current protected area system of Bangladesh includes 18 National Parks, 20 Wildlife Sanctuaries, 1 Marine Protected Area, 2 safari parks, 10 eco-parks, and 10 Ecologically Critical Areas that collectively cover an area of 285841 ha, amounting to nearly 15.2% of all legally constituted forests in the country.

1.4 Bangladesh and climate change

Bangladesh has been rated as the most climate vulnerable country in the world, due to its low deltaic position, poverty, poor infrastructure and low ability to respond to extreme weather events. Global warming and the resultant changes in global climate in the form of rising temperatures, changes in rainfall patterns, sea level rise and a rise in the frequency of extreme weather events, like storm surges and cyclones, are likely to have a serious impact on the people and economy of the country. The country is likely to experience warmer winters, more rainfall over a shorter monsoon, more saline seas and salinity intrusion, and large parts of coastal areas, particularly mangroves, are likely to be submerged under water due to rising sea level. Although productivity of forest ecosystems is likely to go up due to increased photosynthesis in a warmer world, many existing forests may become unsuitable for some species due to changes in ground moisture conditions. The most vulnerable areas are going to be the northeaster hill forests (Sylhet area) which are likely to experience reduction in total rainfall.

As Bangladesh is a low carbon emitting country, therefore, its role in global warming is negligible while it is the worst affected. Although the country is participating whole-heartedly in the global effort to combat climate change, she needs to develop adequate adaptive capacity in order to protect her people and economy against the impacts of climate change.

1.5 Status of National Forestry Policy

Even though some form or the other of forest management had long been practiced in the Indian sub-continent, the British rulers were the first to introduce proper management of ‘forest estates’, which were initially managed through the civil administration. Eventually, the management of forests was vested with the Forest Department after its establishment in the mid nineteenth century. While the first Forest Act was promulgated in 1865, the First Forest Policy came into effect only in 1894. The main focus of that policy was supporting the process of reservation of forest land and the exploitation of its resources for the revenue generation.

The key features of the 1955 Forest Policy, which replaced the 1894 policy, included: higher priority and increased financial allocation for forestry activities, enhanced afforestation and reforestation programmes, and recognition of intangible benefits from forests. The main focus of the policy continued to be on revenue generation through exploitation of forest resources.

The National Forest Policy, 1979 emphasized the use of forest land only for forestry purposes, enhancement of plantation programmes, establishment of modern wood based industries, reorientation of research, education and training programmes to meet the required needs and updating of laws governing the administration of forests.

The National Forest Policy, 1994 underscored the need for bringing 20% of the country's landmass under forest cover by 2015, by establishing plantations in available forest land, private homestead land and public institutions, roadside, railway track side, embankment slopes as well as in the unclassed state forest in the three hill districts, taking support from local communities and NGOs to ensure people's participation. This policy highlighted, for the first time, the need for the involvement of communities in forestry activities and has successfully changed the mindset of the Forest Department personnel and made them community oriented, which triggered a take-off of the "Social Forestry" activities under the leadership of the Forest Department. However, many of the aforementioned policy interventions could not be successfully implemented.

The focus of forest management has changed from a production oriented forestry to one of rebuilding and conserving forest resources in order to deal with new challenges in forest management, arising from various impacts of climate change e.g., repeated cyclones, rising temperature, changes in rainfall patterns and sea level rise. These effects are expected to cause a reduction in the ecosystem services from forests. The recorded large scale depletion of forests resulting in a loss of habitats, species diversity and wildlife populations, are issues of major concern. In addition, increased demand for forest products, rapid industrialisation, overall improvement in the economic conditions of the population put tremendous pressure on diminishing forest resources. The commitments arising from the country's ratification of a number of Multilateral Environmental Treaties, including the Paris Climate Agreement, the launching of Sustainable Development Goals, together with a continuation of a total moratorium on exploitation of forest resources have necessitated review, revision and reorientation of the existing Forest Policy. The New Forestry Policy must ensure that the main foci of forestry activity are on forest asset building, conservation of existing forest ecosystem in changed climatic conditions, enhancement of ecosystem services and increased community participation in forestry activities, and making forests and dependent communities climate resilient.

1.6 Status of the FMP 1995 (Implementation status, targets & achievements, lessons learned, justification for a new FMP)

Bangladesh was one of the few countries in the world to have a comprehensive forestry master plan as early as 1995. The master plan recommended a minimum investment (scenario 1) of Tk. 60.24 billion on programmes grouped as "People-Oriented Forestry", "Production-Directed Forestry" and "Institutional Strengthening" over a period of 20 years. Against this, total development expenditure by BFD during this period was only Tk. 23.7 billion (38.3%). As the FMP had proposed programmes in virtually every aspect of forestry, all the development projects implemented during the relevant period can be treated as a follow up of the FMP but in fact few projects were specifically undertaken to implement the FMP *per se*. No projects on energy conservation, improvement of sawmilling industry, industrial development, institutional restructuring etc. were taken up, despite strong recommendations in the FMP. The separation of the authority and enterprise functions of BFD has not taken place. Principal forestry activity during this period has been social forestry plantations on encroached forest land, strip plantations and coastal plantations. No significant long rotation plantations have been taken up, as recommended in FMP. Institutionalisation of social forestry through the amendment of the law and promulgation of

the 1994 forest policy can be seen as the major achievement of the FMP 1995. Although Bangladesh has achieved 20% tree cover (16.88% of total area; 21% of terrestrial land), in accordance with the goal of NFP 1994, but the country has lost nearly all of the sal and hill forests at the same time. Although there has been significant growth in homestead forests, this has happened mostly without government involvement. The extension infrastructure created under various projects is lying unused due to lack of funds to finance extension activities.

The principal lesson that emerges from the implementation of FMP 1995 is that overambitious plans are difficult to implement in an environment of deep-rooted cultural inertia to drastic change. Planners should expect only incremental changes in institutional structures and capacities, and availability of financial resources. Any proposals conditional on drastic institutional changes and need for resources far beyond the current availability, are unlikely to see the light of the day.

The term of FMP 1995 was for a period of 20 years. Therefore, the need to revise the FMP and reset the sectoral aims, objectives, programmes and strategies in the current context is natural. The FMP 1995 came at a time when the concepts of biodiversity conservation sustainable forest management (SFM) and climate change were barely taking shape. Although FMP 1995 had noted the extremely high rate of loss of natural forests (3% per annum) but its proposals could not stop this trend, perhaps because they just could not be implemented. Despite the loss of natural forests, the forestry sector has seen a major evolution since then. While the dependence of the paper and pulp industry on local forest resources has declined, the furniture industry has come up as an important growth engine for the country. Large scale urbanization of the population and easier availability of alternative fuels has reduced the dependence of the people on wood fuels significantly, although the demand is still growing due to continuous, though slower, growth in population. The urgent need to create a coastal greenbelt, reforestation of the denuded hill forests, improve the climate resilience of the country, and the unlikelihood of the government being able to fund these activities through the traditional sources, indicates the requirement for an innovative approach to financing government programmes.

Although the principles and strategies devised by FMP 1995 are still applicable, they need to be set in the current social, environmental and economic context through a new FMP which looks 20 years ahead of today.

2 Forest Ecosystems

Bangladesh, covering an area of 147,570 km^2, is situated under the north-eastern wing of the Indian sub-continent. The country's main landmass is a low-lying delta, traversed by numerous branches and tributaries of the Padma, Jamuna and Meghna rivers and a number of other rivers. These rivers bring enormous amounts of sediments and nutrients that contribute to the biological richness of the forests, wetlands, wildlife and aquatic biodiversity. Bangladesh is considered to be one of the most climate vulnerable countries in the world. As a lower riparian country with an extensive coastline, floods, storms and cyclones are frequent and intense.

The country's food and economic security is linked closely with its ecological security for which forest and wetland conservation is vital. The country's forest ecosystems, including overlapping wetlands, provide socioeconomic and ecological services in terms of life supporting, provisioning and regulating functions, and have a tremendous impact on water-induced disaster risk reduction, and climate change adaptation of local communities and land resources. Sustainable forest management in densely populated Bangladesh has high socioeconomic and environmental benefits for local communities, who are mainly made up of subsistence farmers and labourers engaged largely in land-based activities. But with climate change becoming the principal concern of the world, particularly of the most vulnerable states like Bangladesh, the importance of sustainable and climate-resilient forestry is now better appreciated than before.

2.1 Current state of various forest types

Forest areas notified under the original Forest Act of 1865 and its successive amendments or acquired or vested in the Government, under the East Bengal State Acquisition and Tenancy Act of 1950, amount to 1,879,503 hectares, although the total area as per the records of various forest divisions amounts to 1,962,360 hectares. Apart from this area, which is under the control of Bangladesh Forest Department (BFD), an area of 6,94,983 ha, known as the unclassed state forest (USF), is under the control of civil administration in the Chittagong Hill Tract (CHT). Despite being called as forest, tree cover in these areas is extremely deficient and varies from place to place. Large parts of these forests are under encroachment or shifting cultivation or have been transferred to other agencies for various development works. Although it is extremely difficult to assess the areas under encroachment without proper survey, an area of 104,154 ha is reported to be encroached while another 125,626 ha area has been transferred to other agencies for various land uses. Thus, approximate net land in the custody of the forest department is as shown in the table below.

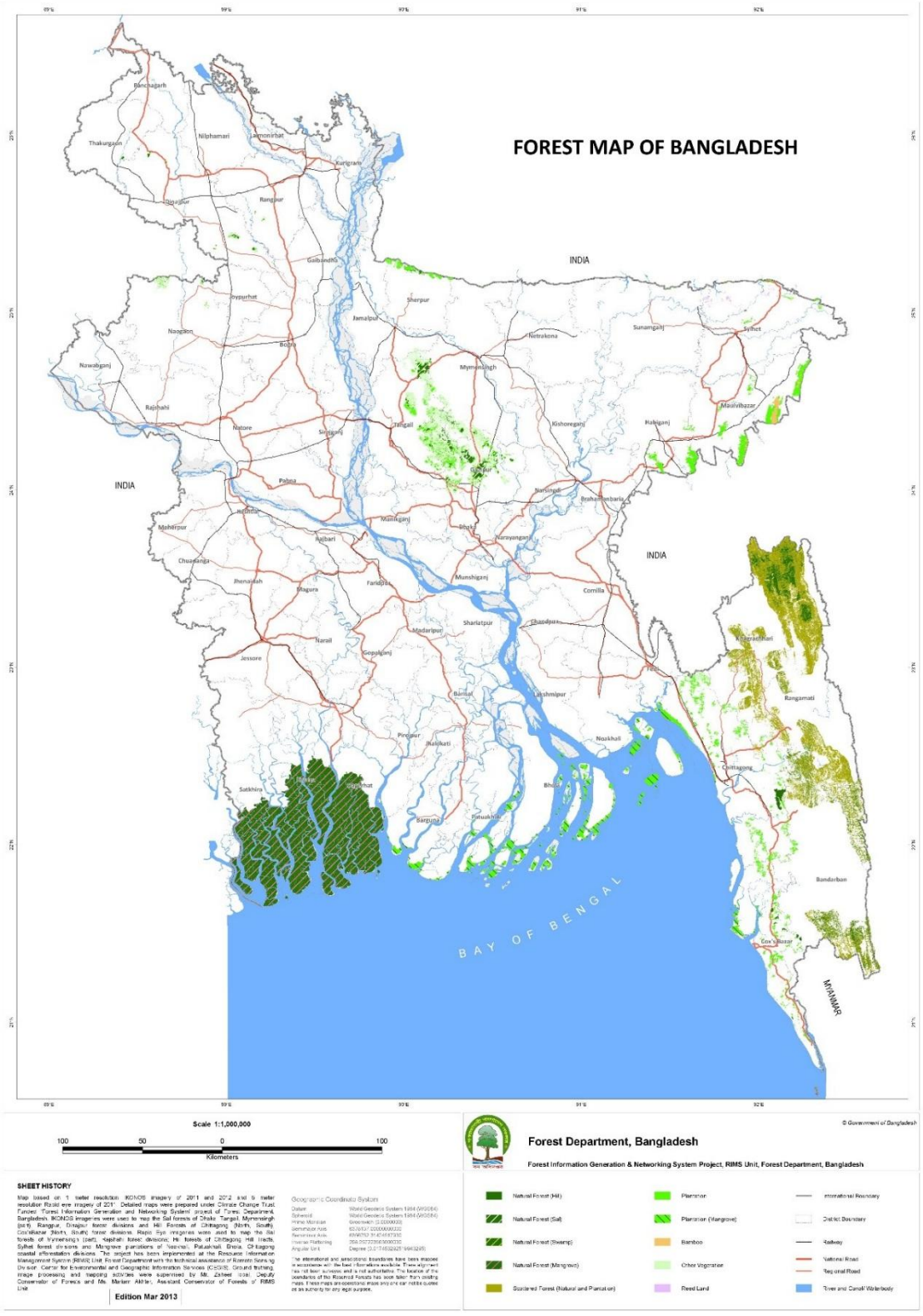
Table 2-1: Current area in the custody of Forest Department

Notified/Recoded Area		Encroached Area	Transferred Area	Net Area
Forest Type	Ha	Ha	Ha	Ha
Sal	125767	45518	8571	71678
Hill	722716	52535	28234	641947
Mangroves	600385	0	9	600376
Coastal Area	209789	6101	88812	114876
Total	1658657	104154	125626	1428877

Note: In case of discrepancies between the records of the head office and forest divisions, figures reported by divisions have been accepted in the above table.

Distribution of forest lands in the country is shown in the map below:

Map 2-1: Distribution of forest lands



While state forest areas are being lost due to various causes, trees outside (designated) forests (TOF) have been increasing steadily. Area under plantations also keeps varying due to many reasons, such as failure to establish, illicit felling, legal extraction (e.g. Social Forestry plantations) or transfer to other agencies (e.g. coastal plantations).

According to their location and composition, forests of Bangladesh are known as sal forests, hill forests and mangrove forests. Last country-wide forest and tree assessment was conducted in 2005–20071 while forest cover in the state forests and plantations was again mapped in 2013 (FIGNSP 2013)2. On the basis of these two assessments, the status of forest and tree cover in the country is approximately as follows:

Table 2-2: Forest and tree cover in Bangladesh

Category of Forest or Tree Cover	Area (Ha)	Source	Remarks
Hill Forest	79161	FIGNSP 2013	>10% Canopy Cover; all RF blocks not mapped
Sal Forest	17495	FIGNSP 2013	>50% sal trees
Mangrove Forest, Natural	390550	FIGNSP 2013	
Bamboo	15039	FIGNSP 2013	> 60% Bamboo
Plantations (Long Term and Short Term)	75872	FIGNSP 2013	
Scattered Forest in CHT Mixed with Teak Plantations	116971	FIGNSP 2013	
Plantations in USF (FD controlled)	17347	BFD	
Plantations, Coastal	61574	FIGNSP 2013	
Plantations, Rubber	9217	FIGNSP 2013	
Plantations, Strip	62329	BFD	
Cultivated land with >10% tree density	449000	NFA 2007	
Rural settlements with >10% tree cover*	11,97,000	NFA 2007	Village/Homestead
Total	**24,91,555**		

*Commonly known as homestead forests.

[1] NFA 2007: National Forest and Tree Resources Assessment 2005-2007
[2] BFD and CEGIS 2013: Forest Information Generation and Network System Project.

Trends in Forest Area

According to FRA 20153, the forest area of Bangladesh has decreased while degraded forest (other wooded land) has been increasing since 1990 as shown in the table below:

Table 2-3: Trend in Forest Area of Bangladesh (unit in ha)

Category	1990	2000	2005	2010	2015
Forest	1,494	1,468	1,455	1,442	1,429
Other Wooded Land	269	279	284	289	294
Other Land with Trees	270	934	1,408	1,882	2,356

"Other land with trees" includes homesteads, agricultural land and other lands which have some tree cover. It is noticeable that while tree covered area outside notified forests has increased at a tremendous rate, since 1990, the proper forests have been degrading at an alarming rate. This has resulted from a combination of over-exploitation of forest resources, failure to protect forests, lack of success in establishing plantations on all available vacant land, pressure on forest land from an ever expanding population and release of forest land for non-forestry purposes.

However, it is to be noted that FRA figures are not based on actual assessment. These figures are projections, using extrapolation and regression analysis, based on the data of previous years. Based on the projections made in FRA 2015 and the results of the FIGNSP 2013, the trends in the forest area under various forest types emerge as follows:

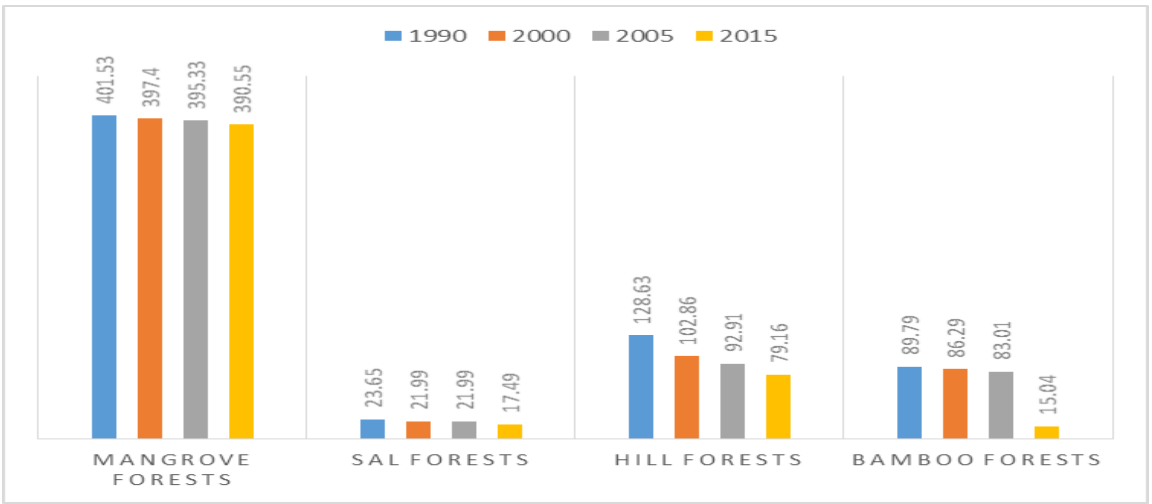


Figure 2-1: Trends in forest area under different forest types (000 ha)

[3] FRA 2015: Global Forest Resources Assessment 2015, Country Report Bangladesh Rome, 2014.

As can be seen, nearly all forest types, except Sundarbans, are on a declining trend. If this trend is not reversed, almost all the natural forests of the country, except, possibly, Sundarban, are likely to disappear soon.

From an ecological viewpoint, the forests of Bangladesh may be divided into the following types. These are:

1. **Tropical wet evergreen forests:** The hill forests of high rainfall regions of Sylhet and some smaller area in Chittagong and Chittagong Hill Tracts fall under this category. This is a multi-storied forest. The principal ever green tree species are Chapalish (Artocarpus chaplasha), Jam (Syzygium spp), Sutrong (Lophopetalum fimbriatum), and Ramdala (Duabanga sonneratioides). Their associated species are Garjan (Dipterocarpus spp), Telsur (Hopea odorata), Chandul (Tetrameles nudiflora), Sal (Shorea robusta), Hargoja (Dillenia pentagyna), Simul (Salmalia spp.), and Koroi (Albizzia spp.). The second story consists of Tilsundi (Talaruma phellocarpa), Chikrassi (Chikrassia tabularis), Gondroi (Cinnamomum spp), Pitraj (Amoora spp), Toon (Toona ciliata), Chatian (Alstonia scholaris), Nageswar (Mesua ferrea), Gamar (Gmelina arborea), Bahera (Terminalia ballerica), etc. Besides these, this forest is rich in different species of banboo. The common bamboo species are Muli (Melocanna bambusoides), Mitenga (Bambusa tulda), Daloo (Teinostachyum dulloa), Ora (Dendrocalamus lognispathus), Kali (Oxytenanthera nigrosiliata), and Bazali (Teinostachyum griffithii). The undergrowth usually is a tangle of shrubs in which canes, bamboo and wild banana plants are common. Ephiphytes are abundant. Aroids, ferns, mosses and orchids are very common. Climbers are also many.
2. **Tropical semi evergreen forests:** Most of the hill forests of Chittagong, Cox's Bazar and Chittagong Hill Tracts belong to this type. Three strata of this multistoried forest are significant and distinct at many sites. The major species of top canopy are Garjan (Dipterocarpus spp), Civit (Swintonia floribunda), Narikali (Pterygota alata), Koroi (Albizzia spp.), Chandul (Tetrameles nudiflora), Champal (Michelia excelsa), etc. The common and important species in the middle story are Tali (Palaquium polyanthrum), Kaamdeb (Callophyllum spp.), Chapalish (Artocarpus chaplasha), Nageswar (Mesua ferrea), Pitraj (Aphanamyxis polystachya), Jam (Syzygium spp.), Banderhola (Duabanga senneratioides), Cham (Michelia champaca), Toon (Cedrela toona), Raktan (Lopopetalum fimbriatum), etc. The lowest story consists of Batna (Quercus spp.), Jam (Syzygium spp.), Jarul (Lagerstroemia speciosa), Chalmugra (Hydnocarpus kurrzii), Pitali (Trewia nudiflora), Gamari (Gmelina arborea), Uriaam (Mengifera sylvatica), Bohera (Terminalia belerica), Horitoki (Terminalia chebula), Jalpai (Eleocarpus robustus), Ashook (Saraca indica), etc. Bamboo barracks, mostly of Muli (Melocanna bambusoides), are common in this type of forests. Other common bamboo species found in this type of forests are Mitenga (Bambusa tulda), Daloo (Teinostachyum dulloa), Ora (Dendrocalamus lognispathus), Kaliserri (Oxytenanthera auriculata), Kali (Oxytenanthera nigrosiliata), Bariala (Bambusa vulgaris) and Bazali (Teinostachyum griffithii).

Under the British rule, starting in 1870s, the hill forests were initially exploited under a selection system where only large trees were removed. Then the forest were regenerated through natural regeneration. This practice continued till 1930s when the management

practices were changed and the forests were worked under a system of clear felling followed by plantation establishment. While teak was the most preferred species, plantation of some indigenous species were also used. This practice was discontinued in mid-1980s, when more focus was given to, reforesting denuded areas and where previous efforts to re-establish plantations have not borne good results. This practice has resulted in plantation of single and many native species, which were available in abundance, have disappeared.

This may be mentioned here that, during the Second World War, large areas of natural forest in Chittagong and Cox's Bazar were clear felled to meet the demand of the war. Also, when the Kaptai dam was built a large area of land upstream, including forests, were inundated, and due to lack of accessibility very limited extraction of forest was carried out. Main damage at that time occurred due to burning of forests by the locals for shifting cultivation. However, the accessibility created by the dam greatly improved the accessibility and large scale extraction of forests in the Hill Tracts was undertaken.

Starting early 1970s, the deterioration in law and order situation in the Chittagong Hill Tracts became a major obstacle to plantation establishment, leaving large areas without any worthwhile tree cover. While there is still large area of vacant land available in Chittagong Hill Tracts, it has not be possible for the Forest Department to resume its normal activities.

No complete assessment of the extent of the hill forests in the country is available since NFA 2005-07. Although NFA 2007 shows 5,51,000 ha natural hill forest, the FRA 2015 shows the extent of these forests as 92,910 ha on the basis of long term trends. The recent assessment4 by the Forest Department seems to confirm this trend as only 79,161 ha area has been recorded, although some small forest blocks could not be mapped. The exercise could locate only about 15,039 ha of bamboo forest. As the areas of the left out blocks are quite small, their inclusion may not have made a significant difference to the scenario.

The loss of forest cover has created a situation where, establishment of large scale plantations is warranted, particularly in the hilly forest areas of the region. However, given the current law and order situation, any work by the Forest Department in a significant part of CHT has become difficult. This situation will require formulating new and innovative approaches and options, which are acceptable to all parties in the troubled areas. The task involved is too large for the Forest Department to currently handle because of a chronic shortage of required manpower and other resources including the huge financial allocation needed to undertake the task. In addition to governmental funds and support from traditional donors, a substantial additional funding can be obtained from different bilateral and multilateral sources including those specially designed to address climate change issues, such as the REDD+ and other similar sources can be successfully tapped. However, the requirements for qualifying to access these funds require extensive preparations and institutions including the Ministry of Environment and Forest needs to build the necessary capacity for fulfilling the requirements.

3. **Tropical moist deciduous forests:** What is commonly known as sal forests occurring in the grater districts of Dhaka, Mymensingh, Dinajpur, Rangpur and Comilla belong to this type. The major species is Sal (Shorea robusta), most of its

[4] BFD and CEGIS 2013: Forest Information Generation and Network System Project.

current crop are degraded coppice growth. Other species found as associates of sal, are Jarul (Lagerstroemia flos reginae), Sidha (Lagerstroemia parviflora), Joginichakra (Gmelina arborea), Kaikha (Adina cardifolia), Chambol (Artocarpus chaplasha), Amloki (Phyllanthus emblica), Ajuli (Dllenia pentagyna), Polash (Butea frondosa), Sonalu (Cassia fistula), Kurchi (Holarrhena antidysenterica), etc.

The sal forests in Dhaka-Mymensingh region was owned by local landlords and while these were vested with the Forest Department in 1950, the Department until today does not have full control over the track. Patches of forests in this region are often small and interspersed with homestead or agricultural land, where interferences are common. In addition, most of the current trees are poor quality coppice and frequent forest floor fire has eliminated the possibilities of the establishment of natural sal regeneration. At present only 17,495 hectares forest, or less than 20% of the forest vested with the Forest department in 1950, is is under tree cover, that too degraded.

4. **Mangrove forests:** While natural mangrove forests occurred in Barisal and Chittagong in the past, it is now available in the Districts of Bagerhat, Khulna and Satkhira. This forest formation, known as the Sundarban, spills over into the State of West Bengal in India, is the largest single tract of such forest in the world. Here trees grow in the intertidal zones where the forest floors are inundated regularly by high tides. While in most other major mangrove forests, species of the family Rhizophoraceae are dominant, the most extensively occurring species in the Sundarban are Sundri (Heritiera fomes), and Gewa (Excoecaria agallocha). This forest also is much richer in species diversity than any other mangrove formations of the world. The other major species are Kankra (Bruguiera gymnorrhiza), Bain (Avicennia officinalis), Kaora (Sonneratia apetala), Goran (Ceriops decandra), Passur (Xylocarpus moluccensis), Jhana (Rhizophora mucronata) etc. and their associates are Golpata (Nypa fruticans), Hantal (Phoenix paludosa) Shingra (Cynometra ramiflora), Kholshi (Aegiceras corniculatum), etc. The recorded vegetation of the Sundarban also include twelve species of shrubs, eleven species of climbers and an assortments of palms and grasses.

Starting in late 19th century, the Sundarban was managed under a simple Selection-cum-improvement system of management where trees above a certain prefixed diameter at breast height were first removed ensuring that such removal does not create any permanent gaps in the forest. This was followed by a thinning operation, where congestions in the crop and dead and deformed trees were removed in a single operation. This operation in an area was carried out once in every 20 years, when natural regeneration replenished the exploited area. This system worked well until the forest came under over exploitation in the 1980s, which resulted in serious depletion in the mature trees of desired tree species. When the situation reached an alarming point, a complete moratorium on all extraction was imposed in the Sundarban. According to available information, the resilient Sundarban ecosystem has recovered and now there is a healthy crop of tress in the forest. However, the Sundri trees in the forest is suffering from a disease locally known as ‘top dying disease of Sundri’. So far, it has not been possible to control it and the causes and the remedy for this disease are still largely unknown.

5. **Fresh water wetland forests:** A much smaller area of seasonally inundated fresh water forest occurs in the haors of Sylhet. The major tree species are Hijal (Barringtonia acutangula), Koroj (Pongamia pinnata), Borun (Crataiva murvala), Kadam (Anthocephalous cadamba) and Salix tetrasperma. Their associated woody shrubs are Asclepiad spp., Asparagus racemasus, Ficus heterophylla, Ipomea fistulosa, Lipia javanica, and Rosa involucrate. The common reeds are Phragmitei karka, Saccharum spontaneum, and Lemna spp. Currently no management interventions, other than protection of these tress are carried out. In earlier days, pollarding of Hijal trees were carried out for fuel wood. However, this practice has long been discontinued.

2.2 Afforestation and Reforestation

The first attempt at raising a forest plantation was made in 1871 with teak, in the Chittagong Hill Tracts using seeds brought from Burma. The policy of converting mixed forests of high species diversity to plantations continued after independence until 1979 when the country's first forest policy was adopted and commercial exploitation of natural forests was progressively restricted in order to conserve biodiverse forests. Since then, plantations of fast growing species under the social forestry programme and coastal plantations for protection of coastal communities have been the main focus.

Apart from the creation of social forestry woodlots of short rotation species in denuded or encroached forests, BFD has also been establishing large-scale strip plantations outside forests. There are some plantations of long rotation indigenous species in the core zones of reserve forests and protected areas, but the total extent is insignificant.

Up to date information on the extent of plantations of different species is not readily available As per NBSAP (2016) an area of 474,312 ha has been planted by the government upto 2015. According to the information provided by BFD, an area of 71,022 ha has been planted under the social forestry program, along with nearly 62,329 km of strip plantations between 1981 and 2015, although FRA 2015 indicates their extent to be 73,000 km before 2005, equivalent to about 73,000 ha. As strip plantation activity has also been promoted by many NGOs in the past, as a part of their social forestry programmes, the actual extent of strip plantations may actually be much more than what the BFD records show. As social forestry plantations are also exploited, and regenerated, at the end of the rotation period, the actual area under plantations may be much less.

The extent of coastal plantations carried out so far is estimated to be nearly 200,009 ha. Most of the coastal plantations have been developed primarily with the objective of stabilising the newly accreted lands. This land is given to the forest department for a period of 20 years to establish plantations and it has to be returned to the revenue department at the end of this period. An area of 45,351 ha has been returned to the civil authorities in this process, in various coastal afforestation divisions. Due to the failure, destruction or diversion of coastal plantations, the actual area under coastal plantations turned to be only 61,574 ha against a planted area of more than 200,000 ha.

As plantations are a dynamic entity, due to continuous establishment and felling, the actual area under plantations at any time is usually different from the planted area. As per the

FIGNSP 2013 study, the actual area under various kinds of plantations was identified as given below:

Table 2-4: Actual area under plantations (ha).

Plantations (Long Term and Short Term)	75,872
Scattered Forest in CHT Mixed with Teak Plantations	116,971
Plantations in USF (FD controlled)	17,347
Coastal Plantations	61,574
Rubber Plantations	9,217
Strip Plantations	62,329
Total	**334,093**

Homestead and other private forests

Homestead forests are essentially tree gardens around rural habitations. Although a large portion of the trees in the homesteads are fruit trees such as mango, jackfruit, coconut, etc., these tree lands are popularly believed to meet nearly 80% (FMP 1995) of the local demand for wood products. The NFA 2005–07 estimated their extent to be far more than all other natural and planted forests put together (2,767,000 ha, all plots over 0.1 ha in size). There are indications that area under homestead plantations has been growing ever since records are available. This underlines the importance of these resources for the local economy.

Bangladesh Bureau of Statistics (BBS) carried out a "Household Based Forestry Survey 2011–12" in 2014 and recorded that 91.9% of households in the country owned trees.

Apart from the formally recorded or recognized categories of forests, people of the Chittagong Hill Tracts (CHT) own significant chunks of private plantations (jot). There is no accurate survey of the extent of these forests, although the estimated area of private forests in North Rangamati division alone is approximately 273,791 ha, which is mostly composed of teak and gamar plantations. The newfound interest of the indigenous people of CHT in horticulture suggests that the extent of these plantations, mostly of teak and gamar, may be further declining.

Other plantations

Apart from the above, rubber plantations and agarwood plantations are the other plantations that contribute to the TOF sector. Bangladesh has approximately 32000 ha of rubber plantations owned by BFIDC, private growers and Chittagong Hills Development Board**.** Agarwood plantations have become popular of late due to their financial promise and are likely to grow further. BFD has done experimental agar wood plantations in the hill districts over an area of approx. 5800 ha. No data is available on private plantations of agarwood.

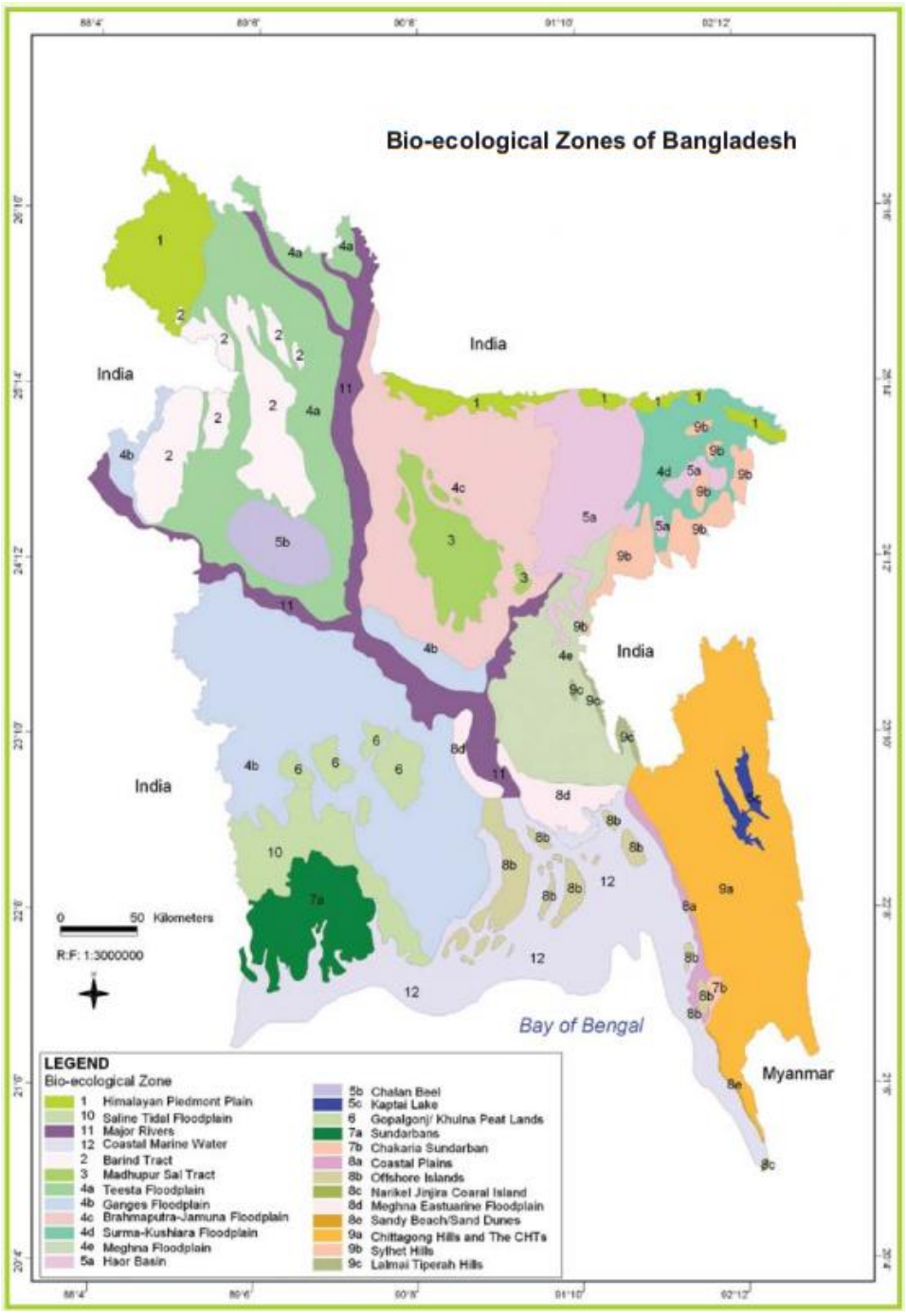
2.3 Status of biodiversity and protected areas

2.3.1 Status of biodiversity and wildlife

Despite its small size, Bangladesh has an impressive variety of ecosystems, which support an equally varied flora and fauna. The characteristics of various landscapes determine the

dispersion of the country's wildlife. Ecosystems may be categorized as either land-based or aquatic. The land-based ecosystems include forested areas, agricultural land and human habitations, while aquatic ecosystems include seasonal and perennial wetlands, rivers, lakes, coastal mangroves, coastal mudflats and charlands, and marine ecosystems. The country is divided into 12 bio-ecological zones and 25 sub-zones. Map 1-2 shows the locations of the ecological zones of Bangladesh.

Map 2-2: Bio-ecological zones of Bangladesh (IUCN, 2002).



Source: IUCN Bangladesh. 2015. Red List of Bangladesh: A Brief on Assessment Result 2015. IUCN, Bangladesh

According to NBSAP 2006, species of plants and animals found in Bangladesh are as given below:

Table 2-5: Recorded and estimated number of wild plant species of different plant groups

Categories	Recorded	Estimated
Algae	3,600	6,000
Bryophytes	290	400
Pteridophytes	200	250
Gymnosperms	5	5
Angiosperms	3,000	5,000

Table 2-6: Number of animal species belonging to the major taxonomic groups

Major Taxonomic Group		Number of species
Monera (Eubacteria, etc.)		166
Protista (Protozoan, Viruses, etc.)		341
Animalia: Invertebrates	Poriferans	7
	Cnidarians	68
	Platyhelmiths	23
	Nematodes	105
	Annelids	62
	Arthropods	1547
	Molluscs	347
	Echinoderms	6
Animalia: Vertebrates	Fishes	735
	Amphibians	23
	Reptiles	136
	Birds	778

Major Taxonomic Group		Number of species
	Mammals	125
Total Species		4,469

Royal Bengal Tiger and Asiatic elephant are the two most important wild animals of Bangladesh. In the Hill Forests, other important wild fauna includes the Asian elephant (Elephas maximus), Spotted deer (Axis axis), Barking deer, Langur, Phyre's monkey, Hoolock Gibbon and numerous snakes, and birds. In the Plain land Sal forest, located in the districts of Gazipur, Mymensingh, Tangail, Comilla, Rajsahi, Rangpur, and Dinajpur, wildlife includes the Rhesus monkey (Macaca mulatta), Barking deer (Muntiacus muntjac), Spotted deer (Axis axis), Langur, Fishing cat, Marbled cat, Jackal (Canis aureus); in the mangrove forests of the Sundarbans, wildlife includes the Royal Bengal Tiger (Panthera tigris), Spotted deer (Axis axis), Wild boar (Sus scrofa), Rhesus macaque (Macaca mulatta), Estuarine crocodile (Crocodylus porosus), and snakes, birds (300 species) and fish. Wildlife in the freshwater wetlands, including haors and baors, is characterized by various species of birds (208 species), turtles and tortoises and fishes (144 species).

Royal Bengal Tiger, masked finfoot, mangrove pitta, brown winged kingfisher, lesser adjutant stork, Indian skimmer, Gangetic dolphin, Irrawaddy dolphin and the saltwater crocodile are some of the most threatened species of wildlife found in Bangladesh.

IUCN Red List

IUCN has recently carried out an assessment of the conservation status of various groups of wildlife found in the county. According to IUCN (2015):

"Among 1619 assessed species, 50% of species are found as Least Concern (LC), 2% as Regionally Extinct (RE), 3% as Critically Endangered (CR), 11% as Endangered (EN), 9% as Vulnerable (VU), and 6% as Near Threatened (NT). Thirty one species are categorized as extinct from the country, while 390 species (29% of the total species assessed) are under the threatened categories (CR, EN and VU). Besides, 17% species are categorized as Data Deficient (DD) due to a lack of appropriate data and information required to justify the criteria used for categorizing. No endemic species is available in Bangladesh to be assessed at the global scale".

Extinct Species of Bangladesh

Thirteen species were marked as extinct from the country in the Red List of 2000 which were reassessed along with all other species under this project. Among 1619 species of Bangladesh of seven faunal groups, 31 species are assessed as extinct from the country which is termed as regionally extinct (RE). Among these 31 species, 11 are mammals, 19 are birds, and 1 is reptile. No species was found as regionally extinct from other four groups (Amphibian, Freshwater Fish, Crustacean and Butterfly). Ten species of mammals were evaluated as Extinct in the previous Red List. Among these extinct species Gaur and Hog Deer have been rediscovered during the last decade. However, the recent edition of Red List enlisted one species of mammal, Sloth Bear as Extinct from the country. According to the

present assessment, 17 bird species are newly declared as regionally extinct, while only two species were adjudged as extinct in the last assessment. Marsh Crocodile (Reptile) was listed in the Red List 2,000 extinct list, which is also assessed as extinct from Bangladesh in Red List 2015". The updated list of extinct species of the country is as follows:

Table 2-7: Extinct Wildlife Species of Bangladesh

Mammals	Birds	Birds/Reptiles
Striped Hyena	Bar-tailed Tree Creeper	Pink-headed Duck
Black Buck	Spot-breasted Parrotbill	Rusty-fronted Barwing
Sumataran Rhinoceros	Green Peafowl	White-bellied Heron.
Swamp Deer	Swamp Francolin	White-winged Duck
Banteng	Bengal Florican	Black-breasted Parrotbill
Indian Rhinoceros	Greater Rufous-headed Parrotbill	Indian Peafowl
Blue Bull	Greater Adjutant	Grey Francolin
Wild Buffalo	Lesser Florican	Spot-billed Pelican
Grey Wolf	Rufous-throated Partridge	Marsh Crocodile (Mugger Crocodile)
Javan Rhinoceros	Sarus Crane	
Sloth Bear	Red-headed Vulture	

The conservation status of important groups of wildlife in Bangladesh is as follows:

Mammals

"Among 1,619 species of seven wildlife groups, 138 mammalian species were considered; of which, 11 are Regionally Extinct, 17 Critically Endangered, 12 Endangered, and 9 Vulnerable. Apart from those, there are 39 Data Deficient, 34 Least Concern, 9 Near Threatened, and 7 Not Evaluated species.

Birds

Birds as a group have the highest number of species that were evaluated, 566 species. Among them 19 have been evaluated as Regionally Extinct and 39 species as under Threatened Category, of which 10 Critically Endangered, 12 Endangered and 17 Vulnerable. Close to this, there are 39 species under the Near Threatened Category; the highest number, 424 had been evaluated as Least Concern.

Reptiles

Reptiles have 167 species and one has become Regionally Extinct. The Mugger or Marsh Crocodile that used to live in the freshwater river ecosystem of the country and possibly it disappeared by the 1960s. Of the 38 threatened species, 17 are Critically Endangered, 10 Endangered and 11 Vulnerable. The remaining species have been evaluated as: 18 Near Threatened, 63 Least Concern, 27 Data Deficient, and 20 Not Evaluated.

Amphibians

A total of 49 Amphibians were evaluated. There are 2 species Critically Endangered, 3 Endangered, and 5 Vulnerable. Apart from the threatened categories, 6 species are Near Threatened, 27 species are Least Concern, and 6 species are Data Deficient.

Freshwater Fishes

Two hundred fifty three Freshwater Fishes were assessed. Nearly one fourth (64 species) of the species are under threat, among them 9 Critically Endangered, 30 Endangered, and 25 Vulnerable. This has been followed by 26 species as Near Threatened. Outside the purview of the Threatened and Near Threatened Categories, there are 123 species that were assessed as Least Concern and rest of the 40 as Data Deficient.

Crustaceans

As one of the new animal groups for the first time included in the national Red List of Bangladesh, so far, 141 species of Crustaceans were evaluated. This group has no species that are registered as Regionally Extinct or Critically Endangered. Eleven species have fallen under the threatened categories of which Endangered includes only 1 and Vulnerable 10. Out of the rest, 48 species were evaluated as Least Concern and 79 as Data Deficient.

Butterflies

Butterfly is another new group included in the current process of evaluation that included 305 species. As newly assessed group, 62% species (188 species) are under

Threatened Categories of which only one Critically Endangered, 112 Endangered, and 75 Vulnerable. The rest 85 are Least Concern and 32 Data Deficient."

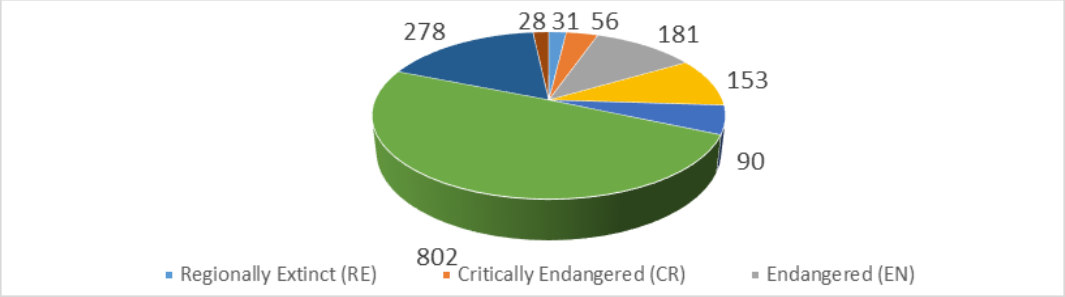


Figure 2-2: Endangered animal species of Bangladesh

A summary of the threat status of various groups is given below:

Table 2-8: Summary of the Red List of Bangladesh 2015[5]

Categories	Mammals	Birds	Reptiles	Amphibians	Fresh-water Fishes	Crustaceans	Butterflies	Total
Regionally Extinct (RE)	11	19	1	0	0	0	0	31
Critically Endangered (CR)	17	10	17	2	9	0	1	56
Endangered (EN)	12	12	10	3	30	2	112	181
Vulnerable (VU)	9	17	11	5	25	11	75	153
Near Threatened (NT)	9	29	18	6	27	1	0	90
Least Concern (LC)	34	424	63	27	122	47	85	802
Data Deficient (DD)	39	55	27	6	40	79	32	278
Not Evaluated (NE)	7	0	20	0	0	1	0	28
Total	**138**	**566**	**167**	**49**	**253**	**141**	**305**	**1,619**

As can be seen, a large number of species of mammals, birds and reptile groups are threatened while 31 are already extinct locally. In view of the growing population and prosperity of the people, the pressure on natural resources is going to mount further in future. Therefore, if special efforts are not made to preserve the threatened species, the losses in future may be even more severe.

2.3.2 Protected Areas

The National Biodiversity Conservation Strategy and Action Plan (NBSAP) 2004, which is currently under revision, has some account about the flora and fauna. The NBSAP has identified the conservation of “megaflora and megafauna” as one of the priorities in the country.

The Wildlife (Protection and Security) Act 2012 is the principal legal instrument that regulates the conservation of biodiversity in the wilderness. That legislation empowers the state to designate protected areas in which representative biota and their habitats are protected. This Act provides for the creation of several types of protected areas, namely, sanctuary, national park, community conservation area, safari park, eco-park, botanical garden, wildlife breeding center, landscape zone or corridor, buffer zone, core zone, national heritage and *kunjban*. All categories enjoy the same level of protection as a wildlife sanctuary (section 14, 15 and 16) although no special protection is available to some categories, namely, community conservation area, buffer zone, or corridor.

[5] IUCN Bangladesh. 2015. *Red List of Bangladesh: A Brief on Assessment Result 2015.* IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh, pp. 24.

As the size of wildlife habitats have shrunk drastically and some of these have become fragmented, it is necessary to extend the Protected Areas to at least 30% of the forest area of the country. A larger area in the Sundarban, which is very rich in floral and faunal biodiversity, needs to be brought under protected area system. In addition all watersheds and other sensitive areas, including rehabilitated watersheds need to be brought under the coverage of Protected Areas.

The current protected area system of Bangladesh includes 18 National Parks, 20 Wildlife Sanctuaries, 1 Marine Protected Area, 2 safari parks, 10 eco-parks, and 10 Ecologically Critical Areas, that collectively cover 285841 ha, accounting for nearly 15.2% of all legally constituted forests in the country. The following areas have been declared as "Protected Area" by the BFD under different Acts and Rules.

Sl No	Name	District	IUCN Category	Area in Ha	Notified on
	Wildlife Sanctuary				
1	Rema Kalenga WS	Habigonj	II	1795	07-07-1996
2	Char Kukri Mukri WS	Bhola	IV	40	19-12-1981
3	Sundarban East WS	Bagerhat	Ib	31226.94	06-04-1996
4	Sundarban West WS	Shatkhira	Ib	71502.10	06-04-1996
5	Sundarban South WS	Khulna	Ib	36970.45	06-04-1996
6	Pablakhali WS	CHT	II	42087	20-09-1983
7	Choonati WS	Chittagong	IV	7763.97	18-03-1986
8	Fashiakhali WS	Cox's Bazar	IV	1302.43	11-04-2007
9	Doodpukuria Dhopachari WS	Chittagong	IV	4716.57	06-04-2010
10	Hazarikhil WS	Chittagong	II	1177.53	06-04-2010
11	Sangoo WS	Bandarban	II	2331.98	06-04-2010
12	Teknaf WS	Cox's Bazar	IV	11615	24-03-2010
13	Tengragiri WS	Borguna	II	4048.58	24-10-2010
14	Dudmukhi WS	Bagerhat	II	170	29-01-2012
15	Chandpai WS	Bagerhat	II	560	29-01-2012
16	Daingmar WS	Bagerhat	II	340	29-01-2012
17	Sonar Char WS	Patuakhali	II	2026.48	24-12-2011
18	Nazirgonj Dolphin WS	Pabna	VI	146	01-12-2013
19	Shilonda Nogdemra Dolphin WS	Pabna	VI	24.17	01-12-2013
20	Nagarbari Mohongonj Dolphin WS	Pabna	VI	408.11	01-12-2013

Sl No	Name	District	IUCN Category	Area in Ha	Notified on
21	Swatch of No-Ground Marine Protected Area	South Bay of Bengal		173800	27-10-2014
	National Park				
22	Bhawal National Park	Gazipur	IV	5022	11-05-1982
23	Modhupur NP	Tngail	IV	8436	24-02-1982
24	Ramshagor NP	Dinajpur	IV	22.75	30-04-2001
25	Himchar National Park	Cox's Bazar	IV	1729	15-02-1980
26	Lawachara National Park	Moulavi Bazar	II	1250	07-07-1996
27	Kaptai National Park	CHT	II	5464	09-09-1999
28	Nijum Dwip National Park	Noakhali	II	16352.2	08-04-2001
29	Medakochchopia NP	Cox's Bazar	IV	395.92	08-08-2008
30	Satchari NP	Habigonj	II	241.91	15-10-2005
31	Khadim Nagar NP	Sylhet	IV	678.80	13-04-2006
32	Baryardhala NP	Chittagong	II	2933.61	06-04-2010
33	Kuakata NP	Borguna	II	1613	24-10-2010
34	Nobabgonj NP	Dinajpur	IV	517.61	24-10-2010
35	Shingra NP	Dinajpur	IV	305.69	24-10-2010
36	Kadigor NP	Mymensingh	IV	344.13	24-10-2010
37	Altadhigi NP	Nowgaon	IV	264.12	24-12-2011
38	Birgonj NP	Dinajpur	IV	168.56	24-12-2011
39	Special Biodiversity Conservation Area Ratargul	Sylhet		204.25	31-05-2015
40	Mirpur National Botanical Garden	Dhaka		84.21	1961
41	Balda Garden	Dhaka		1.37	1909
42	Bangabandu Shekh Mujib Safari Park, Dhaka	Gazipur		1493.93	2013
43	Bangabandu Shekh Mujib Safari Park, Cox's Bazar	Cox's Bazar		600	1999
44	Madhobkundo Eco Park	Moulavi Bazar		265.68	2001
45	Shitakundo Botanical Garden	Chittagong		808	1998
46	Modhutila Eco Park	Sharpur		100	1999
47	Bashkhali Eco Park	Chittagong		1200	2003

Sl No	Name	District	IUCN Category	Area in Ha	Notified on
48	Kuakata Eco Park	Barguna		5661	2005
49	Tilagar Eco Park	Sylhet		45.34	2006
50	Borshijoora Eco Park	Moulavi Bazar		326.07	2006
51	Rajeshpur Eco Park	Comilla		185.9	

Besides these the DOE has declared the following 13 areas at various locations as "Ecologically Critical Areas". Except that declaration nothing visible towards their management or maintenance of these ECAs have been done by the DOE so far.

Sl. No.	Name of the ECA	Type of Ecosystem	Location	Areas (ha)	Year of Declaration
1	Cox's Bazaar-Teknaf Peninsula	Coastal-Marine	Cox's Bazaar	20,373	1999
2	Sundarbans (10 km landward periphery)	Coastal-Marine	Bagerhat, Khulna & Satkhira	292,926	1999
3	St. Martin's Island	Marine Island with coral reefs	Teknaf upazila, Cox's Bazaar	1,214	1999
4	Hakaluki Haor	Inland Fresh water Wetland	Sylhet and Moulvi Bazar	40,466	1999
5	Sonadia Island	Marine Island	Moheshkhali upazila, Cox's Bazaar	10,298	1999
6	Tanguar Haor	Inland Fresh water Wetland	Moulvi Bazar	9,727	1999
7	Marjat Baor	Oxbow Lake	Kaliganj upazila of Jhenaidah & Chaugacha upazila of Jessore	325	1999
8	Gulshan-Baridhara Lake	Urban Wetland	Dhaka city	101	2001
9	Buriganga	River	Around Dhaka	1336	2009
10	Turag	River		1184	
11	Sitalakhya	River		3771	
12	Balu including Tongi canal	River		1315	
13	Jaflong-Dawki	River	Jaflong, Sylhet	1493	2015

Wildlife management

Bangladesh does not allow hunting or trapping of wild animals for consumption or trade. However, wildlife is declining rapidly due to the loss of habitat and illegal exploitation. Royal Bengal Tiger, found only in the Sundarbans now, is the most important wild animal of the country, both from the threat as well as popularity points of view. It is the flagship species of the Sundarbans while another flagship species, the Asian elephant lives in the eastern and northern forests. Tiger is under severe threat from poachers feeding the Chinese and Southeast Asian markets. Its current population is estimated to be only about 106 animals.

Approximately 200 years ago, elephants were abundant throughout the area of present Bangladesh. At present (in 2016) they are listed as critically endangered. Up to 30% of Bangladesh's elephant population is transient, migrating over the borders into neighbouring India or Burma. In 1996 it was estimated that the total number of elephants in Bangladesh was about 200 to 250 (Santiapillai, IUCN 1996). Increasing human population caused intense competition for land and conflicts with elephants, which drove them to only a few limited and isolated areas. The International Union for Conservation of Nature (IUCN) Bangladesh conducted a survey on elephants in 2004, which estimated that their total number in the country was about 239 only of which 94 are captive (used either for logging or for circus). The IUCN enlisted this mammal as critically endangered in 2010. IUCN estimated that 80 to 100 migratory elephants occasionally cross the border with Burma and India. It needs to be mentioned here in that Bangladesh has no active elephant conservation project.

The biggest threats to this tiny population of wild elephants in Bangladesh are

6. Habitat loss and fragmentation.
7. Scarcity of fodder: Elephant fodder represents only 14% of the total local plant species.
8. Disturbed Corridors: IUCN (2001-2003) reported that there were 15 important elephant corridors in Bangladesh involving the native elephants and migratory populations to move from India and Myanmar. Most of these have fallen prey to human settlement.

The above factors have had a serious effect on human elephant relations. Bangladesh is an exceptionally poor country and the government does not have the resources to effectively manage or conserve the wildlife, especially when large areas are required.

Although Bangladesh is not an important source country for international wildlife trade, it is an important route for smuggling South Asian wildlife and wildlife products to the southeastern Asian markets. In Bangladesh, most animals are killed for food, large volumes of birds and reptiles are also captured for the pet trade.

Forest Act, 1927 and the Wildlife (Conservation and Security) Act 2012 are the two main legal instruments for protecting wildlife and its habitats. Apart from the creation of Protected Areas and Reserve Forests, the country is in the process of setting up a Wildlife Centre for capacity building, research and information management on wildlife. Arrangements for wildlife crime control and rehabilitation of rescued and stranded animals need to be strengthened. A wildlife forensic lab for aiding prosecution is under development. There are

seven wildlife divisions whose main job is to control wildlife crime. Despite the proactive approach adopted by BFD for controlling wildlife crime in the country, several institutional issues militate against success in this area. Both the laws have some serious flaws which need to be urgently rectified. For example, the Wildlife Act has no provision for empowering forest officers to arrest wildlife criminals while the Forest Act is not applicable outside the forests where most of the wildlife offences are committed. Moreover, the wildlife Act is not yet fully operational because several important rules and notifications are not yet in place. Field officers are also handicapped in providing effective protection to wildlife due to the lack of necessary equipment including transports, funds for patrolling, travelling and prosecution. As a result, only a small proportion of the wildlife offences are detected and prosecuted. Nearly 60% of the registered cases are those where the criminals could not be identified (UDOR cases) and 78% of the prosecuted cases take more than 8 years for decision in the courts6. Thus, the Wildlife Act do not act as an effective deterrence against wildlife offences.

Although the new law provided for co-management only for sanctuaries, this system is already operational in many Protected Areas which are not wildlife sanctuaries. In many areas, co-management is only cosmetic because the management has no money to pay communities for their services or share any revenue with them. Most Protected Areas suffer from acute shortage of staff and funding. Some, like Madhupur National Park, suffer from heavy encroachments and social unrest. Pablakhali sanctuary which is one of the largest PAs, outside the Sundarban, is severely damaged by encroachment and illicit felling.

Though tourism is one of the principal revenue earning components of Protected Areas, for all practical purposes there is no scientific management. Till 2016, BFD has declared about 51 locations as "Protected Area"; only for a couple of them management plans have been written but their application is not yet a reality. It seems that some of these Protected Areas are getting overcrowded by visitors which in turn not only disturb the wildlife, but also adversely affect the ecosystems. Some such locations are Katka (Sundarban East WS), Lawachara (Sreemongal, Sylhet), Bhawal National Park (Dhaka), Satchari (Habigonj), Ratargul (Sylhet), Modhupur NP (Mymensingh), etc. Such large crowds of visitors very often causes serious pollution and adversely affect the pristine ecosystem[7]. BFD needs to find out the "carrying capacity" of each of their PAs and restrict visitors accordingly. It is high time for the BFD to promulgate rules towards the management of the Protected Areas, prohibiting pollutions and impose punishments to the polluters. BFD needs to undertake systematic and scientific management of all the PAs under their control.

2.4 Demand and Supply

Forest produces significantly contribute to the economy of the country. It not only provides numerous products, but also generates large quantum of services for the nation. Timber and firewood are the basic requirement of a large part of the population and thus create a huge demand on forest products. The demand on NTFPs is also high. Such high demand has caused overexploitation. In a densely populated country like Bangladesh, land is one of the

[6] Bangladesh Forest Department, 2015: NATIONAL WILDLIFE CRIME CONTROL STRATEGY (DRAFT)

[7] Tourism: An Emerging Threat to Sundarban Ecosystem. (An article in the book 'Sundarban' published by Nymphea Publication, Dhaka, Bangladesh. ISBN: 978-984-90160-0-7.) 2013

scarcest resources for which there is a tremendous competition as well. In view of these, the future of the forests in country are briefly discussed below.

Demand for forest land

Land is the pivot to forests and forestry. But in this densely populated country, land is the most precious item. Forest land is perhaps one of the most precious commodities in a land scarce country and there is pressure to grab it from all quarters. There are land disputes between local people and the government over the ownership of the forest land in Madhupur and CHT. Many forest patches have been occupied by people on the basis of dubious documents purportedly during the zamidari days, in the sal forests. For many poor people, cultivation on a patch of forest is the easiest way to make a living. Lack of demarcation and regular survey and mapping of forest boundaries is among the principal reason for land disputes in the country. Although accurate record keeping of encroachments is difficult because of the dynamic nature of encroachment activity. Under such situation availability of regular land for creation of new forest is a dream. However afforestation on new accretions along the coast is being done under various administrative and political barriers. Under this high pressure forest lands are being encroached by the locals, especially with some sort of supports from powerful elites. According to the BFD records, till 2016, about 104,154 ha is reported as Encroached of forest land, which is increasing every day. The actual figure will be much higher than this reported numbers. Besides these the government during this given period has transferred about 70171 hectares of forest land to others. A summary of that is as under.

Agency	Acres	Hectares	% of Total Handed Over
BFIDC	42,509.3	17,350.73	24.73
Army & Law Enforcing Agency	114,529.8	46,746.86	66.62
Others	148,80.88	607,3.829	8.65
Total	171,919.98	70,171.42	100

Such transfer of forest land by the government for non-forestry use is indicative of the fact that the government does not give much importance to this forestry sector. Besides these, there is a large number of title suits on forest land over thousands and thousands of hectares.

The major causes for the above stated situation are as under.

The government has the least importance to Forests & Forestry

Extremely poor manpower of the BFD

Extreme paucity of fund

Very poor or no logistics of the BFD

Improper maintenance of land records by BFD

Improper and poor maintenance of physical land boundaries, etc.

Another area of conflicting demands for forest lands is shifting cultivation. While the need for continuing this traditional practice requires access to unlimited expanse of wild lands, forest management requires that shifting cultivation should be banned. Although shifting cultivation is permitted in the USF lands, it has affected nearly all of the RF areas in the CHT region.

The land for coastal afforestation is transferred by the government to the Forest Department for a fixed period and at the end of this period, the land needs to be retransferred back to the Lands Department. There is often a serious conflict over the possession of such land between the Forest department and locals, often led by influential people and this has in many cases resulted in wilful destruction of plantations. A plantation all along the coast of Bangladesh is being planned as a green belt for protection from sea borne storms. As the green belt will be a permanent belt of plantation, the land under the green belt plantations will have to be permanently transferred to the Forest Department and its protection needs to be ensured. Necessary legal provisions will have to be made in this respect.

Timber and Fuel wood

No estimates of the production of timber (round-wood) and fuel-wood in the country are available in Bangladesh. FAO estimates the current production and consumption of round-wood, which includes both timber and fuel wood, as 26.6 m^3 for 2014 but has no estimate for the timber component. On the basis of a survey of the round-wood consumption by nearly 15880 sawmills of the country, and estimates of total growing stock, annual production of timber in the country is estimated to be approximately seven million m^3 per annum. Thus the total current consumption of firewood can be presumed to be approximately 19.6 million m^3. As has been mentioned before, nearly all of the timber and firewood is produced by private tree growers as there is a ban on cutting of trees in government forests.

Brick Burning Act 1989 imposed a ban on the use of fuel wood for brick manufacturing and introduced licensing for brick kilns which prevented tree felling for brick burning and contributed in projected of forest resources. However, in spite of this ban, a very large quantity of fuel wood is still being used in brick manufacturing and the mechanism in place for enforcing the ban has not been successful in banning the use of fuel wood. According to a study (Khan, 2013) about 1.9 million tons of fuel wood is annually used in brick industry. As the demand, according to the study, the future rates of growth will be 2-3% annually. Unless an effective ban on the use can be ensured demand for fire wood for brick manufacturing will continue to increase. Brick manufacturing is a major cause of destruction of tree covers in villages and also removal of trees as fuel wood from forests.

Brickfields are a major pollutant and generate, according to Khan (2013), generate9.8 million tons of CO_2 annually. Use of natural gas and modern fuel saving brick manufacturing technologies can result in substantial reduction in fuel consumption. As availability of natural gas for kilns is unlikely, only the use of coal in brick industry needs to be enforced though strictly enforcing the ban on the use of firewood. In the absence of a time series data of past consumption levels, it is difficult to make projections of the future demand. However, a reasonable guess about future demands can be made on the basis of various demographic

features and the changing socioeconomic conditions of the country. While the demand for timber is likely to go up in proportion to the rise in population, demand for fuel-wood is likely to be modified by the changing fuel preferences due to increasing urbanization and availability of alternative fuels like gas, electricity and others.

Based on these factors and assumptions, the demands for industrial round-wood and fuel-wood in the future are estimated as follows:

Table 2-9: Projections of timber demand

Year	Estimated Population (millions)	Estimated Demand (million m^3)
2016	163	10.57
2030	186	12.06
2050	202	13.09

Table 2-10: Projections of fuel wood demand

Year	Population (millions)	Population % using wood fuel	Population using wood fuel (millions)	Estimated Demand for fuelwood
1991	110	44.27	48.4	18.392
2011	153	34.8	52	19.76
2030	186	25	46.5	17.67
2050	202	15	30.3	11.514

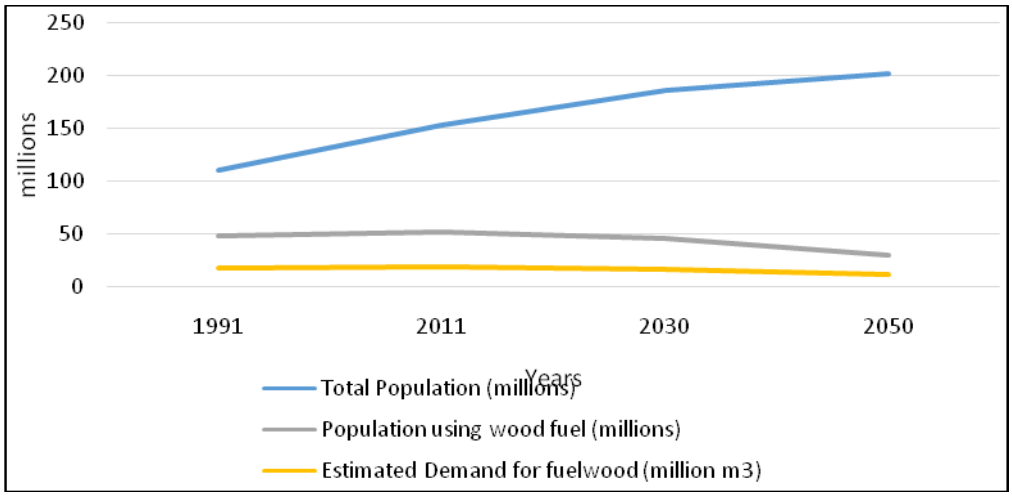


Figure 2-3: Projection of fuel-wood demand

Above tables and graphics show that while the demand for timber or round-wood would continue to grow with the rise in population, the demand for fuel-wood is likely to fall from the current consumption of 19.9 million M^3 per annum to 17.67 million M^3 in 2030 and to 11.5 million M^3 in 2050, despite the rise in population, due to the impending demographic and socioeconomic changes. This trend augurs well for the country as it will go a long way in helping to regenerate its forests.

NTFPs

Good time series data for the NTFP for all the forest division is not available. However, on the basis of general trends, it is clear that the demand for bamboo will continue to rise in view of its versatility and population increase. Demand for Murta in the Sylhet forest division is going down due to the emigration of craftsmen and their opting for other professions. With the increase of population, demand for fish and honey will continue to grow, but their production is declining.

Based on the prevailing demand golpata is collected from the Sundarban by individuals through permit. Thus the quantity collected can safely be used as demand. The graph generated by using the production data for the period 1970 to 2010 of Golpata from the Sundarban is given below.

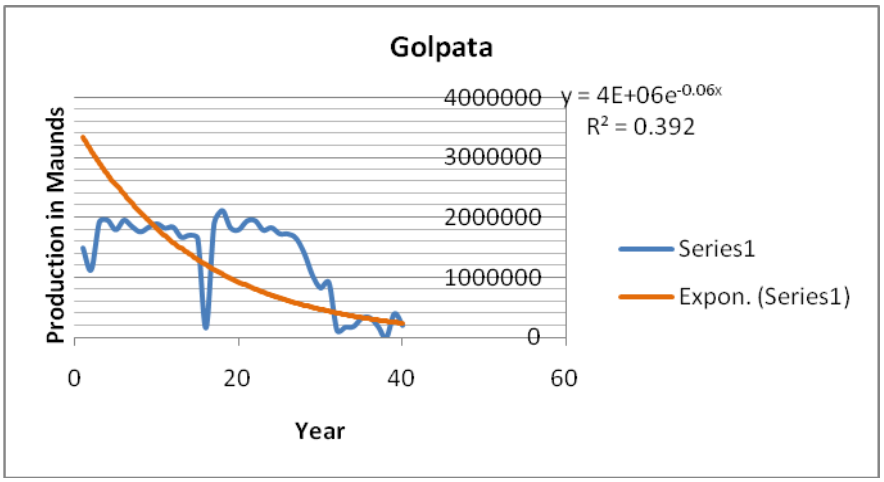


Figure 2-4: Golpata production trend

This graph clearly indicates that the demand for golpata, very widely fluctuates and the overall trend is declining.

Analogous to Golpata, stated above, the graph generated by using the production data for the period 1970 to 2010 of Honey from Sundarban is given below.

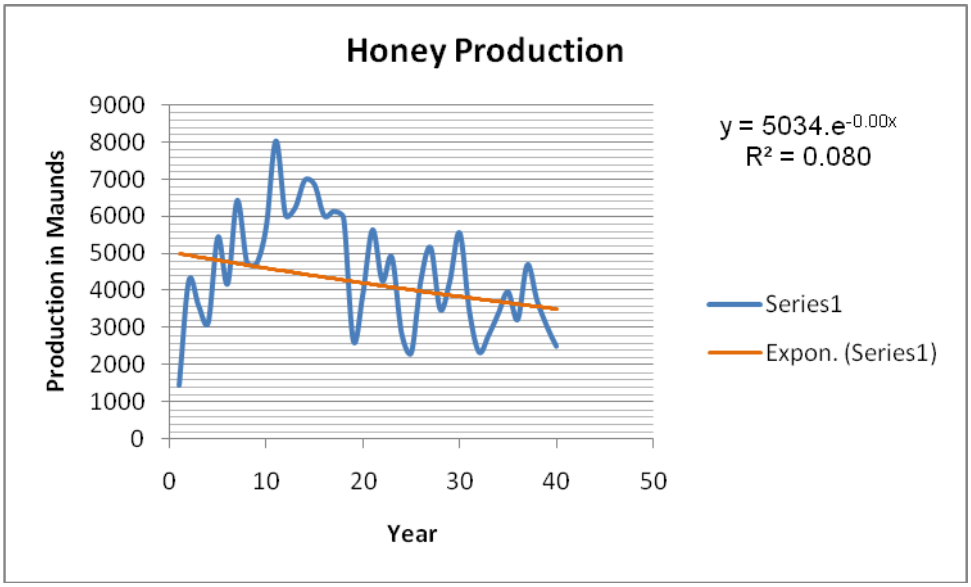


Figure 2-5: Honey production trend

This graph indicates tremendous yearly fluctuation and an overall declining trend. There is every reason to believe that this declining trend is indicative of declining species diversity.

Demand for paper and paperboard is increasing but is met mostly by imports. Consumption of wood charcoal is also growing and will continue to increase in future. Charcoal making is estimated to consume nearly 2 million m^3 of round-wood annually.

Medicinal plants is another commodity that partly come from the forests. With the declining natural forest, their supply from the forest has gone down and many of these are grown by the rural people in and around their homesteads. The SEDF/IC study reported that the total value of the medicinal plants used in Bangladesh annually, is worth 14 Million $ of which 8.4 $ worth is imported. The major species are Amloki, Haritaki, Arshwagandha, Bahera, Peepul, Cheerota, Mutha, Agar, etc. The demand is continuously increasing.

There is a huge market for medicinal plants and this demand is steadily increasing due both because of large scale local demands and demands in the international market. Agar wood and oil are high value commodities in the international market. While the agar trees have disappeared from the hill forests where it was growing naturally, plantations of the species have been established both in public and private sectors and has a large potential.

BFD may take necessary steps to grow these medicinal plants under social forestry programs.

2.5 Ecosystem services and their valuation

Ecosystem services, or ecosystem goods and services (EGS), encompass all provisions from nature. The EGS can be divided into the following categories for the sake of simplification:

- **Provisioning Services:** Food, raw materials, fresh water, medicines.

- **Regulating Services:** Moderation of climate and extreme events, erosion control, pollination, carbon sequestration, waste water treatment, biological control, soil fertility.
- **Habitat or Supporting Services:** biodiversity, wildlife, genetic diversity.
- **Cultural Services:** Recreation, tourism, spiritual value.

Most of these ecosystem services are intangible, thus cannot be measured directly. However, continuous progress is being made to quantify the bounties of nature in order to understand their importance to human existence and progress. A brief description of the EGS provided by various forest ecosystems of the country is given below.

Mangroves

Like all ecosystems, the Sundarbans provide both tangible as well as intangible services. Among the tangible or provisioning services, the mangroves provide food such as honey, fish, shrimp, crabs, timber, fuel wood, thatching materials, herbs, and ornamental plants, as well as other ecosystem services, including detritus and nutrient production, water purification, sediment trapping, and surface water storage. Non-timber forest products are also used for medicinal, cosmetic, and cultural purposes as well as fibres, resins, gum, plant, and animal products. Sundarban is one of the most important ecotourism destinations in the country. Major contributions of the Sundarban to ecosystem services include breeding and nursery ground for a large number of aquatic organisms including fish and crustaceans. Nypa, honey and wax are the other critical goods provided by these mangroves. But the more critical role of the Sundarban is the protection it provides to the coast and coastal communities against the sea storms, tidal surges and other sea borne vagaries of nature, the habitat it provides to hundreds of species like tigers, crocodiles, fishes etc. and the maintenance of the oxygen and carbon cycles in the region. The productivity of the fisheries in the country is dependent on the breeding and migration sanctuary provided by Sundarban to various fish species. Sundarban also holds the largest stock of sequestered carbon in the country. It is also the single largest carbon sink in the country. The Sundarban is one of the most important ecotourism destinations in the country.

This ecosystem has experienced some deterioration, however, because of the overexploitation of resources in the past. The construction of the Farraka Barrage, in particular, has decreased the amount of freshwater flow, which has increased the salinity, affecting the health and distribution of its flora. Then the over exploitation of Sundri and Gewa, together with the top dying disease, which killed large number of Sundri trees have been the main causes of deterioration forest stands in the Sundarban. Withdrawal and diversion of water upstream from the rivers flowing into the Sundarban have decreased the flow of fresh water into the forest causing an increase in salinity concentration. This is adversely affecting Sundri, economically the most important species in the Sundarban, which thieves best in conditions of less salinity. The resulting reduction in tree density has made these areas more vulnerable to cyclones. Some local people have, nevertheless, responded to the changes in the ecosystem to intensively farm shrimp as in the Chakaria Sundarbans. Permanent retention of stagnant water inside coastal embankments has made land unsuitable for agriculture or animal husbandry. As the population in the area have access to very few other income generating activities, this situation has made them more

dependent on the Sundarban. This situation has affected the health, nutrition, workload, and livelihood strategies of surrounding communities.

Hill Forests

The upland or hill forests are located in the Sylhet, Chittagong hills and Chittagong Hill Tracts. Timber, fuel-wood, non-timber forest products including bamboo are the principal resources provided by this ecosystem. These forests also protect catchments and watersheds, provide irrigation water and generate electricity, such as in Kaptai Lake. The hill forests have been rich in floral and faunal diversity. It is home to a large number of animal and plant species, particularly the Asiatic elephant, Hoolock gibbon, Spectacled monkey, Phayre's leaf monkey, Slow loris etc. However the denudation of the forests has resulted in a major loss of habitats and a large number of species have disappeared from these forests. The watershed services provided by the hill forests feed the perennial rivers and recharge the aquifers and provide protection against flash floods. The forests also help to maintain the healthy populations of pollinating insects and birds which ensure the productivity of surrounding agriculture.

In some of the areas under Sylhet, Chittagong and Bandarban districts, Agar (Aquilaria agallocha) plantations have been raised. Valuable aromatic oil is extracted from the infected wood of this species. It fetches a price of about 15,000 USD per Kg.

However, due to the degradation and deforestation in these areas, the services provided by them are dwindling. Due to the moratorium on the exploitation of natural forests, the official production of timber has stopped but the degradation of the forests has not stopped. Due to the deforestation, most of the NTFP production has also declined or stopped. The establishment of monoculture tree plantations has affected this ecosystem by increasing erosion risks and degrading forest soils. Man-wildlife conflict is also increasing as elephants are now causing more damage as a result of the destruction of their habitat.

Sal forests

Lowland forests of sal, including the plantations that have replaced the natural forests, provide a number of goods and services, such as timber, fuelwood, non-timber forest products, root foods, wild fruits, berries, medicinal plants etc. However, sal forests have shrunk to a sal portion of what was vested with the Forest Department due to the failure to complete the reservation process of the vested forests, large scale encroachment and other human interference. It is natural that with the loss of sal forests, most of the biodiversity and other goods and services it provided disappeared. Although these forests did not support any big mammal populations, other than perhaps deer, in the recent past, but the smaller organisms are much more vulnerable to the changes in their habitat and may just disappear without our ever knowing about them.

However, the loss of natural forests in the country has been compensated, to some extent, by the growth in trees outside forests (TOF). Although TOF can be no substitute for natural forests, without them natural forests would have been under much more pressure. Nearly all the timber and fuel wood consumed in the country is produced by the trees in the homesteads and other private lands.

Although the agro-ecosystem is still reasonably healthy and production is still growing, the increase in chemical inputs as well as overexploitation of ground water has started telling on

its health. If the pesticides affect the populations of pollinator insects and birds, the impact on agricultural production may be disastrous in the absence of adequate forest cover to replenish those populations.

Thus, it is obvious that the ecosystem services in general are on a declining trend due to the socioeconomic stresses on the ecosystems. The only reasonably intact natural ecosystem is the mangroves while the sal forest has almost disappeared and the hill forests are in a very degraded condition. The provisioning services such as the production of wood and non-wood products have suffered tremendously while the other services such as flood control, water recharge etc. are equally badly affected. While the goods can either be produced elsewhere or imported, but there is no alternative to ensuring the uninterrupted supply of the support services as life will be difficult without them, if not impossible.

Economic value of ecosystem services

Values of the tangible benefits have been described above. Herein attempts are being made to put forward the intangible benefits as "ecosystem service value" so far known or estimated.

Despite the precarious condition of the forests of the country, the economic value of the ecosystem services provided by forests and tree cover is quite significant, although most of the ecosystem services are not measurable at present. Forests and tree resources of the country contribute to the national economy in many ways, such as by providing consumable goods like wood and non-wood products for trade and industry, providing direct and indirect employment to the people in the collection, processing and trade of forest products. As many of the forest products are traded or consumed without entering formal market and most of the employment generated by forests is of very diverse nature, an exact estimate of the contribution of the forestry sector to the economy of the nation is difficult. However, based on the estimates made in other countries, the economic value of the forests of Bangladesh can be summarized as follows:

Economic value of the protective role of Sundarban against storms and cyclones cannot be measured directly. But SEALS project has indicated that for every cyclone that passes over Sundarban, it saves human lives worth 870 billion taka (equivalent to 11 billion USD).

- Existence value, cultural value, biodiversity conservation and many supportive services cannot be measured in economic terms. Health of fisheries and aquaculture businesses significantly depends on the breeding environment and sanctuaries provided by the mangroves. There can be no wild tigers in Bangladesh without Sundarban. This value cannot be measured directly in terms of money.
- Forests are perhaps the only effective tool to remove greenhouse gases by sequestering them in vegetation. The role played by forests in mitigating climate change, which has huge economic implications for human beings, is one of the most significant service provided by forests. Carbon sequestered by forests can also be traded through various international mechanisms, to generate money. For example, carbon sequestered by Sundarban is valued at USD 1.1 million per year, at current rates for carbon in the international market.
- According to BBS (2014), 5.8 million persons are employed, full time or part time in private and homestead forestry. Nearly two million persons are employed in over

71,000 furniture manufacturing enterprises, nearly 365,000 persons are employed by the bamboo and cane based occupations, nearly six lakh persons are involved in the collection, trade and processing of NTFPs from Sundarbans alone. BBS lists at least 33 occupations/industries based on forest products. Thus, the total employment generated by the forestry sectors is at least ten million persons. The wealth created by these jobs, even at very conservative rates of Tk. 3,000 per month would be nearly Tk. 360,000 crores per annum (USD 4.5 billion).

- The value of timber and fuel wood produced in the country is conservatively estimated to be USD 2.5 billion.
- IUCN-Bangladesh developed a vision to the year 2050 and the assessment of all EGS yielded an estimate of USD 456.32 to $1,191.84 per hectare per year or $273 to $714 million per year for the entire Sundarban.
- The contribution of "Forests and related services" which includes only timber, fuel wood, bamboo and "minor products", to the GDP of Bangladesh in 2013-14, is recorded as Tk. 184014 million (1.43% in 2014), but the contribution of the wood-based manufacturing businesses worth Tk. 101041 million (this figure will go up significantly when estimates are finalised) has not been included in the forestry sector contribution. These contributions are shown in the manufacturing sector. Even if a part of this contribution is credited to the forestry sector, the recognition of the sector as a source of GDP and jobs will at least double. If the full value of all the ecosystem services is considered in the national accounting, the contribution of the forestry sector would easily go beyond 10%.

2.6 Trees outside forests (TOF)

TOF generally refers to the plantations and scattered trees outside natural forests. However, in this case, TOF also includes all trees outside managed forests, including natural tree growth.

Unclassed State Forests

Unclassed State Forest (USF) refers to the forest area in Chittagong Hill Districts which are administrated by district administration. The land under this classification comprises an area of about 712,418 ha out of which nearly 17,347 ha is currently under the control of the BFD. As mentioned before, there is no information on the exact extent of forest coverage within this area, but it is recognized that most of the lands under this category are barren and denuded. A large chunk of this land is being cultivated intensively resulting in loss of top soil and fertility. While the area available is large, there is no major initiative now to bring these land under tree cover. Most of the land is covered by intensive cultivation in a sloping terrain, where top soil and soil fertility have been lost. Because of the prevailing political situation in parts of the Hill Districts, Forest Department has not been able to undertake any plantation programme on these land for quite some time. As, this vast tract of land is one of the biggest chunk of land available for plantation established, it is important that suitable mechanism, acceptable to all parties be found out so that these areas are again brought under tree cover. Some small scale plantation programmes are being implemented successfully by some NGOs in collaboration with local communities and these need to be scaled up and

implanted over more land. All involved parties have also agreed to the implementation of a watershed project funded by UNDP. If successful, this could be a pathfinder.

Homestead and other private forests

Homestead forests are essentially tree gardens around rural habitations. Although a large portion of the trees in the homesteads are fruit trees such as mango, jackfruit, coconut, etc. However, this source is very significant because it is reported to meet around 80% of the fuel wood and timber needs of the country. The NFA 2005-07 estimated their extent to be far more than all other natural and planted forests put together (2,767,000 ha, all plots over 0.1 ha in size). Tree cover in the homestead vegetation is fairly dense, as shown below:

Table 2-11: Village Homestead Area by Tree Cover Classes (000 ha)8.

Tree Cover Classes					
No Tree Cover	<5%	5-10%	10-30%	30-70%	>70%
40	752	873	675	491	31

Table 1-10 shows that nearly 40% of the villages have tree cover, which is comparable with any forest area of the country. Previous studies showed that per capita availability of bamboo and trees from the homesteads had increased between 1981 and 1991. It is presumed that the same trend has continued in the recent past and the area and number of trees in the homestead must be more than those recorded here. NFA 2005-07 shows that the village homestead stands and cultivated lands contain more than double the commercial volume (105 million m3) of round wood compared to the nation's forest areas (43 million m3). This underlines the importance of these resources for the local economy.

Homestead forests consist of mixed fruits, fuel wood, shade, and other multipurpose trees, as well as bamboos. In the upper stratum, it is common to find trees such as Albizia procera, A. lebbeck, Aphanamixis polystachya, Artocarpus heterophyllus, A. lacucha, Polyalthia longifolia, Alstonia scholaris, Azadirachta indica, Dillenia indica, Mangifera indica, Cordial dichotoma, Elaeocarpus floribudus, Bombax ceiba, Syzygium cumini, Samania saman, Swietenia macrophylla, Tamarindus indica, Toona cialiata, Acacia nilotica, Lagerstroemia speciosa, Ficus bengalensis, F. religiosa, F. racemosa, Anthocephalus chinensis, Eucalyptus camaldulensis, Areca catechu, Borassus flobellifer, Cocos nucifera, and Gmelina arborea, among others. In the middle stratum, the major part is composed of small trees and bamboos (Alam 2014).

Apart from the formally recorded or recognized categories of forests, people of the Chittagong Hill Tracts (CHT), Chittagong Hills and Dhaka circle own significant chunks of private forest areas. There is no accurate survey of the extent of these forests, although the estimated area of private forests in North Rangamati division alone is approximately 273,791 ha, which is mostly composed of teak and gamar plantations (pers. Com. DFO). The

[8] BFD: NFA 2005-07

newfound interest of the local indigenous people in horticulture suggests that the extent of these plantations, mostly of teak and gamar, may be declining.

Bangladesh Bureau of Statistics (BBS) carried out a "Household Based Forestry Survey 2011-12" in 2014 to estimate the level of forestry activity in the homesteads and other private lands. A summary of the results is given in the table below:

Table 2-12: Household Based Forestry Activity 2011-12 (BBS 2014)

Item	Estimate	Remarks
No. of Households reporting	13,270,322	91.9% reported owning trees
Total No. of trees	1,447.31	million
Total value of trees	1,346,100	million Tk.
Total wood production	35,785,000	Cft.
Value of wood produced	11,582	million Tk.
Total bamboo production	6,027,000	
Value of bamboo produced	1,067	million Tk.
Firewood production	5,191,835	million tons
Value of firewood	46,505	million Tk.
Gross output of HH based forestry activity	133,712	million Tk.

This study divided the overall private tree planting activity into two categories: Homestead trees and planned forest away from homesteads. It estimated the area of planned forests as only 606,600 acres (245,587 ha) and no estimate of the area under homestead plantations is given. Apparently, the results of this study are not comparable with the earlier assessments and most values seem to be underestimates.

Strip Plantations

Bangladesh has been undertaking the planting of fast growing exotic species, primarily Acacia auriculiformis and A. mangium, on the strips of land along roads, railway lines, and canals under the social forestry programme. While there are conflicting records of the total extent of these plantations, it is reasonable to believe that the area under plantations is growing as the result of the recurring annual establishment of plantations, as well as the security provided by the communities participating in the social forestry programme. According to the records of the BFD, approximately 62,329 km of strip plantations were established between 1980-81 and 2014-15, although FRA 2015 indicates their extent to be 73,000 km before 2005, equivalent to about 7,3000 ha. Since then 23,512 km additional strip plantations have been established until 2014-15 making the total length close to one hundred thousand km. As strip plantation activity has also been promoted by many NGOs as a part of their social forestry programmes, the actual extent of strip plantations may be much more than what the BFD records show.

Other plantations

Apart from the above, rubber plantations and agarwood plantations are the other plantations that contribute to the TOF sector. Bangladesh has approximately 40,000 ha of rubber plantations owned by BFIDC. Besides these there are a large number of private rubber gardens in CHT. BFD so far has raised agar plantations over 5800 ha in Sylhet, Bandarban, Chittagong and Cox's Bazar. Besides these there many small private agar plantations especially in Sylhet region. This has become quite popular at present and is being used privately for "cash crop". No reliable data is available on private plantations of agarwood.

3 Review of Policies, Acts, Regulations and Programs

3.1 Policy

Article 18 A of the Bangladesh Constitution states that

“The state shall endeavour to protect and improve the environment and to preserve and safeguard the natural resources, biodiversity, wetlands, forests and wildlife for the present and future citizens.”

This article of the Bangladesh Constitution will help to pave the path of harnessing all, that may be necessary for improvement, sustainability, conservation, highlighting of ecosystem services, etc., provided sectoral policies, acts and rules are properly formulated and thought out rightly. A critical review of the prevailing policies, acts, rules, etc. is the initial requirement to proceed further in this regard. This chapter is thus is an attempt to undertake the required.

3.1.1 National Forest Policy

The first formal forest policy was declared in 1894 by the then government. The national forest policy of 1894 provides the basic guidelines for the formulation of acts and rules for the management of forest in this part of the world. The salient features of this policy were as under.

- State forests are to be administered for public benefits.
- The rights and privileges of people living nearby may regulated.
- Forests in the hill slopes should be conserved.
- Valuable forests should be managed to yield state revenue.
- Cultivable land within the forest may kept under cultivation as long as do not cause any permanent harm.
- Low yielding forest may permitted for grazing.

Agriculture was preferred over forestry in this policy. The forest act 1927 was formulated under this forest policy. Most of the reserve forests of Bangladesh were declared under the forest act 1927. Most of the rules were also framed under this act.

The present tract of Bangladesh emerged as "East Pakistan" in 1947. In 1955 a forest policy was enunciated. The salient features of 1955 forest policy were as under.

- Forestry sector should receive priority and increased allocations.
- Forests should be classified on the basis of its utility.
- Intangible benefits of forests should be recognized.
- All forests should be managed though an approved working plan.
- Road side and canal side should be afforested.
- Sound management of private forests should be ensured.
- Control adverse land use and
- Conserve soil.

Since revenue earning was a major target, clear felling followed by artificial regeneration became a general practice. Many working plans were written under this policy.

Bangladesh emerged as an independent country in 1971. The first National Forest Policy for Bangladesh was announced in 1979. The salient features of this forest policy are asunder.

- Government Forest shall not be used for non-forestry purposes.
- Forest should be carefully preserved and scientifically managed.
- Plantation raising is to be enhanced.
- Forest based industries shall be set up.
- Research, education and training shall be reorganized & emphasized.
- A cadre of officers shall be constituted for managing the forestry sector.
- Relevant laws of forestry sector shall be updated.
- To conserve forest and wildlife and utilize the recreation potential of forestry sector.
- Mass motivation towards forestry to be done.
- The National Forestry Policy of 1979 was little vague and was not implemented in its full spirit.

The prevailing forest policy was tabled in 1994 with 29 policy statements. The salient features of this policy are asunder.

- The government shall take all endeavours to bring 20% of land under forest by the year 2015 to maintain the ecological balance and attain self-sufficiency in forest produces. To achieve this objective the government shall work jointly with Non-Government Organization and ensure peoples participation.
- Since the area under government-managed forest is very limited, the afforestation activities shall be extended to village areas; newly accreted mud-flat areas and in the denuded areas of un-classed state forests of Chittagong Hill Tracts.
- People will be encouraged to plant up trees in their own fellow and marginal land, on the bank of tanks and homesteads. Technical advice and assistance will be provided for using “Agro-Forestry” practices, to the people if they introduce agro-forestry in their marginal and sub-marginal land. While introducing agro-forestry in state owned and private land appropriate attention will be given to produce fodder and in maintaining the herbs and shrubs.
- Government will encourage people to plant up in the premises of public institutions like union council office, schools, idgah, mosque, maktab, temple, orphanage, madarsha and their surrounding areas. Both technical and other assistance will be provided.
- In the state owned marginal lands like the roadsides, railway tracksides and both the sides of the embankments, the government will, under take afforestation with peoples’ participation and with assistance from the NGOs.

- To ensure pollution control in the cities, the government shall take up special afforestation activities in all the municipal areas of the country. To achieve this goal, the municipalities, town development authorities and other related autonomous bodies shall help the government in the implementation of the programs by way of zoning and allotting land for tree plantation. The town planning authorities must keep provision for tree planting in their development plans by setting aside specific sites for the purpose.
- In the hill districts of Banderban, Rangamati and Khagrachari massive afforestation programs will be undertaken in the USF (Unclassed State Forest) by public and private agencies. The local governments keeping the land rights retained by the land ministry will execute the program.
- In order to preserve the soil, water and biodiversity, the natural forests of the hilly areas and the catchments of the rivers within the country shall be declared as Protected Areas, Game Sanctuaries, and National Parks. It will be the endeavour of the government to keep 10% of the national forests as “Protected Area” by the year 2015.
- An integrated management plan will be prepared for Sunderbans incorporating the management of forest, water and wildlife.
- State owned hill and sal forests will be managed as production forest except those declared as “Protected Areas” for preserving soil, water and biodiversity. The production forests will be managed on commercial basis with due consideration to environment.
- The critical areas like steep hill slopes, vulnerable watersheds, wetlands will be designated as ‘forests’ and will be managed as Protected Areas.
- Denuded and encroached government forest lands will be identified and brought under afforestation program with peoples’ participation on benefit sharing approach preferably under agro-forestry wherein NGOs may be associated.
- Modern and appropriate technologies will be introduced as attempts to minimize the loss at all steps of collection and processing of forest produces.
- Emphasis will be laid on the modernization of forest-based industries to maximize the utilizations of forestry raw materials.
- Steps will be taken to bring in competitive and profit-oriented management to the state owned forest based industries under the purview of open market economy.
- Labor intensive small and cottage industries based on forest products will be encouraged in the rural areas.
- Forest transit rules will be made simpler to meet the present day needs.
- Since wood deficit exists, the ban on export of logs will continue. Processed wood products can however be exported. Import of wood and wood products will be liberalized, but reasonable import duties will be levied on forest products that are abundant in the country.

- Due to shortage of forest area in the country, no forestland will be allowed to be used for any purpose other than afforestation, without the permission of the head of the government.
- In absence of clearly defined land ownership, the tribal people inhibiting adjoining forest lands in some parts of the country, cultivate anywhere in the forest land. Clearly delineated forest land will be set aside for them through forest settlement operation and the rest will be brought under permanent forest management.
- Training, technical assistance and financial support will be enhanced towards private afforestation and tree based rural development programs, from the funds received as international grants and from donors.
- Women folk will be encouraged more in programs such as homestead afforestation, rural tree farming and participatory forestry.
- Eco-tourism will be encouraged keeping in mind the carrying capacity of the forest and the nature.
- To create massive awareness about afforestation, protection and utilization of forests and forest products, mass media camping shall be taken up both in Government and in Non-Government channels.
- Under forestry programs, fruit tree planting shall be encouraged in addition to timber, fodder, fuel wood trees and other non-wood products, in the habitations.
- Steps will be taken to modernize the methodology of extraction of forest products to minimize loss and increase efficiency.
- Forest Department will be strengthened to achieve the objectives and goals of the policy and a new social forestry department will be established.
- The research institutions, education and training institutions related to forest will be strengthened to achieve the policy targets and their roles will be enhanced and integrated.

In the light of the aims, objectives and targets set up in 1994 forest policy, related acts and rules shall be modified, amended and if necessary newly formulated. The 1994 Forest Policy is reasonably elaborate and incorporated & advocated the participatory forestry concept in clear terms. This has opened up the avenue of co-operation between NGOs and Government Agencies in the area of social forestry.

The current forest policy of 1994, has not incorporated climate change aspect. Moreover many new issues and challenges such as extensive loss of forest cover, administrative complicacies, acute manpower shortage, very poor capacity, extremely poor research & education etc. cropped up in recent past. In view of that, a new forest policy draft has been prepared as a part of the FMP development exercise.

The newly proposed National Forestry Policy 2016 (draft) is briefly reviewed below.

The new forestry policy draft has been prepared after an extended process of national consultations and reviews. The revision was necessitated by the emergence of new environmental and socioeconomic changes in the context of climate change and extensive

loss of forest cover in the country in the last two decades. The salient features of the draft forest policy 2016 are as follows:

- The principal aim of the policy is to "to manage all existing forest, wildlife and other forestry resources, adhering to the principles of sustainable management and climate resilience; enrich degraded forest areas; and enhance land areas under forest/tree cover; to produce a wide array of goods and ecosystem services for the benefit of Bangladesh's current and future generations".
- In pursuance of this overall goal, the policy lists 16 objectives out of which the most important is "To arrest deforestation, and degradation of forest resources, enrich and extend areas under tree cover, through appropriate programs and projects, to ensure that at least 20% of the country comes under tree cover by 2035, with at least a canopy density of 50%." This objective is an improvement over a similar objective in the previous policy which did not say anything about the canopy density.
- The policy statements have been grouped into 13 themes. The principal policy statements are as follows:
- Given the acute shortage of forest land, henceforth, no forest land will be released for any non-forestry activities without the prior approval of the Honourable Prime Minister with a vetting from the cabinet. In cases involving priority national interest, equal areas will be handed over to the Forest Department, with required fund for compensatory afforestation. Necessary rules will be formulated to that effect;
- Traditional rights of various ethnic-communities, living in and around state forest areas, will be recognized and maintained with due respect to their forest-related cultural values and religious beliefs. Conservation initiatives related to forest, wildlife and biodiversity by indigenous communities will be encouraged;
- Undertake a credible valuation of the ecosystem services that the forestry sector provides in Bangladesh and demonstrate it as an additional contribution from the forestry sector to the gross domestic product of the country;
- To ensure protection of the Sundarban Reserve Forest from pollution and oil spills, navigational routes inside the Sundarban will be strictly restricted. Access to any waterway inside the Reserve Forest, except the recognised routes between the Mongla Port and the sea, will be subject to prior permission from the forest authorities.
- Encourage the flow of corporate and institutional financial resources into reforestation activities and plough back all forest revenues into reforestation programmes;
- Ensure that forest management plans are formulated and implemented in all Forest Divisions and all silvicultural prescriptions therein are strictly implemented;
- Ensure that all newly accreted land (*char*) are handed over to the Forest Department for extensive coastal plantation establishment with climate resilient species;
- Continue the existing moratorium on exploitation of natural forests without restricting the scope for silvicultural interventions.

- Complete effective mapping and clear demarcation of all notified forest areas using modern tools and technologies, and also update and maintain record of rights, accordingly.
- Strengthen extension activities and expand participatory forestry activities through the establishment of forest extension units in all upazilas with adequate resources and manpower to handle an effective advisory and support program;
- Develop a network of market places for promoting competitive trade in timber produced by private growers.
- Ensure the implementation of the provisions laid out in the Bangladesh Wildlife Master Plan 2015-2035 and the Bangladesh Forestry Master Plan 2017-2035 through appropriate mechanisms;
- Expand the coverage under protected areas to 30% of the state forest land;
- Empower communities, allowing them to have rights and responsibilities and devolved authority, to participate in forestry activities for socio-economic and environmental benefits, and increased forestry production;
- Encourage all wood-based industries to engage in "contract farming approach' to obtain their desired raw material supply;
- Ensure entry level training for all new recruits in the Forest Department and upgrade and modernize curricula for basic training for entry level officials at Forester and Assistant Conservator levels. In the case of foresters, as there is no longer any intake at the Forest Ranger level, upgrade the curriculum so that it prepares the new recruits for eventual responsibility of administering and managing forest ranges;
- Forest Department will liaise and coordinate with universities providing forestry education so that the graduates of these institutions have adequate knowledge of core forestry subjects and could be inducted into the forest service after administrative and field level trainings.
- Maintain maximum area possible under tree cover and ensure through proper actions that deforestation is totally arrested;
- Create a massive carbon sink for carbon sequestration by bringing more areas under tree cover;
- Develop and implement awareness raising strategies and capacity development programmes on the opportunities for adaptation and mitigation measures as per the climate change action plan;
- Create a 'coastal green belt' of thick mangroves and other suitable climate resilient species to reduce vulnerability of coastal communities to the impact of climate change induced disasters;
- Commitments made at the Paris Climate Change Meeting through Intended Nationally Determined Commitments regarding LULUCF, shall guide the future forestry action in the country.

- Enhancement of forestry carbon stocks and generation of benefits through mechanism such as Clean Development Mechanism, Reduced Emission from Deforestation and Degradation Plus (REDD+) shall be one of the main objectives of future forestry programmes;
- Formulate a climate financing mechanism that will help the country to take advantage of new and emerging climate change funds like REDD+, Forest-Carbon Partner facility, Green Climate Fund, and other available sources and also, include innovative ways to fund climate change actions domestically through accessing Bangladesh Climate Change Resilience Fund and support from other governmental allocations and other local sources;
- Transform Bangladesh Forest Research institute into an autonomous body with a major mandate to undertake forestry related applied researches;
- Review, update and rationalize the Forest Research Institute to ensure the induction of staff with appropriate educational background, and facilities for further education and research should be made available to ensure development of appropriate capacity and know-how.;
- Strengthen Bangladesh National Herbarium, and encourage and facilitate taxonomic research;
- Strengthen Bangladesh Forest Industries development Corporation to spearhead the development of forest products industries and ensure a proper policy environment for the growth and modernisation of the sector.
- Help establish NTFP based cottage industries so that it can add value to the processing and marketing of NTFPs for an enhanced income to the producers;
- Forest service will be considered as a technical/professional service and similar to all other such civil service cadres, only forestry graduates will be eligible for entry;
- Formulate a 10-year recruitment plan on the basis of the foreseen needs, and the induction into the service will be made on a regular annual basis;
- Review the current administrative structure of the Forest Department and assigned roles and responsibilities after conducting 'needs and workload analysis' to create a more efficient administrative structure;
- Establish third-party monitoring and evaluation of forestry programme;
- Provide risk/difficulty allowances to forest staff posted in inhospitable and non-family stations.

3.2 Review of other relevant national policies.

Other National policies that are relevant towards the implementation of National Forest Policy are s under.

3.2.1 National Environment Policy 1992.

Primary objectives of the National Environment Policy, 1992 are

- To maintain a balance in nature by preserving and improving the environment,

- To ensure environment friendly development of all sectors,
- To save the community from natural disasters,
- To ensure environment friendly acceptable use of all national resources on sustainable basis,
- To identify and control, all kinds of pollution and activities degrading the environment, and
- To be a partner of all international environmental endeavours.

Environmental Impact Assessment (EIA) is the major tool to analyse possible impacts of development projects. Nearly 15 sectors of the government have been included for which guidelines have been suggested. Forestry subjects such as afforestation, biodiversity, wildlife, etc. have been mentioned in the policy document. The Department of Environment is the implementing authority of this policy. Environment act has been formulated under this policy and lately has been revised & updated. According to the environment policy, large number of activities extended over a very large arena need to be looked after by the DOE. Shortage of manpower coupled with the placement of administrative personnel, in lieu of personnel educated on environment is a serious drawback of the DOE. Full implementation of the environmental policy 1992 is yet to be seen. This policy since has some built in scope to opine on subjects such as raising of pure plantations, degradation of natural forests, conservation process, soil erosion, etc. the BFD has to be technically prepared to combat probable interventions from DOE as such.

3.2.2 National Agricultural Extension Policy 1997.

As the Department of Agriculture Extension has staff up to union level, this policy is being well implemented. The farmers are getting aware of new technologies regularly, on farming practices, agricultural inputs, seeds & seed crops, manures & fertilizers, pests & pesticides, etc. This policy also advocates the promotion of agro-forestry and intercropping. BFD and department of agriculture can collaborate to promote their common agenda.

3.2.3 National Agriculture Policy 2013.

The objectives of the National Agriculture Policy 2013, relevant to the forestry sector include:

- ensure a profitable and sustainable agricultural production system
- preserve and develop land productivity;
- take necessary steps to ensure environmental protection as well as 'environment friendly sustainable agriculture' through increased use of organic manure and strengthening of the Integrated Pest Management (IPM) programme;
- establish agriculture as a diversified and sustainable income generating sector through strengthening of 'Farming System' based agricultural production and agro-forestry programs.
- Inclusion of agro-forestry in the agricultural policy opens the window for developing synergy with the forestry sector. The policy also provides that “Maximum utilization of land will be ensured through promotion of inter-cropping with the main crops” which provides potential for another link with the forestry sector through intercropping with

forestry species. This policy has no contradiction with forest policy. However, at times conflicts may crop up in fixing the priority between forestry and agriculture, with respect to fellow lands.

3.2.4 National Land Use Policy 2001.

The salient features of the national land use policy are given below.

1. Emphasized on the protection of declining cultivable lands of the country.
2. It has the guidance to go for intensive agriculture and expansion of fisheries, at the same time it has enunciated that forestry can play a significant role in poverty alleviation.
3. It has laid ample emphasis on the zoning and has suggested formulation of “Zoning Laws”.
4. It has expressed concern over the engulfment of cultivable land by rural housing and suggested house planning at rural level.
5. It has emphasized on "austerity in land use" with a specific suggestion of putting minimal land under buildings.
6. It has expressed concern over misuse of acquired lands.
7. It has suggested to rehabilitate the landless poor on new chars.
8. It has identified that forestry can combat pollution and has suggested to undertake afforestation and preservation of existing forest areas.
9. For coastal belt areas it has the target to go for agriculture and rehabilitation but along with others have suggested for a *‘functional green belt’* along the coast.
10. It has suggested controlling fragmentation of land to a limit of ‘logical unit’.
11. To release the pressure on land it has suggested using the flood prevention dams as roads and highways.

While expressing concern over the illegal occupation of government land, it has suggested to have a Certificate of Land Ownership Scheme to combat this sort unauthorized occupancy.

It has identified that people’s awareness is a must for successful implementation of the policy.

Though this policy has several progressive features, it has failed to address any of the following important forestry related issues.

- The slice of land to be kept under forests to upkeep the balance.
- Need to prevent forest encroachments.
- Minimize conversion of forest land to other uses.

3.2.5 Coastal Zone Policy 2005.

The coastal zone of the country is highly vulnerable to natural disasters and climate change impacts which deserves to be specially addressed in this national policy. Although a Coastal Zone Policy was adopted in 2005, it has failed to address many of the important issues and

challenges. Coast Zone Policy 2005, covers 19 districts[9] of coastal zone, and involve many sectors, without indicating the linkage of their sectoral policies.

Policies are implemented in the country through Acts that are enacted by the parliament while the rules are formulated by the concerned ministries under the provisions of the Act. Till date no act under the coast zone policy 2005 have been passed by the national parliament. Thus the question of formulation of rules does not arise. Besides these there is no specific ministry that has got identified or entrusted with the responsibility to implement the coastal zone policy 2005. It has been stated in the policy document that the respective ministries and agencies will have the responsibility of implementation; while 'Co-ordination, Monitoring & Evaluation' will be the responsibility of WARPO. It needs to be mentioned herein that the coast zone policy 2005 has incorporated items that are of interest of many sectors, operating in the coastal areas. Any implementation process of this policy, as is enunciated, basically requires a good co-operation between many of the ministries of the government. In fact such generous co-operation mentalities of all these ministries hardly prevail. Besides these, identification of WARPO as lead agency under the ministry of water resources, over a large number of other ministries, might not have been accepted as such. In fact this policy is practically ineffective.

In connection with the non-implementation aspect, an UNDP document (Review of Coastal Zone Policy, February 2014) prepared by IUCN Bangladesh, suggested as follows.

Instead of a policy document by itself, "*a set of policy statements can be developed, which can be followed by the relevant sectors in addition to their respective sectoral policies for the coastal areas".*

3.2.6 National Food Policy 2006.

The goal of the National Food Policy of 2006 is to ensure a dependable food security system for all people of the country, at all times. It has the following objectives:

- To ensure adequate and stable supply of safe and nutritious food,
- To ensure purchasing power of the people for increased food accessibility, and
- To ensure adequate nutrition for all, especially women and children.

Forests play an important role in providing supplementary food and income to the poor people. Honey collection, fishing, crab fishing etc. are the principal professions for thousands of people living near Sundarban. Unfortunately forests, including homestead plantations, as sources of food and medicine, particularly to poor and in the times of food scarcity, have not been mentioned in this policy.

3.2.7 National Water Policy 1997.

- The water policy has the following objectives:
- To address issues related to the harnessing and development of all forms of surface water and ground water, and management of these resources in an efficient and equitable manner,

[9] The districts are Bagerhat, Barguna, Barisal, Bhola, Chandpur, Chittagong, Cox's Bazar, Feni, Gopalganj, Jessore, Jhalkati, Khulna, Lakshmipur, Barisal, Noakhali, Patuakhali, Pirojpur, Satkhira and Shariatpur.

- To ensure the availability of water to all elements of the society including the poor and the underprivileged and to take into account the particular needs of women and children,
- To accelerate the development of sustainable public and private water delivery systems with appropriate legal and financial measures, including delineation of water rights and water pricing,
- To bring institutional changes that will help decentralize the management of water resources and enhance the role of women in water management,
- To develop a legal and regulatory environment that will help the process of decentralization, sound environmental management, and improve the investment climate for the private sector in water development and management, and
- To develop a state of knowledge and capacity that will enable the country to design future water resources management plans by itself with economic efficiency, gender equity, social justice and environmental awareness to facilitate achievement of the water management objectives through broad public participation.

The policy did not identify vital water-forest interactions, although many other connections including water and fisheries and wildlife, and water and environment have been discussed. However, afforestation is suggested in areas with declining water table. Similarly the policy states that the development and management of the nation's water resources should include the protection, restoration, and preservation of the environment and its biodiversity including wetlands, mangroves and other national forests, endangered species, and the water quality. Accordingly Environmental Impact Assessment is recommended when development projects are to be taken up in order to avoid or minimize environmental damages. Climate change has, over the period, emerged as an important socio-environmental concern which needs to be integrated keeping in view strong climate-water interactions.

3.2.8 National Fisheries Policy 1992.

Main objectives of the National Fisheries Policy, 1992, which is in Bangla, are translated as below:

- To develop fishery resources and increase fish production,
- To alleviate poverty and develop socio-economic status of fishers by creating livelihood opportunities,
- To help ensure environmental conservation and protection, biodiversity conservation and public health development.

As many other species of wildlife, such as crocodiles, turtles, dolphins have common habitat with fish, their conservation depends upon proper management of aquatic habitats. As fish is also defined as wildlife in the Wildlife (Conservation and Security) Act 2012, there is some serious scope for conflict between the fisheries and forestry agencies. As Sundarbans has a significant role in keeping the national fisheries healthy and productive, it should have found a conspicuous mention in the policy.

3.3 Conflicts and Compatibility among the various national policies.

The National Land Use Policy 2001 has put most of its emphasis on protecting cultivable agricultural land. It has however recognized the need to conserve the forest cover. With respect to coastal land it has identified afforestation as a tool to reclaim land for agriculture and has suggested for 'functional green belt'. But has not suggested anything about the land status for the "Green Belt" The Land Use Policy suggests to use the riverine new formations (chars) for rehabilitation, which in fact is competing with forestry. It has also suggested the implementation of zoning. In general the National Land Use Policy does not contradict much with the current Forest Policy but has loop holes that may at times be used against forestry strategies.

Forestry is primarily land oriented. National Land Use Policy was enunciated only in year 2001. But before the enunciation of National Land Use Policy, various land laws and land reforms were formulated mostly with agricultural and industrial bias, which sometimes contradict the forest policy. A few of the examples are as follows.

- There is no bar in establishing industries in or adjoining forestland. Thus many small saw mills and veneer mills got established in adjoining forest land, especially in Chittagong and Cox's Bazar area.
- There is no restriction in converting forestland to agricultural land. Thus many of the forest lands all over the country have got converted to agricultural fields.
- There is no bar in establishing fisheries in mangroves. The whole of Chokoria Sundarban RF has got converted to fisheries.
- There is a serious lack of co-ordination between the land administrating agency and forest department, especially at field levels. This has resulted many of the encroachments of the RF land. Deputy commissioners deal with the land on behalf of the land ministry. Under the existing set up in Bangladesh, deputy commissioners are very powerful and very often ignore forestry or environmental aspect of land use. They are more interested to lease the land to private personal without any consideration of its capability to withstand the regression of tillage, and at times through underhand deals. Thus mangroves are leased out for fisheries, hilly tracts with steep slopes are leased out for horticulture or farming etc. Such acts often lead to conflicts with the local forest officials and in such cases the deputy commissioners, being more powerful of all the bureaucrats, succeed to have a smooth sail and are hardly ever questioned by the high ups in the government. As such, many of the forestry lands have already gone under non-forestry use. Such power politics of these bureaucrats some time jeopardizes honest implementation of policies enunciated.

Since the industrial policy 1991 emphasized establishment of export oriented joint ventures, steps may be taken to use forest produce of various kinds as raw material of such industries. Such scope of co-operation between industry and forestry is possible. Similarly private fisheries, especially in the mangrove areas, may be obliged to retain 80% of its land under forest cover and derive benefits of detritus in lieu of forest conservation. The relevant policies do not have any such restrictions.

The agricultural policy is compatible with the forestry policy. Similarly the environment policy is also compatible with forestry policy. National water policy by laying emphasis on erosion control and afforestation has fortified the forest policy.

3.4 Gaps and constraints in forest laws

The conservation and management of forests and wildlife in Bangladesh is based primarily on the provisions of two acts namely, the Forest Act 1927 and the Wildlife (Conservation and Security) Act, 2012. The rules framed under these two acts are the basic tools for the BFD to operate in the field. Besides these two acts, East Pakistan Private Forest Ordinance 1959 and the East Bengal State Acquisition and Tenancy Act, 1950 were used to consolidate the forest estate. From the view point of field operation these are no longer of much significance.

3.4.1 The Forest Act 1927.

Though this Act was promulgated on 22nd September 1927, it was revised from time to time to meet the current needs. This act has the details of the process to be employed for creating "reserved forests". This act also provided all that is required to process forest offences. This is the basic act, based on which the various rules such as 'Transit Rules', 'Drift Timber Rules', etc. have been formulated from time to time. By introducing section 28A in this act, the social forestry received a firm footing, which led to the formulation of various social forestry rules in 2004.

In 2011 the current forest transit rules were promulgated. Before that there were similar but different transit rules for different districts with one General Transit Rules. The 2011 transit rules superseded the previous rules in this regard. The forest transit rules 2011 are, however, not applicable in CHT and Sundarban RF. Under the provisions of these rules, wood produced on private land will need a free permit from the BFD for transportation, except for the 7 species, namely Mango, Jackfruit, Black Berry, Taal, Cocoanut, Shupari, Khajur and Shimul. In CHT, the permission to cut & transport wood from private land are given as "jote permit", issued by the Deputy Commissioner of the district on the recommendations from local DFOs (BFD). It is common belief that pilferage of huge quantities of wood from the state forest occur under the cover of these 'jote permits'.

The basic objective of the forest transit rules was to provide protection to state forests against illegal felling and extraction of forest produces from government forest land. Although these rules have not been able to stop the destruction of the state forests, these are now seen as a serious hindrance to the growth of private forestry, due to their scope for harassment and corruption.

Sundarban has a number of "standing orders" for the day to day control on its forest produces. In 2012 rules were formulated for sawmills. According to these rules, every sawmill will require a license from BFD to operate. Besides these the BFD has two volumes of "Forest Manuals" (Part I & II) describing the steps to be taken under different issues, empowerment of forestry officials, etc.

The Act is fairly comprehensive but many of the notifications issued under the Act long ago need to be urgently revised. For example, notifications issued in 1959 to empower forest officials to exercise powers under section 72 have become anachronous due to the addition of many new designations to the forest staff. Fresh notification of the designations to be

treated as “Forest Officers” under the Act need to be issued to include new designations. Similarly, the definition of ‘forest produce’ needs to be reviewed to include wildlife living outside state forests.

3.4.2 Wildlife (Conservation and Security) Act, 2012.

An wildlife ordinance was promulgated in 1973 for the first time. This wildlife Act 2012 has replaced that ordinance. This wildlife act 2012 provides a comprehensive framework for the creation of protected areas for wildlife conservation and regulation of possession and trade and transit in wildlife specimens. This act also prohibits possession, trade or transportation of wildlife specimens, without the permission of BFD. Violation of the provisions of this act may lead to 12 years of imprisonment. Besides these all export import of wildlife (including specimens) shall be under the CITES framework. The law has five schedules of species to be protected under this law, which include a list of plants as well. This law has the provision of establishing 12 different kinds of protected areas for wildlife and nature conservation, including community conservation areas on private lands. It has a large number of provisions to formulate various rules, such as rules for

- empowering various designated personnel,
- perishable goods seized,
- implementation of CITES,
- issuing various kinds of permits,
- issuing permits for propagation & breeding,
- venom collection, etc. etc.
- Though this act is very comprehensive, it suffers from some serious flaws such as
- absence of powers to arrest suspects,
- absence of power to compel the presence of witnesses,
- poor power and no procedure to compound offences,

This act is yet to be brought under real implementation. This act is reasonably elaborate but its benefits will accrue to the nation, only after the formulation of various rules thereunder, authorisation of various officers to exercise powers under the Act, and by deploying qualified BFD personnel for their implementation. This act has the provision to go for "co-management" of wildlife sanctuaries as well.

3.5 Land laws & BFD

All the forests are situated on land. Forestry is a land based activity. BFD deals with the land, especially in connection with its RF. Though most of the reserved forest lands have been declared as reserved forest under forest act 1927, some of the BFD forests, especially those in the district of greater Sylhet were declared as reserved forest under section 5 of "Assam Forest Regulation 1891". After the reservation, the land goes under the possession of BFD and it becomes the responsibility of the BFD to continue custody of the land and maintain all the relevant records. All the records of all land of the country are basically maintained by the department of LA&LR, through an instrument, termed as "ROR" (Record

of Rights). Every land owner has a copy of ROR, at the same time it is also kept in government offices such as Thasil Office, Upazila Land Office, ADC (Revenue) Office at district level and at the District Judge Office. The LA&LRs keep all of those as custodian.

It is thus clear that just the reservation notification cannot be the only document to continue the possession and right of BFD over the land. Generally a land survey is conducted by the LA&LR to correct the existing land records. It is essential for the land owner to remain present during that field survey to ensure that his land is rightly recorded. In most of such events the BFD personnel do not attend the survey with earnestness, as a result their land records have not been maintained properly. Besides these the BFD personnel are not properly aware of the whole process. Even many of the senior level officers do not have adequate knowledge of this issue. Capacity building of BFD personnel on this issue of land laws is essentially necessary.

3.6 BFD Programmes

The key players in the forestry sector in Bangladesh are BFD, BFRI, BFIDC and BNH. The BFRI is expected to undertake all the applied forestry research to meet the current emerging needs. At present the activities of BFIDC are limited to rubber plantations and running their industrial units. The BNH is confined to floral survey only. The basic programs of BFD are expected to be as under.

- Inventory and assessment of ecosystem services.
- Habitat and wildlife management.
- Production oriented forest management.
- People oriented forestry.
- Generate environmental support through forest management.
- Manpower and capacity building.

But because of the paucity of funds, none of these forestry sector institutions are functioning to deliver the desired. The BFD has become a fully project dependent institution with very poor manpower and low capacity. All the equipment of BFRI have become age old and incapable to deliver.

Under the above stated poor situation however, the forestry sector (BFD, BFRI, BFIDC & BNH) has successfully completed the following programs since 2000.

Table 3-1: Major projects implemented by Bangladesh Forest Department

Project	Implementation	Donor
Development of Social/Participatory Forestry in Bangladesh		
Forestry Sector Project	1997-98 to 2005-06	ADB
Coastal Greenbelt Project	1995-96 to 2001-02	ADB
Social Forestry at the guide dam of Jamuna Multipurpose Bridge	Up to 2003-04	
Food assisted Rural Development Project (WFP supported social afforestation project)	Up to 2000-01	WFP
Integrated Management of Sundarbans Mangrove Forests		
Biodiversity Conservation in the Sundarbans	1998-99 to 2004-05	ADB
Projects in the Hill Forests for Raising Plantations		
Forest Resources Management Project	1991-92 to 2003-04	World Bank

Project	Implementation	Donor
Afforestation in the denuded hills of Ramgarh-Sitakund	Up to 2004-05	GoB
Afforestation in Cox's Bazar Sea beach area (Revised)	Up to 2003-04	GoB
Afforestation and Jhumia Settlement in USF	Up to 2000-01	GoB
Wildlife, Protected Area, Biodiversity Conservation and Recreational Facilities Development		
Development of Madhupur National Park	1999 to 2004-05	GoB
Establishment of Eco-parks at Madhubkundo- Muraichara Waterfall Areas	1999 to 2004-05	GoB
Development of Kaptai National Park	1999 to 2004-05	GoB
Development of Safari Park at Dulahazra (2nd phase)	2003-4 to 2005-06	GoB
Natural Environment/Biodiversity Conservation and Development of Bashkhali Eco-park	2003-04 to 2005-06	GoB
Nishorgo Support Project for protected areas	2003 to 2008	USAID-GoB
Development of Bhawal National Park, Bhaldha Garden and National Botanical Garden (2nd phase)	Up to 2001-02	GoB
Establishment of Botanical Garden and Eco-Park in Shitakund, Chittagong.	Up to 2003-04	GoB
Establishment of Eco-Park at Madhutila and Gazni Recreation Centre (3rd revised)	2003-04 to 2008-09	GoB
Restoration and Conservation of Biodiversity in the Denuded Hill Forests and Barind Sal Forests of the Country.	2011-14	USAID and AF
Special Goal Oriented Projects		
Pilot Project for Agar Plantation	1998-99 to 2004-05	GoB
Development of Bamboo, Cane and Murta Plantation (Revised)	1998-99 to 2005-06	GoB
Reed Land Afforestation in Sylhet	Up to 1998-99	GoB
Coastal Embankment Rehabilitation Project (Phase II)	Up to 2003-04	GoB
Nagar Banayan Prokolpo	Up to 1999-2000	GoB
Mujib Nagar Complex	Up to 2003-04	
Countrywide Seedling Raising Program for Massive Afforestation to Mitigate Climate Change Adverse Impact.	2009-2012	CCTF
Study and Research Projects		
A study on behaviour and ecology of tigers in Sundarban Reserved Forests	2005-06	US Fish and Wildlife Service
Strengthening capacity to generate quality information on forest resources	18 months	FAO
Projects Implemented by other Agencies		
Biodiversity Conservation in St. Martin Island and Establishment of Marine Park and Eco-tourism development (MoEF implemented project)	2000-2005	GoB
The Coastal and Wetland Biodiversity Management Project (DoE implemented project)	2004-09	UNDP-GEF
Market Development of Bamboo and Raton Products and Potentials (BFRI implemented project)	2003-06	INBAR-GoB
Transfer of Technology in Bamboo Shoot Production, Processing and Marketing from China to Bangladesh and Sri Lanka	2008-2010 & 2012	INBAR - GoB

Most of the GOB funded projects were small and their contributions were also not very significant. In absence of very poor allocation of funds the routine activities of BFD such as patrolling, attending of court cases, boundary survey & demarcation, monitoring & evaluation, etc. suffered very badly.

4 Forestry Institutions and Capacity building

4.1 State forestry institutions

Bangladesh forestry sector consists of four major institutions, namely, Bangladesh Forest Department (BFD), Bangladesh Forest Research Institute (BFRI), Bangladesh Forest Industries Development Corporation (BFIDC) and Bangladesh National Herbarium (BNH).

4.1.1 Bangladesh Forest Department

The Bangladesh Forest Department has been responsible for managing the country's forests, for more than 150 years. . The administrative head of the BFD is the Chief Conservator of Forests. The BFD is divided into four wings - Forest Management Planning, Development Planning, Education and Training, and Social Forestry -and each of those wings is administered by a Deputy Chief Conservator of Forests. There are 9 circles, including 5 forest management circles, 3 social forestry circles, and 1 wildlife and nature conservation circle, each of which is headed by a Conservator of Forests. There are 24 forest management divisions, 13 social forestry divisions, 7 wildlife management and nature conservation divisions, and 3 management plan divisions, each of which is headed by a Divisional Forest Officer.

Issues and Constraints

Despite being a premier organisation of the Government, BFD suffers from tremendous systemic constraints, which need to be urgently looked into while devising the roadmap for the future of the organisation. The most important constraints and issues faced by the organisation in successful discharge of its mandate are briefly discussed below:

Shortage of Manpower

The current sanctioned strength of the Forest Department is 10,124 among 4 categories of staff but actual the actual current strength is less than 8000.

Table 4-1: BFD staff position[10]

Class	Approved	Existing	Vacant	Vacancy %
1st	297	172	125	42.09%
2nd	424	307	117	27.59%
3rd	5349	3783	1566	29.28%
4th	4054	3476	578	14.26%
Total	**10124**	**7738**	**2386**	23.57%

As can be seen 23.5% of the staff positions are vacant and the vacancies at the senior level are as high as 42%.

[10] Annual Report of MoEF 2014-15.

About half of the forest cadre service positions are vacant now. The situation is going to worsen further with the retirement of most of the senior staff by early 2017. Because of unplanned and intermittent recruitments, which saw no recruitment of cadre-service officials between 1986 and 2003, in addition to an acute shortage of cadre service personnel, a huge seniority gap has been created. When the last member of 1986 batch retires there will not be any cadre official available to take up the Chief and Deputy Chief Conservator level positions because they would not have served the prescribed length of service, which is a requirement for qualification to be considered for promotion to these afore mentioned positions. There will also be a huge shortage of manpower required to fill in the vacant positions. In addition, the GOB is unable to appoint new ACFs whose selections have been finalised because of some litigations and associated problems which have been discussed later in this section. The situation is not any better at the technical and sub-ordinate levels, where large vacancies exist. Out of the 209 Forest Rangers on BFD's employment records, 187 will retire by 2020! At present all induction to the Range Officer level is through promotion but rules are being amended to create a 30% quota for direct recruitment. Because human resource development and capacity building programmes are virtually non-existent in all the organs and all training or capacity building are only ad-hoc and opportunistic, there is no planned build-up of manpower resources in the Forest Department. In addition, many specialised positions like those in training institutions, GIS, management planning and other similar assignments are filled by officials who may not have the required skill sets and background. Ah-hoc recruitment of nearly 80 non-cadre ACFs against projects and their retention after the projects has created a huge problem. While some of these officials (64 at present), have been given higher responsibilities in officiating capacities, this largest single group, is not properly integrated in the cadre. These officials, who did not undergo the required basic probationary trainings and sit for the departmental examinations, they have been entrusted with important responsibilities, although most of them have now crossed the age (45 years) when they are exempted from departmental examinations. These and other out of turn recruitments have led to serious discontent and have led to institution of court cases, which are interfering with normal HR functions of the Department. However, despite these difficulties, BFD has recruited 7 ACFs in 2016 and another 22 are likely to join by December 2018. The department intends to integrate the non-cadre officers into the cadre through an amendment of rules but has not been successful so far. While there are a number of training and capacity building institutions under the Forest Department, these suffer from an acute shortage of staff, resources and facilities.

The single tier field level set up of the Forest Department at the Forest Division level, which is supposed to handle conservation, management, protection, and plantation establishment are inadequate for meeting the emerging and existing challenges. Although a number of new entities have been created under Social Forestry and Wildlife wings, which are not properly resourced and empowered.

Faulty Field Structure

Traditionally, BFD has had a single tier field structure, in which territorial DFOs performed all the management, enforcement and administrative functions. Quite appropriately, some of these divisions have been named as social forestry divisions in view of the fact that these districts have little forests and the only job of the BFD in these areas is to promote social forestry i.e. plantation outside state forests. However, there is usually no budget for

extension work until an externally aided project is there. Therefore, the only function that most of these divisions perform is that of issuing permits for cutting and transporting of private trees (under forest transit rules) apart from doing a little bit of their own plantation and nursery work. This enforcement work is more of a hindrance in social forestry than being a part of it. All forest divisions suffer from an acute shortage of funds for routine work including payment of travel allowances and other reimbursable costs to staff members, which greatly hinders discharge of routine duties, tools and equipment including road and water transports, and basic amenities including housing for filed level officials. There is also no special allowance for those posted in remote and non-family stations.

BFD has also created 7 wildlife and nature conservation divisions since 2001 but these divisions have also not been given any clear mandate. While many of them hold no territory (protected areas) at all, which they are mandated to manage, their official job is just to advise other DFOs in dealing with wildlife matters. They have no special qualification or capacity to render this service due to lack of training, staff, equipment etc. Their law enforcement activities, related to wildlife crime, are also not exactly legal as the wildlife Act is still not operational, due to the lack of proper notifications and rules, and, as a result, they virtually have no powers to enforce the law.

In the absence of empowerment, lack of clear mandates and shortage of staff, equipment and required funds for discharging their duties, these units are unable to perform assigned duties satisfactorily.

Irregular Recruitments at All Levels

Any large organisation has to plan its staffing needs keeping in view upcoming retirements, creation of new positions and possible attrition due to other reasons. However, BFD has been recruiting its staff very irregularly, generally only when the number of vacancies becomes too large. As a result, it creates serious cadre management problems. For example, whereas a large number of vacancies reduces efficiency, bulk recruitments lead to dissatisfied cadres due to the government's inability to ensure equal promotion opportunities to all members of large batches. As one of the worst examples, members of the same/close batches, until recently , held positions from DCF to CCF.. The situation is no better in the case of Forest Rangers. More than 75% of the currently serving Forest rangers will retire in the next three years. As direct recruitment at the Forest Ranger level has been discontinued after 1995, it is going to be a major challenge to fill up all these vacant positions, close to 200, with competent promotees only. The situation at the Forester and Forest Guard levels have somewhat improved after large scale recruitment in the last few years. However, this will set in motion another cycle of the same problem as they will mature and retire at the same time.

Currently, Officers of 1982 and 1984 batches are placed in the top management of the forest administration. No officer of 1982 batch will continue in the department after January, 2017. The last officer of 1984 batch is scheduled for retirement in December, 2019. Thereafter, officers of 2003 batch will occupy the senior positions in the department with only 16 years of experience. Incidentally, the position of CCF as per recruitment rule of BCS (Forest) Cadre demands 20 years' experience under the Service rules because the post of CCF has been elevated to Grade one of the government service. The incumbent also needs to work in the concerned service, including 3-years as Deputy Chief Conservator of Forests in addition to

another two years as a Conservator of Forests. As none in the 2003 batch has yet been promoted to the position of a Conservator, the qualifying period will be longer unless some special dispensation is possible to make in terms of reduction of the length of qualifying years of service.. This is the result of irregular recruitment of officers in the BCS (Forest) Cadre. Regular in-take of officers is the only possible way of maintaining professionalism in the department.

The situation in most other ranks is similar. There has been no recruitment of forest rangers since 1995 and all the current rangers are promotees from the lower ranks. As a result, they neither have the education nor the modern technological skills, particularly as most of the Foresters recruited until recently did not have the background or education required to perform the current duties, who would require know how to handle modern technologies including computers.. The decline in the condition of forests in the last few decades may be attributed, at least partly, to the loss of vigour and efficiency amongst forest rangers in the department.

Thus, it is important that BFD should have a proper recruitment plan which ensures that trained replacements for potential retirements are available in time.

Adhoc Recruitments

Over the years the BFD has recruited new staff for implementing donor funded projects, without following the standard procedures. These adhoc appointees both at professional and technical/subordinate levels have been retained after the task for which u=such recruitments were made and this has created many kinds of serious administrative problems. A large number of Assistant Conservators of Forests (ACF) were recruited as non-cadre officers under different development projects in 1990, 1993 and 1994. While some of these recruits have left the department, most of them are still working in the Department. Sixty-four ACFs were transferred from development budget to revenue budget after reorganization of the Forest Department in 2001. However, a large number of the retained ACFs are still working in the same rank where they were recruited and because of the shortage of officers, some of them are currently working in positions, for which they are not qualified.

These non-cadre officers have put in more than 20 years of service in the Forest Department and have acquired sufficient professional knowledge and experience in forestry. Moreover, their individual capacities have been developed through training programmes in different fields of forestry at home and abroad.

Dissatisfaction prevails among these trained and long experienced non-cadre officers due to their stagnant position in the department and loss of seniority over very newly recruited BCS (Cadre) Officers. This anomaly has led to the institution of several court cases which has become a serious problem for the Forest Department's administration. Soon, after the retirement of current batches of senior officers, this group is going to be the single largest among the professional level forestry officials. While the resolution of this problem is not going to be easy because of the multiple litigations going on at this time, ways and means need to be found to resolve the issue and extricate Forest Department form this messy situation..

Similarly, a large number of staff at various levels, starting from wildlife scouts, wildlife rangers, biodiversity conservation officers, veterinary officers etc. have been recruited under

the ongoing Strengthening Regional Cooperation for Wildlife Protection (SRCWP), but their fate is also uncertain. Only a few of them are likely to be transferred to the revenue budget and these lucky few will face the same situation which the ACFs have been facing. Moreover, as they do not qualify as forest officers, they have not been empowered to exercise any legal or financial powers. Therefore, they are unable to work at full efficiency.

Lack of Human Resource Development and Management Policy

BFD has a training and education wing but there is no coherent training policy. As mentioned earlier there is no plan for phased out recruitments at different levels to meet the new and emerging needs as well as vacancies arising from retirements. The tradition of induction training, immediately after recruitment, has been discontinued ever since BFD started recruiting forestry graduates to the officer ranks. Even at lower ranks, there is no induction training. As a result, people are posted on field jobs without any training in procedures and field craft prevalent in the department. Due to irregular recruitments, and consequent non-availability of trainees, the training institutions are also in a state of decay. Many of them have only skeletal staff and all their facilities are unused. All the current training programs are project driven short term training events, which may have no relevance to the current job of a trainee. Those who obtain foreign/Specialised trainings abroad, are not necessarily posted in positions where their acquired skills will be applicable. Those holding teaching positions at the different training institutions also do not have any specialization in teaching. Likewise, the officer in charge of the RIMS is a forest officer, while some persons in RIMS do have specialised training. However, there are no provisions for career progression for these personnel. In addition, the salary scales for some specialized positions are well below what they can get elsewhere outside the government.

Weak ICT Infrastructure

Internet and computing capability is the backbone of any modern organisation. In BFD, computing facilities are, in general, limited to typing and e-mail level only. While currently ICT plays a very important function in the day to day operations of many organisations, it is still mostly paper based at the Forest department and other sector organisations. In all sector organisation, access to ICT facilities is restricted to major offices and does not include field offices. There is no networking even at the headquarters. There are no databases, apps or any other tools to facilitate efficiency. A limited GIS facility is available only in the RIMS but no other office uses or demands GIS support. Due to this limitation, it is virtually impossible for BFD to implement any modern programme efficiently because all such programmes need reasonable levels of computer and communications support across the enterprise.

Weak Monitoring and Evaluation Systems

Forest Department raises large areas of plantations every year. In addition, it also undertakes a number of cost intensive activities. However, there is no appropriate mechanism in place for independently monitoring the success and/or failure of any activity. The large scale failures of plantation establishment could not be detected in time because of the absence of a comprehensive monitoring and evaluation programme. In practice, there is no system in place to check whether a task has successfully been completed except the submission of a report from the officer who executes the task. Under the current arrangements offices of the three DFOs of Working Plan Divisions are supposed to carry out

monitoring of the primary stages of establishment of different plantations and submit their reports to the ACCF, Monitoring and Evaluation, who in turn is supposed to analyse and compile such result after conducting some spot verifications. However, the Working Plan Divisions are grossly understaffed and resources to carry out the task diligently are not available to them. The office of the ACCF Monitoring and Evaluation is also understaffed and as all these reports generated are on paper, any analysis is a very difficult task. As forest cashbooks have traditionally been the veritable storehouse of all management information, digitisation of range and divisional cashbooks can be extremely helpful in collection of management data. Incidentally, there is no system of annual reports nowadays, at any level. Therefore, nobody feels the need to compile all the reports and any compiling and analysis is now done only on the basis of sporadic demands for information from higher offices.

Weak Resource Information Management Systems

Resource Information Management Systems (RIMS) is the unit, in the BFD, responsible for generating, managing and disseminating resource related information. However, due to the lack of necessary equipment, appropriately trained manpower and other resources, it has not been possible for the unit, which could play a major role in forest management, to function satisfactorily This unit, which is supposed to undertake highly specialized functions, is treated like any other unit within the Forest Department and it is extremely difficult to hire staff for some positions which require special skills. In addition, it also suffers from shortage of funds and is only active when it becomes a part of an externally funded project...

Scope of activities at the RIMs is enormous. A survey of the forest resources of the country is currently underway. It will be important for RIMS Unit to be able to manage the information, which this survey will generate, and also, undertake periodic updating of such information. In addition, it could manage all other information, which will be helpful in forest management decisions. It can also act as a depository of all digitized records, maps and other important documents and information.

Lack of Forest Management Planning

Bangladesh had a long tradition of forest management planning in the form of 10-year working plans. These plans required a detailed survey and enumeration of forest stock every ten years. However, this system was abandoned in the late nineteen eighties and at present the only planning being done is for the preparation and implementation of occasional projects. Field interventions are based on the recommendations made in these project documents. In the past, the management plans, which were known as working plans, were prepared after undertaking extensive field work and filed level assessment of different forest stands and the needs of the forests and required supporting activities necessary for the implementation of the plan. Detailed site specific management prescriptions for tending and felling operations were detailed out in the plans and all field activities were based on the plan prescriptions. So, the current implementation of field operations through project based interventions is ad-hoc at best. There are three Forest Management Plan Divisions based in Dhaka, Khulna and Chittagong. However, it appears that these divisions have no role to play in the formulation of activities under the aforementioned projects. Project based management interventions in different natural forests and plantations the last few decades may be linked, to some extent, to this passivity in forest management planning.

Legal Issues

Forest Department is responsible for enforcing the Forest Act 1927 and Wildlife (Conservation and Security) Act 2012, While the wildlife Act has completely replaced the 1973 wildlife ordinance, the Forest Act has also been amended many times to bring it in tune with the demands of the changing times. One major amendment in the forest law was the institutionalisation of social forestry while several other amendments aimed at effective enforcement have been carried out from time to time.

However, many of the notifications issued by the government to implement various provisions of the Forest Act have not been reviewed for a long time and many of them have become obsolete or not implementable due to the changes in the organisational structure of the Department over time. For example, three notifications, numbering 2404, 2405 and 2406 dated 26th December 1959, which empower only gazetted

officers to exercise powers invested in forest officers under section 72 of the Act, need to be urgently amended as all action against criminals is taken by the subordinate staff, not by gazetted officers. Moreover, many new designations in the department, such as wildlife scouts, wildlife rangers, do not fall within the definition of "forest officer" as defined by notification no. 2396 dated 26th December 2016 and, as a result, have no powers to enforce the Act. In fact, some courts have started refusing forest cases on the ground that the complainant officers (foresters) are not authorised to file cases in the courts.

Similarly, the three sets of transit rules prevailing in the country need to be reviewed to create unified regulations that govern the whole of the country. In fact, these rules continue to be seen as an obstruction to the growth of tree cultivation in the country, as they have lost their relevance with the virtual disappearance of sal and hill forests and their only use at present is to harass the public. The provisions of the current transit rules are also not friendly to those who are growing trees on private land and have become a major issue associated with the harvest of trees outside forests. These need to be amended and made more user friendly.

Although the Wildlife Act was promulgated in 2012, it has still not been fully operationalized as the necessary rules have not been promulgated yet and the empowering notifications have not been issued. Moreover, the law has some serious shortcomings, which need to be urgently addressed. For example, forest officers have no power to arrest wildlife criminals or to file cases in courts, under this Act.

There can be many more such law-related issues which may need urgent attention. It is, therefore, necessary to conduct a comprehensive review of the current forestry and wildlife related legal framework of the country in order to make it effective in meeting the current and emerging challenges faced by the forestry sector.

Lack of Research Support

Modern forestry is highly research dependent as the availability of modern tools and techniques makes it possible to go deep into questions, which brooked no answers a few decades ago. The appearance of new challenges such as climate change, biodiversity conservation, valuation of ecosystem services etc. make it imperative for the forest managers to have access to researched information and knowledge for correct and efficient decision making. Due to the poor state of the BFRI, BFD has been deprived of the

necessary research support in making management decisions. The country needs to find out, for example, climate resilient tree species suited to different habitats, new fast growing species for meeting growing demand for timber and other products, demands and markets for forest products, silvicultural and financial rotations for homestead trees which contribute bulk of the timber to the nation's markets, new combinations for agroforestry, *ex situ* conservation of species of NTFP and medicinal value, and so on. Forest industries also have no access to research facilities for information on modern technologies, efficient operations and wood substitutes. BFRI and a few universities are involved in limited forestry research in the country but not much research of applied nature has been carried out in the country so far. The country has to take stock of the situation and create a proper research environment to support the growth of forestry sector.

Financial Constraints

Bangladesh has lost most of her sal and hill forests and the pace of this loss has been quite fast in the last few decades. The country has made ambitious plans and policies for preserving its forest wealth in the past, but has not been successful, although the conservation of natural resources in such a densely populated and poor country is not an easy task. Although it cannot be said that this failure in conservation has been entirely due to lack of resources, the rate of loss could have been far less if BFD and other BFRI had been well funded. Apart from the shortage of development funding, to take up new capital works, the sector has acute shortage of funds for undertaking obligatory activities, such as patrolling. There is no fund available to cover the travel expenses of field staff, costs of taking offenders to the court of law or in the absence of the availability vehicles or river crafts for patrolling, any fund for renting a transport for patrolling. In addition, most field offices and staff housing are both inadequate and often in poor condition because of lack of funds for building new staff quarters or maintaining the existing ones. This situation does not create an enabling working environment.

Inadequacy of Field Infrastructure and Logistics

As indicated earlier, there is a tremendous shortage of field infrastructure particularly in remote areas like the Sundarban and CHT. Staff accommodation is often not available or is of very poor quality. Transportation is often not available as there is hardly any money for fuel even if a government vehicle is available. Travel bills are rarely reimbursed. Staff working in remote areas have to maintain double or triple establishments in order to look after their families and aged parents. This puts tremendous financial burden on them and often initiates them into corrupt practices. Staff working inside the forests have no furniture, often no electricity, no safe drinking water, no facilities for keeping government records safe. Of course no computers. Most agencies working under such circumstances, like police, BGB etc., are paid special allowances to compensate for their difficulties. However, forest subordinates are paid nothing, despite the fact that the facilities they get in the field are much worse than what other agencies get.

4.1.2 Bangladesh Forest Research Institute

The Bangladesh Forest Research Institute (BFRI) is a national institute under the administration of the Ministry of Environment and Forest, as well as a component of the National Agricultural Research System through which it collaborates with international forestry organizations and networks. It is the only national organization that has the mandate

to conduct forest management and forest products utilization research and maintains the largest forestry library and documentation facilities in the country. It has published more than 1,360 research papers and 160 technical bulletins and trained more than 10,000 individuals in using the technologies that have been developed by the Institute's research scientists.

BFRI currently has two research wings - the Forest Products Wing, with six research divisions, and the Forest Management Wing, with eleven research divisions. There are also two service divisions in BFRI. BFRI has established 21 research stations and sub-stations under five field divisions which cover forest types that spread over eight dendro-ecological regions of the country.

Issues and constraints

Like other institutions, BFRI is also suffering from acute shortage of manpower, especially at the senior level. The latest available status of manpower the instate is as follows;

Table 4-2: Staff position in BFRI[11]

Class	Approved	Existing	Vacant
1st	103	56	47
2nd	43	23	20
3rd	433	310	123
4th	213	136	77
Total	**792**	**525**	**267**

It is disheartening to note that 33% of the approved positions in the institute are vacant at present while the vacancies at the senior level (scientist level) are as high as 45%. During discussions, the faculty came across as highly aggrieved and demotivated due to the problems they are facing in the institute.

The primary constraints that restrict research activities of BFRI are:

- No new divisions created since the creation of BFRI: original structure continues despite new challenges and areas of interest/concern, ex. Climate change, social forestry.
- Shortage of manpower due to retirements, no new recruitments, recruitment process very slow (takes 2-3 years to fill a vacancy). Most recruits leave due to lack of career advancement opportunities. No promotions for 20-30 years. Promotions are vacancy based.
- Recruitment rules are grossly outdated (1985 vintage), revision proposed several times but not finalized. While it is the only mandated forestry research. organisation in the country, forestry is not included among the qualifying disciplines for recruitment in research jobs in the institute.

[11] Annual Report of MoEF 2014-15.

- A proposal for funds designed to modernise the institute and upgrade its research and other needed facilities has been submitted to the MOEF. Implementation of this project will create facilities and required support for an enabling environment for conducting research.
- There are no facilities at BFRI for research on current and emerging disciplines like climate change, genetic engineering, social forestry, remote sensing and GIS, biotechnology, monitoring and evaluation or capacity building and technology transfer.
- Infrastructure is in bad shape, even worse in 20+ field stations, no modern equipment procured since 1955, except a few computers. The IT infrastructure is poor and is not available to a large section of the staff.
- Almost entirely dependent on the government's regular budget. Has very limited access to externally funded project funding
- The Bangladesh Journal of Forest Science, which is published by the BFRI does not come out regularly because of a shortage of funds and suitable contribution from authors. Only two issues have come out in last 8 years!. .
- Funds for the acquisition of new books and journals are not available. No digitization of library, no library management software.
- No incentive is available to the scientists and promotions are slow and there is very few career progression opportunities.
- Scope for higher training and capacity building among the young scientists is very limited . There is also no arrangement for exchange of scientists with other reputable forestry research organisations
- Separate funds have never been allocated for undertaking research for BFD or FIDC. Opportunities for research for private sector industries have never been explored.
- None of the recommendations made about the BFRI in the previous Forestry Master Plan has been implemented.
- No research planning division, so no planning.
- BFRI does not have a marketing or extension channel, does not know how to get product to market, incl. NTFPs.

4.1.3 Bangladesh National Herbarium

The Bangladesh National Herbarium (BNH), which is attached to the MoEF, is the national r organisation for plant taxonomic research and museum of taxonomic specimens. It is involved in the exploration, collection, identification, and preservation of the country's plant resources. During explorations, its scientists collect plant specimens, as well as associated information on locations, local names, collection dates, phenologies, diversity, abundance, distribution, local uses, and risks. These endeavours have not only enriched the herbarium with recent collections, but also have contributed to the knowledge as well as publications among others, the Flora of Bangladesh and the Red List Data Book of Vascular Plants of Bangladesh, and checklists, of the national flora. The BNH currently has a collection of more

than 100,000 plant specimens accompanied by records that include the names of species and families, accession numbers, collection dates, names of collectors, collection numbers, ecology, and important notes regarding the plants. These specimens are used as the basis of plant identification and plant diversity assessments throughout the country that will be bequeathed to posterity and continue to be used as reference materials in plant taxonomic research and the conservation of biodiversity and the environment.

Issues and constraints

The herbarium is suffering from the same problems as other sectoral institutions, namely the shortage of staff, funds and capacity building initiatives. The latest available staff position in BNH is given in the table below:

Table 4-3: Staff strength of BNH[12]

Class	Approved	Existing	Vacant
1st	19	9	10
2nd	3	3	0
3rd	18	14	4
4th	12	11	1
Total	**52**	**37**	**15**

More than half of the senior scientist level, including the position of the Director is vacant. The current service rules are inadequate and need revision. There is a serious shortage of funds, equipment, logistics and other necessities for running a smooth operations. The IT and computer facilities are inadequate and there are no facilities available yet for the digitization of the taxonomic data collected.

The Herbarium works in complete isolation without any linkages/networking with other reputable similar institutions elsewhere.

The herbarium suffers from a shortage of funds for undertaking its core activities and has never received any outside funding or any other development funds for conducting new surveys except last year when it received Tk. one crores for a new survey and specimen collection project.

4.1.4 Bangladesh Forest Industries Development Corporation

The government of the then East Pakistan established this autonomous body under the name 'East Pakistan Forest Industries Development Corporation' in 1959. The name of the corporation was changed to Bangladesh Forest Industries Development Corporation, with its headquarters at Dhaka, in 1972.

The corporation is functioning on a commercial basis. The Board of Directors exercises all powers and performs all activities of the corporation under the guidance of the Ministry.

[12] Annual Report of MoEF 2014-15

Functions and Responsibilities

Currently, BFIDC's functions are confined to:

- Procurement of timber & other forest produces from forest land;
- Establishment of industries/factories for commercial uses of forest produces;
- Treatment and Seasoning of Timber;
- Manufacture of furniture and various wooden items for supply to Government offices;
- Raising of Rubber Plantations and rubber production;
- Promotion of Rubber cultivation in Bangladesh through Private Sector/Multinational companies.

Organizational Structure

The general direction and administration of the Corporation and its affairs are vested in a Board consisting of Chairman and three Directors, namely, Director (Finance), Director (Planning and Development), Director (Production and Commercial) and a Secretary in charge of Secretariat Division.

The responsibilities of many of the positions are vested with officers of lower rank due to lack of sanctioned manpower for those positions.

Human Resource

The staff strength and vacancies in the BFIDC structure is given below:

Table 4-4: BFIDC staff position[13]

Class	Approved	Existing	Vacant
1st	228	84	144
2nd	13	4	9
3rd	519	237	282
4th	551	404	147
Labour	5277	4340	937
Total	**6588**	**5069**	**1519**

As can be seen in the above table, 63% of the senior posts and 44% of the total staff positions are vacant. This is a very serious disability on the part of the organisation.

The corporation has proposed a reorganization and strengthening plan to the government which will give it a total permanent staff strength of 2,215.

[13] MOEF Annual Report 2024-15

BFIDC's human resources activities are almost negligible. Occasionally, some training in field operations is given to the field staff. Overseas training to senior staff is almost non-existent.

The functions of BFIDC can be divided into two sectors, namely, industrial sector and rubber sector. A brief description of the two sectors is given below:

Industrial Sector

Nineteen Industries were established by BFIDC. Out of these most have been sold or are under the process of being sold.

Seven Industrial units are currently running under BFIDC: These are: (i) Cabinet Manufacturing Plant (CMP), Dhaka, (ii) Eastern Wood Works (EWW),Dhaka, (iii) Sangu-Matamuhuri Timber Extraction Unit, Chittagong, (iv) Wood Treating Plants (WTP), Chittagong, (v) Cabinet Manufacturing Plant (CMP), Chittagong, (vi) FIDCO Furniture Complex, Chittagong and (vii) Lumber Processing Complex (LPC), Kaptai, Rangamati.

Shortage of wood is one of the constraints in the industry sector. As there is a moratorium on felling of trees in natural forests, the seized wood procured from the Forest Department does not meet the full requirement of BFIDC.

Rubber Sector

The corporation owns 36,654 acres (14,834 ha) of forest land. It has so far established 16 rubber gardens in 32,635 acres (13,207 ha) of land by use of Malaysian clones. There are seven Rubber Gardens in Chittagong, 4 in Sylhet and 5 in Tangail and Sherpur areas. 2 million rubber trees in BFIDC's plantations are now under production. Many of the plantations are old and underproductive and are continuously being replaced with new plantations. The production figures reflect an annual average production of 5,447.57 MT. The low level of production is attributed to loss of economic life (>32 years) of a large number of rubber trees as well as theft of latex.

As an Apex Body, BFIDC has been promoting rubber cultivation in the private sector. A total of 32,550 acres (13,172 ha) of hilly land have been allotted to 1,302 individuals (25 acres/ person) for raising rubber gardens in the private sector. Out of this, 13,000 acres (5,261 ha) of rubber plantation are under Chittagong Hill Tract Development Board. Tea gardens and other organizations have also raised about 20,800 acres (8,418 ha) of rubber plantation. Private sector produces about 5,500 MT of rubber annually.

The production level at both BFIDC and the private sector plantations are quite low compared to the levels in countries like Thailand, Indonesia and Malaysia. The sector suffers from a number of serious problems, which include old trees, shortage of trained manpower, , old and outdated machinery, factories, smoke houses etc., Low Yielding Factor, re-plantation/raising of new rubber plantation and disposal of trees over economic life cycle.. The less than 10 hectare (25 Acres) allocated to private sector entrepreneurs in Chittagong Hill tracts is too small a parcel of land to be a viable unit of management. In addition, current cost of production and sale prices does not make the practice, under the current system of management and production, very viable. In order to make rubber plantations by private entrepreneurs successful, it is necessary to increase size of the allocated land, make provisions for loans, access to high quality planting stocks and modern

technology. In addition, it is necessary to review if at the current levels of production, it is economically feasible to continue raising rubber plantations, particularly under the BFIDC where the enterprise is incurring huge loss and rehabilitation of the plantation and upgrading of equipment and machinery will be a cost intensive undertaking. Rubber timber, with chemical treatment and seasoning is suitable for furniture manufacturing and is extensively used for the purpose in the rubber producing countries in Southeast Asia. BFRI has developed technology for chemical treatment and seasoning, which BFIDC is using for manufacturing furniture. This practice can be promoted provided suitable facilities for treatment and seasoning can be established.

Financial Resources

BFIDC is a self-financed organization. The corporation submits the same to Ministry of Finance through MoEF for its approval. The corporation pays BDT 5.0-10.0 million to the Government from its profit, annually. The state of its finances varies from year to year depending on the market conditions and the performance of its various units. It earned a profit of TK 403.97 lakh in the year 2014-15, mainly on the strength of its manufacturing operations while the rubber business suffered a loss of Tk. 875 lakh. The corporation consumed 1,110,034 cft. of timber in its manufacturing operations in that year, out of which 613,511 cft. came from its own plantations in the form of old rubber trees.

The corporation is reported to be suffering from over centralisation of financial decision making and decentralisation efforts have not been successful so far. The corporation has very limited IT infrastructure, its field units have no internet access, in general. The website of BFIDC is also in a very poor condition.

Issues and constraints

- As indicated above, BFIDC faces the following challenges in performing it mandate efficiently:
- Shortage of staff and large number of vacancies.
- Lack of forestry experts and industry experts on staff
- Shortage of quality timber for manufacturing wooden furniture, cabinets and doors and windows.
- Lack of financial and administrative freedom
- Old and obsolete technology in rubber processing
- Aging rubber plantations and poor clones of rubber trees.

Looking at the overall forestry based and industrial nature of its operations, it is surprising to note that there is no forester or industry expert in its top management. Although, the corporation has been instrumental in spreading rubber cultivation to the private sector, it has no role in promoting the development of forest industries in the country, beyond running its own businesses. As the forest based industries and occupations are among the biggest employment generators in the country, the country needs a body to spearhead their growth and development. It will be fitting for the BFIDC to take up this role.

4.2 Forestry education, training & capacity building

BFD has established the following training institutes for training its staff:

- Bangladesh Forest Academy Chittagong
- Forestry Science and Training Institutes (FSTIs) Chittagong, Rajshahi and Sylhet.
- Forest Development and Training Centre (FDTC), Kaptai

Forest Academy, established in 1964, is the oldest institution among these and was providing training to all ranks of foresters in the beginning. Later on, training of junior staff, namely foresters and forest guards was farmed out to the FSTIs and FDTC.

Although the professed mandate of the Forest Academy is to provide professional training to forest rangers and assistant conservators (ACFs), it is running only short term refresher courses because there has been no recruitment of ACFs since 2003 and that of Forest Rangers since 1995. Although the Academy is affiliated to the Chittagong University for providing B.Sc. (Forestry) and M.Sc. (Forestry) courses, but these courses are not in operation at present.

FSTI Chittagong is running a four-year diploma in forestry for general public. The diploma is recognized by the Bangladesh Council of Technical Education. The course is fully subsidized and is a qualifying examination for recruitment of foresters in BFD. As the recruitment of foresters is not regular, these candidates find generally look for employment with various development NGOs.

FSTI Rajshahi and Sylhet run a two-year diploma course for foresters, which has now become a qualifying course for promotion to the level of forest rangers. This course is in high demand due to its link with promotion.

FDTC is virtually idle and has not run any major courses for a long time although it is meant to provide training to forest guards. 226 forest guards have been recently recruited but they have been posted to the field without any training.

With the change in recruitment policies, where diploma holders are inducted as foresters and soon, all ACFs may be forestry graduates, the mandate and roles of these institutions need to be reviewed and adjusted to meet the current needs when there has been a shift in management from the age old traditional practices to a new technology based one, where forestry officials need to be prepared to handle these issues and challenges.

Induction of new Recruits and in service training.

Forest department recruits its staff at three levels: Forest Guards, Foresters and ACFs. Earlier, recruitment was also done at the level of Forest Rangers but it has since been abandoned. Surprisingly, instead of undertaking recruitment every year in small batches, BFD organises its recruitments intermittently, usually in large batches. This creates problems in cadre management. In addition, a large number of field staff and non-cadre ACFs were recruited for project activities. However, these large number of temporary officials were retained after the completion of the respective projects. While the services of a number of these officials have been regularized, many ACFs and subordinate/technical staffs are working with an undefined status. This anomalous situation has led to discords, and have resulted in litigation, which has become a major hindrance to new recruitment and other HR

related issues and is largely responsible for the department's inability to recruit after 2004! It may be mentioned that while the process of recruitment of a batch of ACFs have been finalised by the Public Service Commission during the current year, they could not be appointed because of the existing problems and litigations.

Induction training

The primary purpose of the various training institutions was to provide induction training, immediately after recruitment, to all new recruits but this system is no longer in practice. Although induction training curricula for forest guards, rangers and ACFs exist, these courses are no longer offered, primarily because there is no regular intake and the institutes do not get trainees for giving training on a regular basis. Although all recruits at the level of forester and ACF are forestry graduates, from FSTI and universities, officials need to undergo a field oriented training on relevant subjects and disciplines..

In-Service Training

All the institutes of the department provide in-service. Apart from the two year courses run by the FSTIs at Rajshahi and Sylhet, all other courses are specialised courses supported by various development projects. The nature and content of these courses varies with the focus of the sponsoring project. As all these institutes are being run on skeleton staff, most of the teaching is done with the help of outside resource persons.

Forestry Education

Three universities i.e. Chittagong University, Khulna University, and Shahjalal University of Science and Technology run different courses for graduate, postgraduate and doctoral degrees in forestry discipline in Bangladesh. A brief overview of the institutes or departments that operate forestry discipline is given below:

Institute of Forestry & Environmental Sciences (IFESCU), Chittagong University, Chittagong

Institute of Forestry in Chittagong University, established in 1976, was the pioneer in forestry education. It later offered additional courses on environmental sciences and was renamed as Institute of Forestry and Environmental Sciences (IFESCU) in 1996. Besides offering B.Sc. (Honours) in Forestry degree since 1978–79, the Institute began offering M.Sc. in Forestry since 1996, in-service training (Master of Forestry) to newly recruited Assistant Conservators of Forests under Bangladesh Forest Department since 1977–78, B.Sc. (Honours) in Environmental Science since 2000–2001, and M.Sc. in Environmental Science since 2004. The Institute imparted M.Sc. in Forestry in two batches (during 1977–1978 & 1985–1986) to 38 ACFs recruited by PSC and Master of Forestry to one batch (2003–2004) to 30 ACF recruits for Bangladesh Forest Department. Side by side, 4 years professional B.Sc. (Hons.) in Forestry programme was also started. So far IFESCU has offered professional B.Sc. (Hons.) degree to 1,055 students and M.Sc. (in Forestry) to 608 students, Ph.D. to 09 students with 32 foreign students. IFESCU has 32 faculty members (15 Professors, 05 Associate Professors and 10 Assistant Professors) who have expertise in diverse arena of forestry and environment, including agroforestry, biodiversity conservation, carbon measurement, climate change, GIS, community forestry, forest and environmental economics, genetics, mangrove forestry, resource management, restoration ecology & tree improvement. The Institute has courses on advanced areas of research in forestry and

environment such as Sustainable Forest Management (SFM), climate change, protected area management, biodiversity conservation, ecosystem analysis, community forestry etc. in its curriculum. It is interesting to note that nearly every forest officer in Bangladesh is a graduate from this university. A survey on IFESCU graduates was conducted and revealed that graduates of IFESCU had found their employment in: BFD, BFRI, BFIDC, DoE, SPARRSO, KU, SUST, MoEF, BTRI, IFESCU, Bangladesh Academy for Rural Development, Training and Educational Institutions, Hill Tracts Development Board, different tea and rubber gardens, forest based industries, Bangladesh Civil Services, Banks, NGOs and research institutions: BCAS, IUCN, CEGIS, Arannayk Foundation, and international organizations like FAO, UNDP, ADB, Winrock International and also abroad (in 23 countries). The scope of employment is increasing day by day.

IFESCU maintains its own seminar library with adequate books, journals, references and other reading materials covering forestry, environmental science and related fields. The institute also has Physical, Chemical, Biological, GIS, Computer, Climate Change, Watershed and Tree Propagation Laboratories with a permanent nursery covering an area of about 2 hectares, which is used by the teachers and students for research work and for raising quality seedlings. The plantation program was initiated in the year 1982 and till date an area of about 650 acres out of 800 acres of hills and valley land has been planted successfully with different timber, wood fuel, medicinal, rare and endangered species. At present IFESCU has plantations of 110 different tree species in the campus. All students of IFESCU get physical training and rifle training and compulsorily enrolment to the Bangladesh National Cadet Core (BNCC).

Forestry and Wood Technology Discipline (FWTD), Khulna University, Khulna

FWTD was established in 1992 with four years professional B.Sc. (Hons.) programme in Forestry broadly in line with the curricula and courses developed in Institute of Forestry at the Chittagong University, but with more emphasis on wood technology and computer literacy. Special emphasis is also given on the Sundarban mangrove forest and social forestry programmes. The FWTD also runs M.Sc. and Ph.D. programmes in forestry. So far FWTD has produced 600 B.Sc. (Hons) and 595 M.Sc. graduates form this discipline. Graduates are working for BFD, DoE and other governmental and semi-governmental departments, academic institutions; wood based industrial, non-governmental and corporate sectors in Bangladesh. This must be mentioned here that a number of the graduates of FWTD have pursued higher studies abroad and are currently engaged in research, teaching and other professions, both here in Bangladesh and abroad. FWTD has 32 faculty members (13 as Professor, 05 as Associate Professor, 06 as Assistant Professor), and has expertise in diverse areas of forestry, including agroforestry, biodiversity, forest ecology, ecophysiology, environmental science, forest genetics, forest management, forest nutrient dynamics, forest pathology, forest policy, forest product technology, genetics & tree improvement, mangrove ecology, social forestry, tourism, wildlife, wood microbiology and wood science. Since its inception, the faculty members have been conducting research on various fields of forestry and wood science, which have already earned recognition and fame both nationally and internationally. FWTD has facilities to carry out advanced research in the areas of mangrove ecology, wood science, social forestry and tree improvement. FWTD possesses a pool of sophisticated equipment in its Nutrition Dynamics Laboratory, Wood Science Laboratory, Tissue Culture Laboratory, Nano Biomaterial Laboratory, Eco-

Physiology Laboratory. Besides, research funds for various projects so far have been obtained from Khulna University Research Cell; University Grants Commission; Ministry of Information, Science and Technology; Ministry of Education, Bangladesh Agricultural Research Council; Bangladesh Academy of Science; GIZ (German Cooperation); US Department of Agriculture (USDA); World Bank; Nagao Natural Environment Foundation; The World Academy of Science; Japan Society for the Promotion of Science (JSPS); Asian Development Bank; Bangladesh Forest Department.

Linkages have been established with various forestry organizations like Bangladesh Forest Department, Bangladesh Forest Research Institute (BFRI), Bangladesh Forest Industries Development Cooperation (BFIDC) and different wood-based industries in Bangladesh. Besides, the university has also established collaborations through an exchange program like EXPERTS (Exchange by Promoting Quality Education, Research and Training in South and South-East Asia), funded by European Commission. The projects provide scholarship opportunities for faculties and students to study and conduct research in seven European Universities. Every year, a good number of faculty and graduates get scholarship for pursuing M.Sc., Ph.D., Postdoctoral studies and also for academic staff fellowship.

Department of Forestry and Environmental Science (DFES) Shahjalal University of Science and Technology (SUST), Sylhet

Department of Forestry was started in 1998 with a four-years professional B.Sc. (Hons.) degree in Forestry, broadly in line with the curricula and courses developed in the Institute of Forestry in Chittagong University. Subsequently, the Department of Forestry was upgraded to Department of Forestry and Environmental Science (DFES) in 2007. So far, DFES has offered professional B.Sc. (Hons.) in Forestry to 308 students and M.Sc. to 184 students. Graduates from this discipline are engaged with BFD, DoE and other governmental and semi-governmental departments, academic institutions; wood-based Industries, different non-governmental organizations and corporate houses, and banking sector in Bangladesh.

DFES has 22 faculty members (04 as Professor, 01 as Associate Professor, 17 as Assistant Professor) who have expertise in diverse arena of forestry discipline, including climate change, ecology, environmental law, governance and community based natural resource management, environmental science, forest ecology, forest tree improvement & genetics, GIS & remote sensing, non-wood forest product, natural resource management, resource economics & wood science. Six of the faculty members have doctorate degrees from reputed universities abroad; eight others are pursuing doctoral studies in different universities in the UK, Germany, Canada and Malaysia; and eight other faculty members are pursuing different M.Sc. programmes abroad. Many graduates are currently working in the Bangladesh Forest Department and other government agencies, NGOs and corporate institutions. The department is contributing significantly in the broader context of forest management by producing professional forestry graduates. Furthermore, the department is rendering services to BFD as and when required.

Ongoing activities of the department include offering undergrad and post graduate courses in forestry, thereby producing trained forestry graduates for the country, conducting research on multidimensional attributes of forests and environment particularly climate change, forest ecology, environmental law, GIS, tree improvement and forest resource economics, supporting the Forestry Science and Technology Institute in providing teaching support to

the forester's course and providing human resources support to the Department of Environment, BFRI and other related organizations during training, workshops and seminars, on and off. The Department has already signed an MoU with the Forest Department for collaboration on research, education and training for the Wildlife Centre of the Forest Department. It is also in the process of signing of LoA to conduct national forest inventory in association of the BFD.

4.3 Monitoring & Evaluation and Information Management

BFD has a very basic and limited monitoring and evaluation system. Monitoring of the forest resources is the responsibility of the Resource Information and Management System (RIMS unit while the monitoring of management activities is the responsibility of Assistant Chief Conservator of Forests (Monitoring).

4.3.1 The Resource Information Management Unit (RIMS)

RIMS is operated by the Resource Information Management Unit (the Unit is commonly referred to as RIMS, which practice is also adopted here).

RIM) was established in the mid 1980's with the objective to establish a computer-based resource information system. Its design was based on a similar system in use in Sri Lanka. The emphasis was on forest inventory and mapping in order to give decision-making information to Management Plan divisions. Initially, maps with forest formations and drainage patterns were prepared from aerial images using digitizing boards.

Gradually, more advanced surveying and mapping techniques were introduced, largely through externally funded projects.

Staff

RIMS has the following approved staff resources:

DCF (1), ACF (3), Research officer (1), Assistant Computer Programmer (1), Draftsman (2), Office Assistant (2), Data entry operator (1), Computer operator (1), Driver (1), MLSS (4).

Out of the 12 positions, 6 technical positions are currently vacant. RIMS therefore lacks capacity to undertake general IT tasks such as server and network management.

Facilities

Hardware

RIMS operates a GIS/RS laboratory at BFD Headquarters. The main GIS laboratory has 13 basic computers connected in a local network.[14] There is one professional workstation with dual large-screen monitors and which is being used for image analysis. There are also large format plotters, printers and uninterrupted power supply. The workstations can share GIS data sets, but there is no server computer to control data access and version control. For field work there are two laptops and a collection of GPS devices. Many of the projects that RIMS implements set up separate labs for GIS or RS work.

[14] The workstations are relatively recent commercial-grade PCs with a 19" screen, without any specific hardware additions to support GIS or RS analysis. The workstations were acquired in 2012 under the FIGNS project.

Software

RIMS has three licences for GIS analysis (ESRI ArcInfo, up-to-date versions) and three licences for satellite image analysis (2x Erdas Imagine, 1x PCI Geomatica). In addition, there are some licences for older versions of the same packages but these have limited usability due to lack of functionality and compatibility with current operating systems.

Facilities management

RIMS has no adequate budget allocated for maintaining the facilities. While hardware prices continue to fall, the requirements of new software is requiring ever more capable – and thus expensive – hardware. Software licenses from commercial partners are prohibitively expensive, making RIMS dependent on external support for maintaining the GIS and RS capability operational.

Current RIMS activities

Remote Sensing capability and products

RIMS currently has limited capacity to undertake large-scale satellite image analysis and mapping. Such mapping is typically undertaken with external support, using one of two modalities:

12. RIMS is operating in the capacity of project coordination unit for activities undertaken through external support, the role of RIMS staff being limited to specific tasks such as procurement of imagery, etc.
13. The image analysis is outsourced to another organization in Bangladesh, such as SPARSSO or CEGIS.

MIS/GIS database management

RIMS currently does not have any databases for MIS or GIS data[15]. Neither is there any appropriate infrastructure (server computers, networking, etc.) to support the operation of databases for concurrent access.

Currently, GIS data is not available to offices in BFD outside of RIMS, due to the lack of basic infrastructure (such as a modern office network capable of supporting intranet applications) and applications for use by BFD staff.

Additional tasks

RIMS is undertaking many activities in BFD in addition to its primary task of resource information and monitoring:

- The BFD web site is hosted and email system maintained.
- Maintaining CCF's and Departmental info email accounts.
- Maintaining internet connection of the Department.
- Generic business databases (e.g. human resources) maintained.
- Equipment and infrastructure inventories

[15] The available GIS data is managed in the form of individual shape files on regular computers, data is not integrated into a single platform for concurrent multi-user access.

- General ICT activities and reporting, digital innovation fair; troubleshooting of Computers, LAN and Internet
- Employment, higher scale examination of officials
- Preserve & Supply of forest related photos; “National Tree Fair” information and photos since 2005.

Under the CRPARP project a package was defined to undertake a “Technical Study to Strengthen Forest Resources Monitoring and Assessment (FRMA) System and Forest Resources Management Information System (FRMIS) in Bangladesh Forest Department” (package BFD/S4).

4.3.2 Assistant Chief Conservator of Forests (Monitoring and Evaluation)

ACCF (M&E) is primarily collecting data on social forestry and compiling that into reports. The data that is being collected is compiled into reports like the Plantation Survey & Monitoring Report by Division.

Beyond the social forestry data – primarily areas of social forestry projects and harvesting of timber from those areas – no other aspects of forest resources or forestry management are being monitored. The Monitoring and Evaluation Unit does not operate a monitoring *system* as such.

The Planning Unit of BFD collects forest resource and industry data that is sent on to FAO for inclusion in National Reports for the Forest Resources Assessment every five years.

4.4 Non-state institutions

Apart from the government organisations, the forestry sector comprises numerous non-state stakeholders such as forest based industries and craftsmen, sawmills, development NGOs etc.

Although not entirely dependent on local raw materials, there are more than 80 paper and pulp mills in the country. Only one of them, the Karnaphuli Paper Mills produces its own pulp from local raw materials, primarily bamboos. All others are dependent on recycled fibre and imported pulp. There are nearly 71,000 furniture manufacturers, nearly 15880 sawmills and lakhs of small artisans and craftsmen producing handicrafts and various items of domestic and commercial use. BBS lists 33 different professions/industries, which are dependent on wood, bamboo or other forestry related raw materials. Apart from the industry there are many big and small NGOs, such as BRAC, DRDS, PROSHIKA etc. which are engaged in promotion of social forestry or agroforestry. Some international aid agencies such as Helvetas Swiss Intercooperation, SEDF etc. are also engaged in forestry projects. There are no formal training institutions for the workers employed in these organisations. The industrial workers can get their basic training in the technical training institutions but most of their learning has to be done on the job. Some industrial houses have started their own training centres. For example, Akhter Furniture has started their own furniture training school in Dhaka. One of the factors, which is limiting the growth of forest products based industries in the country is the shortage of skilled workers, difficulty in securing financing and ability of market products at appropriate prices. There is a dire need for creating training facilities for industrial workers in view of the fast changing technological scene.

5 Impacts of climate change

The impacts because of the change in climatic components, such as changes in case of temperature, rainfall, humidity, wind velocity, etc. need to be assessed to get an idea about climate change. Attempts are being made here under to assess the climate change impacts, especially with respect to forests and forestry in Bangladesh.

Different parts of the country have different climatic vulnerabilities and associated impacts. The magnitude of impacts will also vary across the region, depending on socio-economic and physiographic conditions. The coastal area of the country is prone to salinity intrusion and tropical cyclones; floodplains in the central areas are prone to flood; the north-western region of the country is prone to drought; the north-eastern part of the country is prone to flash flood; and hilly regions of the country are prone to erosion and landslide (NAPA 2009).

Bangladesh Climate Change Country Study has made an attempt to qualitatively analyze the impact of climate change on forest resources of Bangladesh. It was found that increased rainfall during the monsoon would cause increased runoff, since the forest floor will not have the capacity to let all the rain water infiltrate into the soil (Ahmad et. al. 1999). As a result there would be enhanced soil erosion from the forest floor. The erosion problem would be more pronounced in degraded hill forest areas (Ahmad et al. 1999).

5.1 Climate Change Projections for Bangladesh

Climate change projections for Bangladesh based on the latest IPCC-AR5 GCMs protocol (CMIP5) and CORDEX ensemble, using Representative Concentration Pathways (RCPs) 4.2 and 8.5, with 38 GCMs coupled with about 105 model runs are presented hereunder, in conjunction with other relevant studies.

5.1.1 Temperature

Temperature regimes throughout Bangladesh are similar, with the highest temperature in the month of June-July (average of 25°C) and the lowest in December-January (average of 12.5°C). The maximum temperature ranges from 25°C in winter (NDJF), with a peak of 33.5°C in summer (JJAS). Past trends indicate that the mean temperature has already increased by about 0.65°C during the period of 1950 to 2015. The increase of minimum temperature is more than that of the maximum, in all seasons.

The projections indicate that temperature in Bangladesh will continue to rise. This rise will affect all seasons, but the winter will warm-up more than the summer. The RCP8.5 clearly indicates that the mean summer temperature will increase by 1°C in the 2030s and winter will be slightly warmer than 1°C. The same RCP8.5 indicates that in the 2050s the mean summer temperature will increase by 1.5 to 2°C and winter temperature will increase by 2.5 to 3°C, which will particularly affect the south-west region (Sundarban area) of Bangladesh. The rise in maximum temperature in winter is projected to be considerably higher than the summer; both in case of 2030s and 2050s. This rise of temperature will affect central and northern part of Bangladesh, especially Rangpur, Rajshahi, Dhaka, and Sylhet regions. These areas will experience warmer winters in the future.

5.1.2 Rainfall

The seasonal distribution shows that most of the rainfall, about 72% of the total, occurs during the monsoon season (June to September). The pre-monsoon season receives about 17% and the post-monsoon season receives about 9% of the annual rainfall. The current rainfall shows increasing trends all over Bangladesh with the exception of Srimangal. The south-eastern hill station, Rangamati, shows an increasing trend of around 11 mm/year; while the south-western coastal zone exhibits a moderate increasing trend of about 7 mm/year. Central and northern to north-eastern Bangladesh show dominant trends of 4 to 8 mm/year. North-western Bangladesh shows the trends of 6.5 to 16.5 mm/year.

Future rainfall projections show an increasing trend during the monsoon, especially in July and August. The south-eastern part of the country, is expected to experience an increased rainfall by about 5 to 10%, during 2030s. While there will be countrywide significant rainfall change by 2030s, an increase of about 10 to 15% of the prevailing total rainfall is predicted all over Bangladesh by 2050s. The highest increase of about 20% is predicted over the south-eastern hilly region of Bangladesh by 2050s. Districts like Chittagong, Rangamati, and Cox's Bazar will, therefore, receive more rainfall in future.

This indicates that the rainfall, country wide will be increasing in future.

5.1.3 Floods

The intensity, duration, and geographic extent of floods in Bangladesh mostly depend on the combined influences of three river systems, the Ganges, Brahmaputra and Meghna (GBM). Findings revealed that, in the near-future, by 2030s, the long-term annual runoff is projected to increase by 11.3, 6.7 and 19.1% in the Ganges, Brahmaputra, and Meghna basins, respectively. The wet season will be wetter in the future. Amongst the three basins, the Meghna shows the highest increase in runoff, indicating a higher possibility of flood occurrence. The southwest region will be more vulnerable than other regions.

Thus country wide there will be more floods in future, especially more in Meghna basin.

5.1.4 Sea Level Rise

The likely range of global mean sea level rise (SLR) is from 0.5 to 1.5 Meter at different RCPs. Sea level rise in Bangladesh has been predicted to slightly higher, about 5 to 10% more than the global mean. This means that by 2050 SLR in Bangladesh could be up to 4 cm higher than the global mean and up to 10 cm by the end of the century. The likely inundation ranges show that a 0.5 m, 1.0 m, and 1.5 m rise will inundate 2000 km^2 (1.3%), 3930 km^2 (2.5%), and 5300 km^2 (3.5%) of the country.

Globally the sea level will go higher in future and in case of Bangladesh it will be about 5 to 10% higher than the global mean.

5.1.5 Tropical Cyclones

Major cyclones have drastically increased in recent decades. During the period of 1978 to 2016 a total of 131 tropical cyclones formed in the Bay of Bengal, showing annual mean occurrence of 3.6. Bangladesh was hit by 33 tropical cyclones, which constitute about 25% of the total number of cyclones formed during that period.

Global warming and increasing sea surface temperatures by about 1.5°C by 2050, in the Bay of Bengal will cause the wind speed of the tropical cyclones to intensify further. It is predicted that the tropical cyclones originating in the Bay of Bengal in future will be 2 to 11% stronger, though their frequency may decline. The stronger these tropical cyclones are, they likely to be more and more devastating, especially to the forests and forestry of the country.

Stronger tropical cyclones but at lower frequency will occur in future.

5.1.6 Lightening

As the planet warms, it may spark more lightning strikes, which in turn can ignite wildfires. Just a 1°C rise in temperature, which is highly probable by 2030s, will cause about 30% more lightning strikes. Forests in Bangladesh are particularly vulnerable to more than 50 strikes/Km^2 annually.

Lightning strikes will increase.

5.1.7 Climate Change Projections for Sundarban

Coastal regions such as the Sundarban, which include the vast mangrove forest, will face the adverse effect of temperature increase and rising sea-level in the near future. Based on the RCM RCP8.5 projection, it is evident that this area will face a 3°C rise in temperature by 2050s. Projected SLR is 0.5 Meter by the 2050s, which would inundate approximately 491 Km^2, about 8% of Bangladesh part of the Sundarban. By the end of the century, the projected 1 to 1.5 Meter rise, would inundate approximately 43 to 61% of the Sundarban. In addition, the El Niño event will cause more forest fires and a La Niña event will cause more inundation due to higher sea level. The species composition will also change. The proportion of the species such as Gewa and Goran will increase.

Freshwater flow either from rainwater or from upstream rivers is critical to the stability mangrove forests. The freshwater flows from the rivers and the tidal ingress result in a gradient of three salinity zones namely (1) less saline (salinity <2dS m^{-1}), (2) moderately saline (2 – 4 dS m^{-1}) and (3) strongly saline (>4dS m^{-1}). Salinity decreases from west to east and these three zones correspond to technical classification of oligohaline, mesohaline and polyhaline zones respectively (Siddiqi 2001). Variations in salinity along with physical factors such as topography, soil condition, tidal variation, etc. causes implications on the floristic composition, forest type, growth habits, etc. At present considering geomorphology there are roughly 6 ecological niches where species find their habitat, which are (1) mudflats, (2) ridges or levees, (3) back swamps or basins, (4) river channels, (5) tidal creeks and (6) bay or sandy shore. Sundari (*Heritiera fomes*) dominates the less saline and elevated back swamp or basins. The combined impact of reduced fresh water flow due to loss of connection with the Ganges due to Farakka barrage, Halifax cut and the Mangla–Gashiakhali cut and the projected rise in sea level will alter the salinity regime and may reduce habitat for Sundari species (IUCN 2014).

5.2 Threats and impacts of climate change on forests and biodiversity

Bangladesh has about 17% of its geographic area under tree cover. The country has not been successful in preserving much of its forest wealth outside of the Sundarban due to rapid population growth and increasing pressures from different quarters. Forests in

Bangladesh are generally concentrated in the coastal mangroves, central Sal forests and eastern hill forests. An analysis based on satellite estimates of Normalized Differential Vegetation Index (NDVI) and Net Primary Productivity (NPP) over the period 2000 to 2015 suggests that the inland Sal forests and eastern Hill forests have suffered heavily from large-scale degradation in the last 15 years compared to the mangrove forests (figure 1-1). NDVI is generally considered an indicator of vegetation health. Degradation of ecosystem vegetation, or a decrease in 'greenness', is reflected in a decrease in NDVI value. Similarly a negative value of NPP means forest degradation and forest loss, while a positive NPP value indicates a healthy and growing forest ecosystem. However, field based analysis and assessment is required to identify the processes and drivers of the forest degradation in these areas.

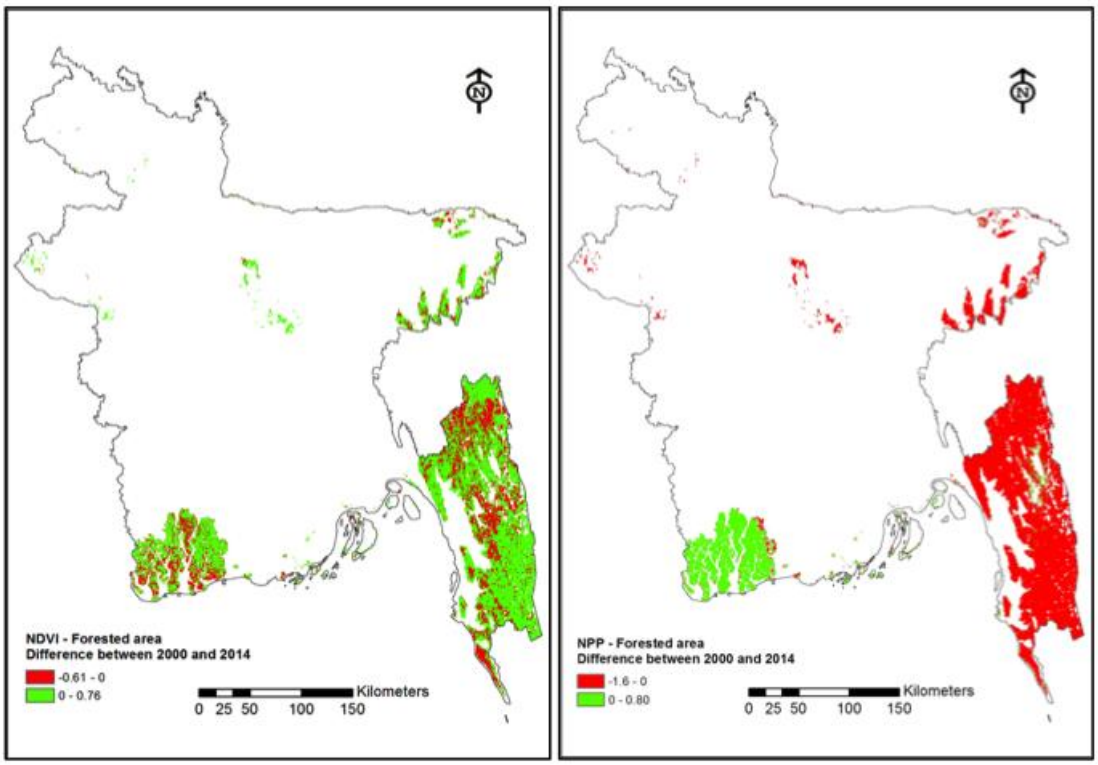


Figure 5-1: Observed changes in NDVI and NPP in Bangladesh forests from 2000 to 2014 (Source: IISc analysis based on MODIS satellite data)

The Sundarban forests, however, face a different set of challenges, in the form of increased salinity, sea level rise and damage due to frequent cyclones. For example, in 2007 Cyclone SIDR completely damaged 30,000 ha of mangrove forest and partially damaged another 80,000 ha. While there is no consensus, some researchers link 'top drying' of Sundari trees in Sundarban to the increase in salinity over a long period of time, especially due to Farraka barrage.

Forests are dependent on the climate system for their vital physiological processes. Hence it is important to understand how the projected changes in climate could potentially impact the distribution of forests and forest carbon stocks in Bangladesh. A number of approaches are

available to assess the impact of climate change on forest ecosystems. The Fourth Assessment Report of the IPCC suggests that one of the most advanced tools to estimate the impact of climate change on vegetation dynamics are Dynamic Vegetation models (DVMs). In this study, the Lund-Postdam-Jena (LPJ) model, one of the most actively used DVMs, was used to project the impact of climate change on forest ecosystems in Bangladesh. The model was first run for the baseline scenario i.e. the current climate, and then for climate change scenarios in the future i.e., Representative Concentration Pathway 4.5 (RCP4.5) and RCP8.5. Climatology data from Climate Research Unit of the University of East Anglia (CRU) was used to drive the historical simulations. Historical simulations of vegetation distribution in this study match well with the current vegetation distribution as reported by the Bangladesh Forest Department, which is based on a combination of satellite and ground based observations. This provides the confidence in the model's ability to project the future impacts on the forests of Bangladesh. Climatology projections from 17 CMIP5 GCMs and 1 CORDEX RCM (SMHI) were used to drive simulations of climate change impacts in the short-term (2030s) and long-term (2080s) for RCP 4.5 and RCP 8.5[16].

Based on the LPJ projections, the impact of climate change on vegetation distribution, forest productivity (NPP) distribution, and biomass and soil carbon distribution over Bangladesh was assessed. While LPJ is capable of simulating the impact of changes in climatic factors, such as temperature, precipitation etc., it is not capable of simulating the impact of sea level rise, or increase in salinity on the forests in the coastal areas e.g. for mangroves. In this report the impact of sea level rise and salinity on the mangrove forests is explored outside the LPJ modeling framework. The study finds that forests in the eastern and hilly parts of the country are particularly vulnerable to climate change impacts. It suggests that many of the forested grids in the eastern and hilly parts of the country are projected to experience vegetation shift as these forests may not remain suitable for the existing vegetation types in the future climate change situation.

[16] CMIP5 GCMs stands for Global Climate Models from Coupled Model Inter-comparison Project 5, while CORDEX RCM (SMHI) stands for Regional Climate Model from 'The Swedish Meteorological and Hydrological Institute', which was provided to the research community under the Co-ordinated Regional Downscaling Experiment of World Climate Research Programme.

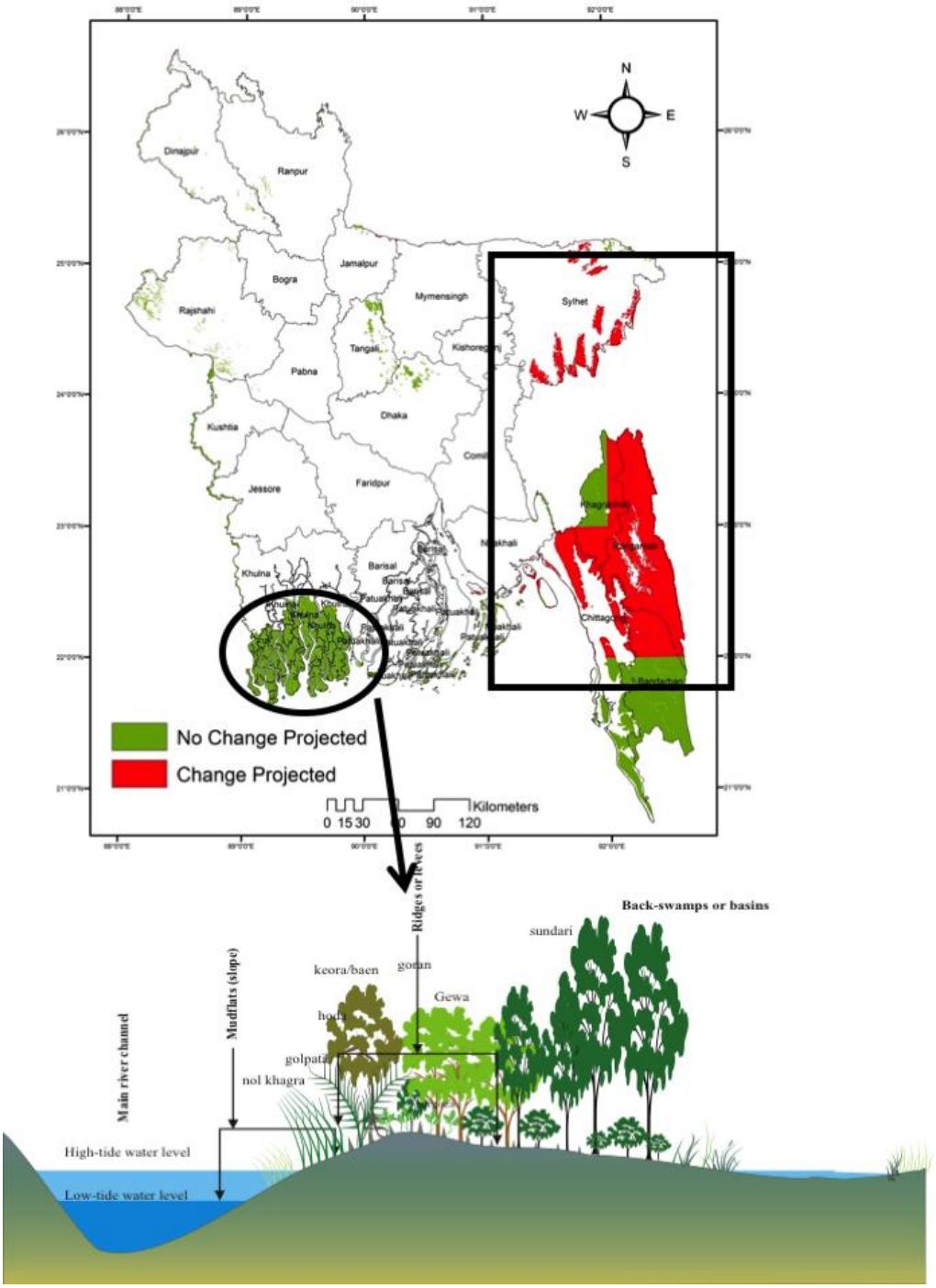


Figure 5-2: Model simulated changes in vegetation distribution in the forests of Bangladesh by 2080s under the RCP8.5 (Source: IISc)

While the mangrove forest type of Sundarban is not particularly threatened by the projected temperature increase and changes in rainfall patterns, these forests are particularly vulnerable to the impacts of sea level rise, increased salinity and increased risk of climatic extreme events, such as cyclones. According to global sea level rise (SLR) models, under the Business As Usual (BAU) emission scenarios (RCP6.0-RCP8.5) the global sea level is expected to rise by 80-100 cms (with rapid SLR expected in the second half of the century). It is estimated that about 40% of the Sundarban will get inundated at a SLR of 100 Cms.

Studies available from literature suggest that at an SLR of 88 Cms, the suitable area for Sundari forests will decrease by approximately 50%, the proportion of well diversified forests in the Sundarban will decline by approximately 50%, and moderately diversified forests will decline by approximately 25%. Low salinity preferring species assemblages such as Sundari forests are particularly vulnerable, while moderately salinity preferring species such as Gewa are expected to remain stable. Figure 1-3 shows the projected changes in areas of mangrove vegetation assemblages due to sea level rise and increasing salinity in the future.

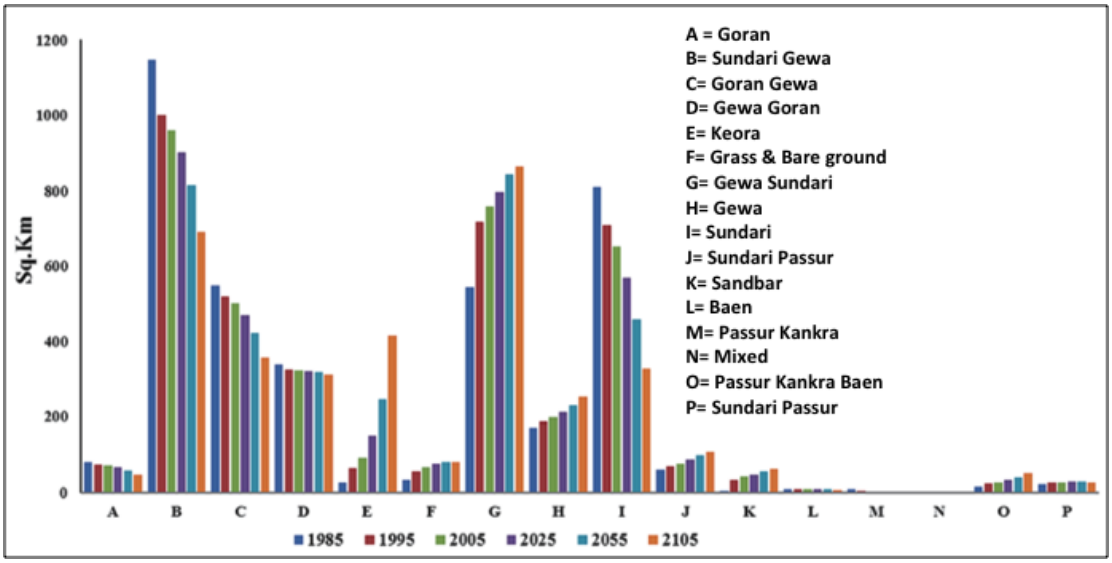


Figure 5-3: Projected changes in area of mangrove vegetation assemblages in the forests of Sundarbans (Source Mukhopadhyay et al. 2015)

Net Primary Productivity (NPP) is an indicator of the forest health and soil carbon (SOC) is an indicator of the soil productivity. NPP and SOC estimates for Bangladesh forests suggest that generally NPP and SOC will increase due to CO_2 fertilization effect. However some areas in the north-eastern parts of the country will experience a slow growth in NPP or decline in SOC.

Viewed together, projections on vegetation shift and NPP increase suggest that climate change presents both an opportunity and a threat to the forests in Bangladesh. The opportunity arises from the projections of increased net primary productivity, biomass and soil organic carbon in some parts of the country. However the threat comes from the projections of shifting vegetation boundaries, especially in the eastern and the hill forests. Shifting vegetation boundaries in itself may not be a big problem. However in combination with the lack of biodiversity, and disturbed and fragmented habitats, it poses serious threats to forest ecosystems. The fragmented and isolated forests in low biodiversity areas are especially vulnerable to the impacts of climate change which, in turn, could hamper the dispersal and migration of species. Hence, it is necessary to carry out afforestation and forest restoration activities, keeping in mind the need to build corridors to link fragmented and isolated forests. While building these corridors, a mix of native and relevant species should be used. Such corridors will not only be useful for building resilience of the forest

ecosystems, but they will also provide crucial points for the movement of fauna as well and will be useful in avoiding human-animal conflicts.

The growth of different species will have different response patterns against the changing climate, especially temperature. While experimenting with tropical tree seedlings in a controlled environment of plant growth chamber, elevated temperature (30, 32 and 34°C) showed positive growth for *Swietenia macrophylla* seedlings, where their height growth got enhanced But their collar diameter and leaf number mostly remain unaffected (Rahman *et al*., 2013). *Lagerstroemia speciosa* showed tolerance with high temperature when grown at elevated temperature in controlled growth chamber conditions and better growth was found in *Albizia procera* when exposed to medium high and high temperatures for (Ullah, 2008). Ahmed (2007) similarly found a positive response to elevated temperature between 31.58 and 39.6°C for germination and initial growth performance of *Shorea robusta*. Ullah and Al-Amin (2008) found *Cassia fistula* to grow better at 34.58°C than 32.78°C.

There are some negative responses as well. In case of *Artocarpus chaplasha* it was found that they get stunted and suffer from higher mortality to elevated temperature (Al-Amin, 2009; Rahman *et al*., 2012). Combined effect of elevated temperature and salinity on seedlings of *Artocarpus chaplasha* showed stunted growth than reared at existing outdoor temperature irrigated with regular fresh water (Rahman *et al*., 2012). Species like *Swietenia macrophylla*, *Gmelina arborea* may also suit elevated temperature in near future and withstand with better shoot growth performances (Rahman *et al*., 2012) where there is no increase in salinity.

Prolonged floods would severely affect growth of many tree species, while it would cause high incidence of mortality for *Artocarpus* species (Ahmad et. al. 1999). In contrast, enhanced evapo-transpiration in winter would cause increased moisture stress, especially in the Madhupur areas, which will be affecting the Sal forest ecosystem (Ahmad et. al. 1999). The tea plantations in the north-east would also suffer due to moisture stress. It was found that the Sundarban mangrove forest would be most severely affected by climate change. Due to a combination of high evapo-transpiration and lowered flow rate in winter, the salinity of the soil would increase. As a result, the growth of freshwater loving species would be severely affected (Ahmad et. al. 1999). Eventually the species offering dense canopy cover would be replaced by non-woody shrubs and bushes, while the overall forest productivity would decline significantly. The degradation of forest quality might cause a gradual depletion of the rich diversity of the forest flora and fauna of the Sundarban ecosystem (Ahmad et al., 1999).

Species composition and regeneration status study by Nur et al. (2016) in natural hill forest of Shitalpur under Chittagong North Forest Division, found that 17 out of 47 species, i.e. only 36% of the tree species are regenerating in the study area, which means that majority of the tree species, i.e. 64% are not getting favourable conditions to regenerate. This study (Nur et al. 2016) attributed that such poor regeneration status to absence of mature trees of these species. Overexploitation or illicit felling by the local people has caused this situation. The tree density at Shitalpur was found as 1425 stems/ha (Nur et al. 2016), which was better in comparison to 381 stems/ha in Sitapahar reserve forest of Chittagong Hill Tracts, South Forest Division (Nath et al. 1998). At Chunati WS the tree density was found as 459 stems/ha (Rahman and Hossain 2003). In Ukhiya natural forests of Cox's-Bazar Forest

Division the density was found as 257 stems/ha (Ahmed and Haque 1993). In Bamu RF of Cox's Bazar North Forest Division, the density was found as 369 stems/ha (Hossain et al., 1996). In a Dipterocarpus forest in Bangladesh the density was reported as 384 stems/ha (Biswas and Misbahuzzaman 2008). Though the age and species are not similar, the number of stems per hectare varies from 257 to 15425, which is very wide and reasonably low. This is indicative of the fact that these areas are subjected to heavy illicit felling. If such anthropogenic pressures cannot be reduced, no forestry program will be able to reduce the vulnerability of the given forest ecosystem to climate change impacts.

Al-Amin and Rahman (2011) compared current (2011) and projected (2100 year) habitat suitability of 18 important forest tree species using GIS tool based on future climatic parameters. The suitability projection indicates decrease for 13 species and increase for 5 species. They found that geographical distribution of species like *Heritiera fomes* and *Terminalia belerica* will decrease by 100%, followed by *Melocanna baccifera* and *Artocarpus chaplasha* by 68%, *Albizia lebbeck* by 39%, both *Lagerstroemia speciosa* and *Cassia fistula* by 31% (Al-Amin and Rahman 2011). On the other hand, habitat suitability will increase for *Sonneratia apetala* by 110%, *Leucaena leucocephala* by 45%, *Shorea robusta* by 34%, *Terminalia arjuna* by 25% (Al-Amin and Rahman 2011). The above studies provide indication of how species habitat will be affected by the climate change.

In the face of rapid degradation of the government forests of the country, the homestead forests are considered as major supplier of forest products. It has been reported that over 20 Million homestead forests of Bangladesh meet the country's demand of more than 80 % of timber and 70 % of bamboo (FMP 1992; Salam et al. 2000).

5.3 Vulnerability assessment

Vulnerability is defined as "the propensity or predisposition, of a system, to be adversely affected". It includes sensitivity or susceptibility to harm and lack of capacity to cope and adapt" (IPCC, 2014). Vulnerability is the degree to which a forest ecosystem is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of

(i) the character, magnitude, and rate of climate change and variation to which a forest ecosystem is exposed,

(ii) its sensitivity, and

(iii) its adaptive capacity.

Vulnerability can be due to biophysical hazards, such as cyclones, sea level rise, etc. but also due to socio-economic, policy and institutional factors, such as poor governance, can result in mangrove forest being cut down, leaving coastal areas more prone to sea surge and winds during a cyclone. Vulnerability can be situation-specific, interacting with a hazard event to generate risk. For example, a community may be vulnerable to cyclones but not to landslides or floods. While vulnerability is generally hazard-specific, certain factors can aggravate or affect vulnerability levels, regardless of the type of hazard, ex. poverty, or lack of social networks.

5.3.1 Vulnerability of forests

Forest degradation (status of biodiversity, species composition and structure) and fragmentation, predominantly due to socioeconomic pressures in the case of Bangladesh, results in forests being more vulnerable to current climate risks and long term climate change, compared to a healthy, well-stocked forest. By assessing the current or inherent vulnerability of forests to the risks of current climate change, adaptation strategies can be designed to tackle the sources of vulnerability, in order to reduce the vulnerability of forests to future climate change. By identifying and prioritizing the most vulnerable forests, policy makers and forest managers can prioritize and develop adaptation interventions that will enhance the resilience of forests to climate change by restoring their health and productivity.

Assessing the vulnerability of a forest ecosystem is challenging since the mechanisms that determine vulnerability cannot be observed directly. Assessment of inherent vulnerability enables the identification of underlying mechanisms, such as different species regenerating at lower density due to overgrazing, which in turn affects biodiversity, which has implications for adaptive capacity and vulnerability. By selecting indicators that represent the underlying mechanisms, focus is put on the identification and treatment of the causes of vulnerability, rather than the impacts.

Forest vulnerability index

A vulnerability index is a measure of the exposure of a population to a hazard. The index is usually a composite of multiple quantitative indicators, which when applied to a formula, produces a single numerical result. Such an index allows "diverse issues (to) be combined into a standardised framework...making comparisons possible" (Wikipedia).

A forest vulnerability index was developed for the forest lands of Bangladesh to identify which forests are most vulnerable to climate change/variability. A quantitative approach was used to assess the vulnerability of the forests by developing a vulnerability index (ranging from 1 to 4) which can be used to assess current climatic conditions as well as future projected climatic conditions. When constructing a vulnerability index, individual measures are weighted according to their relative importance. A cumulative score is then generated, typically by adding the weighted values. Vulnerability assessments are often influenced by data availability, data reliability, scale, rating methods used for vulnerability indicators, and interpretation of the results.

Assessment of inherent vulnerability is important to identify the underlying causes and mechanisms which have implications for designing and implementing suitable adaptation measures for addressing vulnerabilities for building forest ecosystem resilience, thereby enhancing its capacity to adapt. Rather than dealing with its impact, forest ecosystem vulnerability is addressed better by the identification of its underlying causes and resolving them. But many causal processes are not observable and measurable directly, and so proxy indicators are needed based on an analysis of the factors that cause vulnerability.

Methodology used to develop regional forest type-wise vulnerability profiles

The vulnerability of forests under 'current climate' scenario, also referred to as 'inherent vulnerability', was assessed using an indicator-based approach, pair-wise comparison

method for assigning weights, and geographic information system (GIS), based on the work by Sharma et al, (2015).

Thirteen vulnerability variables/indicators were selected based on literature and local expert opinion (refer to Table 1-1) and analyzed at 1 km x 1 km resolution. The vulnerability indicators were broadly classified into: satellite imagery-based products (NDVI – Normalized Differential Vegetation Index[17], which indicates current land cover, ex. forest/plantation, agriculture, settlement, water bodies, open barren lands; and canopy cover/forest density); topographical (elevation, slope gradient and flood prone); climatological (mean maximum temperature, mean maximum rainfall, mean minimum rainfall, and storm/cyclone affected; soils (soil salinity and topsoil texture); and demographic (population density and illicit timber seized).

Studies on characterization of the inherent vulnerability of the forested landscape have used several significant indicators such as biological richness, disturbance index, and fragmentation. In the absence of these significant indicators, the choice of vulnerability indicators was narrowed down by invoking expert judgment to quantifiable variables pertaining to the physical structure of the forests, the plausible factors of disturbance and the constraints with respect to availability of data on the indicators and/or access to maps. Often, the lack of data became the deciding factor in selection of the vulnerability indicators. While the focus is on the current climate conditions, the time-line for the indicator data used in this analysis has been sourced from as early as 1988, up to 2016. For example, the topsoil texture map was obtained from a map that was generated during 1988, while the Normalized Difference Vegetation Index (NDVI) map was obtained from 2016. Similarly, the data for storm/cyclone affected areas was based on the analysis of 1600 storms that occurred from 1980-2000.

Table 5-1: Indicators used for the vulnerability analysis along with range and source

Indicator category	Input Indicators	Source (year)
Satellite imagery -based products	NDVI	MODIS - MYD13Q1 (2016)
	Canopy cover density	Forest Resource Assessment (FRA), FAO – Geonetwork. (Based on 2001 data, published in 2010)
Topography	Elevation	GTOPO30 (1997)
	Slope gradient	GTOPO30 (1997)
	Flood prone area	Bangladesh Agricultural Research Council (2000)-

[17]Normalized Differential Vegetation Index (NDVI) is a measurement of the balance between energy received and energy emitted by objects on Earth. When applied to plant communities, this index establishes a value for the 'greenness' i.e. how green the area is, that is, the quantity of vegetation present in a given area and its state of health or vigour of growth. Since NDVI is a dimensionless index, its values range from –1 to +1. Generally, the values that are below 0.1 correspond to bodies of water and bare ground, while higher values are indicators of high photosynthetic activity linked to forestlands and agricultural activity. NDVI is generally considered an indicator of vegetation health, as degradation of ecosystem vegetation, or a decrease in 'greenness', is reflected in a decrease in NDVI value (Tovar, 2011).

Indicator category	Input Indicators	Source (year)
		Modified based on expert knowledge
Climatological	Mean Maximum temperature	Bangladesh Meteorological Department, GoB (Based on data from 1950-2015)
	Mean Maximum rainfall	Bangladesh Meteorological Department, GoB (Based on data from 1950-2015)
	Mean Minimum rainfall	Bangladesh Meteorological Department, GoB (Based on data from 1950-2015)
	Storm/ cyclone affected area	Socioeconomic Data and Applications Center (SEDAC) - World Bank - Modified based on expert knowledge (Based on 1600 storms from 1980-2000, published in 2005)
Demographic	Population density	Bangladesh population and housing census 2011, Bangladesh Bureau of Statistics - Modified based on expert knowledge (2011)
	Percent of illicit	BFD records
Soils	Soil	Bangladesh Agricultural Research Council - Modified
	Top soil	Bangladesh Agricultural Research Council - Modified

Box 5-1 provides a brief description of the methodology used to analyze forest vulnerability

Box 5-1: Methodology used for analysis of forest vulnerability

1. The first step involved identification of inherent vulnerability indicators specific to the region of study based on local knowledge and expertise.
2. The second step involved the compilation of the indicator data (in the form of maps, tables, graphs).
3. The third step was the preparation of indicator maps to work in a GIS environment.
4. The fourth step was the gathering of expert knowledge on the ranges for each vulnerability class for all the indicators - based on published data and verification by local expert's knowledge.
5. The fifth step was to reclassify the indicator maps based on the ranges to obtain vulnerability class map (1=least/no vulnerability, 2=low, 3=medium, 4=high) (tables 1 to 5). These vulnerability class maps were reviewed by senior forestry staff to verify that the maps reflected the reality on the ground. As a result of this review, it was realized that additional indicators needed to be added (flooding, elevation, illicit timber seized).
6. The sixth step was to rank the indicators based on the Pairwise Comparison Chart (PCC) by rating the indicators on a relative scale of importance - indicating the degree of importance of each indicator with respect to the other indicators (from the most important indicator to less important indicator). The comparison was made by senior

forestry staff based on reality on the ground.

7. The seventh step was to assign normalised weights (*W*) for each indicator (table 6) based on the relative ranking, created from PCC, to obtain vulnerability due to an indicator ($VC_{ij} \times W_i$), where $VC_{ij}$is the vulnerability class value for the i^{th} indicator in the j^{th} grid cell and W_i is the weight for the *i*th indicator.

8. The eighth step was the calculation of the vulnerability value (VV_j) at that grid cell level by adding the values for all the indicators in a grid cell ($VV_j = \sum_{i=1}^{13} VC_{ij} \mathrm{x} W_i$). It is the vulnerability value for i^{th} indicator of the j^{th} grid cell.

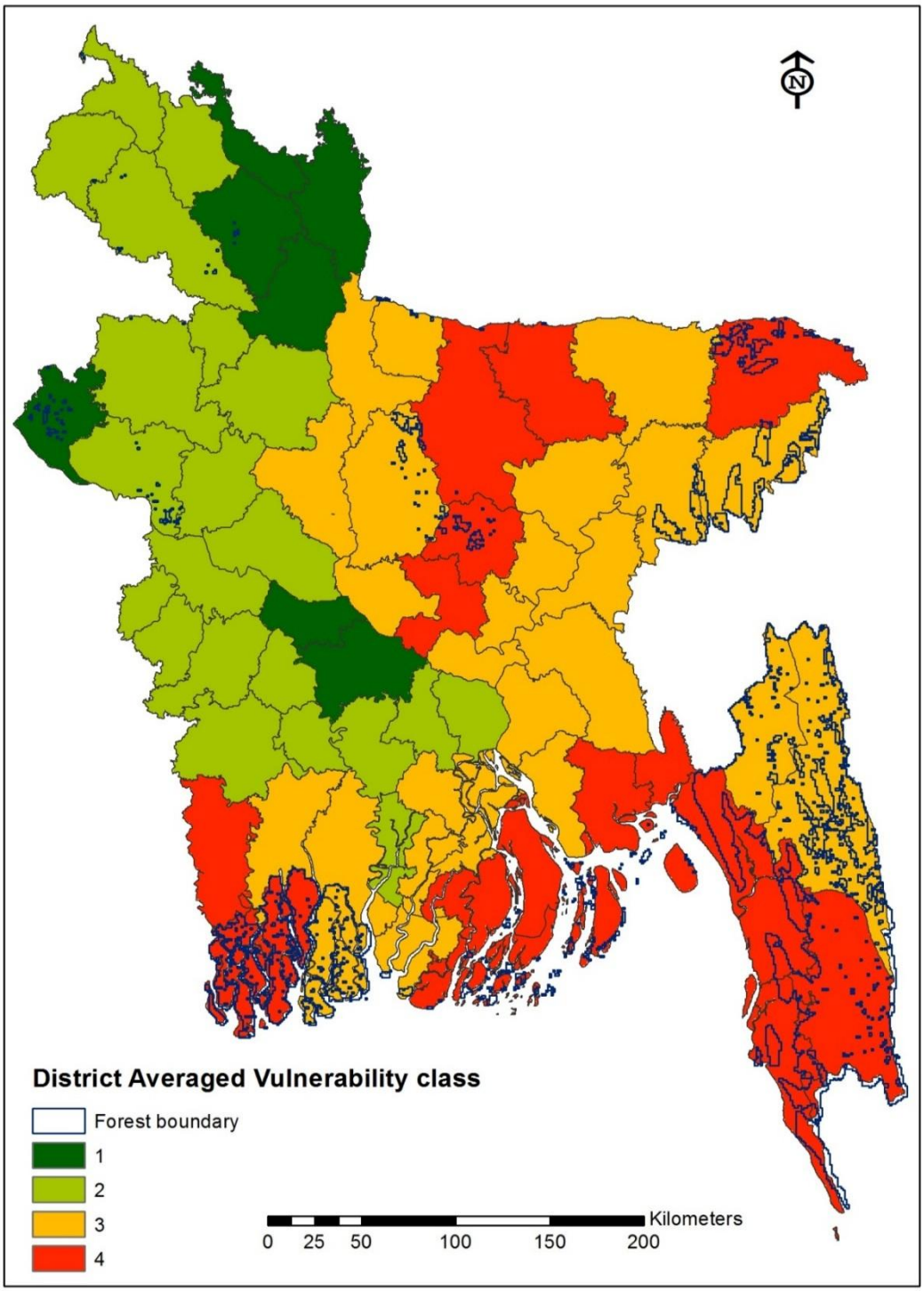
9. The ninth step involved mapping the assessment of vulnerability of forests at grid and district levels using the 13 indicator variables for the entire country and within the forested boundary (the area classified as forest by Bangladesh Forest Department). These forest vulnerability maps were reviewed a final time by forestry staff.

10. The last step involved the calculation of the area under each vulnerability class within the forested boundary and the entire country.

Results of the regional forest type-wise vulnerability assessment

Maps 1-1shows the vulnerability of forest lands in Bangladesh. Rather than showing vulnerability classes for only the forest land under the control of the BFD, vulnerability classes are also shown for all of Bangladesh in order to capture the homestead/village forests.

Map 5-1: District-averaged vulnerability classes with forest distribution.



Analysis of the Forest Vulnerability Index

Table 5-2 shows the extent of area within each vulnerability class for forested land under management/responsibility of the Bangladesh Forest Department, while Map 1-1shows forested land within the entire country (including homestead forests). The majority (65.8%) of the GOB forest land falls within the vulnerability classes 3 and 4 – moderately (37.2%) and very vulnerable (28.6%), while only 13.4% falls within the no/little vulnerability class and

20.8% falls within the low vulnerability class. In comparison, 52.1% of all forested land within the country has a VI of 3 (26.2%) or 4 (25.9%).

Table 5-2: Area by vulnerability class within GOB forested area and forested land within the entire country

Vulnerability Class	Area within GOB		Area of forested land within the entire	
	Km^2	%	Km^2	%
1	2,184	13.4	11,148	24.1
2	3,400	20.8	11,029	23.8
3	6,061	37.2	12,165	26.2
4	4,664	28.6	12,027	25.9
All classes	16,309	100.0	46,369	100.0

Note – area of forested land will differ from other figures in the FMP due to limitations in using grid cells 1 km x 1 km in size

The most vulnerable (VI=3 or 4) forests are found:

- Along the coast (western half and coastal portion of the Sundarban, and all the coastal plantations);
- Hill forests located in the southeast corner of the country, including Chittagong and Cox's Bazar Districts, as well as most of the Chittagong Hill Tracts, except for the very northern portion of Rangamati District;
- Sal forest from Dhaka District north through Gazipur, Tangail, Mymensingh and Netrokona Districts;
- Hill forests in Sylhet District, and
- Fresh-water swamp forest in Sylhet District.

The least vulnerable (VI=1 or 2) forests include:

- Northeast portion of the Sundarban (mangrove forest);
- Northern portion of the CHTs, i.e, northeast corner of Khagrachari District and northern part of Rangamati District (hill forests);
- Hill forests in the northeast corner of the country, close to the boundary with India, in Habiganj and Moulvibazar Districts; and,
- Small pockets of Sal forest found in northwestern Bangladesh in Dinajpur, Rangpur, Nawabganj and Rajshahi Districts.

Each forest type faces a different combination of vulnerabilities, based on the 13 indicators. Table 1-4 below highlights which indicators pose the greatest vulnerability (VI=3 or 4) for each forest type and location.

Table 5-3: Indicators posing moderate to high vulnerability for each forest type and location

Forest type and location	Popu	Illicit	Fore	Cyclo	Eleva	Soil	NDVI	Soil	Maxi	Maxi	Slop	Mini	Flood	Distri	Distri
Sundarban –west half, coast		X			X	X							X		X

Forest type and location	Popu	Illicit	Fore	Cyclo	Eleva	Soil	NDVI	Soil	Maxi	Maxi	Slop	Mini	Flood	Distri	Distri
Sundarban – north east		X				X				X			X	X	
Coastal plantations			X	X	X	X			X			X	X		X
Hill forests, CHT in southeast (excl. northern Rangamati District)		X						X	X	X	X	X		X	X
Hill forests, CHT, northern Rangamati District and NE corner of Khagrachari District		X						X		X		X		X	
Hill forests, Chittagong and Cox's Bazar Districts	X	X X	X X	X X	X X	X X	X X		X X			X	X X		X X
Sal forests – central part of country	X	X	X				X			X				X	X
Sal forests – northwest corner			X				X			X		X			
Hill forests – northeast (Habiganj and Moulivibazar Districts)		X						X	X					X	
Fresh water swamp forest and hill forest - Sylhet		X	X		X		X	X	X				X		X

As seen in the table above, and the map, the most vulnerable (VI=4) forests are located along the coast (Sundarban RF, coastal plantations), Chittagong and Cox's Bazar Districts (hill forests), the southern half of CHT (hill forests), through the central part of the country north of Dhaka (Sal forest) and in Sylhet District (hill forests and fresh water swamp forest). Although each forest type and location has its own unique combination of indicators that pose high vulnerability, indicators with a high vulnerability class (VI=3 or 4) that tend to be common to the highly vulnerable (VI=4) forest types include: illicit timber harvesting, forest canopy density, elevation, maximum rainfall, and flood prone.

While forest staff ranked population density as being the most critical factor/indicator that affects the health and resilience of a forest, this indicator did not prove to be directly strongly correlated with a forest's vulnerability. While both the Sundarbans and the CHTs have low population densities (VI=1), the forests face heavy pressures from illicit timber felling, as well as extraction of NTFPs (legally and illegally), because this is where the large areas of forest are situated. In the case of the coastal plantations, population density is low but there is strong pressure to convert the plantations to agricultural land due to land hunger. On the other hand, the Sal forest is under tremendous pressure because of a high population living adjacent to, or within, the forest. When this vulnerability index is recalculated in the future, it is recommended that population density not be included as an indicator, or if it is included, that it be given a low weight.

A forest climate vulnerability index was developed, based on 13 indicators. The most vulnerable (Vulnerability Index = 4) forests are situated along the coast (Sundarban RF and coastal plantations), Chittagong and Cox's Bazar Districts (hill forests), the southern half of the Chittagong Hill Tracts (hill forests), through the central part of the country from Dhaka District north (Sal forest), and in Sylhet District (hill forests and fresh water swamp forest).

Given that up-to-date data was not available for two of the most critical indicators, i.e., forest canopy and cyclone affected areas, it is recommended that the forest vulnerability index be recalculated in 5 years' time using recent data.

5.3.2 Community Vulnerability

Livelihoods vulnerability index

By assessing the vulnerability of forest-dependent communities to climate change and climate variability, it is possible to prioritize policy interventions and/or to develop and monitor adaptation plans for specific vulnerable groups and areas. Including climate change/variability issues in policies and plans will increase their effectiveness and help build socio-ecological resilience among the affected communities, ensuring resource allocations are needs based. In 2015, UNDP-Bangladesh developed a Climate and Disaster Vulnerability Index (CDVI) to assess the vulnerability of communities in six Bangladeshi landscapes or 'hot-spots' that are known to be prone to major hazards. The CDVI can be used as a baseline vulnerability profile and a tool to help prioritize where development programs are implemented, in order to reduce the vulnerability and sensitivity of the most vulnerable communities and improve their adaptive capacity. Climatic and disaster vulnerability was quantified at the national, district and upazila level.

The six hydro-meteorological hazard zones or 'hot-spots' selected, which are expected to be exacerbated due to climate change and climate variability, correspond very closely with the different forest types within the country, and thus correspond to where forest-dependent communities are situated. The hazards evaluated included: drought in the Barind area in the northwest (Sal forest found in this hazard zone); river flooding and erosion along the Brahmaputra-Jamuna-Ganges River system (Sal forest found in this zone); flash flooding affecting the deeply flooded haor basin in the northeast (fresh water swamp forest found in this zone); coastal zone with high levels of salinity, high exposure to cyclones, and waterlogging (Sundarban mangrove forest and buffer zone found in this zone); coastal zone with high exposure to cyclones and moderate salinity (mangrove forest (non-Sundarban) and coastal plantations found in this zone); and, landslides and flashfloods in hilly areas (tropical evergreen and semi-evergreen hill forests found in this zone).

Forty-six (46) indicators were used to assess the current extent of exposure, sensitivity and adaptive capacity – the three factors that contribute to vulnerability. The indicators were grouped under eight major components: *Adaptive capacity* – Socio-demographic Profile, Livelihood Strategies and Assets, Institutional Functions and Social Networks / Social Capital; *Sensitivity* – Health Services, Food Security and Water Security; and *Exposure* – Natural Disasters and Climate Variability.

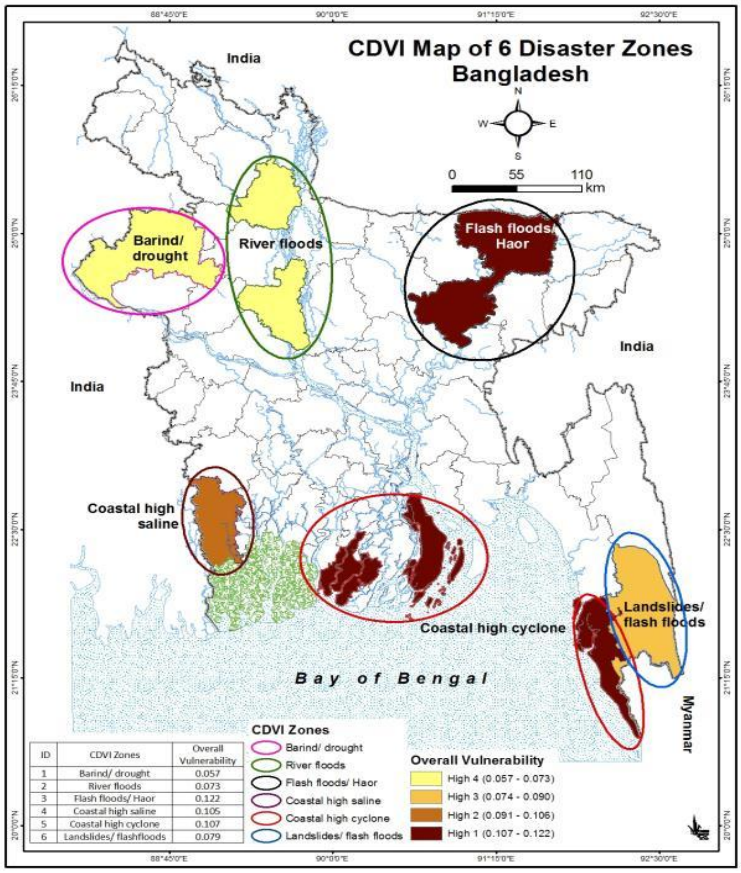
An analysis of the data is presented, broken down by exposure, sensitivity and adaptive capacity, which together result in overall vulnerability. The Haor zone in the northeast (corresponds to fresh-water swamp forest) is ranked as the most vulnerable hotspot due to relatively high levels of exposure and sensitivity to disasters (highest among the six hot-spots) combined with weakest adaptive capacity. The coastal zone with high exposure to cyclones and moderate salinity (corresponds to non-Sundarban mangrove forest and coastal plantations) and the coastal zone with high salinity, exposure to cyclones and waterlogging, (corresponds to Sundarban mangrove and buffer zone) ranked virtually equally in terms of vulnerability, just behind the haor zone. While both of the coastal zones have the highest

levels of exposure of any of the zones, they have relatively low sensitivity and higher adaptive capacities, which contributed towards a lower overall vulnerability than that of the Haor zone. The coastal zone with high salinity (corresponds to Sundarbans mangrove and buffer zone) is more sensitive than the coastal zone with high exposure to cyclones (corresponds to non-Sundarban mangrove forest and coastal plantation), due to being severely affected by saline water intrusion, which in turn affects availability of potable water.

The remaining three hazard zones are much less vulnerable: the landslide zone (corresponds to hill forests) was ranked fourth; the river flooding zone (corresponds with Sal forest) was ranked fifth; while the drought-prone Barind tract (Sal forest) was ranked sixth. These three zones had a moderate level of adaptive capacity which lowered their level of vulnerability.

The zones with water-induced vulnerability (coastal zones, flash-flood prone Haor/fresh-water swamp forest, river flood/Sal forest) had higher levels of exposure than the drought-prone Barind Tract/Sal forest and landslide/hilly zones.

Map 5-2: Map of overall vulnerability by disaster / hot-spot zones



ID	CDVI Zones	Overall Vulnerability
1	Barind/ drought	0.057
2	River floods	0.073
3	Flash floods/ Haor	0.122
4	Coastal high saline	0.105
5	Coastal high cyclone	0.107
6	Landslides/ flashfloods	0.079

Source: UNDP, 2015

5.4 Mitigation and adaptation policies and practices for Bangladesh

In view of the foregoing description of climate change projections, potential impact on forests and the vulnerabilities of various forest types and forest dependent communities, following

interventions are proposed for enhancing the resilience of forest ecosystems and communities.

5.4.1 Mitigation and adaptation policies and practices for forest ecosystems

Forest ecosystems of Bangladesh can be sub-divided into two broad categories, namely:

Natural forests: sal forest, hill forest and mangroves.

5.4.2 Mitigation and adaptation policies and practices for natural forests

As shown in the vulnerability analysis, nearly all the natural forests of Bangladesh are in the high vulnerability category. Whereas the major threat to Sundarban comes from climate change related impacts, *per se*, the other forests are more threatened by anthropogenic impacts such as encroachments, shifting cultivation and illicit felling. In keeping with this scenario, following approaches are suggested for the conservation of natural forest ecosystems in the country:

- The existing moratorium on exploitation of all natural forests should be continued. However, silvicultural operations such as thinning, singling, cleaning, stump dressing etc. should be permitted in sal and hill forests.
- All surviving sal and hill forests with more than 10% canopy density should be protected as a *national monuments* and *national heritage*, with the participation of the local people as far as possible, as these forests are in danger of immediate extinction. Although these forests are highly fragmented, all sizable patches can also be declared protected under the wildlife Act.
- All degraded sal and hill forests, where the land is not yet converted to any other land use, must be reforested either through natural regeneration or through plantations. The core zones of these forests should be preferably regenerated naturally, with enrichment plantations where necessary, under the assisted natural regeneration (ANR) approach, while the peripheral areas (buffer zones) should be planted with fast growing species, under the social forestry programme.
- High quality, low impact, ecotourism should be promoted in all natural forests, in partnership with professional operators and local communities. This is necessary, both for generating awareness about the rarity and value of these ecosystems as well as for generating benefits for the local people in the form of jobs and businesses.
- No further alienation of forest land for any purpose, legal or illegal, should be permitted. In cases of extreme national interest, where there is no alternative but to use forest land for a development or security project, permission from the highest office of the country, on the advice of an expert committee, must be mandatory and the minimum necessary land may be alienated on conditions of compensatory afforestation and payment of the net present value (NPV) of the alienated area. Imposition of the NPV is a must to discourage frivolous claims on forest lands.
- All-out effort must be made to control the practice of shifting cultivation in the CHT districts by giving people viable economic alternatives. Without controlling shifting cultivation, there is no future for any forests in that tract.

- Forest department must develop strong partnerships with various rural development agencies, including development NGOs, to promote and strengthen sustainable livelihoods among forest-side communities. This approach, popularly called *eco-development* in many countries, can reduce the pressures on the forests and strengthen the bonds of the local people with forests and forest department. BFD and conservation stakeholders must campaign for giving priority to remotest areas in the allocation of development resources.
- All state forest lands must be clearly demarcated on the ground, fenced where possible, and mapped. All forest officers, beat officers upwards, must carry latest maps of the area under their responsibility, all the time, and must check the boundaries from time to time. A GPS must be a standard part of the kit of every field officer now.
- Sundarban being the most critical surviving forest ecosystem in the country, with global significance, special attention must be given to its preservation. It must be treated as a research laboratory on ecosystem research and all national and international research institutions should be encouraged to set up permanent research stations around Sundarban. More information about this ecosystem will help in better recognition of its value and will also help in generating resources for its preservation.
- Management of protected areas notified under the Wildlife Act must be strengthened and all habitations inside the PAs must be relocated outside, under a suitable, humane, rehabilitation program.
- Wildlife of the country is under serious threat from poachers and traffickers. Wildlife outside the forests, particularly inhabiting water bodies such as haors, baors, beels etc., is the most vulnerable as no agency has the mandate or the means to look after these habitats. A nationwide program to control poaching in these habitats, in collaboration with local communities, is required to conserve wildlife outside state forests.
- With the loss of forest cover, production of NTFPs has taken the biggest hit, although no assessment of the situation has yet been made. NTFPs including medicinal plants, make a substantial contribution to the rural economy and well-being. They also lend diversity to forest ecosystems and, consequently, enhance their resilience. Therefore, an immediate assessment of the state of affairs related to the gene pool of various NTFPs in the hill forests must be made and suitable steps for their rehabilitation and conservation, in partnership with local communities must be taken. Wherever permits for the extraction of NTFPs are issued, as in Sundarban, Sylhet etc., the sustainability of current harvest levels may be studied and efforts to bolster production may be taken in view of the market demand.
- As CHT districts have the largest forest land after Sundarban, restart of active forest management is critical to the survival of those forests. The ongoing land tenure issue must be resolved at the earliest. Recognition of the rights of the ethnic communities on state forest lands is central to the CHT problem. Experiences of the district councils in northeastern India, and implementation of the “Tribals and Other Forest

Dwellers (Recognition of Forest Rights) Act 2006", popularly called the Forest Rights Act in India, may be seriously examined for adaptation in order to resolve the problem of land tenures.

5.4.3 Adaptation policies and practices for plantations

Bangladesh has a very long history and experience in raising forestry plantations, going back into the nineteenth century. The plantation programs have evolved, since then, from teak plantations in the hills to coastal shelterbelt of mangrove and non-mangrove species, and short rotation social forestry plantations in the hinterland, both inside as well as outside state forests. While no long rotation plantations in the hills are being undertaken now, social forestry and coastal plantations are the primary afforestation programmes at present. Apart from the government's afforestation programmes, entire population of the country is active in planting trees on private, institutional and community lands, in collaboration with, and under the guidance of many NGOs such as BRAC, Proshika, RDRS, Arannayk Foundation etc. Following approach is recommended to further strengthen the afforestation movement and to generate sustainable, climate resilient, results:

- The current approach to the creation of a coastal shelterbelt and social forestry plantations should be continued but the pace of coverage must be enhanced. Coastal people are the most vulnerable segment of the society, in view of the frequency of climate change induced disasters they have to face. Their losses can be significantly mitigated with the help of an effective green shelterbelt. Therefore, the completion of the proposed coastal greenbelt should be one of the highest priorities for the country.
- Plantation of trees under the shelterbelt program should not be limited to newly accreted charland only. Plantations of suitable climate resilient species must be undertaken all along the existing coast line, especially near thickly populated areas. It must be a time-bound program, not limited by the availability of external resources. In case the government has to acquire land for this purpose, even that should be done. As an alternative, private occupation/ownership in the identified land can be made conditional to maintaining a minimum level of tree cover.
- The country has notified more than a million acres of charland as reserve forest in anticipation of accretion. However, the charlands stabilized by tree plantations are diverted to other uses after 20 years, when the land becomes suitable for other uses. In view of the importance of coastal trees as a shelterbelt, no such alienation should be permitted unless the required depth of effective shelterbelt planation exists on landward side of the concerned charland. In any case, if such lands have to be released in extreme cases, it should be released only on the condition that a minimum number of trees per hectare shall be maintained by the custodian of the land.
- Security of the young coastal plantations is reported to be difficult in view of large population of buffaloes kept by people. These buffaloes graze unattended in these plantations and eat and trample young plants. Therefore, it is important that all coastal plantations be fenced against illicit grazing. An understanding with the neighbouring communities on the issue is important. If the community undertakes to

keep their buffaloes out of the plantation without the fencing, the cost of the fencing may be paid to them as an incentive.

- Almost all social forestry plantations in the country are of *Acacia auriculiformis* (Akashmoni) with some spattering of *A. mangium* and A. hybrid, even in natural forests. These plantations are being clear felled at 10 year rotations and are replanted. They suffer from lack of biodiversity as any native species remaining there are often uprooted by the beneficiaries. This makes the plantation climatically less resilient and prone to serious damage in case of an extreme climatic event. Secondly, these plantations uniformly produce small sized timber, creating a shortage of large logs in the country. Therefore, it is necessary that beneficiaries be educated about the value of diversity in the plantation and an approach to a suitable species mix in social forestry plantations should be adopted. Alternately, a small patch or a few rows of native species can be planted at suitable interval within monoculture plantation. Secondly, a staggered harvesting approach may be considered so that about 10% area can be felled at longer rotations of 20 years or more. A suitable economic rotation for long rotation trees should be determined so that people are not put to loss. These trees can also act as seed bearers for natural regeneration.
- Although akashmoni seems to be very popular as a plantation species, its mean annul yield is only about two m^3 per hectare while increments upto 15 m^3 are possible in a climate like Bangladesh. Therefore, proper research should be conducted as to how the yield of akashmoni plantations can be increased in the country.
- Dependence on a single species for countrywide plantations can be disastrous in the event of a climatic extreme or a disease. Therefore, trials on other, exotic as well as indigenous, high yielding species should be conducted to create more options for social forestry. Species like, Eucalyptus species, *Gliricidia sepium*, *Leucaena leucocephala*, and *Gmelina arborea* must be tested for different site conditions and under a variety of input regimes.
- The prevailing ban on planting Eucalyptus in government programmes is not based on sound scientific grounds. Eucalypts are a very diversified and versatile group of species which can produce desired results under a range of ecological conditions. Therefore, the issue must be re-examined in the light of latest scientific evidence and international experience. If results are positive, a list of species suitable for different climatic and edaphic conditions should be considered for meeting the plantation needs in different regions of the country.
- Currently, there is no regular provision for plantation activities in the country except the money coming from the tree farming fund (TFF) of social forestry, which is only 10% of the proceeds of a felled plantation. Moreover, TFF is meant only to replant an existing plantation site, not for expanding coverage. Efforts must be made to provide assured and enhanced funding for plantation work in view of the dire needs of the country. More than 300000 ha of BFD forest and an unspecified but almost similar extent in the unclassed state forests (USF) is awaiting treatment. Government funds,

even with the generous help of the donors and lenders, are never going to be adequate for this purpose. Therefore, efforts must be made to garner more resources for re-afforestation of degraded forests must be made. For one, the size of TFF can be increased to 100% of the government share from the revenue of a plantation. Secondly, government must consider reinvesting all other forestry revenue (which is not much in any case) in afforestation and conservation as a symbolic gesture of its commitment to conservation. Thirdly, an institutional mechanism must be developed to use corporate and institutional finance for re-greening the country. Forest department and many others, have been genuinely reluctant to allow private players into forests for the fear of losing forest land to dubious land uses. However, under the current circumstances, there is no alternative but to invite private resources into this domain, albeit under sufficient safeguards to ensure that forest land is not diverted for any other purpose. Care will also have to be taken that local communities have a strong partnership in these programs as without their support nothing will be possible. Therefore, a tripartite agreement, in which the government is more of a guarantor of fair distribution of benefits and responsibilities, should be developed to facilitate corporate and institutional (say banks) participation in reforestation conservation of state forests.

- It is obvious that with full participation from the public and development NGOs, great results in greening the country can be achieved. Most of the trees outside forests, particularly on homesteads and thousands of strip plantations have been planted under programs spearheaded by NGOs like BRAC, Proshika, RDRS, along with many international organizations. These NGOs not only motivated the public for tree planting but also brought the finance for the plantations under benefit sharing arrangements between the land owners (strip plantations), beneficiaries and the NGOs. As a result, the entire country now looks green as there is hardly any space for planting additional trees except degraded state forests. Forest department has taken a rather back seat in this revolution. BFD has a country wide extension infrastructure consisting of nurseries and social forestry training centres, but no money to run any extension activities or do any significant plantations on its own. Donor funds have also been rare and are often available only for coastal areas in view of their links with climate change issues. However, it is time for the GoB to review the situation and take up a strong role in forestry extension and strengthening the hands of NGOs interested in such work. A strong partnership between BFD and NGOs can go a long way in ensuring a sustainable supply of wood to the country from trees outside forests, while the state forests are regenerating for discharging their ecological functions under a vigorous plantation and regeneration program.
- Nearly all of the round-wood used in the country is now produced outside state forests, by the general public. According to a conservative estimate the total round-wood produced in the country is approximately 27 million cubic meters per annum, out of which at least seven million cubic meter is industrial round-wood or timber. Even at a conservative rate of Tk. 5000 per cubic meter, the value of this commodity comes to at least Tk. 135 billion. There are millions of producers and lakhs of traders and consumers of this produce. The primary processors of this product, the sawmills are more than 16000. However, there is no proper trading system under which

producers and consumers can interact and determine a fair price. Good, competitive market for wood can go a long way in ensuring the sustainability and growth of private forestry in the country and will strengthen the country's defences against climate change related disasters and difficulties. It is, therefore, proposed to create a network of wood markets across the country where timber producers, dealers and consumers can interact to determine a fair and competitive price for wood produced in the villages.

- Although social forestry has made a strong headway in the country, agroforestry in its true sense has not made much progress. There are trees on all the vacant lands but mixtures of agricultural and silvicultural crops have not been promoted much. In view of the fact that most of the vacant lands have already been planted, the only way to increase the tree growing stock significantly now seems to be possible by promoting mixed crops. BFRI and BFD, in cooperation with Bangladesh Agricultural Research Institute (BARI) and universities, must test combinations of tree and agricultural crops suitable for various regions in the country and mount an extension campaign to promote suitable agroforestry practices.
- Bangladesh does not have a culture of using quality seeds and planting material in plantation programs Even BFD usually does not purchase seed from the seed orchards created by BFD. Seed is collected by the field staff from the nearby plantations, locally. One reason for low productivity of plantations is certainly the quality of planting materials. It is, therefore, proposed that BFD must ensure only the use of high quality seeds and seedlings, from recognized provenances and genetic sources, in its planting operations and encourage private planters and nurseries to do the same. In order to promote the use of quality planting materials by private operators, a system of nursery certification may be started so that the nurseries using quality seeds can have a commercial edge over others.
- Forest transit rules continue to be a major deterrent for tree growers. These rules require that any owner of trees obtains the permission from the forest department before cutting a tree and transporting the timber. Some species are exempted from the operation of these rules, but the commonest species, Akashmoni, is not exempted. These rules are no longer helpful in protecting government forests, for which they were primarily invented, because there virtually are no government forests now, outside Sundarban. These rules now breed corruption and are a means of harassment of the public. It is, therefore, proposed that the relevance of these rules in the current context may be reviewed and may be further liberalised or totally scrapped keeping in mind the pros and cons.

5.4.4 Adaptation policies and practices for communities

The more robust a forest (or other natural resource) is, the more resilient it will be to cope with future climatic stressors, such as temperature rise, and change in rainfall pattern and amount. Given the intense pressure on forests by poor rural households to help meet their livelihood needs (both to consume and to sell) there is a need to reduce local communities' reliance on forests. In a populous and poor country such as Bangladesh, effective forest protection is not possible without the partnership of local communities. Management is needed to enhance the capacity of both forest ecosystems and local communities to adapt

together and be resilient to changes and disturbances. A proven means of reducing this reliance on forests is to increase people's awareness of the multiple purposes that forests provide, as well as increasing the resilience of the local communities by diversifying their livelihoods through the promotion of alternative income generating activities, the promotion of community savings, access to credit, and the strengthening of social capital.

Several initiatives, aimed at building partnerships between conservation agencies and local communities and also aimed at reducing community dependence on forests, have been going on in Bangladesh. A number of strategies that have/will strengthen the resilience of forest-dependent communities so that communities are less reliant upon forest products to meet their needs are reviewed below. All of the projects reviewed aimed to reduce degradation of the natural resource base and restore the natural resources; to reduce the dependency of local people on natural resources by providing alternative income generating options; and to ensure the engagement of local people so that they feel ownership and protective of the natural resources. These strategies need to be continued, and strengthened, in order to improve the resilience of the communities to the impacts of climate change.

5.4.5 Laying the Groundwork

Identification and selection of project beneficiaries in a fair and transparent manner is fundamental to any climate change adaptation programme. Conduct a Community Risk and Vulnerability Assessment (CRVA), involving the entire forest-dependent community. The community identifies risks and vulnerabilities it faces. The CRVA helps in identification of beneficiaries who need help in building secure livelihoods to cope with climate change.

Select beneficiaries in an open and transparent process, and form community groups. Since the aim of livelihood diversification is to reduce dependency on the forest, care needs to be taken during the participant selection process to ensure that the participants selected are in fact dependent on forest resources. Target should be the landless and/or female-headed households for participatory forest management, since they tend to be more vulnerable than households with land.

Conduct a baseline survey to verify types and quantity of timber, firewood and NTFPs being extracted from the forest by males and by females.

Provide a start-up activity to project beneficiaries ex. distribution of vegetable seeds and quick growing fruit seedlings, poultry and ducks) to provide a quick source of cash/income to generate interest/provide income while waiting for yields from longer term investments such as tree plantations.

5.4.6 Formation of community/forest dependent groups and federations

Since the poorer households tend to be more heavily reliant upon extraction of NTFPs, and tend to be the most vulnerable to the impacts of climate change due to their low adaptive capacity, these households should be targeted to be members of the community group (known as forest dependent group in some projects).

Each forest dependent community group should be part of a federation at the Union level. In accordance with the Law on Union Parishad, Union level Forest Conservation Forums (UCF) are under the leadership of the respective Union Parishad Chairpersons. The

institutionalization of the federation at the Union level, as well as being registered as a cooperative, provides access to local government for voicing concerns and interests of poor forest users in policy and decision making, and provides perceived legitimacy to the federation.

5.4.7 Co-management structure

According to the Co-Management model used in Protected Areas, there are two management bodies for each PA: (i) Co-Management Council, which includes 55 members (minimum of 10 females) from various categories of stakeholders. The Council functions as the general body of the management structure (ii) Co-Management Committee, which acts as an Executive Body, consisting of 19 members (of whom one-fifth should be female).

In theory, it is desirable to have representatives from the various stakeholders as members of the Co-Management Council, i.e. representatives from local administration, local government, land owners, brickfield owners, sawmill owners, poor and ethnic communities. However, the weaker members (i.e. the poor and ethnic representatives) find it difficult to have their voices heard. In addition to sensitizing the Co-Management Council on the need to respectfully listen to all members of the CMC, it is recommended that the number of females and representatives of the poor, be increased, with a corresponding decrease in the number of representatives from the local land owners, brickfield and sawmill owners. As well, it is recommended that each person serve a three-year term on a CMC, with one-third of the membership replaced each year, in order to minimize the opportunity for personal profiteering and to enable a wider cross-section of persons to sit as members.

5.4.8 Strengthen linkages between forest-dependent communities and various service providers

Collaborate/ strengthen linkages with various organizations for technical expertise in natural resources and agricultural production, ex. BFD, Agricultural extension, Dept. of Environment, Dept. of Fisheries, Bangladesh Water Development Board, and with NGOs for their expertise in community mobilization and revolving loan funds. Since climate change/variability will also affect agricultural production, there is a strong possibility that a decrease in agricultural production will result in greater pressure on the natural forest for NTFPs that can be used to meet household subsistence needs or be sold. Therefore, it is important that the BFD and agricultural extension staff support each other.

Work with NGOs who are already established and working within the targeted Upazila/District. These NGOs will know the area and the communities and their strengths and weaknesses, reducing the amount of time required to gain the trust of the beneficiaries and to get a new project/program up and running.

Forest-dependent community groups should be linked with the local government at the union and upazila levels, local authorities such as the District Administration, in addition to the Department of Forestry. Strengthening the social capital of community groups improves their ability to cope with external shocks to their livelihoods since the groups will have established a relationship with these stakeholders and will be more confident to approach them in times of need. Linking forest dependent communities and their Union-level federations with their Union Parishads will ensure that participants have better access to various supports ex. social safety net, provided by the GOB and implemented through the Union Parishads, to the poor and extra poor people.

Link community groups with local providers ex. Union Disaster Management Committee, Upazila Disaster Management Committee, to avoid duplication, ensure transparency, and to increase their input into the development of climate resilient and pro-poor Union Development Plans (WB, 2015).

5.4.9 Awareness Creation on impacts of climate change/variability

Increase awareness of the protective value of forests, and of how forests are/ will be impacted by climate change/variability. Awareness creation needs to target not only forest-dependent communities, but also the general public and government officials. A number of communication techniques have been used successfully within Bangladesh to raise awareness among people on climate change issues, including: radio program, newspaper articles, school curriculum (including training for teachers), pot songs/traditional theatre, flip charts and posters. Any of these proven techniques can be modified to increase the focus on the impacts of climate change on forests.

5.4.10 Revolving Savings and Loan Fund

Establish a revolving savings and loan fund (RLF) component (also referred to as Micro Capital Grant or Mutual Rotating Savings and Loan Funds in some projects) with the Union Federations of Forest Dependent Groups, to provide loan support for AIGA activities to FDG members. The RLF provides a sustainable ‘access to capital’ (AF, 2011). Each member contributes a monthly amount (usually 100 Taka). In Arannayk Foundation-supported projects, loan sizes have varied from 5,000 to 15,000 Taka, with an average of 10,286 Taka.

The RLF approach is very effective in promoting AIGAs among forest dependent poor people and in reducing their dependency on the extraction or collection of forest resources. Extra awareness raising efforts may be required with indigenous communities in the CHT in order to promote participatory saving programs among them (AF, 2011).

Given that the targeted group members in most cases will be the extremely poor, the members may have limited experience with banks and formal savings. Each community group receives intensive training on how to manage a RLF. Guidelines on how to manage the RLF are established by each community group. A grant or loan is given by the Implementing Agency (usually a donor) to each community group, which acts as a catalyst to jump start savings. The amounts of grants/loans given out by various projects have varied from 100,000 to 300,000 Taka. In addition to receiving a loan or grant from the implementing agency, members have a monthly saving scheme (projects to date have had members saving 20Tk to 100 Tk/member/month), and an annual share scheme (where part of the savings from the joint account are shared on an annual basis with each member). Service charge for members borrowing money has tended to be around 10%, which is less than what banks or most other micro credit loan schemes charge.

Community groups lend out money to individual group members, with the maximum amount set in the guidelines developed by the group. High repayment rates on past projects, which have been over 90% and often as high as 100%, are attributed to: (i) the borrower is one of the owners (lender) of the RLF money and feels obligated to comply with the group's policy (ii) regular participation in group meetings (iii) pressure from other group members who are waiting to get approval for new loans upon the repayment of existing loans (iv) timely repayment of a loan creates the possibility of obtaining a second, larger loan.

Once the community group is well organized and holding regular meetings, with a savings and loans program in place and membership contributions are collected on a regular bases, the group should be registered with the Department of Cooperatives. The group is audited by the Department of Cooperatives at least once a year.

An endowment fund is an investment fund, specifically for not-for-profit organizations, in which regular withdrawals from the invested capital are used to pay for ongoing operations. In order to ensure long-term viability of the community groups and their apex associations, they need a source on ongoing capital – which an endowment fund can provide.

5.4.11 Alternative Income Generating Activities (AIGAs)

Provide alternative sources of livelihoods (also known as AIGAs – Alternative Income Generating Activities) at both the household and at the community level, that are climate-resilient to reduce people's reliance on forest products.

Box 5-2: Participants invest in AIGAs

In a study conducted in 2010, in 18 projects funded by the AF with AIGAs, 43 different AIGAs were practiced. The choice of AIGAs was related to the agro-ecological characteristics of the area, marketing opportunities, input availability and access to extension services. Vegetable cultivation was the most widely adopted AIGA (23% of all participants), followed by fruit gardening (22%), small-scale business (8.3%) and rice cultivation (7.6%, usually on leased land). In terms of distribution across the projects (locations), small business (retail selling of vegetables, banana, dry fish, betel leaf, goat, fish fry, green coconut, grocery or stationery shop, trading of wood) was the most widely adopted AIGA, practiced in 12 out of 18 projects (75%), followed by vegetable cultivation (69%), poultry rearing (63%), nursery (63%), goat rearing (56%),cow rearing or beef fattening (56%), fish cultivation (50%) and fruit gardening (50%).

Investments by participants in the AIGAs ranged from 4,000 to 10,000 Tk on average. According to estimates made by project staff, the gross returns of the AIGAs ranged from 1.2 to 3.1 times the value of the investment, with small-scale businesses being most profitable.

AF, 2010

It is important to note that simply providing money to participants to start an AIGA is not enough. Hands-on training in the proposed AIGA is important, as is follow-up training/support and monitoring, in order to improve the chance of the AIGA being successful. This was evident in the SEALS Project, where NGOs contracted by the project to promote AIGAs, provided funds ranging from 6,800 up to 16,000 Taka per beneficiary, with only a limited number of beneficiaries successfully managing and growing their AIGA (SEALS, 2015). Rather than attempting to reach huge numbers of beneficiaries, it is advisable to focus on a smaller number and provide excellent and on-going support to them.

Projects that promoted AIGAs but limited their efforts to skills development training and/or promotion of marketing linkages, did not succeed since the poor project beneficiaries could not take advantage of alternative livelihood opportunities due to lack of capital, ex. Integrated Protected Area Co-management (IPAC) Project.

Box 5-3: Impact of AIGAs on extraction of NTFPs

The AF monitored the impact of its alternative livelihood development support to forest dependent communities by tracking the extraction or collection of NTFPs. Forest entry points were identified. Monitoring was done twice a month: once on a market day and once on a non-market day. A local market survey was conducted once a month and in at least three adjacent markets, to record prices and quantity of the forest products (same type of NTFPs collected). Data was collected from six co-management project sites (three national parks, one wildlife sanctuary and two reserve forests). Over four years, the illegal extraction of forest resources was reduced by 47 percent. See Annex A for more details.

Seed money for AIGAs has been provided by past projects with amounts varying widely. Research is needed on how large a grant is required to be effective in improving livelihood of a household in the long-term so that the household no longer needs to extract NTFPs from the forest in order to meet basic needs.

Box 5-4: A Valuation of the Forest Conservation Impact of AIGAs

"In the AF-funded Homestead Agroforestry Project of CODEC in Patiya and Chandanaish sub-districts of Chittagong, 142 forest dependent households are now engaged in AIGAs and have stopped cutting trees and bamboos from the forest. Previously, at least one person from each of these households used to go to the nearby forests and cut at least three sapling- to pole-sized trees per week, or 12 trees per month. Therefore, not going to the forest, each of those households saved an estimated 144 trees in a year. Thus the 142 households saved at least 20,448 trees. Each of these trees, yielding at least 20 kg of dry fuelwood, has a market value of BDT 150 at the minimum. Thus, the value of the saved trees (avoided being felled) accounted for the 142 households stands at BDT 3,067,200 per year." AF, 2011

Some of the AIGAs promoted at the household level have included: saline tolerant rice, drought tolerant rice, quick maturing rice (such as BRRI-28 and BRRI-29) and wheat, vegetable cultivation, aquaculture (crab fattening, shrimp rearing, tilapia, fish nursery), poultry and duck rearing, goat and cow rearing (need to make sure that grazing land or fodder is available outside of forest lands), tailoring/sewing, rickshaw pulling, grocery/tea stall. At the community level, eco-tourism, making energy efficient cooking stoves, and agricultural firms were promoted. Skills training, and follow-up refresher training, is required in each of the AIGAs.

In the above example, an investment of 288,000 in a RLF support from the project and BDT 549,000 of participatory savings of the participants resulted in savings of over BDT 3.0 million worth of trees from being felled in one year. The return on investment was more than 1:3.6.

Having at least three different sources of income/occupations within a household increases the likelihood that one or more of the income sources will survive a climate event, thus reducing the possibility of households being forced to turn to the forest to meet their needs for income. To date, a number of projects have promoted alternate livelihood options, but the livelihood options usually have been limited to one or two per household, which has a minimal impact on increasing adaptive capacity. At least 3 AIGAs per household should be promoted to enhance the adaptive capacity of a household.

Demonstration plots are an effective method to promote and share information to promote alternative technologies, such as salt tolerant rice varieties and short duration rice varieties, integrated pest management and crop diversification. Although participants may express preference for a particular AIGA, a market analysis should be conducted to determine if there is a demand for that product, and to determine what type of profit can be expected. Provide trainings (including at least one refresher training for each AIGA), using the technical expertise of local persons as trainers ex. Upazila livestock officer, Upazila agriculture officer, veterinary surgeon. Additional informal needs-based training can be included as part of the regular monthly meetings of the CBO. Additional research is required on assessing the impact of alternative livelihood interventions on reducing forest dependency and forest degradation, and assessing the resilience impact due to afforestation/reforestation activities and AIGAs.

5.4.12 Promote Climate Smart Farming Systems

Since the majority of forest-dependent communities rely on agriculture to supplement their income and provide food, climate smart technologies should be encouraged and supported

with support coordinated between the FD and Ministry of Agriculture. If agricultural production suffers, households will be forced to rely more heavily on NTFP, fuel-wood, etc. from the forest. Examples of climate smart technologies include: drought tolerant rice and wheat varieties, saline tolerant rice and rice varieties that are tolerant of inundation. In areas protected by coastal mangrove forests but outside of embankments, the Triple F model can be used. Since the entire model is raised, it is protected from tidal surges and storms. The Triple F model consists of building mounds and ditches, with fruit and timber trees grown on the mounds, interspersed with high yielding vegetables grown on top of the mounds and along the banks of the ditches, and fish and ducks in the ditches18.

5.4.13 Market Linkages and Market Value Chains

Communities benefit when a significant number of persons organize production around a single product line, with cooperative sales and marketing. The Nishorgo Project found that it was wise to focus on one product such as bamboo from the beginning of a project, as a strategy to avoid time lost while the FD or NGO or donor debated a wide range of opportunities (BFD, 2007).

Mobilize groups to purchase/produce/sell collectively. Form Producers and Collector Groups. Collective production and sales helps avoid middlemen and allows producers to retain more profits.

Link community groups with local providers and develop market linkage and value chains to get the products produced to market. A rapid value chain assessment can determine which livelihood activities have the potential to have value added, the latest technology, prices that can be charged, and what products can be successfully marketed due to an unfulfilled demand.

Community level value chain activities ex. cooperative marketing of local products, community based eco-tourism, manufacturing of improved cooking stoves (ICS) - need to include training on small business management, product quality control, market expansion/scaling up, access to banking. There is a need to ensure institutional and financial sustainability of established groups. A risk with many projects is sustainability of the interventions and assets created, after closure of the project (as projects are usually of only 3-5 years in duration).

Value chain development activities should include the following:

Orientation meeting with community groups to agree upon the selection of value chains for value-adding economic activities, using matrix scoring techniques, with extensive stakeholder interviews and FGD

The community to select lead farmers (respected, experienced in the activity being promoted/considered)

Validation workshop on the value chain – establish linkages with all value chain actors including FDG members, suppliers, producers, output traders, private companies and GOB line departments

[18]"A new land use model: forest fruit fish. UNDP Bangladesh, 2011.

Hold a needs analysis meeting with lead farmers to determine the needs of lead farmers as they will take the lead in promoting the business and improved technologies/practices among other producers. Provide advanced training for lead farmers as needed

Conduct a promotional campaign at the village level to promote awareness about the activity. Provide incentives as appropriate, ex. feed, medicine, vaccine, house, cage, and hatching pot for chicken growers

Arrange for training as required, ex. 3 day long vaccination training to community level vaccinators, with a certificate and tool kits distributed to participants at the end of the training

Hold an inception meeting with participants from the community, value chain actors and local elites to promote and expand awareness of the value chain

Facilitate a production and sales planning workshop at the village-level, for input producers cum sellers, service providers, poultry producers and output traders. At the workshop, all the participants will produce production and sales plans, based on mutual demands. The result of this planning will be that inputs and services should be readily available in the villages

5.4.14 Improved Cook Stoves

The use of improved cook stoves decreases fuel-wood usage by 40-45%. A study conducted by Arannayk Foundation showed that a forest-dependent person, who used to go the forest 5-6 times a week to collect fuel-wood, now goes only 1-2 times a week (Arannayk Foundation Newsletter, Vol.2 Issue 4). The average fuel-wood saving per household is approximately 1.45 kg, cooking time is reduced by 44 minutes per day, and production of ash is reduced by 338 g per day. Since the majority of very poor and poor households cannot afford to purchase an improved cook stove, this is an input that should be provided to project/program beneficiaries.

5.4.15 Capacity Building

Provide capacity training to the community group leaders and members on natural resource conservation, organizational management and livelihood enhancement. Build the capacity of the community groups and their apex associations. For example, in Component 2 of CRPARP, the 200 FDGs were federated into 55 federations at the Union level (FDG Federations). In accordance with the Law on Union Parishad, 55 Union level Forest Conservation Forums (UCF, including members of the FDGs) were formed under the leadership of the respective Union Parishad Chairperson, and are registered with the Department of Cooperatives. The sustainability of the FDG, FEG Federations and UCF, depends upon their funding capacity, and locally perceived legitimacy. The institutionalization of the UCFs provides the opportunity for poor forest users to have a voice and lobby in policy and decision making. An additional advantage of establishing UCFs is that at the monthly meetings, local conservation issues are discussed, including measures that can be taken to protect plantations and forests.

The establishment of CPGs, FDG Federations and UCF has proven effective in engaging communities and local governments in environmental protection, sustainable forest management and enhancing climate change resilience during the life of the project. The sustainability of the CPGs can be enhanced with their own source of income (possibly via small grants received as part of the exit strategy to be used to establish a revolving loan fund

for AIGAs) and ensuring that the UCF participates in the development of Union Development Plans. The CPGs should be formally recognized through a government gazette notification. In order for the UCFs to remain sustainable once project funding ends, they will require an ongoing income source – perhaps a Revolving Loan Fund through which the UCFs retain the interest paid.

Membership in apex associations/federations should change every two years to reduce possibility of corruption/intimidation of BFD and other group members.

Capacity building of community groups is a long term process. Some projects have worked with the same groups for nearly ten years before the groups were capable of functioning on their own.

As is often the case, strong effective leadership is critical at the community group level.

5.4.16 Cross-visits/Exposure trips

Cross visits can be cost effective and very helpful in improving awareness and understanding of new technologies being promoted and new management structures, ex. Co-management Council and Co-management Committee. Exposure trips to other countries can be useful to view new practices. For example, the AF sponsored 11 government and NGO officers to visit Nepal where they learned about bio-briquette production, solar driers and stall feeding of goats (along with several other practices) that help improve resilient to the impacts of climate change.

5.4.17 Forest Protection

Organize the communities to protect the forest against unsustainable extraction of NTFPs and timber harvesting by forming Community Patrolling Groups19 (CPGs). CPGs are sub-groups of Forest Dependent Groups (FDGs) and receive uniforms and minimal pay to help forest guards protect new and old plantations and the natural forest. CPGs have proven to be effective in protecting the forest and reducing deforestation. Sustainability of the CPGs after project funding ends can be enhanced through the provision of a grant (Arannayk Foundation provided USD 4000 – 5000 per CPG) to establish a revolving loan fund for alternative income generating activities and to enhance their sustainability.

Reduce fuel-wood consumption by promoting improved cooking stoves, solar energy devices. A study carried out by a partner NGO of Arannayk Foundation found that a household using an improved cooking stove reduced its fuel-wood consumption by 1.45 kg/day, a 50% reduction in fuel-wood usage. Cooking time was also reduced by 44 minutes/day, ash production was reduced by 338 g/day, and less smoke was created and inhaled by the family. During a case study conducted with four indigenous communities located adjacent to, or within Lavachara National Park in northeast Bangladesh, villagers claimed that using improved cook stoves reduced their fuel-wood usage by 50 – 70% (Rahman and Alam, 2016).

[19]Each CPG consists of 21 members selected from among the FDG members. On a rotational basis, three members of a CPG will patrol, together with Forest Guards of the local Forest Beat office.

5.4.18 Exit Strategy

Develop an exit strategy. Identify what sustainability measures need to be included in on-going project activities, and who will implement them once the project ends. Develop a strategy and budget. Ideally, once a project/support ends, the participants should be empowered to continue collaborating with relevant government agencies, and to have the necessary skills, knowledge and financial resources to plan and implement local development activities on their own. The collection of membership fees and interest earned from a RLF could provide the CBOs with on-going operational funds after a project/support ends.

To help ensure long term sustainability of the community groups, and to increase their voices, community groups need to be linked to an umbrella group at the union, upazila and district level. The president of each community group within a given upazila is a member of the upazila management committee. The Upazila Nirbahi Officer (UNO) chairs the committee, and a member of the Implementing Agency (i.e., donor or FD staff) is usually the secretary. This management committee provides guidance to the community groups and helps resolve issues.

As previously mentioned, the provision of a grant to each Community Patrol Group after project funding ends (Arannayk Foundation provided USD 4000 – 5000 per CPG) to establish a revolving loan fund for alternative income generating activities would enhance their sustainability.

5.5 Synergy between mitigation and adaptation as well as between different conventions

It is well known that global temperatures are going to continue to rise due to the quantum of GHG gases already accumulated in the atmosphere. The efforts to reduce the rate of emissions in future are going to make an impact slowly and in the meanwhile more gases will enter the atmosphere. Therefore, while we continue to reduce the emissions and increase sequestration of accumulated gases, it is necessary to be prepared for the inevitable climate events which we will have to face in the future. Adaptation to climate change means to reduce human vulnerability to the impacts of climate change on issues like livelihoods, food security, impact of increased floods, storms, cyclones etc. It is obvious that both mitigation and adaptation approaches have to go hand in hand. While mitigation aims to slow climate change and keep its extremes within levels of human coping capacities, adaptation measures enhance human resilience in the face of climate induced difficulties and disasters. In the absence of effective mitigation action, the cost and effort of adaptation may be beyond human capacity while adaptation alone cannot save the world if the global temperatures continue to rise and destroys the very ecosystems on which human existence depends. Thus, there has to be a strong synergy between mitigation and adaptation efforts in dealing with climate change.

Various international conventions and multilateral environmental agreements, such as the Convention on Biodiversity (CBD), United Nations Framework Convention on Climate Change (UNFCCC), UN Convention to Combat Desertification (UNCCD), and the Ramsar convention on wetlands of international importance etc., have a common goal of preserving the environment and biodiversity against human impacts, which include climate change.

While they together address the whole environment holistically, individually they have their own specific areas of focus, as their names suggest. Whereas lack of action on one focal area can undermine the achievements of others, their achievements can strengthen each other's effectiveness. It is therefore important that all these conventions and MEAs get equal importance from the reporting and implementing agencies. Moreover, their data requirements are common to some extent (e.g. forest area, protected areas, population, biomass production etc.) and a common database can reduce the workload involved in reporting. Therefore, a synergistic and unified approach to all the MEAs is good both for the reporting agencies as well as for the MEAs themselves. Reporting on all MEAs should ideally be the responsibility of a single agency so that they can plan data collection and collation keeping the requirements of all MEAs in mind.

5.6 Deforestation, REDD+, CDM & LULUCF

5.6.1 Deforestation

Deforestation and forest degradation have accelerated in the country as a result of rapid population growth, poverty, expanding cultivation, infrastructure growth and industrialization. Inadequate forestry investment and inadequate institutional capacity have been the other principal reasons behind the lack of sustainable forest management and biodiversity conservation. Since Bangladesh is a delta with good rainfall and fertile soils in plain lands, most of the forest areas in the country are suitable for agriculture as an alternative land use in a land scarce, agrarian economy. Therefore, the pressure for converting forest lands into agriculture is very high.

The principal drivers of deforestation and forest degradation in Bangladesh include various combinations of the following factors:

- High dependence of a large rural population on natural forests for fuel-wood, construction timber, fodder and various non-timber forest products;
- Encroachment of forest land for agriculture or habitation by poor people living in and around forests, as well as by migrants;
- 'Land grabbing' by influential people for various commercial purposes;
- Conversion of forest land into non-forest uses by the government for infrastructure or industrial development; and,
- Commercial timber felling and the smuggling of valuable timber trees by criminals.
- Weak institutional capacity to enforce forest laws.

These factors are aggravated by an extremely high population density, poverty and lack of good governance. The absence of the clear demarcation of forest blocks on the ground makes encroachment by neighbours both easy and defensible in courts. The intensity and combination of factors driving deforestation varies from area to area. The sal forests are more prone to agricultural encroachments because of the suitability of the plains land for agriculture. The hill forests of the CHT suffer from progressively decreasing cycles of traditional shifting cultivation (shifting) by the local indigenous people. The dependence of local people on neighbouring forests for fuel-wood, fodder and small timber is prevalent

throughout the country. Frontier areas of Sundarban are degrading under pressure for fuelwood and small timber from the people living on the periphery of the forest.

Although it is difficult to estimate the extent of encroachments in a vast landscape with any degree of accuracy, without proper survey, especially when many encroachments are converted into social forestry plantations, approximately 104154.43 ha area of forest land is estimated to be under various kinds of encroachments in 2016. In addition 125626 ha forest land has been officially converted into other land uses and transferred to other agencies. According to the latest assessment only 15% (17490 ha) of the remaining sal forests have more than 10% canopy density while only 11% (79161ha) of the remaining hill forests have more than 10% canopy density.

A major driver of deforestation/degradation in Bangladesh is the widespread poverty and land scarcity. This results in over-exploitation and encroachment of easily accessible public natural resources such as forests and wetlands. This nexus can be broken by gainfully involving rural poor in the protection, sustainable use and management of government forests. Both, climate change mitigation issues (through avoided deforestation and forests degradation) and adaptation issues (reducing the vulnerability of communities by involving them gainfully in forest protection and sustainable co-management), can be addressed within the framework of the National Climate Change Strategy and Action Plan formulated in conformity with the national development goals of Bangladesh. It is important to identify conservation options that will result in restoring and maintaining forests while being beneficial to local communities for the sake of sustainability. The REDD+ program of the UN offers excellent scope for such action and Bangladesh has been quite active in this area.

5.6.2 Reduced Emissions from Deforestation and Forest Degradation (REDD+)

The REDD+ mechanism was proposed in 2005 to enable the incorporation of GHG emission reductions from natural forests in non-Annex I countries into mitigation programmes. The REDD+ mechanism is still under negotiation as of June 2016, although most elements of the mechanism have been defined in a series of decisions from the Conference of the Parties to the UNFCCC.

The REDD+ mechanism has five eligible activities:

- Reducing emissions from deforestation
- Reducing emissions from forest degradation
- Conservation of forest carbon stocks
- Sustainable management of forests
- Enhancement of forest carbon stocks

If Bangladesh opts for the REDD+ mechanism then all Forest Land[20] in Bangladesh will have to be included in the National REDD+ Programme. The only exceptions will be made for forests included in other climate finance agreements, such as the CDM, FCPF, FIP, etc.

[20]"Forest Land" is a land use category under the IPCC Guidelines. In principle it contains all land that is currently forested, but it should also include land that is designated as forest even though it is not currently forested, such as degraded RF land and land accretion in RF areas.

Decision 1/CP.16 defines the four required elements of a National REDD+ Programme:

- A national strategy or action plan
- A national forest reference emission level and/or forest reference level, in accordance with national circumstances
- A robust and transparent national forest monitoring system for the monitoring and reporting of the eligible activities, in accordance with national circumstances
- A system for providing information on how the safeguards are being addressed and respected throughout the implementation of the eligible activities

In effect, the safeguards require Bangladesh to have full and effective engagement of all local stakeholders, specifically also indigenous peoples and local communities in all relevant aspects of any activities implemented under the National REDD+ Programme. Bangladesh has to prepare a Technical Annex to the National Communication with full details of the REDD+ Programme and activities. This Technical Annex will be assessed through the International Consultation and Analysis process organized by the UNFCCC Secretariat. If the Technical Annex is found to be compliant with UNFCCC decisions, then Bangladesh can apply for "results-based finance" at the Green Climate Fund. The current (June 2016) price for REDD+ GHG emission reductions is approximately USD 5 – 5.50 per ton of CO^2. Any amounts awarded would accrue directly to Bangladesh and are expected to be applied towards the operation of the National REDD+ Programme and otherwise be distributed to the stakeholders of the REDD+ activities in a form deemed appropriate by the government. Once the system is properly set up it is rather straightforward and many current programmes and activities could be brought under the National REDD+ Programme with limited additional work, such as the social forestry programme. However, establishing the reference (emission) levels and the national forest monitoring system are complex undertakings and a continuous system for forest resources assessment has to be set up and maintained. Bangladesh is actively participating in various REDD+ initiatives and a project is currently being implemented with support from the UN-REDD Programme.

The Bangladesh Climate Change Strategy and Action Plan is built on six pillars including mitigation and low carbon development. Under the USAID funded Integrated Protected Area Co-management Project (IPAC, 2008-13) a Clean Development Mechanism and two REDD+ proposals were prepared for the Chunoti Wildlife Sanctuary, and the Sundarban Reserved Forests (SRF) and 6 PAs respectively. Bangladesh became a partner country of the UN-REDD in August 20110 and a National REDD+ Steering Committee was formed in July 2011. The REDD+ MRV Action Plan, REDD+ Readiness Roadmap, and REDD+ Readiness Preparation Proposal ware prepared in the year 2011-12. The Roadmap was endorsed by the National REDD+ Steering Committee in December 2012. Bangladesh is now a member of the UN-REDD and in 2015 the UN-REDD Bangladesh National Program was approved with funding from the UNDP and the USAID. In the same year Bangladesh has been identified as a pilot country under the Forest Investment Program (FIP) under the World Bank's Climate Investment Fund.

By following a verified carbon standard (VCS) methodology, a concept document for REDD+IFM (Improved Forests Management), called "Collaborative REDD+IFM Sundarbans Project (CRISP)" was developed by the BFD in 2011. A similar concept paper was prepared for 6 PAs by following a VCS methodology for REDD + Assisted Natural Regeneration (referred to as Bangladesh REDD+ANR Protected Area Project or BRAPAP). The documents were developed by following the approved VCS methodology VM0006. (Methodology for Carbon Accounting in Project Activities that Reduce Emissions from Mosaic Deforestation and Degradation).

The overall aims of the CRISP and BRAPAP are i) to enhance carbon sequestration with improvement in community livelihoods; ii) community participation in forestry activities for better forest governance; and iii) conservation of flora and fauna.

5.6.3 Clean Development Mechanism (CDM)

The CDM of the Kyoto protocol has as objective to reduce emissions of GHG through provision of financial and technical assistance from Annex I countries to non-Annex I countries in the establishment of projects. Under the CDM Scope 14 is for Afforestation and Reforestation.

CDM has fairly elaborate administrative, reporting and validation requirements, reasons why afforestation and reforestation projects have not been many because the overhead costs erode the financial viability of the project. As a result, small scale activities were allowed, with reduced administrative requirements and hence lower overhead costs. More interestingly, a Programme of Activities (PoA) can be defined which acts as an umbrella for multiple small projects in a country, with its concomitant benefits of scale. For instance, a PoA for social forestry could include all new plantations on degraded RF land throughout the country and then be registered as a single CDM project.

For afforestation projects only that land can be included which did not support actual forest in the past 50 years.

For reforestation projects only that land can be included which did not support actual forest since 1 January 1990.

The minimum area would be several tens of thousands of hectares21 for the project to be financially viable.

Bangladesh needs to formally submit the CDM proposal to the UNFCCC. Local stakeholders need to be consulted and detailed assessments need to be made of additionally, persistence and leakage.

CDM projects always need a donor country that provides technology and financing of the project. Any issued Certified Emission Reduction (CER) certificates will be assigned to the donor countries to offset their domestic GHG emissions with the reductions achieved in Bangladesh.

[21]A regular CDM project should have a minimum projected annual emission reduction of 16 ktCO_2e/yr (decision 9/CMP.3), for a small-scale CDM project the amount is less than that. Given the administrative overhead and low price of Certified Emission Reduction certificates, projects tend not to be financially viable unless much higher annual emission reductions are achieved.

The Kyoto Protocol, of which the CDM is part, is currently in its second commitment period and it is doubtful if the Kyoto Protocol will be extended following the adoption of the new climate agreement at COP-21 in December 2015 and which will become operational from 2020 onwards.

Individual afforestation and reforestation projects are not likely to be financially viable, but bundling them into a PoA is a more tenable option.

Nishorgo developed a CDM project for the Chunoti Wildlife Sanctuary in 2007, but this has not been submitted to the UNFCCC. Field inventory design, formats and methods were established in accordance with the guidelines of the Intergovernmental Panel on Climate Change (IPCC) and the GOFC (Good Practices for AFOLU - Agriculture, Forestry and Other Land Use). The nature of carbon pools, including above-ground biomass, below-ground biomass, on-ground necromass, and soil carbon, was assessed by following the carbon inventory manual developed by the BFD.

5.6.4 Land Use, Land Use Change and Forestry (LULUCF)

The LULUCF is an important land-based sector that mitigates climate change, strengthens terrestrial ecosystems and builds resilience among communities. Conservation and growth of forests can ensure substantial sequestration and storage of carbon dioxide, in addition to numerous socio-economic and environmental co-benefits. Global warming is adversely affecting Bangladesh's climate, with serious consequences for natural resources including water, soil, forests and air. Forests provide low cost mitigation opportunities to combat climate change by the removal of greenhouse gases (GHGs) from the atmosphere as carbon sinks and by reducing GHG emissions through avoided deforestation and forest degradation. By conserving the country's forests and establishing climate resilient plantations in unused public and private lands, biodiversity and water shall be conserved *in-situ*, and community biomass needs can be met. Besides, sustainable forest management has significant potential to attract investments and technology, and upgrade institutional capacity of BFD and local community organizations for biodiversity conservation, forest restoration, and meeting their energy needs.

Avoiding deforestation and forest degradation is in line with the Poverty Reduction Strategy of the GOB. In accordance with the measures envisaged in the Partnerships for the Global Environment, it supports the Sustainable Development Goals by ensuring environmental sustainability and by addressing rural poverty alleviation. Climate resilient afforestation and reforestation on unused public and private lands, in partnership with local communities, will offer excellent opportunities for achieving national environmental goals. It will mitigate GHG emissions while conserving biodiversity and alleviating rural poverty. Greening of the country through community conservation activities will result in empowering local communities, thereby contributing in improved forest governance.

Due to her favourable climate, Bangladesh is a good case for forest restoration and conservation in partnerships with forest dependent communities. Forests which act both as sink and source of greenhouse gases, are indeed in need of restoration and sustainable management. Bangladesh is a low-carbon emitting country due mainly to low level of industrialization. Carbon dioxide emissions are derived mainly from energy sector, with some contributions from the LULUCF sector. The protection and sustainable management of

existing forests and enhancement of carbon stocks through afforestation and reforestation will improve their ability to sequester and store carbon.

Activities in the Land Use, Land Use Change and Forestry (LULUCF) sector can provide a relatively cost-effective way of offsetting emissions, either by increasing the removals of greenhouse gases from the atmosphere (e.g. by planting trees or preserving forests), or by reducing emissions (e.g. by curbing deforestation). However, there are drawbacks as it may often be difficult to estimate greenhouse gas removals and emissions resulting from activities of LULUCF. In addition, greenhouse gases may be unintentionally released into the atmosphere if a sink is damaged or destroyed through a forest fire or disease.

Forest carbon sinks benefit the country's forest-dependent communities through enhanced incomes and better quality of life. Forest ecosystems enhance the resilience of poor people against climate change by providing economic safety nets in a disaster prone economy. Forest and wetland ecosystems contribute to the mitigation of climate change by sequestering and holding CO_2 which depends on their growth and conservation.

5.7 Carbon stocks and inventory

Forest carbon inventories are becoming increasingly important because of the expanded global emphasis on developing afforestation/reforestation, Clean Development Mechanism (CDM) and REDD+ activities. The development of national forest inventory institutions and processes for objectively assessing baseline scenarios and reference emission levels is essential for developing proposals to receive carbon payments available under these programmes.

A seminal effort in Bangladesh was initiated in the Chunoti Wildlife Sanctuary in 2007 when the BFD conducted a carbon inventory for developing a CDM reforestation proposal under the Nishorgo Support Project. Field inventory design, formats and methods were established in accordance with the guidelines of the Intergovernmental Panel on Climate Change (IPCC) and the GOFC (Good Practices for AFOLU - Agriculture, Forestry and Other Land Use). The nature of carbon pools, including above-ground biomass, below-ground biomass, on-ground necromass, and soil carbon, was assessed by following the carbon inventory manual developed by the BFD. Carbon stock changes over a project activity area of 5,000 ha were estimated to be 2.78 M ton of CO_2 over a maturity period of 40 years.

The carbon inventory programme conducted in the Chunoti Wildlife Sanctuary provided the means for planning and conducting a mangrove carbon assessment in the state reserve forest for developing a REDD+ proposal under the USAID-supported Integrated Protected Area Co-Management project (IPAC). The Collaborative REDD+IFM Sundarbans Project (CRISP) is an AFOLU activity with an emphasis on REDD+ and Improved Forest Management (IFM) in the project area through avoiding unplanned frontier deforestation and degradation and improved forest management through conversion of logged forests to protected forests, including the protection of currently logged or degraded forests from further logging. A manual on carbon inventory methods was developed for the mangrove forests based on the experiences of the Chunoti project. The project forest area of 412,000 ha was estimated to generate an average of 213,115 tons of CO_2 annually over a 30-year project period for total project enhanced removals of 6.4 $MtCO_2e$ (an average of 15.52 tons of CO_2/ha, excluding soil carbon).

This effort was succeeded by another REDD+ proposal developed by the BFD, the USAID-supported "REDD+ARR (Afforestation, Reforestation, and Revegetation) Protected Area Project" (BRAPAP), for which a forest carbon inventory was conducted in six Protected Areas. The proposed project is calculated to generate annual net greenhouse gas (GHG) emissions reductions from reducing deforestation and carbon stock enhancement of 103.7 M tons of CO^2 for 40 years over a mere 33,344 ha, or an annual average of 3,110 tons of CO^2. This estimate is very obviously impossible and is indeed due to methodological errors[22]; this proposal is therefore not further considered. In 2014, under the USAID-supported Climate Resilient Ecosystems and Livelihoods project (CREL), a forest carbon inventory was also completed by the BFD in 17 Protected Areas, including the 6 Protected Areas covered under the BRAPAP. Carbon stocks varied from 146 to 381 $MtCO_2e$/ha. Unlike the CRISP and BRAPAP projects, however, there was no REDD+ proposal developed under this initiative.

Arannayk Foundation has estimated carbon stocks in the community conserved forests managed by the indigenous communities of the Chittagong Hill Tract. CREL has in 2015 estimated carbon stocks in the country's 15 Protected Areas (PAs).

Various current activities are striving to produce a national coverage of forest resource information and carbon densities and dynamics. The NFI project is preparing a national land cover classification and will sample all land cover classes in such a way that carbon densities will be established and the National REDD+ Programme will establish a national forest monitoring system that should envelop all the sources of forest resource information in a unified format.

Apart from the generation of forest information through internationally-funded programmes, BFD has no in-house system or policy of data collection, storage, retrieval and analysis. The data related to forestry activities such as afforestation, reforestation, and extraction are not systematically collected and information is generally collected from field offices on an *ad hoc* basis. Even though standard formats for submitting periodic performance reports from field offices exist, the information is prepared and transmitted manually and it is virtually impossible to compile or access this information at the central level. The BFD will have to review not only its resource inventory systems, but the establishment of an effective, operational database on forest management activities, as well. The BFD is in the process of creating a web-based database on wildlife crime management and similar information management systems are urgently required for managing data on forest crimes, as well as forest resources management.

[22]The main methodological issues are two-fold. First, reduced emissions from reducing deforestation and forest degradation is calculated over the entire area of the PAs for each of the 40 years. This clearly violates the principle of permanence: deforestation and forest degradation is avoided only once and thereafter the forest is considered to be protected from further threats. Effectively, the emission reductions are over-estimated by a factor of 40, in addition of which the project implementation period has to be considered (not all forest is protected right from the beginning). Second, the ANR uses a rather high MAI of 4.95 m3/ha/yr over the 40-year span of the project. Such a high MAI can be attained in a plantation where trees are optimally spaced, but in a natural forest crowding reduces the MAI, while the natural growth rate of forests over a 40-year period gradually declines to 0.

6 Issues and Challenges

This chapter sheds light on the key issues and challenges that thwart the progress of the sector in general, and cause serious impediments to the smooth functioning and discharge of mandated duties and roles of the forestry sector institutions. In what follows, selected major issues and associated challenges are flagged and discussed in some details. Under each theme, the contextual realities are summarized first, followed by the identification and discussion of the relevant major challenges. In appropriate cases, some suggestive tips for improvement of the situation are also furnished.

6.1 Containing the Dwindling trends in Natural Forests

The Context

Over the years, the natural forests of the country have seriously been depleted and degraded. During the Second World War, the accessible hill forests in the east were heavily exploited to meet the demand of the war in Burma and elsewhere. After 1947, when the supply of timber from Assam ceased, these forests came under heavy exploitation. Due to its inaccessibility, the forests in Chittagong Hill Tracts continued to remain in good natural condition until the Kaptai Dam was built and the area became easily accessible by water, when, in addition to the felling in areas submerged by the lake created, large scale exploitation of forests in Raingkheong and Kassalong valleys started taking place. The decimation of forests in the Sangoo-Matamuhri reserves is of a more recent origin. In addition, clearing for shifting cultivations by local communities, which have been a major cause of destruction of forests in CHT, which has been on-going all along large scale destruction of forests have taken place in the last three decades. According to available latest information, 85% of the Forests in Chittagong, Cox's Bazar and Chittagong Hill Tracts have a canopy cover of less than 10%. However, the situation is the other forested areas, including the plain land Sal forest is not much better.

Out of the total notified hill forest area of 722,716 hectares, only 79,161 is currently under a minimum acceptable level of tree cover (FIGNSP, 2013). This has resulted from over-exploitation of tree resources, encroachment of forest land, clearing of forest land for shifting cultivation, transfer of land for non-forestry purposes and large scale illicit removal of trees from the hill forests.

The plain land semi-deciduous forests were already very fragmented and depleted when these were vested with the Forest Department in 1950. Sal (Shorea *robusta*), the main tree species in these forests, was of poor quality, mostly small shoots of coppice origin. Initial transfer from private ownership was only on paper and the actual reservation of the transferred land under the Forest Act has not been fully complete today, even after 65 years have since lapsed. Out of the transferred area of 125,767 hectares at the time of vesting, barely 15% of the land is still under tree cover! There are several reasons for this. These include ownership conflicts and slow process of reservation, encroachment of forest land, overexploitation of tree resources mainly for fuel wood and poles and transfer of large chunks of land for non-forestry purposes. The quality of forest remains poor because of its inability to regenerate through seeds naturally as a result of frequent incidences of deliberate

setting of fires on forest floors by neighbouring communities to ensure growth of grass for their cattle in rainy season.

While there was serious depletion in the quality of forest cover in the Sundarban, a contiguous patch of 601,000 hectares of forest, where overexploitation of the trees associated with a 'top dying disease' and the subsequent removal of diseased Sundri trees constitute the main cause of this deteriorating situation. Three successive inventories of the tree resources in the Sundarban between 1959 and 1996 reveal a serious decrease in the number of Sundri and Gewa trees. However, a 2010 assessment by Integrated Protected Area Co-Management Project revealed a significant improvement in the occurrence of all major species, except Keora. This improvement in crop condition has resulted from an imposition of a total moratorium of extraction of timber, when the resilient ecosystem, under protection has been rehabilitating itself.

Over exploitation of some commercially important forest resources together with a large scale destruction of forests in the hill and low land forests have diminished the level of ecosystem services, which the forests in Bangladesh generated. Apart from the loss of biodiversity and production of timber, fuel wood and various NTFPs and raw materials for cottage industry, regulation of flow of water into the streams, haors and aquifers has been seriously affected resulting in frequent floods and deepening of the ground water table. With the loss of forests, the carbon footprint of the country has increased and will require some serious efforts on the part of the government to sequester the GHG gases released into the atmosphere as a result of deforestation and forest degradation. With the loss of forests, the country also lost many of the populations of pollinating insects and birds, leading to a loss in agricultural production. The loss of forests has already affected the livelihoods of millions of forest dependent people. Although the growth of the TOF sector has compensated the country for the loss of forest cover, to some extent, Bangladesh has no alternative but to regenerate her forests, whatever the cost.

Sundarban is the only, relatively, intact natural ecosystem in the country and is providing its full share of ecosystem services to the country in the form of livelihoods and protection against cyclones and storms.

Restoring the ecosystem services means the recovery of lost forest areas. This will require rehabilitation for forests, protection of watersheds, re-introduction of economically important species etc.

Issues and Challenges

1. Over-exploitation of resources of the hill and plain land forests and failure to restock the area through plantation establishment have resulted in serious reduction in area under tree cover. This has also very adversely affected the capacity of the forest to generate ecosystem services. The challenge will be to reforest these areas as early as possible. Current political and law and order situation in the Chittagong Hill Tracts is not favourable to undertaking such an exercise. An option, agreeable to all involved parties, will have to be devised to ensure reforestation of the Hill tract forests. The shortage of manpower and other needed resources are also major constraints to achieving this goal.

2. Large scale illicit removal for forest resources from the forests is a major cause of depletion of tree resources. While this could not have been possible without the active connivance of those assigned to protect the forests, the legal and other tools, resources and the protection machinery available are grossly inadequate for undertaking this task. In addition, the large scale felling of trees in the hill forest could not have been caused just by clearing forests for shifting cultivation. These have been possible only because somehow these timbers have reached the timber markets. This, together with issuance of jot permits for large quantity of timber in CHT and large scale removal of trees in other hill forests will have to be reviewed in details and the reasons for this situation will have to be identified and addressed permanently.
3. It may be mentioned here that very large scale timber removal has taken place from the area under the Chittagong and Rangamati Forest Circles, the area where most of the terrestrial forest of the country are located, over the last few decades under the coverage of jote permits. Between 2009-1o and 2014-15 fiscal years a total of more than one million cubic meters of timber have been removed from the forest of these two circles! As this practice has been continuing since the 1980s, it is not difficult to assess how many cubic meters of timber may have left the area during the period. It is well, known to all who are associated with forestry activities in the country, the privately owned forests do not have the kind of tree cover which will yield this kind of timber! While there are privately raised plantations in the area under the two circles, the trees are still small and are not of the size, which will be able to generate such large scale production on a sustainable basis! In fact the misuse of the jot permits issued for the extraction of timber from private holdings is popularly believed to be the principal reason for the devastation of hill forests, particularly in the CHT districts. The figure below clearly shows that the timber extraction in the name of jote permits is increasing every year, which would not be possible if this had been coming only from private holdings where extraction has been going on for decades now. The procedure for issuance of jote permits is also very flawed, particularly in the areas under the Rangamati circle.

Table 6-1: Year-wise details of timber removed under jote permits from different circles.

Forest Circle	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Chittagong	28410.33	32949.26	35295.06	43111.38	48738.19	53266.77	56432.39
Rangamati	71246.88	77870.93	107131.26	139171.60	115545.74	139898.01	138736.91
Dhaka	4834.87	5601.14	4332.03	3722.92	3261.57	2340.62	2089.60
Total	104492.08	116421.33	146758.35	186005.89	167545.50	195505.39	197258.90

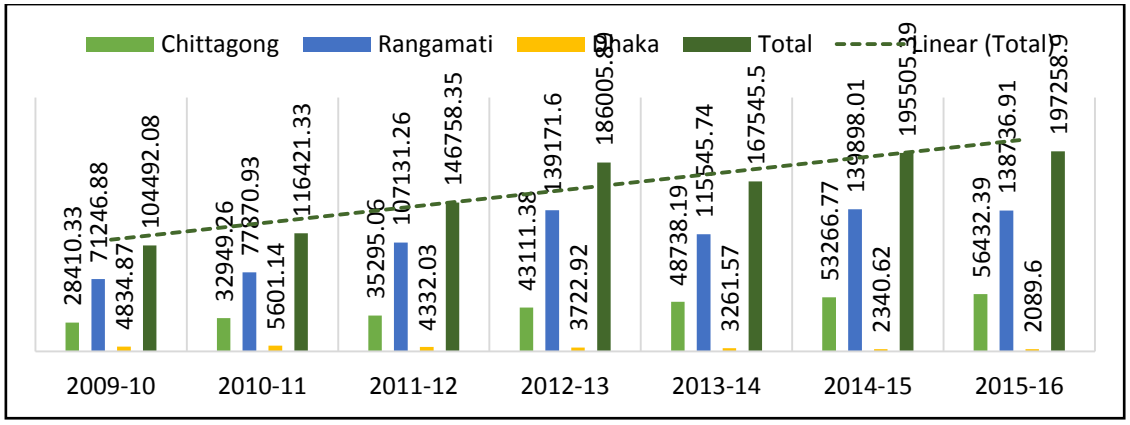


Figure 6-1: Trends in the production of logs through 'jote' permits (m^3).

4. With the drastic reduction of the rotation and fellow period (from 10-12 years to 2-3 years in the present time), the practice of slash and burning of large areas in CHT for traditional cultivation practice has contributed to a degree of destruction of forests in the Hill Tracts. This has been a practice followed by locals for ages and it will be an uphill task to convince them to refrain from this practice. To ensure conservation of hill forests, it is crucial to work with the local communities to explore possibilities of reducing the need to resort to shifting cultivation and tap into settled agriculture and other off-forest sources of livelihood.

5. The encroachment of forest land elsewhere for agriculture and other purposes is also a major concern. In addition to failure to protect the forest areas, the lack of forest boundary demarcations, court cases taking too long to resolve and Forest Department's inability to pursue these cases properly due of the lack of adequate and trained manpower capable of pursuing these cases also do not serve as deterrent. Delineation of boundaries with visible pillars and through recording of GPS coordinates better protection of the forests from encroachment and arrangements for ensuring quick disposal of forest cases by courts are the main challenges.

6. The management of forest has been relegated to just nominal overseeing of the forest estates. There is no management plan in operation in any of the forests and very few silvicultural operations to manipulate and improve the quality of the forest are currently in practice. Any systematic information on growth and yield is non-existent. In a situation where both trained manpower in adequate numbers and for more intensive management of forests together with generation of silvicultural and biometric information on the forests are among the main challenges.

7. In the absence of alternative fuels for cooking, communities living in areas close to forest depend almost entirely on fuel wood from forest to meet their needs. In addition to a large scale illicit felling, which have taken place over the years, the timber needs of these communities have also been met from the forests. Challenge here will be to decrease the demand placed on the forest by these communities and gradually encouraging them to explore alternative sources.

8. The depletion of tree resources have also its adverse bearing on the catchment areas of many rivers, particularly in the Eastern Bangladesh in the districts of

Chittagong, Cox's Bazar, Chittagong Hill Tracts, Habiganj, Moulvibazar and Sylhet districts. This has diminished the flow of water in the dry season, erosion in the hills and siltation of rivers and lakes including the Kaptai Lake. The challenge will be to identify, demarcate and reforest the critical catchment areas and bring these under full and effective permanent protection.

9. The loss of tree cover has adversely affected the large array of ecosystem services, which these forests provided. Apart from the loss of biodiversity and its habitats and production of timber, fuel wood and various NTFPs, flow of water into the streams, haors and aquifers has been seriously affected resulting in frequent floods and deepening of the ground water table. With the loss of forests, the carbon footprint of the country has increased. In order to restore the level of aforementioned services which the forest ecosystems provided, a major drive for the restoration of the forest will have to be undertaken.

10. The Forest Department seriously lacks resources needed for the protection and management of the forests. While the number and volume of sanctioned staff in the Department are insufficient, a significant number of these positions are already vacant and the situation will further worsen after a large scale retirement of BCS Cadre and Forest Ranger level officials in the immediate future. The size of such operational management units as Beats and Ranges are too large for the small number of officials deputed to manage and protect these units. The same 3 or 4 person units are responsible for both managing and protecting a large area of a Beat. There is also inadequacy in the field level training of staff members and financial and physical resources provided to them are also inadequate for the task they are supposed to undertake.

11. Financial resources available for the management are often inadequate for the involved tasks. Unless funded from an external source through a project, the GoB allocations for the management and protection of forest resources are small compared to the needs. Again these project funded endeavours also lose steam when a project ends and there are no funds available to continue the good work done under a project. In addition, the rehabilitation of the denuded forest is a major cost intensive task, which the FD will find difficult to mater even with external donor funding. So, additional sources of funding, including from the private sector, will have to be identified and accessed

12. Forest related cases, instituted in the courts of law, are tried under the Forest Act, 1927 (with subsequent amendments). These cases take an unreasonably long time to resolve, and often are not effective in functioning as a deterrent to committing forest crimes. The Forest Department also does not have the adequate manpower with adequate training in legal matters to be able to affectively follow up on the instituted cases.

13. The Forest Department does not have the required manpower and resources to carry out its stated mandate. Help from the other law enforcing agencies is inadequate, and not spontaneous because they (the other agencies) consider the protection of forest and its resources as solely the responsibility and task of the Forest Department. In addition, the current level of effort and scale in effectively involving

local communities in the protection of forests are limited. The protection of forests need to be seen as a responsibility of all citizen of the country.

14. In order to restore the capacity of the forests to generate an enhanced level of ecosystem services, forest rehabilitation programmes should include the conservation of watersheds, and other sensitive areas, and re-introduction of economically important species. As this has not been done consciously in the past, the challenge will be developing mechanism for achieving this objective.

6.2 Conserving the remaining Biodiversity richness and resources

The Context

For its small size and large population, Bangladesh is rich in both floral and faunal resources. However, the loss of habitats both in the forest areas and plain land, including seasonally inundated areas (*haors*) is a major cause of faunal biodiversity depletion. According to the country's 'red listing exercise' carried out by IUCN 2015, out of the 1619 species of fauna occurring in Bangladesh, 31 are regionally extinct, 56 are critically endangered, and 181 are endangered and another 243 species are either classified as vulnerable or near threatened,. The population of the Royal Bengal Tiger has shrunk to as low as 100 and it is confined only to the Sundarban. While the habitat and the food chain for tigers in the Sundarban has remains satisfactory, given the high value in the clandestine international market for tiger skins and body parts, the decrease in the size of tiger population can be attributed very largely to poaching. Given the resources and facilities available at the disposal of the poachers, Forest Department would require well trained additional manpower, modern tools and equipment and other amenities to control poaching.

With the loss of sal and hill forests, the biodiversity of these areas has taken a serious blow due to wildlife habitat loss. Nearly 15% of the forest area in the country is notified as Protected Area (PA) but most of these areas are not well protected due to the shortage of staff and resources. While PAs should be free from human interference, most PAs in Bangladesh have people living right inside or close to them and are exploiting the remaining forests in the PAs. PAs should be managed for the purpose for which they have been declared PAs and in addition, more areas should be brought under PAs so that size of wildlife habitats is increased and watershed and other sensitive areas are well protected.

While no recent assessment of total tree species is available, the floral species diversity in Bangladesh is rich with a reported more than 5,700 species of vascular plants (Khan, 1977) occurring in the hill and plain land forest alone. Over-exploitation of some choice species have made these very rare or non-existent in the hill forests. According to a new study, there are 528 species of vascular plants occur in the Sundarban (Reference: M. Sayedur Rahman et.al 2015) (reference: An annotated checklist of the vascular plants of Sundarban mangrove forests of Bangladesh J. Plant Taxon. 22(1): 17–41, 2015 (June) © 2015).

Issues and challenges

1. In order to restore a respectable tree cover in the forests of the country, a massive forest restoration programme will have to be undertaken. This will require manpower, capacity and resources, which the Forest department does not currently have at its command.

2. Protection of all wildlife habitats including those outside the forest areas will have to be strengthened. In addition, protection measures against poaching of flagship wildlife species would have to be ensured through appropriate actions.
3. The existing Protected Areas are not appropriately managed, and as there has been a major habitat loss, the area under Protected Areas will have to be enlarged keeping in view that they include representation of different types of wildlife habitats and also, conservation of watersheds and sensitive areas.
4. Adequate trained manpower, financial, logistic and other necessities, and capacity and legal backing for ensuring biodiversity conservation is seriously lacking in the Forest Department. These need immediate upgrading.
5. While recently concluded Red Listing of Species exercise has furnished detailed information of the status of various species of fauna, no such current knowledge is available on the flora of the country. In addition to the lack of knowledge about the status of different species there is no effort to conserve these in either in-situ or ex-situ conditions. BFD will need to take necessary measures to restore habitats for the conservation of all wildlife species
6. In addition to the loss of habitats, the remaining current habitats have become very fragmented, in many situations, interspersed with habitations and agricultural lands. Efforts need to be made to create corridors among these fragmented habitats and/or, at least to ensure safe passage of wildlife from one habitat to another.
7. The shortage of fodder for elephant and food for, particularly older tigers, result in their seeking food in neighbouring villages. These create wild-life human conflicts. In some cases, it involves wildlife coming in from across the borders from neighbouring countries. This issue together with the provisions for feed for wildlife needs to be addressed.
8. Special efforts need to be made to ensure protection and proliferation of vulnerable, threatened and endangered species. This will require special research into the lives and habitats of the species. In addition, assessment of the feasibility of re-introduction of some of the extinct species needs to be made. However, trained manpower, technical know-how, required facilities and other necessary resources are not currently available...

6.3 Rationalizing Plantation establishment and maintenance through scientific planning and management

The Context

While plantation programmes in the forests of the country were initiated about a hundred and fifty years ago, in the early days, small areas of plantations were established by clearing natural forest. These plantations were properly managed under rigorously designed and followed silvicultural regimes. The rest of the forests were worked under a selection system. The management system was subsequently changed in the 1930s and larger areas of forests were clear felled and replanted mostly with teak. Large areas of accessible forests were exploited during World War II to meet its demand of timber. As at that time, little fund was available for non-war activities, these high-graded forests were left to nature to recoup.

After 1947, when the supply of timber from the rest of India ceased, the forests came under large scale exploitation to meet the local and some demands from West Pakistan. At this stage more areas were clear felled to meet the demand, and replanted mainly with teak and some other choice species. Starting mid-1960s, establishment of plantation in the costal mudflats with mangrove species and coastal embankments with *Acacia arabica* (babul) were initiated as a measure of protection against sea borne storms. This practice gained steam in the 1970s and still continues to be a major component of plantation programme in the country. Plantations of rubber (*Hevea brasiliensis*) and agar (*Aquilaria malaccensis)* have also been established successfully both in the public and private sectors.

According to draft NBSAP (2016), the total area of plantations established since the liberation in 1971 is 474,372 hectares. These include plantations on forest and USF land, coastal *char* land, roadside and along railway tracks and plantations with rubber and Agar. Plantations currently in existence in the denuded hills and plain land forest land under the Forest Department are only 75,872 hectares. This figure also includes some plantations which were established before 1971. Likewise, around 200,000 hectares of mangrove plantations have been raised since, mostly after 1971. However, out of this, only 79,700 hectares are reported to be currently in existence.

According to available information, out of the total forest area of 722,716 of notified forest area in the hill forests, only 79,161 hectares are under an acceptable level of tree coverage. This area (comprising 79,161 hectares) includes both remnant natural forests in the Hills and plain land forests and the surviving plantations, which have so far been established. As mentioned earlier, out of around 200,000 hectares of mangrove plantation has been raised. However, out of this area, only around 79, 000 hectares are in existence today.

The above scenario clearly demonstrates a large scale failure to successfully establish and retain a major portion of the plantations. The reasons for these, in the cases of hill and plain land forests, include failure to establish and maintain plantations properly, inadequate care, and inability to protect plantations from damage, return of some coastal land to Revenue department and grazing and illicit removal of plants, even while these are young. In the case of the mangrove plantations of char land, the main causes of failure are human interference, grazing, trawling for fish, tidal waves during the monsoon and deposition of silt/sand in plantation areas.

Issues and challenges

1. The main issue is the failure to raise plantation properly, followed by maintenance in the early years, undertaking desired silvicultural operation and providing adequate protections. The main challenge will be to improve the overall planning and management of nurseries and planting activities making provisions for adequately trained sufficient manpower, know-how and resources, backed by regularly implemented silvicultural prescriptions and ensuring that the plantations are protected from all adversities. In addition, attracting resources from private sector and other non-conventional sources for the purpose of plantation establishment will be a major challenge.

2. Shortage of properly trained and adequate manpower, poor quality of planting stocks, and nominal supervision include some of the major constraints to plantation of quality outputs form the activities undertaken by the FD. The capacity of the entire Forest

Department needs to be enhanced greatly in terms of manpower, up to date knowledge about the current nursery and plantation establishment practices. Given the current situation of the acute shortage of manpower and other resources, in addition to implementing a plan for augmenting the staff strength, the Forest Department will have to implement innovative models involving communities, private sector and other entities to re-green the forests of the country.

3. The choices of species for plantation are often based on what has grown in the past and limited to a few species. Given the new challenges arising from climate change related issues, acute shortage of timber and other forestry products, these plantation establishment programmes need to be better planned ensuring that climate resilient species are planted, which have the potentials for meeting the future demand of timber in the country. Research and field trials need to be conducted to generate necessary information to help with making choices of species.
4. Due to the removal of the cover, exposure and desiccation of soil may have led to a change in the edaphic condition of the forests. Research and field trials are needed before undertaking large scale plantation programmes to assess the suitability of different species to this changed habitat condition. It may be necessary to under a two-step process where short rotation, leguminous trees are planted first to enrich the soil before undertaking plantation establishment with choice species.
5. Adequate Protection against various outside interferences, which are detrimental to the establishment of plantations needs to be strengthened. However, the current administrative structure, manpower strength and available resources are too inadequate for the task. Involvement of communities in protecting plantations is one valid option provided the Forest Department is ready to share benefits with such protectors.
6. Desired silvicultural operation to ensure good growth and vigour are often not carried out. This often causes failures of plantations or at least does not allow these to attain a satisfactory level of growth. Inadequate funding, lack of accountability and lack of know-how are among the main reason for this. Availability of required funds, appropriate silvicultural prescription and know-how to carry these operations are the main limiting factors.
7. A huge area of land suitable for plantation establishment is available in CHT. This area is too large for the forest Department to carry out plantation programmes single handed. In addition, given the current situation in CHT, the Forest Department is unable to undertake plantation establishment programmes in a significantly large area. Alternative models of plantation establishment with the involvement of important parties and stakeholders in CHT needs to formulated and implemented.
8. Rubber plantations have been successfully established by private entrepreneurs in CHT on land leased to them by the Government. In order to bring more areas under tree cover and increase the production of rubber in the country, more areas can be allotted to interested private parties. However, current size of less than 10 hectare plots are too small to be a viable unit. Larger sized plots will have to be allocated and in addition, necessary technical backstopping will have be provided.

9. The causes of large scale failures of the Forest Department to successfully establish plantations needs to be reviewed and the problems associated needs to be removed. There is also a case of clear lack of accountability for the chronic failures over the years, which needs to be addressed.
10. The involvement of communities, civil society organisations and credible NGOs in the cases where on, like some areas in the CHT and participatory forestry activities, a practice which will be a major departure from current practices needs to be prompted and facilitated.

6.4 Consolidating and expanding Participatory Forestry in TOF areas

The Context

Trees outside forest (TOF) are the main sources of timber and firewood consumed in the country. Although virtually no area is without trees in Bangladesh, nearly 1.7 million ha area outside the state forests are under tree cover, which is producing nearly seven million cubic meters of timber at present. The role of trees outside forests in meeting the timber and fuel wood and other tree related products are extremely significant. Given the current status of forests and the on-going moratorium imposed on nay extraction from state forests, the only source of available for meeting almost all demand is the trees outside forest, which will continue to play a very important role in meeting the demand of tree products in the country during the foreseeable future.

Because of the aforementioned reason, it is extremely important that all help is extended to tree husbandry practices outside forests. This will involve good advice and imparting of know-how on selection of right species, ensuring access to good quality planting stocks, caring for the planted trees and access to a market where the tree farmers get appropriate price for their products. In addition to fruit and timber trees, a significant market has evolved in the country for medicinal plants, rubber and aromatic plants like Agarwood.

Given the extreme importance of trees outside forest in Bangladesh, all out support needs to be extended to ensure that the areas under trees outside forests continue to grow. This will require massive support extended to ensure that this sector continues to flourish. Though BFD has significantly contributed to the establishment of the culture of tree growing in the past, through several projects, this sector is now being mostly sustained by the individual initiative supported by a very intense NGO activity. While people need technical advice and easy availability of quality planting material, they also need convenient marketing facilities to get competitive and remunerative prices. As there is a shortage of land available for planting trees, the productivity of existing planted area has to be improved in order to meet the demand of the future. For this, intensive counselling of the beneficiaries and supply of quality inputs shall be required. Given that individuals, communities and NGOs are leading the tree planting programmes, BFD should review and ease the provisions laid under the Transit Rules to ensure that a grower does not face any hassle while try to cut trees grown by them. In addition, Forest Department needs to take up the roles of capacity builder, facilitator and coordinator among the players, including NGOs to join this movement in order to improve coverage. As most of the funding projects are generally focused on coastal and mangrove areas, in view of their importance for mitigating climate change impacts, finding enough

resources to intensify efforts to boost the homestead and TOF sector is going to be a serious challenge for the country.

Issues and challenges

1. The Forest Department needs to play an important role in ensuring that the areas under tree outside forests continue to grow. However, it does not have the required manpower, resources and technical capacity to undertake this task. So far, Forest Department has been active in forestry extension work only when such activities were funded from external sources through projects. These activities fold as soon as funding is exhausted. Forest Department need to make forest extension services a component of its core programme, supported from its normal budget.
2. For ensuring proper support to participatory activities all over the country, the Forest Department needs to maintain it's operational in all Upazila with officials at an equivalent status as those of other relevant government agencies. This will require a large increase in qualified manpower and other resources. As externally funded projects are not the answer to sustainably providing supports, ways and means are to be evolved to fund these activities sustainably. The main challenges will include creating a well-trained and resourced structure within the Forest Department, spread all over the country, who have the capacity, resources and mentality to promote and support participatory forestry activities. BFD need to convert the social forestry programme into a major continuous campaign.
3. Large area outside government forests suitable for plantation establishment are available in CHT, where BFD is facing problems (concerning access, credibility, and political sensitivity) in undertaking activities. Formulating and implementing innovative models, involving parties acceptable to all concerned, for undertaking massive plantation programmes under participatory parties in the CHT.
4. While the Social Forestry Rules have established rights of collaborating participants, there are reported instances where all rights are not allowed to accrue; this undermines the spirit of participatory forestry. In addition, there are objections from some potential collaborators about the provisions of the Social forestry Rules. These need to be reviewed and made 'participant friendly'.
5. Use of fuel wood for cooking is still very prevalent in rural areas. This results in consumption of a significant portion of the wood produced making less wood available for other purposes. BFD need to have a good program encouraging the use of alternative fuels for cooking, so that tree products are available for more productive use.
6. Promote farming of cash crop like medicinal plants, rubber and agar wood so that the participants have recurring income. BFD may take an initiative for creating a market network, and disposal mechanism, which will ensure that the tree farmers get appropriate prices for timber and other forestry products
7. Credible NGOs, who are better at motivating communities, can play a major role in participatory forestry endeavours. Further brainstorming may be required to explore and design an appropriate modality through which NGOs can play a more significant

role in participatory forestry programmes especially in bridging the government agencies (including BFD) with local communities. BFD may develop some programs to support the NGOs towards tree farming.

6.5 Meeting the Growing Demand for wood and non-wood forest products

The Context

Due to the imposed moratorium and large scale destruction of tree resources in the forests of the country, the current needs of forestry products, except for some imports are entirely met from local sources of trees outside state forests. Although no reliable data on the subject is available, the best estimates indicate that the current consumption of timber in the country is nearly 8.57 million m^3 a year out of which approximately 1.57 million m^3 is imported timber. If the rate of consumption persists at the current level, the demand is likely to reach 9.77 and 10.62 million m^3 in 2030 and 2050, respectively. However, given a decline in the trend of using wood as cooking fuel, the demand for fuel wood is set to decline substantially.

Honey, bee wax, medicinal plants, golpata (*Nypa fruticans*), Murta (*Schumannianthus dichotomus*) and a variety of bamboos are the major NTFPs produced in the country. While demands for some of these have decreased, the demand for bamboo, medicinal plants and honey will continue to rise. Medicinal plants have a tremendous potential and is available in the forests and can be grown in agro-forestry and other participatory forestry endeavours. However, as the status of most medicinal species in the wild is unknown, any plans for their conservation or exploitation can be prepared only after proper assessment of their status in the wild.

Issues and challenges.

1. The demand for timber and industrial wood will continue to increase steadily. Given the limited land available for growing trees outside forests, it will not be possible for meeting the demand of tree products indefinitely from trees outside forests. An assessment needs to be done to find out ways and means to meet the future demands.
2. In the absence of a correct assessment of the actual demand and supply of timber in the country, it will not be easy to figure out and plan on how this demand can be met. All land suitable for afforestation/reforestation in private and public institutions should be brought under tree cover.
3. At present, the state forests in the entire country are under a moratorium and also, given the current degraded conditions of the forests, some provisions need to be made immediately for meeting the demands of tree products in the future from state owned forests. A section of the state forest land should be set aside to supply products to meet the relevant demand. Easing of moratorium in some forests or in parts of it and allow exploitation under strict supervision and control.
4. While, trees outside forests are the main sources of tree products in the country, there are no comprehensive plans for extending necessary back up support to ensure that the sector grows in the right direction. Creation of a market for trees

outside forests should be initiated so that the growers get proper prices for their products.

5. In the absence of any promotion, incentives and extension of needed facilities, there is very limited private sector involvement in tree farming. Some arrangements should be done to provide incentives for private sector involvement in tree farming activities.
6. Land suitable for plantation establishment are available in both, private and public sector, intuitions and enterprises. These is no efforts to bring these land under tree cover.
7. While NTFP has a significant demand in the country, it has not been developed into an organised sector. Steps need to be taken to institutionalise production of commercially viable NTFP after making correct identification and assessment of its market size.
8. Given that the demand of tree products cannot currently be met locally, there is hardly any significant consorted effort to incentivize, promote development and marketing of wood substitutes. Attempts need to be taken for promoting production of wood substitutes at a reasonable/ affordable price to meet partial demand of wood products.

6.6 Arresting the Loss of forest land

The Context

Loss of Forest Land is a major problem for the BFD. In there are two major reasons for the loss of forest land. These are encroachment and transfer of land to other organisations. BFD furnished a report of 68,538 hectares under encroachment. Large areas in Chitagong Hill Tracts are reported to be encroached and converted into human habitations and in all probability, because of the current law and order situation in the hills, it has not been possible to make an estimate of the loss of land.. So, it is very likely that this quoted figure is significantly lower than the actual area under encroachment. According to BFD records a total of 125,626 hectares of forest land have been transferred to other agencies with a major chunk transferred to defence and law enforcement agencies. Out of the transferred land 66% of the land has been transferred to institutions, which will use the land for non-forestry/non plantation purposes, while the area transferred to BFIDC is being used to raise rubber plantations.

6.6.1 Issues and Challenges

1. Absence of pillars delineating forest boundaries or any other means of readily recognising forest boundaries, make encroachment easier along the periphery of forest estates. In addition, detailed maps and descriptive records of land are also not available. Demarcation of forest boundaries, fixing of boundary pillars, recording of GPS coordinates of each pillars and maintenance and regular upgrading of records are among required to be taken immediately. However, given the current level of resource availability and absence of manpower required to undertake the task specialised task are major challenges.
2. Shortage of staff member and other needed facilities to carry out regular patrolling of forest land, weak protection of forest land, lax punitive measures and long-time taken

at the courts of law are among the main reasons for encroachment. Current field level staff strength at the Forest Beat level, together with the tools at their disposal is too inadequate for the protection of these tract. In addition, the long-time taken to complete the process of reservation of the Dhaka-Mymensingh sal forest area has led to the dispossession of a large chunk of forest in the region. Improvement of the protection measures, quick disposal of court cases and involvement of local communities are among the major challenges.

3. As the area under encroachment of forest areas is large, special measures need to initiated, if necessary through promulgation of new legislation for swift disposal of court cases and quick eviction of encroachers. However, the question is whether BFD or the MOEF can master the support needs to be able to pursue this option.
4. Forest cases lodged in the courts of law are often not properly formulated and documented. The witnesses often do not turn up or are unable to provide a credible account of the offense committed. The Case Conducting Officers who represent Forest Department court cases, are also not trained to handle court cases. No lawyer represents Forest Department! It is important that the staff who file cases are adequately trained and a lawyer is at hand to represent the Forest Department in courts.
5. Forest land have been transferred to other agencies on several occasions. Normally the land size are often large. Given the fact that the country has a small area under forest cover, a transfer of land for non-foes try purpose should immediately be discontinued. However, given the lack of clout of the MOEF in governmental hierarchy, will it be possible for the Ministry to ensure that no further transfer of land for any other purpose takes place?
6. The currently available legal tools are inadequate to handle encroachment and transfer of land for non-forestry purposes. The currently enforced legal tolls need to be reviewed and updated so that these can act as deterrents against encroachment and also makes even legal transfer of land for any non-forestry purposes

6.7 Combatting Climate Change impacts on forests

The Context

Bangladesh is among the most vulnerable countries in the world to the impacts of climate change. The changes in temperature regime, pattern of seasonal rainfall, intensity and duration of flood, sea level rise in the Bay of Bengal, and frequent extreme events in Bangladesh, offer a set of diverse and complex challenges to its forest ecosystems and forest dependent communities. Devastating cyclones, floods and change in both temperature and rainfall patterns are major issues facing the country. Owing to its diverse geographical extent, the challenges faced by different forest ecosystems will vary in extent and degree. Since the exposure and sensitivity of particular forest to different climatic stressors (i.e. temperature, rainfall, SLR, etc.) are different, the challenges and issues are to face in forests will be unique in terms of spatial and temporal dimension. For example, the south-eastern hill forests of Chittagong might have a different set and degree of challenges than the south-western mangroves in the Sundarban.

While climate change and its impacts are real, it is often difficult to assess timing, intensity of impact etc. until the last minutes. It is also extremely difficult to assess the magnitudes of the various impacts of climate change. As a result, the options of any direct measure to minimise these impacts is very limited. In addition, the causes of these climate change related impacts do not arise within the boundaries of countries like Bangladesh. Indirect measures, mostly mitigative and adaptive in nature, are required to be taken to ensure that the impacts of climate change related issues are minimised.

The forests, particularly the Sundarban, faces severe adverse impact of the impact climate change. Any significant rise in the sea level will permanently inundate a section of the forest making it unsuitable for mangrove trees, which cannot grow on stagnant water. The extent of such submersion will depend on the actual sea level rise. The plantations on the coastal mud flats will also face similar fate. While the rise in temperature may improve productivity of forest ecosystems, different species will be impacted differently, depending on their inherent capacity for tolerance and resilience to this disturbance and this may influence their flowering and fruiting. Similarly, erratic rainfall patterns together with the change in temperature regimes, may change the biological rhythms of different species. Sea level rise, together with an ever increasing withdrawal of fresh water from different rivers upstream will cause significant increase in salinity intrusion further upstream and overall increase in salinity concentration in river waters, which is expected to change habitat conditions resulting in making habitats unsuitable for some species, particularly, less tolerant Sundri and will lead to a change in species composition, with more salinity tolerant species like gewa being dominant.. The destruction of hill forests has resulted in the change of edaphic conditions on the ground with drier desiccated soils, where top soils have been eroded in many places. This condition may not be suitable for the original crop of trees the site supported. This situation has further been aggravated by the change in rainfall and temperature regimes, which are pronounced in some forested areas. The denudation of forests has resulted in big shrinkage in the size of the carbon sink, which however, has to an extent been compensated by the increase in area under trees outside forests.

Nath et al. (2014) studied earnings from homestead forest in Cox's Bazaar – Teknaf Peninsula area and found that due to repeated inundation of tidal surge, the mortality of betel nut tree is on the rise and homesteads are earning less compared to non-affected areas. Such situation is also very likely to change homestead vegetation composition in coastal areas, where tidal surge is regularly breaching and rainfall is not able to flush away salinity in the soil.

Issues and Challenges

1. While climate change is a stark reality and its impacts expected to be disastrous, forestry sector in Bangladesh has not been able to address the issue at the level of seriousness it warrants. It has very little capacity, understanding and know-how on how to handle this steadily emerging threat. In addition to the above, it also has not placed much of its resources, developed capacity, established institutions and has not yet deployed its own resources for the implementation of the relevant components of the Bangladesh Climate change Strategy and action Plan, 2009 and so far have been dependent on intermittent availability of funds from external

sources. This needs to change and addressing the impacts of climate change on forestry sector needs to become a top priority.

2. Very little is known about the various impacts of climate change on species, forests and ecosystem services in Bangladesh. At present, most of the assessments are based on certain assumptions. In order to gain a better understanding of these impacts, so that proper actions can be taken, to ensure protection against the impacts of climate change considerable research work is needed to be undertaken so that informed decisions can be taken in the matter. There is hardly any forest area available that is free of human disturbance.

3. As it is not possible to assess correctly the magnitudes of the impacts of climate change and combat them, necessary mitigative and adaptive measures need to be taken to minimise or if possible, neutralise impacts. This would require correct identification of possible impacts and this will require research, assessment and studies for which adequate capacities do not exist in the country. Necessary measures need to be taken in this respect. This will require trained manpower and resources which are not available at this time.

4. Preparedness to face impacts of climate change will include establishment of a physical barrier comprising of trees, in the form of a shelter belt all along the coast of the country with climate resilient species. This is a massive cost intensive task. Among the major issues are availability of land where coastal accretions are not available. The acquisition of private land is not going to be easy. There is no legal framework in place for providing legal coverage to the undertaking. In addition, the coastal plantations, which will form a part the shelter belt is not permanently vested with the Forest Department. Necessary resources, legal coverage and other tools need to be made available to ensure the success of the establishment of this important protective measure against sea borne storms.

5. Research on the possible impact of climate needs to be carried out to make available relevant information on possible impacts of climate change and how best these can be addressed. In addition, physical indicators need to be identified and monitored to evaluate the changes in forest ecosystem, biodiversity and other components of sensitive ecosystems. Capacity for carrying out this task is barely in existence.

6. As enhanced tree cover is important as a measure, it is important to bring as much available land as possible under tree cover. This will require binging all denuded forests together with all other available and suitable land under tree cover. This is a massive and challenging undertaking, which is beyond BFD's current capacity to handle. In addition, because of prevailing situation in CHT, innovative models acceptable to all parties will have to be implemented.

7. It is apparent from the past experience that protection of existing plantations is a serious problem. Poor plantation practices, inadequate protective measures, and lack of accountability are among the main causes of this problem. Imposition of accountability, In addition to appropriate legal tools, manpower, and logistic support will have to be available to ensure protection of plantations. Such a move is neither in

the Forest Department's plans nor does it have the manpower and resources to set it up.

8. As tree cover outside forest is larger than that in state forests, it is important to promote the practice of tree planting outside forests so that the area under tree cover outside forests continues to grow steadily. This will require establishment of extension facilities all over the country, encouraging NGOs and civil society organisations to join the programme and making rules and regulations covering the trees outside forests more tree grower friendly. This is both manpower and resource intensive neither of which is available with the Forest Department at the present time.
9. Deforestation and degradation of the ecosystem are causing loss of biodiversity, food insecurity and poverty. In practice, forest management is focused with forestry operations only. In fact an integrated approach towards landscape management that increase synergies among multiple land-use objectives is required. Better coordination among the players, their capacity building, adequate funding and above all the interests of all stakeholders is vital.
10. The capacity of the forest sector to respond to climate change is low in general. Practitioners and decision-makers are not always equipped with the information, tools, or have access to the information and resources, to enable the most effective responses to a changing climate. Therefore capacity building at the national and local level will be a key issue as well as challenges for the sector.
11. Resilience of forest ecosystems against impacts of climate change can be enhanced by minimisation of fragmentation of forests, and maintaining connectivity among ecosystems. But this is easier said than done. Given the priority on development, the balance between development and conservation will remain a challenge even in the face of climate change.
12. A large part of hill forests lies in the Chittagong Hill Tract region. For any forestry program to become effective, this area needs to be brought on board with support and participation from all stakeholders. Both afforestation and reforestation in CHT are very important to face the ensuing climate change adversities.
13. Funding opportunities on climate change research in relation to forestry sector are very limited. A concentrated effort is necessary to identify research priorities, funding mechanism and institutional coordination, to facilitate research and integrate knowledge into practices.
14. The forest dependent communities, need to be approached and motivated so that they distribute their demands on diverse services of the given ecosystem. This will enhance their climate resilience aspect.
15. To ensure an efficient and coherent policy approach to forests and climate change, policy-makers need to integrate climate change strategies and plans with national forest policy framework and other sectors that affect forests. Equally importantly, there is a need for institutional reforms to strengthen their structures, operations and capacities. At the current level of capacity, the Forest Department cannot support

regular forestry operations, let alone taking on the burden of combatting climate change.

6.8 Revitalizing Forestry institutions

The Context

All major forestry sector institutions are suffering from a whole variety of human resources related problems, which are hindering proper functioning of these institutions. This situation is making it impossible for these institutions to discharge their respective mandates properly. . These include shortage of manpower, inadequate capacity building, inadequate facilities, insufficient funds and a number of other malaises.

Nearly all the institutions in the forestry sector are reeling under huge number of vacancies in their ranks. While BFD has 24% of all posts vacant, vacancies in BFRI, BFIDC and BNH are 33% 44% and 30%, respectively. About half of the forest cadre service positions are vacant now. The situation is going to worsen further with the retirement of most of the senior staff by early 2017. When the current lot of senior officers retire, no one in the Department with the required seniority will be available for filling the two top tier positions. Despite the glaring shortage of officers, the no significant recruitment of forest officers has been done since 2003 although 7 have been recruited in 2016. The department proposes to recruit another 22 officers by December 2018, but recruitment of large batches creates serious problems in cadre management as they all need to be promoted together and they will also retire together. The situation is not any better at the technical and sub-ordinate levels, where large vacancies exit. Out of the 209 Forest Rangers on BFD's employment records, 187 will retire by 2020. There is no explanation for how this situation was allowed to be created and clearly the BFD and MOEF failed in their respective responsibilities to ensure that such a situation does not occur. There is no planning for regular inductions of officials in place and any sort of human resources planning or development is non-existent in BFD. In addition, many specialised positions like those in training institutions, GIS, management planning and other similar assignments are filled by officials who may not have the required skill sets and background. Ah-hoc recruitment of non-cadre officials against projects and their retention after the projects have created a huge problem. These officials, who did not undergo the required basic probationary trainings and sit for the departmental examinations, which are essential to be allowed to certain positions but in the absence of required qualified officials, they have been entrusted with important responsibilities as they have crossed the age limitation for passing these examinations. These and other out of turn recruitments have led to serious discontents and led to institution of court cases, which are interfering with normal HR functions of the Department. However, here is no alternative for the department but to use their services to man the field posts of DFOs when most of the existing cadre officers will be promoted on the retirement of 1986 batch soon. A batch of 7 cadre officials was selected by the Bangladesh Public Service Commission earlier this year while another 22 are proposed to be recruited by December 2018. This should ease the pressure at the lower level to some extent but there will be a serious crisis at the middle level if the non-cadre officers are not properly used and motivated. While there are a number of training and capacity building institutions under the Forest Department, these suffer from an acute shortage of staff, resources and facilities.

The single tier field level set up of the Forest Department at the Forest Division level, which is supposed to handle conservation, management, protection, and plantation establishment are inadequate for meeting the emerging and existing challenges. In addition a number of new entities have been under Social Forestry and Wildlife wings, which are not properly resourced and empowered.

The human resources situation at the Bangladesh Forest Research institute (BFRI) and Bangladesh National Herbarium (BNH) is no better. Almost a half of the positions of senior level research scientists and an overall 33% of the posts in the BFRI are vacant. The recruitment rules for BFRI have not been revised after 1985. Though it is a facility for forestry research to recruit forestry graduates, they are not eligible to apply for employment at BFRI. The scientist have very limited access to internet and also the library does not have current relevant journals and other research publications. There is very little opportunity for career progression or any other incentive to work at the BFRI. Likewise, at the BNH, a half of the senior positions and almost a third of all positions are lying vacant. These research entities are run like other government agencies with no local autonomy. Every recruitment initiative requires to be processed through a lengthy bureaucratic time consuming process. These institutes also lack necessary incentives to attract researchers.

The human resources situation at the Bangladesh Forest Industries Development Corporation (BFIDC) is even worse. Only 64.5% of management positions are currently filled. There is a major shortage of skilled manpower among, both management and filed levels. Many of the top decision making positions, including that of the Chairperson are filled up by officials on deputations, who necessarily do not have the required experience, skill, ownership and motivation needed to run such a commercial entity. BFIDC has not been a profitable organisation and will continue to remain so unless major overhaul and acquisition of manpower and other resources are made available.

A major weakness of all these institutions concerns the nearly complete lack human resources management including carrier planning especially timely recruitment, capacity building and human resources development. Management activities in these organisations are run on an ad-hoc basis. This has precipitated a situation where there is a huge shortage of manpower and capacity in all the forestry sector institutions which is greatly hampering the discharge of their mandates. In addition, in the case of BFD, the shortage of manpower is so acute and has so badly been compounded by administrative issues, litigations and other complexities that current staff strength is inadequate for overseeing the routine activities let alone the implementation of the ambitious recommendations this master plan revision exercise is going to make.

Issues and challenges

1. In the case of the Forest Department, there is no ‘quick fix’ solution available to fix the current mess. Meanwhile, short term resolution will partially lie in hiring some healthy retired officials on a contractual basis to fill some vacant positions, while undertaking a planned induction so that this situation can be resolved in the next 10 years.
2. To shorten the indication period, it is advisable to temporarily recruit only forestry and wildlife graduates, who will not require any academic training in forestry or wildlife

and thus, the time taken by them after selection will be at least a year and half shorter than those coming from other unrelated disciplines. This will require a revision of the Recruitment Rules.

3. Recruitment at the Forest Ranger's level was discontinued after 1995. This position is very crucial in the field administration of the Forest Department. Given the gradual modernisation of management practices, incumbents in Forest Ranger's level will require higher level on education and capabilities including computer literacy, which the current lot of Deputy Rangers, whose entry level required qualification was higher secondary, when they joined as Foresters, will find difficult to handle. The matter needs to be reviewed and fresh recruitment at Forest Ranger's level needs to be initiated for at least 50% of the Forest rangers positions. However, this can only be done after the current problems associated with the recruitments at various levels are resolved.

4. The current patterns of recruitment, particularly in the BFD does not follow any norms or plan. Human resources management including recruitments, trainings, capacity building etc. are all done on an ad-hoc and unplanned manner. In order to avoid recurrence of the current situation, Forest department needs to formulate and implement a long term recruitment plan for all levels of officials taking into consideration to the expected vacancies resulting from retirements and newly created positions. Again, the implementation of such a plan hinges upon the resolution of the matter associated with the human resources related problems and issues. Because of the change in recruitment policy, where basic forestry trainings may not be required to be imparted, the roles and responsibilities of different academic and training institutes under the Forest Department need to be reviewed and refocused. Current staffing arrangements at these institutions also need to be reviewed and given the dearth of qualified offices from the department, the possibility of recruitment of qualified teachers and instructors from outside should be explored. In the event this proposition is pursued, a clear career advancement plan for such recruits will have be put in place.

5. Proper induction training of all the newly recruited officers and subordinate/technical staff must be ensured. No official should be given charge of a substantive position before such trainings are completed. None should be given the charge of a Forest Division until and unless s/he successfully completes the departmental examinations. Main constraint in the short run will be the acute shortage of officials and the training of recruits if a large scale recruitment is carried out for tiding over the current crisis.

6. Various anomalies, discords and litigations created by out of turn recruitment are adversely affecting the smooth functioning of the BFD. These need to be resolved immediately through whatever means it takes. There are many possible options. However, as no solution can satisfy one and all, it is advisable to constitute a high powered commission to look in to the issues and make binding recommendations, which all involved parties will have to accept. This will require an intervention at the highest level in the government and in the absence of a possibility of a quick resolution, it is advisable that BFD and MOEF should pursue this path.

7. Current long bureaucratic procedure associated with recruitments in BFRI and BNH are making recruitments difficult. The Recruitment Rules of BFRI are grossly inadequate and out of present day reality. Career progression at the BFRI is very slow and there is very little or no incentive for researchers. The 30+ year old recruitment Rules of BFRI need to be urgently revised to bring it in line with the current time and needs.
8. Capacity building opportunities should be given to research scientists through providing opportunities for pursuing advanced level research programmes in Bangladesh and abroad. The opportunities for promotions at the two research institutions are limited. Often a scientist spends long years in the same positions and in the same pay scales. In the absence of any clear career progression, incentives in the form of higher time scales can be introduced under clearly spelled out conditions.
9. There are large vacancies at the BFIDC, particularly at the professional and technical levels. Most top positions are run by officials who are on deputation. This does not a desirable situation and needs to be seriously reviewed the current staff strengths of different enterprises and recommend rationalisation.

6.9 Strengthening Information management

The Context

The general state of information and data management situation within the Forest Department is dismal. . There is hardly any systematic cataloguing, management and storage of reports, publications, forest maps, official records including the land records of the Department. It is extremely difficult to locate any document/report, which the BFD has produced. The library is in a very poor condition and in the absence of any cataloguing it is extremely difficult to locate a document, even if it is available.

Very little information on the growth and yield functions of important individual species and forest stands have ever been generated. These information are fundamental to preparing forest management plans. Prescriptions in connection with the natural forest, plantations, protected areas, etc. cannot be formulated without the basic forestry data. These data are neither generated nor stored properly.

Besides these monitoring and evaluation of the forestry activities is almost absent. The GIS based approach is almost absent. To address some of the above issues, particularly those which could be digitised, a Resource Information Management System (RIMS) was set up at the Forest Department Headquarters late in 1980s. However, it has not undergone the desired level of development in terms of manpower, tools, facilities and funding to be able so far to take up the task, mostly from project funds. Thus when there is no project this unit sits idle.

Again so far RIMS facilities have not been established at the Circle or Forest Division levels. In addition, RIMS suffers from an acute shortage of trained manpower. In order to operate this system efficiently, personnel with specialised skills are needed. These people are not available in the Department and the salary, which the Department is able to pay is lesser than what they can get elsewhere and is unable to attract such skills. There is no clear opportunity for promotion and career progression such persons working in the RIMS unit. A

detailed review of the functioning of the RIMS unit is being undertaken under the Climate Resilient Participatory Afforestation and Reforestation Project (CRPAR) and it is expected that a detailed plan for investment will be chalked out under this exercise. However, that necessary resources and equipment and other necessities are made available, together with ensuring that RIMS will continue to function at the same level whether it is project funded or funded from the core Forest Department budget.

Issues and challenges

1. There is no depository for management information and safekeeping of all important documents like land deeds and maps of different forests. When needed it is extremely difficult to locate documents easily. Creation of a depository with branches down to Range level is extremely important. Modern technologies make it easy to store and retrieve such documents and maps. However, creating such a facility at the FD will not be easy because of the lack of know-how resources and inability of officials to handle nay modern systems.
2. Over the years, the Forest Department and BFRI have generated a lot of information in the form of working plans, project based documents and research publications. Forest Department, in particular has not been able to retain most of these documents. In many cases even a single copy of many documents is unavailable. The library maintained at the Forest Department Headquarters is totally disorganised, with no cataloguing and finding a specific document would require checking the titles of all the documents one by one. It is important to put this facility in order and also extend the library facility to all circle offices. FRI also needs to upgrade its library. Availability of funds, upgrading the libraries and capacity to manage modern libraries are seen as challenges.
3. There is no comprehensive mechanism in place for the RIMS unit to function properly. The funding for this unit must come from the core forestry budget on a regular basis, so that it can collect, collate all data including digitised forest maps, growing stock data, M&E data, etc.
4. A detailed TOR for the RIMS unit need to be tabled by the BFD. This unit should have adequate equipment and logistics to discharge its duties and responsibilities. This unit need to have line function personnel up-to Forest Division levels and be headed by a full time DCCF.
5. Many positions at RIMs are of specialised nature and incumbents for such positions need to have specialised background. However, the Forest service rules have no provision for paying remuneration at the market rates and there are no career advancement opportunities as well. It is difficult to provide such special salary scales for specialised positions. As these positions are essential for running the RIMS operation smoothly, inability to obtain services of such specialists will be a major obstacle for the operation of RIMS.

6.10 Effectively responding to International conventions, commitments and reporting requirements

The Context

Bangladesh is a signatory to almost all the international conventions and multilateral environmental agreements (MEAs). These agreements commit the country to certain actions which help to preserve the forests and environment. These MEAs have extensive reporting requirements which need intensive data collection and collation capacity. The agreements in which BFD has a direct or indirect reporting role include:

United Nations Framework Convention on Climate Change (UNFCCC): This convention requires "National Communication" (NC) every four years, Biennial Update Report (BUR) every two years.

- Nationally Appropriate Mitigation Actions (NAMA): Optional activity
- Intended Nationally Determined Contributions (INDC): Once every five years.
- National Adaptation Plan of Action (NAPA): Optional. Bangladesh has proposed coastal afforestation with community participation as a priority activity under NAPA in 2005.
- Convention on Biological Diversity (CBD): National Report, once every five years.
- National Biodiversity Strategy and Action Plan (NBSAP): Once
- Programme of Work on Protected Areas (POWPA): Once
- Ramsar Convention: National Report for every COP.
- United Nations Convention to Combat Desertification (UNCCD): National Report on every COP, and National Action Programme (NAP) once.
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES): Biennial Reports
- Forest Resources Assessment (FRA): Once every five years.
- United Nations Forum on Forests (UNFF): Voluntary
- Sustainable Development Goals (SDG): Schedule not yet established.

In view of the large number of international agreements, fulfilling the reporting requirements is quite an involved process. However, there are many generic elements, which are common to most reports and a common database on those elements can help make the process of reporting simpler. Although BFD is not the reporting authority for most of the MEAs, except CITES, it still has a significant role in preparing the reports.

6.11 Issues and challenges

1. The most important challenge regarding all the MEAs is that they require actions for which the country does not have enough financial and technical resources. Although all these MEAs require virtually the same programmes, aimed at conservation of forests, wildlife and biodiversity, which the country should in any case be pursuing,

the shortage of funds and technology are major challenges in conforming to the obligations.

2. There is no established set-up for collecting and collating necessary data for preparing the reports regarding all the MEAs. As every convention has a different reporting frequency and format, although data elements may be common to some extent, data has to be collected afresh every time a report has to be prepared. As the staff is generally overworked and the reports have to be prepared at short notice, quite often data collection is done hurriedly, without enough thought for quality. A common online database, at least on basic elements of the reports, which is updated by data generating agencies/offices as a matter of routine, in real time, can be a big help in preparing the reports.
3. Preparation of many of these reports requires technical knowledge and experience which sometimes is not available in the country. In such cases, either faulty reports are prepared or reports are just not submitted or are delayed. With the retirement of senior officers in near future, this problem is likely to be more aggravated. International agencies need to provide frequent training to the national staff in order to keep their skills and knowledge up to date. The country often has to engage international consultants to prepare national reports and finding funds for such engagements is often not easy.
4. A separate office with fulltime responsibility of handling MEA related obligations need to be set up and the staff trained in handling MEA related issues and obligations. Shortage of adequately trained manpower and resources are the main constraints.

6.12 Upgrading the Capacity of Forestry research institutions

The Context

Forestry research in Bangladesh is carried out by BFRI, BNH and three universities where forestry is taught. While the universities carry out mostly academic research, BFRI is the prime institution which is formally mandated to carry out need-based operational research to support BFD and other stakeholders. With some exceptions, however, the quality of products, him resources, infrastructure and operational funds at BFRI have generally remained less than satisfactory, almost since inception.

Research facilities and equipment at the BFRI have become outdated, and logistics and resources necessary for conducting research are grossly inadequate. In addition, library and internet support are very poor. The recruitment rules at BFRI are very outdated, and do not cater for the needs of the present time. . A large number of senior research positions at the BFRI are vacant and in the absence of a clear career advancement opportunity or any other incentives, BFRI is not seen as an attractive place to work. There is also very few opportunities for sponsorship for higher studies. The recruitment process is also very bureaucratic and time consuming As a result, only minimal research is going on in BFRI at present and very little of that is of practical use. Whatever technologies are developed, these cannot be transferred to users because of the absence of an extension division. Revitalising forestry research, in partnership with the universities and international research institutions, is a big challenge for the future. The research areas that need immediate attention include identification of climate resilient species and silvicultural practices, production, consumption

and demand in forest products, assessment of ecosystem goods and services, conservation of biodiversity and NTFPs, and so on.

6.13 Issues and challenges

1. Attracting and retaining high quality researchers at BFRI is one of the biggest challenges as the service conditions, career prospects and research facilities are far from satisfactory.
2. Research institutions all over the world prosper only if they are free from the usual bureaucratic control but still have enough government support to carry out their mandate. Creating an autonomous institution with adequate government support is a challenge for the immediate future.
3. As BFRI does not have any practicing foresters on its staff, its linkage with BFD which is the only official agency responsible for implementing forestry in the country, is rather poor. The bond between the two agencies needs to be strengthened.
4. BFRI and BNH get little annual research grant from the government. Whatever little research fund is provided, it is project based and takes years for approval. What is required is a regular research budget for these institutions, out of which projects can be sanctioned by a research advisory body, locally.
5. It is important for any research organisation to ensure that their staff have access to cutting edge and latest knowledge. BFRI and BNH do not have any regular staff development programmes. As a result, the quality of staff remains mediocre, at best. Finding resources and opportunities for faculty development programmes is an issue which needs immediate attention.
6. Very limited access to IT infrastructure and internet connectivity is a major hindrance for the research community.
7. The condition of the library in BFRI is extremely poor. Building a modern library and liking it with the global library network must be seriously pursued.
8. BFRI needs to be immediately restructured to focus its attention and limited resources on topical issues. Any structural changes need government approvals and creation or renaming of existing posts is a difficult task in the government. Simplifying such procedures in order to allow BFRI the flexibility to form and reform staff units as per the need of the hour or emerging challenges and opportunities, is another challenge for the sector.
9. A research institute is only as good as the clients it serves. Therefore, BFRI's clients need to become research conscious and must demand research support from BFRI as per their needs. Creating a live link between BFRI and its clients, i.e. BFD, forest industries, development NGOs, forestry farmers etc. remains a challenge.
10. BFRI and the various universities involved in forestry research need to coordinate their programmes in order to avoid duplications and gaps. This can be done either by providing research grants from a common pool or by having a coordinating committee which reviews all the research programmes and suggests realignments where necessary.

6.14 Making Monitoring and evaluation systems effective

The Context

In a situation where large scale loss of forests as well as failure of plantation establishment are rampant, a sound monitoring system for keeping track of the status of natural forests as well the conditions and status of existing plantation, both newly established and old ones is particularly topical and crucially important. While BFD has a Resource Information Management System (RIMS) unit for monitoring the changes in the forest cover in the country, and another dedicated office (ACCF Monitoring) to monitor the progress and performance of management activities, the capacities and resources, both manpower and financial, are grossly adequate for the tasks. Large scale loss of natural forests and plantation could possibly have been prevented had there been a robust monitoring system in place.

6.15 Issues and challenges

1. The monitoring unit and the Forest Management Plan Divisions, which undertake field level monitoring for the monitoring units are under staffed and under-resourced for the assignment they are mandated to carry out. In order to ensure satisfactory output, more resources, manpower trained in modern monitoring processes and
2. Necessary funds have to be assigned, which is difficult for the Forest Department to commit at this time.
3. The monitoring activity in the office of ACCF (Monitoring) predominantly paper (desk) based, and is limited to the recording of the survival and growth statistics of new plantations, through management planning divisions. There is hardly any way to produce any significant output when required as compiling these field reports into an intelligible national output is just impossible.
4. Most of RIMS resource assessment work is dependent on external resources, both financial as well as technical. Therefore, RIMS is not able to provide any regular status reports to the sector as donors decide when they are in a position to support new assessments.
5. RIMS does not have adequate staff to carry out any resource assessments on its own, and has to depend on private/public service providers for every significant assessment activity. Many efforts to bring in modern information management systems in BFD have gone waste due to lack of sustainability.
6. Lack of adequate ICT infrastructure and manpower is a major hurdle in building adequate monitoring capabilities. While the need to have a good resource and management information management system is widely appreciated, the cost of building a modern MIS/GIS network, across the enterprise needs substantial and sustained, commitment in resources over a long period of time. As most of the development work in the forestry sector is supported by short-term donor projects, creating an environment for such qualitative development has been difficult so far.
7. Although donors can provide capital for starting the process but unless GoB commits its own resources to sustain the activity over the long run, building up a modern

monitoring system shall be virtually impossible. And without a modern monitoring system, modern management is impossible.

8. The government systems traditionally depend on career civil servants who settle for a secure career over a life time. However, fast growing technologies, which are the backbone of modern enterprises need a proper hiring and firing policy to attract and encourage quality staff and to get rid of any deadwood. Without such an approach, RIMS shall remain a non-functional adjunct of the BFD. How to allow RIMS the independence and flexibility to become an efficient technology hub for BFD is going to be a huge challenge.
9. The quality and efficiency of a monitoring system depends on the quality of the data collection and generation systems. As the number of people involved in capturing, pooling and transmitting data for the monitoring network is huge, the quality of this data is always uneven and questionable. In any new M&E initiative, training and motivating the field staff to produce quality data at assigned frequencies shall be a huge challenge. It has to be a regular exercise due to continuous retirements, transfers and recruitment of new staff.

6.16 Addressing the acute shortage of funds and capacity for field operations

The Context

Bangladesh has limited resources, and there is extreme competition between various sectors for the limited funds available with the government. Most of the available funds go to the sectors considered more critical than forestry, such as health, education, and security. As a result, forestry sector has been surviving mostly on donor funding. As donor interest in the sector cannot be guaranteed, many programmes fail because of lack of financial sustainability. Forestry Master Plan 1995 received only 38% of the minimum level of required investment indicated in the FMP. If net present value (NPV) is considered, the allocation to BFD in 2015-16 was even lower than that in 2004-05. Although donor support, especially from climate change related sources such as Forest Investment Program (FIP) of the World Bank and Global Climate Fund (GCF) of the IPCCC, is likely to increase in future due to the recognition of Bangladesh as the most vulnerable country in the world, but, unless GoB increases allocations for the core functions of the BFD and other sectoral organisations, efficient utilisation of the donor support will continue to be difficult. Training and other capacity building activities are also linked to various donor supported projects, and the training institutions are often without work if there are no projects to support trainees.

In view of the chronic shortage of funds, BFD and other forestry sector institutions need to look elsewhere for funding. While BFD should evaluate the scope for public private partnership (PPP) model for afforestation/reforestation programmes and other possible sources of funding, BFRI and BNH, who will find it difficult to harness funds from non-traditional sources, need to seek the government's commitment for enhanced budget allocation, seek funds from external donors and also, can perhaps explore the corporate social responsibility (CSR) sector of the industry to garner some funds.

6.17 Issues and challenges

1. The most important challenge for the forestry sector is to convince GoB of the importance of forestry as a multidimensional tool, such as a shield against climate change impacts, creator of jobs and businesses, provider of critically required goods such as timber and fuel wood, protector of soil and watersheds and the backbone of the agricultural productivity by maintaining healthy populations of pollinating agents, and so on. For this a comprehensive assessment of all the ecosystem services provided by forests and trees is required and accounted for in national wealth accounting.
2. BFD needs to tone up its anti-corruption and accountability systems as an efficient use of available resources is as important as getting additional resources. As many systemic shortcomings, like lack of travel funds, lack of funds to deal with crimes and criminals, etc. induce and encourage corruption, lack of efficient monitoring, evaluation and supervision of field operations makes it difficult to detect corruption, which is a serious drain on scarce resources.
3. Although climate change mechanisms do promise a lot of funds, the country, especially the implementing agencies, lack the expertise to access these resources. The country has to depend on external consultants to prepare projects for tapping into climate change funds, which again depends on external assistance. Development of in-house capacity to develop projects for international funding remains a serious challenge for BFD and other agencies.
4. Although GCF, REDD+, CDM and other climate change related mechanisms promise significant results based returns to the country, achieving results in combating deforestation and forest degradation is the most serious challenge in this regard. Even if the country is able to develop the expertise and mechanisms such as forest assessment, baseline emissions, methods of MRV etc. achieving results on the ground shall be extremely difficult unless forest governance is strengthened and the livelihoods of the forest dependent communities are made sustainable. This is perhaps the biggest challenge to the forestry sector, as results will be possible only over the long term, in tandem with the socioeconomic development of the country.
5. Even if the GoB is able to tap all the traditional sources to support the forestry sector, the growing demand for afforestation and reforestation cannot be fully met. Therefore, the country will have to look at some novel options such as public private partnerships (PPP), institutional finance, corporate social responsibility (CSR) activity etc., to finance big ticket projects like reforesting the denuded hill forests. Although the country is already going ahead with the idea of using PPP to finance core sector projects, forestry is not one of those sectors. As forestry is not a high yielding business, particularly in money terms, developing profitable PPP investment projects will be a big challenge. Moreover, due to prevailing land tenure issues in most forest areas, and the direct stakes of local communities in state forests, in the form of grazing livestock, collecting fuel wood and small timber etc., PPP projects in forestry shall be more challenging than the usual infrastructure projects which are financed by PPP.

6. Apart from afforestation and reforestation, PPP models can also be explored in the area of processing and marketing of forest products such as NTFPs, medicinal plants, handicrafts etc. The biggest challenge for the sector shall be to start thinking out of the box, beyond the government coffers, for financing forestry projects. Development of the necessary systems, processes and projects will be a lesser task, though not very easy, once the mindset is ready.

The forestry sector institutions suffer from a very large number of limitations, issues and challenges, which cause serious impediments to the smooth functioning and discharge of respective duties. Some of the important issues and associated challenges are listed below:

7 Vision and objectives

The current National Forest Policy of Bangladesh was enunciated in 1994 in tandem with the coming into effect of the Forestry Master Plan. However, in view of the expiry of the old master plan, and additionally, in view of the emergence of new challenges such as climate change, rampant deforestation, rising demand for forestry products, the Forestry Master Plan and the National Forestry Policy are being revised

A draft National Forestry Policy document has been submitted to the government by BFD for its approval. The following discussion is based on the new draft as it is likely to come into effect shortly.

7.1 Vision of the National Forestry Policy

Vision for the forestry sector is provided in the draft National Forestry Policy 2016, in the form an "Aim of the Policy" as follows:

The main aim of the policy is to manage all existing forest, wildlife and other forestry resources, adhering to the principles of sustainable management and climate resilience; enrich degraded forest areas; and enhance land areas under forest/tree cover; to produce a wide array of goods and ecosystem services for the benefit of Bangladesh's present and future generations

As can be seen, this is an all-encompassing, ambitious goal for the forestry sector. The policy wants the forestry sector institutions to strive for managing all natural resources on the principles of sustainable forest management and climate resilience. It also aims to rebuild forestry sector institutions, restore degraded forests, enhance the tree cover both within as well as outside state forests and enhance protection against various effects of climate change. The aim to produce a "wide array of goods and ecosystem services" is a very comprehensive goal, which flows from the success in the foregoing aims, i.e. sustainable management and enhancement of tree cover and enrichment of forests.

As the forest resources of the country are in a much degraded condition and the rates of deforestation are very high, it will take a gigantic effort from the country to rehabilitate forest cover in its degraded forests and put forest management on a sustainable path. However, trees outside forests are flourishing and are meeting almost all the requirements of timber and fuel wood in the country. Restoration of degraded forests, in an environment created by strong tree growth outside state forests, will be the major aim of this plan.

7.2 Objectives of the National Forestry Policy

1. To arrest deforestation, and degradation of forest resources, enrich and extend areas under tree cover, through appropriate programmes and projects, to ensure that at least 20% of the country comes under tree cover by 2035, with at least a canopy density of 50%.
2. To ensure strict conservation, growth, increased ecosystem services and sustainable management of state forests. Introduce Forest Certification as a tool to improve forest management through market influence.

3. To significantly increase tree cover outside state forest, through appropriate mechanisms, in both public and private land including urban areas.
4. To encourage all types of participatory forestry activities and creation of off-forest job opportunities to reduce dependence of forest-dependent communities on forests.
5. To improve management and conservation practices of wildlife in Protected Areas and other habitats.
6. To incorporate measures to deal with climate change impacts on forest ecosystems.
7. To delineate and designate catchments of rivers, lakes and other wetlands as strict nature reserves.
8. To ensure enhanced groundwater recharge and perennial stream flow, extend the coverage under Protected Areas to 30% of all notified forest land.
9. To strengthen the research, education and capacity building in 'state of the art' forest ecosystem management practices to cope with existing and emerging challenges including impacts of climate change, population pressure, and urbanization.
10. To include valuation and payment for ecosystem services in planning and management of forest ecosystems.
11. To ensure effective implementation of the relevant programmes identified by the Bangladesh Climate Change Strategy and Action Plan, 2009.
12. To ensure that the policies prescribed herein, and the formulated programmes there under are properly implemented, and to establish a strong information management, monitoring and evaluation set up.
13. To facilitate the establishment of efficient wood and wood substitute-based industries, together with capacity building of rural communities and entrepreneurs, to enable them to setup wood and wood-based production facilities, small and large.
14. To ensure fulfilment of the country's commitments under different Multilateral Environmental Agreements like CITES, CBD, UNCED, and Ramsar etc.
15. To encourage community involvement, particularly, women's involvement in forestry activities, wherever feasible.
16. To make plans for converting the policies outlined herein into actions by developing appropriate plans backed by commensurate financial provisions and proper accountability.

The above objectives break up and elaborate the overall goal of the forestry sector into various specific, measurable, achievable, realistic and time-bound (SMART) elements. The SMART action areas that emerge out of this list are as follows:

- Increasing the tree cover to 20% of the geographical area with minimum canopy density of 50%. The current area under tree cover, including state forests, is approximately 2.49 million hectares. This means an additional coverage of approximately 460,000 ha to reach the 20% level. The policy also enjoins that the enhanced forest cover must have a minimum canopy density of 50% while the

existing forest cover estimate includes all areas above 10% canopy density. No estimate is available of the area below or above this minimum density level but the ongoing national forest inventory project can furnish this break up.

- The second concrete action area included in the objectives is to promote people's participation in forestry. Inclusion of women has been specially mentioned. The country has already made significant progress in social forestry, both in state forests and outside. The expansion of tree cover outside state forests is a clear indication of the interest and participation of the people in tree growing. Social forestry plantations on state forests, have been instrumental in bringing encroached forest lands under significant tree cover along with alleviation of poverty. NGOs have played a very significant role in spreading the umbrella of social forestry into all corners of the country. More than 16% of the beneficiaries of the social forestry have been women so far, which needs to be significantly improved. Innovative approaches, acceptable to all parties, will be employed to establish plantations in areas of the Chittagong Hill Tracts where current situation has made it difficult for the Forest department to work.
- The policy directs the forestry sector institutions to improve the conservation of wildlife. The area notified under the Wildlife (Conservation and Security) Act 2012 is to be enhanced to 30% from the existing 15% of the notified state forest area. However, as the only sizable, intact, forests, outside PAs, are now available in the Sundarbans, any expansion in the PA area shall have to be done only in the Sundarbans. As Sundarban is also a source of livelihoods for a large number of people, a suitable management and legal category shall have to be devised so that security of wildlife and biodiversity can be increased without sharpening the conflict with local people. The objective for the enhancement of PA area has been clubbed with enhancing groundwater recharge, which means the PAs shall be created in the hill forests.
- The policy emphasises on rebuilding of all forestry sector institutions which have been suffering from both acute shortage of manpower and technical/professional capacities will be a major focus. This will involve assessment of immediate and future capacity needs, formulation and implementation of a manpower recruitment plan followed by capacity building to make the recruits ready for different forestry assignments within different sector institutions.
- The policy mentions research and education as a priority area. Forestry research is being carried out by BFRI and while forestry education is being carried out by universities of Chittagong, Khulna and Sylhet, besides the BFD training institutes. Some universities, such as Jahangir Nagar, Dhaka etc. run programmes in wildlife biology as well. A Wildlife Centre has just been established, which has a mandate to provide training, conduct research and be a depository of all wildlife related information and documents. FMP will review the status and conditions of these institutions and will help them modernize their facilities, curricula and teachers' knowledge.
- The policy provides that goods and services (EGS) provided by the forest ecosystems of the country shall be evaluated and their valuation shall be given due

weightage in planning. So, far the value of EGS has not been assessed in the country but, going by the studies done in other countries, their valuation may be USD 5-10 billion per annum which is far higher than estimates of the current contribution of the forestry sector to the national GDP. The value will improve further with the improvement and spread of tree cover. Recognition of the EGS provided by forests and trees in the national accounting system will help in higher allocations for the sector which will result in a snowballing effect on EGS.

- The new policy lays a strong emphasis on dealing with the impacts of climate change and implementation of the Bangladesh Climate Change Strategy and Action Plan (BCCSAP). BCCSAP is an overarching policy of the government and all sectoral policies of the country need to internalize BCCSAP in developing future programmes. Forests have a major role in mitigating climate change and its impacts. Forestry aimed at dealing with climate change will develop strong synergies with this emerging field which is likely to have more access to global resources than any other sector in future. For progress in this field, the sectoral institutions shall have to develop a strong capacity to develop projects under REDD+, CDM, NAMA, NAPA, INDCs etc., which will not only help improve the forest and tree cover in the country, with all the co-benefits, it will also bring in additional resources for the sector. The emphasis on building strong monitoring and evaluation capacity is critical to make progress on the climate change front and the policy specifically gives directions in this regard.
- The policy objectives include development of forest products based industries. This will not only improve employment in the industrial units but it will also help develop the private sector forestry initiative. At present, nearly all of the timber and fuel wood in the country is being produced by the private sector. With increase in demand from the industry, the tree growing activity shall get a boost due to increased demand and competition. Furniture exports have recently started growing almost at the 104% per annum, bringing in much needed foreign exchange. Demand for SFM certified timber is going to grow with growing exports. If the country can meet the certification requirements of international organisations, as demanded by trade, it will give a tremendous boost to the rural economy.
- The new policy also commits the country to strengthen compliance with various international conventions and multilateral environmental agreements (MEAs). By mentioning MEAs, the policy indicates that the systems and procedures required for dealing with the monitoring and reporting requirements of these instruments be internalized by the sectoral institutions in order to improve compliance. Compliance with these conventions is in the country's own interest as it helps focus energy and resources on the critical areas on which reporting to MEAs is required.

Although the above objectives of the NFP are quite comprehensive, there is a very significant omission: the objectives make no mention of the need to conserve Sundarbans and the creation of a coastal shelter belt in order to deal with the impacts of climate change and as a source of livelihoods for thousands of people. As Sundarban is a multifaceted ecosystem, and the only one which is reasonably intact today, its preservation deserves a specific mention in the objectives of every important policy document of the country.

Similarly, creation of a coastal greenbelt is a recognized national priority for protecting the coastal communities against cyclones and storms, but there is no mention of the same in the objectives of the NFP. Despite this omission, the FMP shall emphasize the importance of the mangroves and coastal shelter belt to the country and shall propose appropriate programs for their conservation/development.

The strategies and programmes proposed under this FMP aim to achieve the vision and objectives of the National Forestry Policy. Most of the proposals have crosscutting effect as they contribute to the progress in pursuit of multiple objectives. For example, an afforestation programmes shall increase the tree cover, improve the delivery of EGS, provide raw materials for the industry, sequester carbon to mitigate climate change and will also create jobs in multiple locations.

The policy aims to follow the sustainable forest management (SFM) principles as enunciated by various international organisations, in pursuit of its objectives. The objectives listed above are in conformity with the international SFM criteria. They propose to enhance the forest area, improve its productive and protective functions, conserve biodiversity and promote participation of communities in boosting the forestry sector. The country will need to make a serious effort to come out of the current trends of growth outside but degradation inside forests.

On the basis of the above discussion, the objectives of the forestry sector are proposed as follows:

Long-term objectives of forestry master plan

1. To increase the forest and tree cover in the country to at least 20% of the geographical area with minimum canopy density of 50%.
2. To increase the extent of protected areas to 30% of the state forests.
3. To conserve the Sundarban
4. To manage the state forests in accordance with the principles of sustainable management and qualify for SFM certification.
5. To encourage the participation of the people, particularly women, in all aspects of forestry.
6. To enhance the resilience of forests against climate change.
7. To develop forest based industries.
8. To develop a competitive market for the produce of homestead and other private forests.
9. To reduce of the dependence of rural communities on state forests for fuel wood, timber and livestock grazing with the help of viable alternatives.
10. To encourage pubic private partnerships (PPP) in reforestation of degraded forests, to complement government efforts.
11. To develop the institutional capacities for achieving the long-term objectives of the forestry sector.

Short-term objectives of forestry master plan

1. To stop degradation of forests and deforestation, particularly in the remaining sal and hill forests.
2. To create a coastal greenbelt all along the coast as a buffer against sea storms and cyclones.
3. To restore the degraded hill forests through plantations as well as natural assisted regeneration.
4. To maximise production of timber and fuel wood through social forestry and agroforestry outside forests. To strengthen BFD and other forestry sector institutions to enable them to discharge their responsibilities successfully.

8 The Logic and Components of the Proposed Programmatic Interventions

On the basis of the aims and objectives of the forestry sector enshrined in the proposed forestry policy, and an analysis of the state of the forestry sector as done in the previous chapters, a menu of programmes and strategies for the future management of forests is proposed in this chapter.

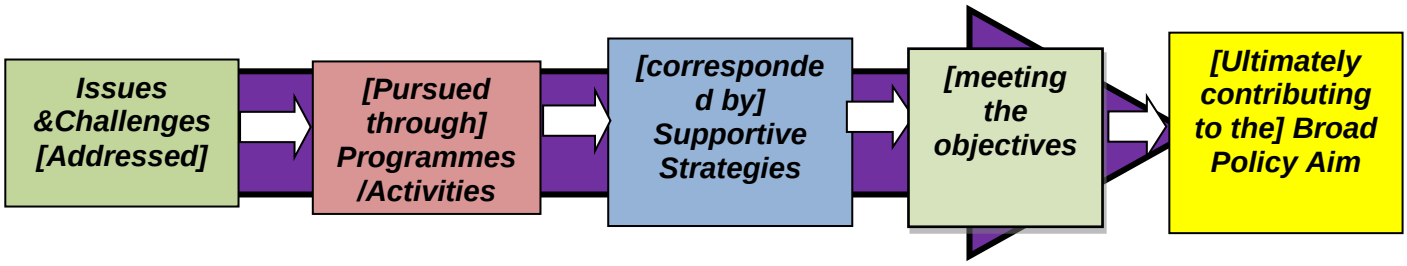
The proposals in this master plan follow an Action Logic model, and consist of such complementary elements as the broad Aim of the national policy, Objectives, Programmes, and Supportive Strategies.

In what follows, the discussion is organized into three sections. The first section outlines the Action Logic based on which the proposals are formulated and furnished. The second section then elaborates the proposed programmes in some details including a description of the context and rationale together with the suggested interventions and associated actions. In the third section, the proposed strategies are elucidated in the same vein.

8.1 Outlining the Action Logic

The attainment of the above policy Aim is contingent upon the production of three logic phases concerning the linkages between key challenges and issues of the sector through programmatic interventions to achievement of the national policy aim. The Programmes' Action Logic is as follows:

Figure 8-1: The (Proposed) Programme's Action Logic



Issues and Challenges: A Recapitulation

The major sector challenges and issues have already been identified and analysed in the preceding chapter (six). Suffice here to briefly recapitulate the key challenges as the basis for recommending the programmes, strategies, and associated activities:

The principal challenges that the FMP programmes and strategies need to address included the rampant deforestation and degradation of sal and hill forests, impacts of climate change on various types and forest dependent communities, growing demand for biomass, loss of biodiversity and wildlife, conservation of Sundarban and coastal afforestation, support required by the growing homestead forests and TOF, weak research, monitoring and evaluation systems, shifting cultivation and difficult law and order situation in CHT, forest encroachments, weak institutional capacity and governance and shortage of sustenance and operational funds. The nexus and functional linkages between these issues and challenges and the proposed strategies and programmes are further explained in Table ….

Table 8-1: The 'Challenge-Programme-Strategy' Nexus: A Summary

Strategies/Programs to meet challenges	Environmental and socio-economic challenges												
	Meeting the biomass demands.	Arresting loss of natural forests	Arresting loss of biodiversity, wildlife and ecosystem services	Conservation of mangroves and need for a coastal green belt	REDD+ and CDM strategy, and climate resilient REDD+ and CDM projects	Forest and community resilience enhancement	Weak institutions and governance	Shifting cultivation and forest encroachments and illicit felling	Shortage of Financial resources	Weak research, monitoring and evaluation systems	Support to ToF	Support to Forest industries	Strengthening compliance with MEAs
Reinstitution of Forest management plans													
Conservation of remaining natural sal, bamboo and hill and mangrove forests													
Reforestation of 3000000 ha degraded forests, mostly in hill areas.													

Strategies/Programs to meet challenges	Environmental and socio-economic challenges												
	Meeting the biomass demands.	Arresting loss of natural forests	Arresting loss of biodiversity, wildlife and ecosystem services	Conservation of mangroves and need for a coastal green belt	REDD+ and CDM strategy, and climate resilient REDD+ and CDM projects	Forest and community resilience enhancement	Weak institutions and governance	Shifting cultivation and forest encroachments and illicit felling	Shortage of Financial resources	Weak research, monitoring and evaluation systems	Support to ToF	Support to Forest industries	Strengthening compliance with MEAs
Afforestation outside state forests including USF (Extension support to private tree growers)													
Coastal afforestation including creation of a coastal shelterbelt													
Management of PAs and protection of wildlife													
NTFP plantations and related enterprises													
Climate Change related programmes (REDD+ and others)													
Forest based industries													
Reforming institutions and capacity building													
Forestry research and knowledge management													

Strategies/Programs to meet challenges	Environmental and socio-economic challenges												
	Meeting the biomass demands.	Arresting loss of natural forests	Arresting loss of biodiversity, wildlife and ecosystem services	Conservation of mangroves and need for a coastal green belt	REDD+ and CDM strategy, and climate resilient REDD+ and CDM projects	Forest and community resilience enhancement	Weak institutions and governance	Shifting cultivation and forest encroachments and illicit felling	Shortage of Financial resources	Weak research, monitoring and evaluation systems	Support to ToF	Support to Forest industries	Strengthening compliance with MEAs
Livelihood support to forest dependent communities													
Promotion of fuelwood saving devices and technologies													
Control on forest encroachments													
Maintenance and protection of existing plantations													
Public Private Partnerships in forestry													
Consolidating and expanding community participation													
Strengthening of monitoring, evaluation and database facilities													

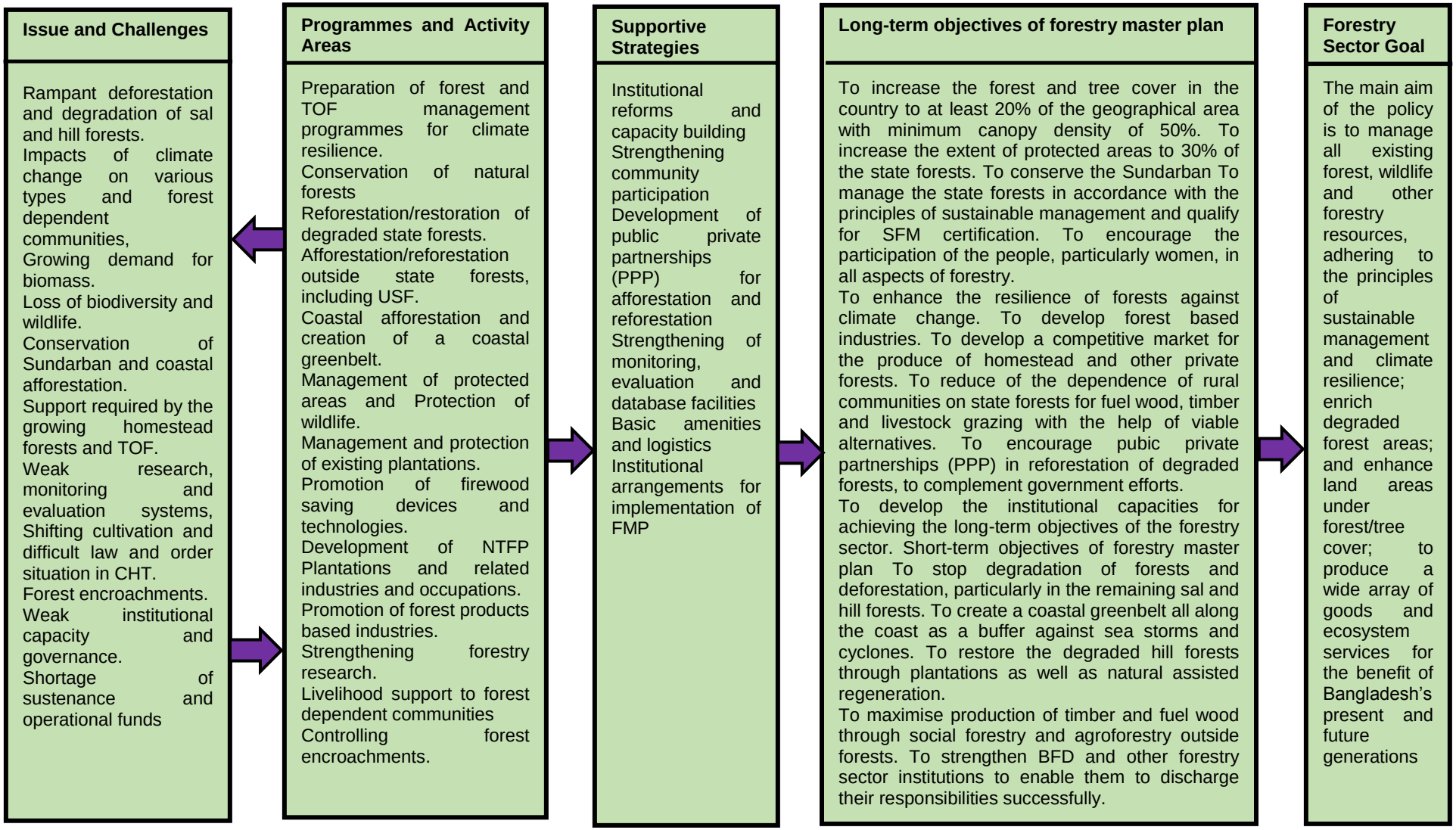
Strategies/Programs to meet challenges	Environmental and socio-economic challenges												
	Meeting the biomass demands.	Arresting loss of natural forests	Arresting loss of biodiversity, wildlife and ecosystem services	Conservation of mangroves and need for a coastal green belt	REDD+ and CDM strategy, and climate resilient REDD+ and CDM projects	Forest and community resilience enhancement	Weak institutions and governance	Shifting cultivation and forest encroachments and illicit felling	Shortage of Financial resources	Weak research, monitoring and evaluation systems	Support to ToF	Support to Forest industries	Strengthening compliance with MEAs
Ensuring basic amenities and logistic support													

Programmes and Strategies

For the purpose of this plan, *Programmes* are groups of concrete physical interventions that will happen on the ground and will affect forest expansion, composition, production or protection directly, while S*upportive Strategies* are the overarching systemic actions which, although are not directly related with forests, but are crucial for the success of the programmes aimed at improving the condition of the forests.

Most programmes will have a crosscutting relationship and intersectoral incursions with multiple objectives of the forestry sector, and will help deal with multiple challenges and the proposed strategies will improve the effectiveness of multiple programmes. For example, both afforestation and reforestation programmes will help meet the demand for forest products, enhance carbon sequestration, increase community resilience against climate change, help in watershed protection and so on. A list of various programmes and corresponding strategies proposed is presented in the Table below: Each of these programmes and supportive strategies is further discussed and rationalized in subsequent sections (2 and 3)

Table 8-2: A Menu of of the proposed programmes and corresponding strategies



As noted above, the proposed programmes, activities and strategies are anchored on a carefully crafted 'Action Logic'. The Logic consists of three interrelated elements: an analysis of the key Challenges, the broad Aim (of NFP/FMP), short and long term Objectives. ,

Long-term objectives of forestry master plan

- To increase the forest and tree cover in the country to at least 20% of the geographical area with minimum canopy density of 50%.
- To increase the extent of protected areas to 30% of the state forests.
- To conserve the Sundarban
- To manage the state forests in accordance with the principles of sustainable management and qualify for SFM certification.
- To encourage the participation of the people, particularly women, in all aspects of forestry.
- To enhance the resilience of forests against climate change.
- To develop forest based industries.
- To develop a competitive market for the produce of homestead and other private forests.
- To reduce of the dependence of rural communities on state forests for fuel wood, timber and livestock grazing with the help of viable alternatives.
- To encourage pubic private partnerships (PPP) in reforestation of degraded forests, to complement government efforts.
- To develop the institutional capacities for achieving the long-term objectives of the forestry sector.

Short-term objectives of forestry master plan

- To stop degradation of forests and deforestation, particularly in the remaining sal and hill forests.
- To create a coastal greenbelt all along the coast as a buffer against sea storms and cyclones.
- To restore the degraded hill forests through plantations as well as natural assisted regeneration.
- To maximise production of timber and fuel wood through social forestry and agroforestry outside forests. To strengthen BFD and other forestry sector institutions to enable them to discharge their responsibilities successfully.

Broad Aim:

The main aim of the policy is to manage all existing forest, wildlife and other forestry resources, adhering to the principles of sustainable management and climate resilience; enrich degraded forest areas; and enhance land areas under forest/tree cover; to produce a wide array of goods and ecosystem services for the benefit of Bangladesh's present and future generations

In what follows, the above menu of programmes and strategies is elaborated:

8.2 The Proposed Programme Portfolio

8.2.1 Preparation of forest and trees outside forests (TOF) management plans for climate resilience

The Context and Rationale

Until some years back, forests in Bangladesh had traditionally been managed through implementation of 'working plan' prescriptions, typically formulated for a period of ten years at a time. These prescriptions were formulated with a view to achieving a set of pre-agreed management objectives. However, the system of forest working plans was discontinued some years ago and all desired forestry interventions are now included in development project documents and implemented through these projects, depending upon the availability of funds.

However, the management scenario has become more complex with increased pressure on forest by an increasing population and after the impact of climate change on forests became a reality. In view of the vulnerability of forests to climate change impacts and associated hazards, it is all the more important that the vulnerability of each forest unit is assessed in detail including consultation with local stakeholders and suitable adaptation and mitigation plans are prepared. A broad vulnerability assessment of various forest ecosystems, based on NFA 2005-2007 forest maps, has been undertaken during the FMP preparation. However, this assessment needs to be updated and refined at the forest division level and necessary adaptation measures such as reforestation, afforestation and rehabilitation of partially degraded forests, subsidiary silvicultural operations (SSOs), soil and water conservation measures, enrichment planting, livelihoods planning for forest dependent communities etc. need to be taken to ensure that forestry practices are climate resilient.

Moreover, with the recognition of TOF as a significant factor in sequestering carbon and being the main source of various ecosystem goods and services, it is necessary to review and analyse the status of this sub-sector periodically and plan the interventions required to give it a desirable direction and impetus. This may involve the promotion of certain species, silvicultural practices, use of innovative approaches to plantation establishment, improvement of marketing conditions, induction of new techniques and inputs, review and revision of relevant legal tools, a change in focus of awareness campaigns, etc.

The Proposition and Actions

It is, therefore, proposed to reinstitute the practice of using forest management plans, incorporating interventions for addressing emerging challenges in addition to routine silvicultural prescriptions. All forest divisions shall be managed under a 10-year management plans.

As TOF have become the main source of forestry products, given the size of the area under tree cover and being an important carbon sink, it is very important to ensure that this sector continues to grow. This can only be done through the implementation of properly formulated management plans backed by required tools and resources.

8.2.2 Conservation of the remaining natural forests

The Context and Rationale

Out of the total area of approximately 1.43 million ha under the control of the BFD, only about 700,000 ha is natural forest. While nearly 600385 ha of the natural forest lies in the Sundarbans (including rivers and water bodies), 79161 ha lies in the hills, mostly in the CHT districts. Sal zone has only 17495 ha of remaining natural forest while the rest has been either encroached or converted into social forestry plantations. It is pertinent to mention here that while at one time large tracts of natural forest existed in the greater Chittagong and Sylhet regions, only a mare 5,075 ha of natural forests remain today. In the case of Chittagong Hill Tracts, the current area under natural forest is a very small percentage of the forest that existed say, 50 years ago. This reflects the gravity of the current situation.

Except the Sundarban, most of these areas are too small and fragmented to be ecologically significant now from a larger landscape perspective. However, they are of extreme symbolic and heritage value as, if they are lost, Bangladesh will lose an important part of its natural identity forever. The Sundarban, on the other hand, is of extreme economic, ecological and environmental value for the country.

The Proposition and Actions

In this backdrop, the remaining natural forests deserve special attention, and must be protected with utmost seriousness. Accordingly, the following actions are proposed under this programme:

- Demarcation and mapping of forest boundaries, fixing of boundary pillars, recording of GPS coordinates of forest boundaries and erection of fences, where feasible;
- Improvement of field infrastructure, such as field offices, staff residences, transport facilities etc.;
- Strengthening of institutional support (funds, lawyers, strong laws etc.) in investigation, filing of criminal complaints and prosecution of offences;
- Capacity building for BFD field personnel to enhance their skills and competence for effective protection of forests and the conservation of biodiversity;
- Establishment of a properly staffed and equipped information management, monitoring and evaluation unit for information generation and assessment of the national forest programme under the Forest Department. Strengthening of protection measures for the

existing natural forests through appropriate intervention and where necessary, with help and support of local communities, other stakeholders in forest protection and law enforcement agencies;

- Conduct an early review of legal provisions for empowering BFD staff to take effective action against forest offenders;
- Extension, enhancement and strengthening of information, education and communication (IEC) campaigns all over the country;
- Enhancement and strengthening of forest fire management measures at filed levels through provision of trained manpower, required tools and equipment;
- Intensification of enrichment planting and assisted natural regeneration (ANR) activities in degraded and depleted forest areas;
- Undertaking of extensive subsidiary silvicultural operations (SSO), where necessary, to rehabilitate depleted forests;
- Making ecotourism one of the principal foci of use of the remaining natural forests;
- No more alienation of forest land to be allowed, except in the matters of extreme national interest.
- Protection and management of the Sundarban, a global heritage and largest forest formation of its kind, through necessary legal and programme interventions.
- Formulation and implementation of ecosystem restoration and conservation focused management plans for all natural forests.
- Implementing Forest Certification as a tool to improve forest protection and management through market influence.
- Strict regulation and control of river navigational routes within the Sundarban, other than the recognised route to the Mongla Port, to ensure that there is no oil spills and pollution from the movements of oil tankers and cargo boats within the forest.

8.2.3 Reforestation/restoration of the degraded state forests

The Context and Rationale

The objective of this programme is to reforest degraded forests, mostly in the hilly region. A total of about 300,000 hectares, 1,179 in sal forest area, 129,811 ha in hill forests outside of Chittagong Hill Tracts and another 152,905 ha in the Chittagong Hill Tracts have been identified for the purpose. These lands are shown as “shrubs and grass” in the satellite based maps (FIGNSP 2013) of the hill/sal forests. These are areas where deep forests once existed and which have now become completely denuded because of large scale extraction, both legal and illegal, and the failure in many cases to successfully establish plantations as a replacement for natural forests, leaving large tracts of degraded, denuded, land.

It is important from environmental, social and economic points of views to bring these areas under tree cover. This activity will restore tree cover in the aforementioned area along with the creation of a larger carbon sink and a larger source of ecosystem goods and services

The Proposition and Actions

Site and situation specific strategies shall be used for these plantations, namely,

- A correct assessment of the actual status of natural forests and plantations including areas needing rehabilitation will be made using the information generated by the on-going forestry survey and additional survey/assessment where necessary and formulation and implementation of necessary rehabilitation/management intervention.
- Retention of all existing forests through appropriate measures for their enrichment, conservation and protection
- Review of existing plantation practices and techniques in the context of the low survival of past plantations and necessary steps to improve survival through better planning, implementation of the plan, monitoring, protection, upgrading of nursery and plantation techniques, better accountability, and training of staff and improved protection of plantation sites etc. and implementation of the recommendation of the review.
- Planting of sal seedlings in the long rotation sal forest and carrying out necessary silvicultural operations and providing necessary protection to ensure re-introduction of robust trees of the species. Establishment of short rotation plantations in the sal forests with community involvement under a participatory arrangement avoiding establishment of plantations with a single species, wherever possible.
- Formulation and implementation of a strategy for the rehabilitation and enrichment of all degraded forest ecosystems, catchments and other fragile and ecologically sensitive areas located within forests. Declaration of ecologically sensitive, catchments and fragile areas as Protected Areas.
- Making forest areas climate resilient and creating of larger carbon sinks in all natural forests and plantations through the establishment of plantation and assisted regeneration programmes over large areas of barren or degraded forests, coastal accretions and other available land using appropriate site and situation specific models with community involvement wherever possible.
- Formulation and implementation of a phased out rehabilitation plan on the basis of a rapid survey of the candidate areas, based on FIGNSP maps, or any other updated maps, to determine the extent of areas with existing coppice/root stock, regeneration or advance growth and those without any existing young stock..
- Investigation of the feasibility of reduction of dependence on the monoculture of Acacia auriculiformis for buffer zone and participatory forest plantations by assessing the suitability of other fast growing species in for these plantations.

- Review conducted on the decision on the ban of eucalyptus for plantations based on a report based on the latest scientific information.
- Establishment of seed orchards to ensure the supply of good quality seen for plantation establishment.
- Identification, demarcation and restoration of critical watershed areas in the hill forests and declaration of these as Protected Areas.
- Establishment of plantation and their protection using alternative approaches and models involving local communities and administration, tribal Chiefs and other leadership and credible NGOs in areas in CHT where Forest Department is currently facing difficulties.
- Institution of joint forest management (JFM) approach to the restoration of degraded hill forests in situation, where it is feasible, with the involvement of local communities and suitable NGOs, under clearly defined roles, responsibilities and benefit sharing.
- Promotion of public private partnerships (PPP) with individuals or corporate groups for the establishment and management of plantations in areas where the Forest Department can not undertake the task because of shortage of fund availability.
- Setting up of an appropriate body in the public sector for spearheading and fast tracking the development of PPP projects, and for channelizing institutional finance for the reforestation of degraded state forests.
- Initiatives for link thee operations listed above with the REDD+, CDM, INDCs, NAMAs and NAPAs strategy of the country, at an early stage, in order to secure climate finance as well as to help fulfil the country's commitments under INDCs.

8.2.4 Afforestation/reforestation outside state forests including on USF

The Context and Rationale

Bangladesh is rich in trees outside forests (TOF). Nearly all the timber and fuel wood requirements of the country is now met from the TOF, mainly the homestead plantations. While the tree resources in the state forests have diminished over the years, the number of trees and the area under trees has very significantly increased. While the government recognised the significance of trees outside forest and made all efforts to support such endeavours, its initiatives, which were mostly financed through externally funded projects, were marred by problems arising from discontinuity of project funding. NGOs have played a major role in promoting TOF activities and should be given due credit for the achievement. While the state forests have lost extensive tree cover and productivity, TOF has gained momentum as a campaign and today, it is the main source of supply of forest products in the country.

Under all circumstances, for the purpose of ecological security of the country, establishing a source of income for individuals, supply of wood and other related products and mitigation of climate change, TOF shall be developed further to meet the growing needs of the country for forest products.

The Proposition and Actions

Following steps shall be taken to promote ToF:

- Assess the feasibility of the creation of an independent Department of Social Forestry or Forestry Extension with a clear mandate to develop the ToF sector through intensive extension support, and until this becomes a reality, a wing within the BFD with clearly defined authority and resources, will support TOF programmes.
- Creation of a BCS cadre position in each upazila along with adequately trained staff, necessary funds and other logistic and office support to strengthen extension services and technical advice available all over the country will develop a strong forestry extension programme with support from development NGOs and Department of Agricultural Extension (DAE);
- Conduct an assessment of the state of ToF at the earliest, to document the full dynamics of issues faced by rural tree growers, which will include the quantification of forest produces that they produce and the kind of supports that they will require to harvest the full potentials of the sector. Repeat similar assessment every five years in order to determine the trends in species choice, demand and supply of wood products, any impediment to the growth of the ToF.
- Bring all fallow land in tea gardens, fruit orchards and other barren land suitable for tree plantation under tree cover.
- Promotion of cultivation of medicinal and aromatic plants along with other recurring income generating plants in government and private lands.
- Development and implementation of situation specific agroforestry models for hill, coastal and plain land forest areas.
- Formulation and conducting through BFRI a strong research programme on TOF, particularly regarding suitable species for different plantation programmes including situation specific climate resilient species, seed source growth rates of various species in different combinations, economic and silvicultural rotation periods, timber quality etc. and a strong forestry extension programme to disseminate their findings in partnership with BFD, NGOs and DAE etc.
- Development of Appropriate agroforestry models for the promotion of agro-forestry practices outside encroached forest land, undertaken by BFRI in collaboration with other relevant institutions and universities.
- Initiation of a forest nursery certification programme to encourage best practices in seed production and supply by BFRI, in partnership with BFD and other relevant agencies and private sector to the producers and suppliers of quality seeds of important timber species used in homesteads and other private or community plantations.
- Development of a network of timber markets across the country to facilitate producer-buyer interaction for the benefit of both parties.

- Review of the forestry related laws and regulations, particularly Forest Transit Rules, to liberalise the regulations and remove hindrances in the way of developing TOF as a mainstream economic activity and the . Social Forestry Rules to be made more grower friendly if necessary.
- The proportion of tree farming fund (TFF) in social forestry plantations shall be enhanced by incorporating government share in order to increase momentum of the plantation programmes.
- Involvement of NGOs, such as BRAC, Proshika, RDRS, Caritas, etc. and the Grameen Bank in promoting and facilitating further development of the TOF programmes.
- In view of the role of CHT as a major watershed in the country, soil and water conservation measures shall be taken up in the USF as a part of the watershed management initiatives.

8.2.5 Coastal afforestation including the creation of a greenbelt (shelterbelt)

The Context and Rationale

Coasts are the most vulnerable areas of the country in the context of the impacts of climate change impacts and a belt of mangrove and non-mangrove tree species can be extremely helpful in controlling damage to life and property during cyclones and storms. The main purpose of the coastal plantations on the newly accreted land has been to help in stabilisation of such land and also to establish a barrier against the onslaught of frequent sea borne storms. Plantations were also established on coastal embankments as a second tier of protection against sea borne storms. So far more than 200,000 ha of plantations have been established. However, at present, only 61,574 ha of mature plantations have been found to be in existence. The rest have either been eroded by the sea, returned to Revenue Department or destroyed under biotic pressure. As these coastal plantations do not extend over the entire coastline because of non-availability of suitable land and also, as the lands under such plantations are relinquished back to the Revenue Department after 20 years under plantations, Forest Department has embarked upon the creation of a permanent 'green belt' all along the entire coast of the country with the sole purpose of creating a barrier for protection of coastal habitations against sea borne storms. Depending on the suitability of available land, the greenbelt will comprise plantations of both mangrove and non-mangrove species. The area currently available for this purpose is estimated to be approximately 98370 ha out of which 66273 ha is mudflat suitable for mangrove plantation while 27002 ha is estimated to be bare land and remaining 5095 ha is sandy area. However, during the implementation of the green belt, where a continuous belt of trees is envisaged, some areas will have to be acquired for creating a continuous shelterbelt, where coastal accretions are not available.

The Proposition and Actions

Main features of the coastal afforestation and the greenbelt initiative shall be as follows:

- Continue to establish coastal plantations with climate resilient mangrove and non-mangrove species with good carbon sequestering abilities and create a multi-layered

multispecies tree formation which also allows accrual of some benefits to the neighbouring communities while continuing to perform their protective role.

- Create a permanent 'green belt' with mangrove and non-mangrove species on newly accreted land as well as acquired land where accreted land is not available.
- Ensure protection of these plantations with support and cooperation from the local communities and also, through the creation of Plantation Protection Units, whose sole function will be to ensure protection of the coastal plantations including green belts.
- Review the current rules governing the coastal plantations and make appropriate changes to make them more effective. In addition, as the shelter belt is a permanent protective feature, current policy on 20-year vesting of forest with the forest Department will have to be revised to ensure that there is a provision in the policy for a permanent retention of land under the green belt by the Forest department.
- The layout and the species to be planted shall be in accordance with the mapping results of the CEGIS study (2015)[23] for the coastal greenbelt.

8.2.6 Management of protected areas and protection of wildlife

The Context and Rationale

Bangladesh has 51 protected areas, three dolphin sanctuaries and a marine protected area, covering nearly 286,000 ha of forest land spread over all regions of the country. Most of the protected area lies in the Sundarbans (172239 ha), while nearly 55000 ha lies in the hills and the rest 19000 ha lies in the sal zone.

The Proposition and actions

Following steps shall be taken to conserve wildlife in the country:

- Recently created Wildlife crime control unit shall be fully strengthened and supported to curb wildlife crime.
- The Wildlife Centre constructed near the Bhawal National Park, shall be made fully functional at the earliest to initiate wildlife research and training programmes.
- Protected areas and wildlife shall be managed in accordance with the "Wildlife Master Plan for Bangladesh", prepared in 2015, which is awaiting approval of the Government. Salient programs given in the wildlife master plan are as follows:
    - ✓ Species management includes proposals for the conservation of tigers, elephants and all other important species and groups, including reintroduction of locally extinct species such as buffalo, swamp deer, marsh crocodile etc.
    - ✓ Habitat management proposals including wetlands management.

[23] CEGIS 2015: Technical study for the mapping of potential greenbelt zone in the coastal areas of Bangladesh.

- ✓ Ecological networking proposals for the expansion of the PA network in the country, and,
- ✓ Protected area management group of proposals covers all aspects of PA management such as management planning and zoning, boundary demarcation and fencing, control of domestic animals, participation of communities, tourism etc. As per the wildlife master plan, PAs shall be managed purely for ecosystem services and wildlife conservation and there will be no production function of PAs.

- The status of the existing Wildlife and Nature Conservation Circle shall be raised to the level of a wing under the charge of a DCCF. All field officers shall take directions and report to DCCF (Wildlife) in matters related to wildlife conservation and all offences occurring within their jurisdictions.

- The mandate and effectiveness of the Wildlife Divisions shall be reviewed in the light of the following:

  - ✓ The mandate of the wildlife divisions need to be extended beyond the protected areas, especially to wetlands.
  - ✓ As most of the PAs are small and scattered, it will be more cost-effective and efficient if these small PAs are continued to be managed under territorial divisions.
  - ✓ Large PAs e.g. Lawachara National Park, Bhawal National Park, Sanctuaries in SRF, etc. be placed under the charge of independent wildlife divisions.
  - ✓ The control on wildlife offences within the jurisdiction of territorial forest divisions shall be the responsibility of territorial DFOs.
  - ✓ The wildlife DFOs shall shoulder the responsibility to patrol poaching-sensitive sites outside forests such as haors, beels, baors, etc., where most of the wildlife offences take place.
  - ✓ The wildlife divisions shall be made specifically responsible for controlling wildlife offences outside state forests.
  - ✓ Wildlife protection units shall be created focusing on all large water bodies or other sensitive locations, outside forests, as most wildlife offences are committed around those.
  - ✓ Management of the Bangabandhu Safari Park shall be upgraded and placed under the charge of a senior official, not below the rank of a Deputy Conservator of Forests, in view of the high public exposure of the park and frequent visits of VIPs.
  - ✓ Wherever people are living inside a protected area, legally or illegally, they shall be encouraged to resettle outside. Incentive will be provided to willing parties. Proper guidelines for this purpose shall be prepared at the earliest.

8.2.7 Maintenance and Protection of existing plantations

The Context and Rationale

Establishing new plantations is an expensive forestry operation. But the budget for the maintenance of plantations is normally provided only for the first 3 years. In case of social forestry plantations, the beneficiaries continue to look after the plants but in coastal and other long rotation plantations, the plantations are virtually uncared for after the period of their initial establishment. Both large and small trees and even saplings are removed illicitly. More than

200,000 ha of coastal plantations and a larger area of plantations have been raised in the hilly region of the country. However, a large portion of these plantations are currently not in existence although some good quality high value plantations are still in existence.

The Proposition and actions

Following measures shall be taken in order to ensure that all the plantations are looked after and protected in perpetuity:

- Plantation protection measures for all types of forested areas will be strengthened through providing adequately trained manpower, requisite tools, and logistics along with support from other law enforcement agencies. This will include watch over all plantations until they are felled.
- Innovative mechanisms for management and protection of existing plantations will be developed and implemented.
- The current practices of issuance of 'jot' permits in CHT will be reviewed and revised and adequate measured will be to incorporated in the process to ensure that this practice does not allow the illegal transit of timber from the government forest of area.
- Assistance from communities living near plantations, shall be garnered through the provisions of alternate income generation activities.
- Engagement of local communities for the protection of long rotation plantations of teak and other species in the hill forests will be explored and facilitated
- Plantations of historic and heritage value shall not be harvested and shall be preserved as national monuments.
- The state of all old plantations in CHT and other hill areas shall be reviewed and a suitable programme to regenerate all the destroyed/degraded plantations shall be developed in partnership with local people on the basis of social forestry provisions.

8.2.8 Firewood saving devices and technologies

The Context and Rationale

It has been established that more than 80% wood is consumed as cooking fuel and fuel-wood shortage in the rural areas is the principal reason for the degradation of state forests. However, use of improved cook stoves can save up-to 50% fuel-wood for the same amount of cooking. Apart from cook stoves, biogas and solar cookers can also reduce the consumption of fuel-wood significantly. Preferential supply of cooking gas to forest-side communities can go a long way in protecting forests. Many NGOs are already working in this field and considerable progress has been made in this regard. But there is plenty of scope to improve these technologies in aid of conservation of forests. Because of the important stakes of the forestry sector in this activity, BFD should join hands with existing players to spread the fuel-wood saving technologies, particularly in the impact zones of state forests.

The Proposition and Actions

Following steps shall be taken to promote the fuel saving devices and technologies in the country:

- Review the on-going programmes of various agencies to promote various fuelwood saving devices and technologies and identify the interventions necessary to improve;
- Develop synergies with existing players and increase their presence in the impact zones;
- Collaborate with the department of energy and other agencies to develop suitable subsidy programmes in order to increase the popularity of fuel saving devices in the impact zone.
- The social forestry wing of the BFD should lunch programs on fuel-wood saving activities.
- Register this programme as a CDM, INDC or NAMA activity to generate more resources for conservation.
- BFRI must take up research to develop innovative cost efficient energy saving processes and devices.

8.2.9 NTFP plantations and related enterprises

The Context and Rationale

Although reliable information on the subject is not available, production of non-timber forest products is believed to have gone down considerably with the degradation of forests, in general. NTFPs such as bamboo, agar, cane, 'murta', honey, etc. in addition to being the most significant components of the forest biodiversity, have always been a significant part of rural economy. It needs to be mentioned herein that the interest in medicinal herbs is growing globally.

The Proposition and Actions

Following actions are proposed to promote the conservation of NTFP and their sustainable use:

- A comprehensive assessment of the status of various NTFPs in the wild as well as outside forests, processing industry, employment, consumption and demand etc., shall be carried out.
- On the basis of the assessments, a detailed plan for their conservation, cultivation, processing, marketing etc. shall be prepared and implemented in consultation and partnership with various stakeholders and implemented. Main objective of the said plan shall be to conserve the wild genetic resources as well as generate maximum employment based on various NTFP items.
- Introduce NTFP species wherever possible in the plantations and natural forests.
- Plantations of bamboos, cane, Murta, golpata etc. items of common use shall be undertaken in their native forests.

- NTFP producing forest trees, like arjun (*Terminalia arjuna*), bohera (*Terminalia bellirica*), *chalmugra (Hydnocarpus wightianus), amloki (Phylanthus emblica), haritoki (Terminalia* chebula), etc. will be included in the species mix for plantation establishment programmes.
- Cultivation of NTFPs outside forests and development of NTFP based businesses shall be encouraged through suitable subsidies.
- Incentives and know-how will be extended to small scale entrepreneurs interested in establishing small scale NTFP processing facilities.
- Agar is a high value commodity in the international market. Its cultivation in the TOF areas should be encouraged. Easing of the process associated with the movement and export of agar oil be reviewed and simplified.
- Processing of wild fruits from trees such as keora (*Sonneratia apetala*), golpata (*Nypa fruticans*), amloki *(Phyllanthus amblica*), etc. may be encouraged especially through small scale cottage industries.
- Biodiversity of Sundarban being of special significance to the country, sustainable levels and methods of extraction of various NTFP items shall be studied and recommendations will be considered for implementation.

8.2.10 Forest based industries

The Context and Rationale

As reported by the BSS, there are 33 kinds of industries and occupations based on wood and other forest products. Out of these, furniture manufacturing, construction and herbal medicines industries are perhaps the most significant ones. Furniture industry, for example, is valued at Tk. 67 billion per annum and employs nearly two million people. Exports of wooden furniture are growing at the rate of nearly 104% per annum and the Government has declared furniture industry as a thrust area of the economy. However, the use of local timber in furniture making is reported to be only 20%, while the rest is either imported timber or imported processed wood products such as composite boards and veneers. FMP shall aim to increase the share of local timber in furniture making as a means of import substitution as well as to tone up the local timber production and markets. At present the industry is suffering from a shortage of quality timber, access to modern technology and shortage of skilled workers.

The Proposition and Actions

In view of the critical role that the forest products based industry plays in the economy of the country, following actions shall be taken:

- A comprehensive assessment of the forest products based industry shall be launched to plan and encourage wood based industries.
- Steps shall be taken to resolve the issues faced by the forest industries, such as supply of quality raw materials, import export facilitation, skilled manpower, rationalization of regulations, etc.

- BFIDC shall be entrusted with the responsibility to spearhead the growth and development of the forest products based industries and help in the overall development of the sector including capacity building and taking lead in the implementation of timber industry related policies.
- The use of modern and efficient wood processing technologies will be promoted and encouraged to ensure better quality products and reduction of wastage during processing ;
- As use of substitutes will reduce consumption of timber, establishment of industries engaged in producing wood substitute products will be encouraged through provisions of incentives, including tax breaks, for modern plants and equipment imports.
- Wood and other forest product based industries will be encouraged to set up their own plantations.
- Establishment of commercial wood seasoning and treatment plants shall be encouraged especially in the private sector. A massive drive to sensitise the industry and artisans about the importance of using seasoned and treated wood shall be launched.
- A value chain study will be under taken to benefit both the growers of wood in the TOF and the wood based industries.
- Existing difference between the import duty on round wood and processed raw materials, and accessories, of the furniture industry shall be reviewed in order to make the furniture industry more competitive in the export market.
- BFRI will undertake research on wood processing and also provide training on field application of their research findings.
- Given the low level of production of rubber, when compared with other major rubber producing countries in the region and the fact that BFIDC's rubber estates are incurring huge losses every year, a detailed review of the viability of BFIDC's continued management of these estates should be undertaken and recommendations of the review implemented.

8.2.11 Forestry research and knowledge management

The Context and Rationale

Modern forestry is highly dependent on scientific data and analysis. Forestry is facing many new challenges which can be addressed only on the basis of solid information collected through scientific programmes. In order to enable science and knowledge based decision making in forestry, research in forestry and allied disciplines shall be provided adequate support.

The Proposition and Actions

Following actions shall be taken in this regard:

- Bangladesh Forest Research Institute (BFRI) shall be modernised and strengthened with resources and staff to enable it to take lead on forestry research in the country.

- Given the lengthy bureaucratic process with recruitment, procurement and other routine activities faced by BFRI, to remove these obstacles, a comprehensive assessment of the need to make BFRI a partial or full autonomous organisation shall be conducted and recommendations of the review will be implemented.
- ON a priority basis, BFRI will undertake research on identification of tree species not vulnerable to climate change and efficient in carbon sequestration for plantation programmes in different types of forest of the country. In addition, the institute will also conduct studies and field trials about the suitability of different species for different sites for the forest types of the country. In addition, research on participatory and agroforestry models involving multiples species along with their economic feasibility will be carried for field implementation.
- Create opportunities for pursuing appropriate higher education programmes, at home and abroad, for research scientists of the Bangladesh Forest Research Institute, universities dealing with Forestry science and the Bangladesh National Herbarium,
- Develop an interface in policy and forestry science. Generate forestry knowledge to cope with the problems and prospects for day to day forest management.
- Upgrade the training facilities administered by the Forest Department and ensure adequate staffing and resource availability so that appropriate training programmes can be implemented on a regular basis.
- Capacity for research on social and economic aspects of forestry operation will be strengthened.
- Use of Forestry Departments of different universities for forestry and wildlife research will be promoted and resources shall be made available for the purpose
- A definite allocation must be available with the BFD for financing the research and studies it needs to conduct for its own use.
- BFRI shall organise an annual forestry research seminar in which the forestry scientists will present their work while the user agencies, such as BFD, private planters, forest based industries, NGOs etc., will evaluate their work and will communicate their research needs to the researchers.

8.2.12 Livelihood support to forest dependent communities

The Context and Rationale

Well-being of the rural communities and forests is interlinked. Whereas poor communities tend to overexploit their natural resources, degradation of natural resources fuels further poverty in the neighbouring communities. Therefore, helping rural communities to have access to sustainable livelihoods is as important to forestry as afforestation and reforestation programmes. This approach of using sustainable rural development to support conservation of natural resources is called ecodevelopment.

The Proposition and Actions

Following steps are proposed to strengthen livelihoods of forest dependent communities.

- A study will be undertaken to identify sustainable environment friendly income generating activities and the recommendation of this exercise will form the basis for ecodevelopment activities in the country.
- Provisions for necessary know-how and resources needed for promoting income generating activities will be made available.
- BFD shall, partner with interested NGOs and various rural development departments/agencies, to identify forest dependent communities/families and shall provide them viable alternatives by linking them with relevant government schemes and NGO programs.
- Ecodevelopment committees (EDC), comprising community representatives, BFD staff, any other interested rural development department, and local NGOs, shall be formed to explore and implement ecodevelopment activities.
- Ecodevelopment plans for all forest dependent villages shall be prepared by the EDCs, in a participatory manner, using techniques like participatory rural appraisal (PRA), to identify families in need of livelihood alternatives and potential sources of help.
- The ecodevelopment plans shall also identify the impact of the concerned villages on the forests and steps that can be taken to reduce the impact to sustainable limits.
- The ecodevelopment committees shall contact various rural development department agencies in search of support to implement the ecodevelopment programmes of the villages.
- 20% of all forest development project funds shall be reserved for community development and livelihood support in the project's neighbourhood.
- Joint forest management (JFM), as proposed elsewhere, shall also have a strong element of ecodevelopment approach.

8.2.13 Control on forest encroachments

The Context and Rationale

Although the extent of recorded forest encroachments in the country is reported to be only about 104,000 ha, the actual extent is likely to be considerably larger. The dynamics of encroachment is complex, and both subsistence-oriented as well as by well-to-do people are involved in the process. Many forest lands are claimed and occupied on the basis of dubious documents. Although forest encroachments are a complex socioeconomic issue, forest lands have to be secured against unauthorised occupation in the interest of environment and ecology.

The Proposition and Actions

In order to ensure that no further encroachments on state forests take place, following steps are proposed:

- All state forest lands which are under the undisputed possession of the forest department must be immediately surveyed, demarcated and mapped, using the mauza maps, in conjunction with the LA&LR. The demarcation has to be done with the help of permanent, conspicuous, concrete pillars of uniform design which are visible from one another on both sides. Every pillar shall be numbered and accurately recorded on the map along with their GPS readings. This task should be completed within two years.
- All existing encroachments shall be surveyed individually and the claim of each occupant shall be examined by a "mobile court", in consultation with a designated forest officer and a revenue officer, and a decision taken on the legitimacy of the claim on the spot, following due process of law.
- A decision may be taken by the government if any category of poor and old encroachers (occupation since prior to a specified date) are to be allowed to continue to occupy their occupied land. A suitable legal provision may be made in this regard, if necessary.
- All honeycombing encroachers, whose claims are admitted, shall be rehabilitated on vacated lands on the periphery of the forest block. If no such lands are available, they shall be paid an attractive cash compensation for vacating the forest land.
- Government must allocate adequate funds to accomplish the above stated activities in two years.

8.2.14 Climate change related programmes

The Context and Rationale

Bangladesh has been adjudged as the most vulnerable country, in the world, to the impacts of climate change, primarily caused by the activities of the developed world. The magnitude of these impacts will vary across the country. The coastal areas of the country are prone to impacts of sea level rise, salinity intrusion and tropical cyclones; floodplains in the central parts are prone to erratic floods; the north-western region of the country is prone to recurrent droughts; the north-eastern part of the country is prone to flash floods; and hilly regions of the country are prone to erosion and landslides. Recent studies have revealed changes in rainfall pattern including intensive large volume rainfall over short periods of time, causing surface runoff, surface erosion and flash floods. Prolonged floods would severely affect many tree species. The enhanced evapo-transpiration in winter would cause increased moisture stress, especially in the Madhupur Tract areas, affecting the Sal forests. Higher evapo-transpiration coupled with lowered flow in winter, would enhance soil salinity, which in turn would severely affect the freshwater loving species in the Sundarban, which will be most severely affected, eventually leading to a change in species composition. The degradation of forest quality might cause a gradual depletion of the rich diversity of Sundarban flora and fauna. The combined impact of reduced fresh water flow due to the loss of connection with the Ganges, withdrawal and diversion of water upstream and the projected rise in sea level, will alter the salinity regime that is expected to change the edaphic conditions and make the forest unsuitable for economic species like Sundri.

All over the country, erratic rainfall patterns and change in temperature may adversely affect the flowering and fruiting, resulting in reduced regeneration and establishment of tree cover, which will ultimately cause lower production as well as biodiversity resulting in reduced ecosystem services, which will adversely affect human wellbeing.

Addressing climate change issues is a major technology, know-how and resource intensive exercise, which countries like Bangladesh are unable to fund. However, funds have been made available under different bilateral and multilateral arrangements.

Under the aegis of the UNFCCC, there are several mechanisms such as CDM, REDD+, INDCs, NAPAs, NAMAs etc. which entitle developing countries to sell carbon credits, earned by sequestering carbon or by preventing emissions of greenhouse gasses, to developing country entities to offset their carbon emissions. Although carbon prices have sharply declined over the last many years, and currently hover around USD 5 per CER, taking action to sequester carbon or prevent its emission is still high on the agenda of governments because these actions bring in huge co-benefits. For example, preventing deforestation or degradation of forests in pursuit of carbon credits under REDD+ framework, brings huge benefits to the country in the form of enhanced production of wood, generation of employment, conservation of soil and water, mitigating floods and other climate induced hazards and so on. Countries can also get international assistance for setting up the institutions and processes which can enable them to launch programmes which can produce carbon credits for sale. REDD+ is the most significant programme among all due to the huge co-benefits that a national REDD+ programme can generate for the country while setting the stage for earning significant revenues from the sale of carbon credits as the forests mature. As most of Bangladesh's natural forests have already been degraded and destroyed, the potential for earning credits under a REDD+ programme are quite good as there is not much more to destroy and the only way the country can go is upwards.

Bangladesh is preparing to set up its National REDD+ Programme, under the UN REDD+ programme, which will encompass all forests of Bangladesh, as is already suggested in the BCCSAP. The Afforestation/Reforestation scope under the CDM is not considered a feasible option due to administrative overheads, the absence of an Annex I partner to finance activities and assume the emission reductions and uncertainty over the continuation of the mechanism under the new Climate Agreement that will come into effect in 2020.

Based on IPCC framework and key principles for integrating climate change in forestry, Bangladesh can effectively participate in REDD+ programs and reduce its emissions by focusing on the following key approaches:

- Minimizing conversion of forests to other lands (equivalent to deforestation);
- Managing degraded forests to remain as forests (covering degradation, conservation, enhancement of carbon stocks in existing forests, and sustainable management of forests);

- Supporting the rehabilitation and reforestation of forestlands with no cover to become forests (covering afforestation, reforestation).

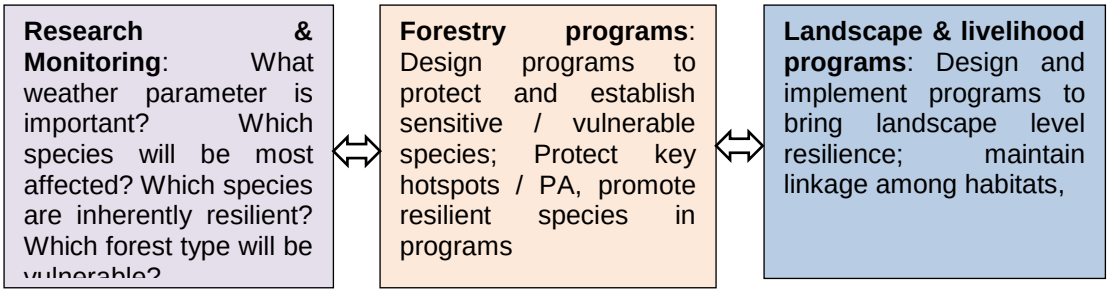
In this climatic context, flowering and fruiting time may be affected, resulting in reduced regeneration and establishment of seedlings and saplings, and ultimately affecting production. Such impacts on processes will result in reduced biodiversity, reduced ecosystem services and ultimately affecting livelihoods of populations surrounding the forested ecosystems.

The proposition and actions

With climate change becoming a major element in forestry, the management of forests needs to be research generated knowledge-based. This practice is particularly important in the context of Bangladesh where very little pertinent information is available. The practices need to be adaptive in nature in order to maintain key processes and ensure healthy biodiversity, steady stream of ecosystem services and resilience livelihood to local communities. Adaption, in case of forestry may be practiced through the use of species that will be suitable under the changing climatic impacts.

In this context, the broad areas of climate resilient forest management framework may comprise of the following:

1. Identification and monitoring of key climatic parameters that will have most pronounced effect on species cohorts and vulnerable process within the lifecycle of a species;
2. Promote species that are climate resilient and special programmes on species requiring recruitment and establishment of support for any reforestation, afforestation and restoration program;
3. Ensure that landscapes and community livelihoods are secured and improved and
4. Design landscapes in such a way so as to use trees/ forests as part of production and protection services.



Within this framework, the programs can be divided into two categories – adaptation and mitigation. Many of the recommendations correspond to the recommendations made by BCCSAP, 2009 and NAPA, 2005.

Research & Monitoring Programmes

(A) Adaptation:

- Identify forest, fruit and other trees/plant species, which are climate resilient in general or in site specific situation and those which are vulnerable;Identify weather parameters that will have major influence on physiological processes of trees.
- Develop a forestry based climate change early warning system or monitoring mechanism.
- Set up a well-designed monitoring system to evaluate changes in ecosystem and biodiversity, covering all important and sensitive ecosystems and implement a participatory monitoring system by involving local trained people such as school teachers, communities and academic researchers.
- Report changes in ecosystems and biodiversity and assess the implications including those for the livelihoods of local people and recommend adaption measures.
- Initiate modelling in inundation and salinity impacts of sea level rise by specific time lines.
- Assessment of probable impact of climate change on all types of tourism in Bangladesh.

(B) Mitigation

- Identify species that can sequester carbon, maintain biodiversity, are resilient to climate change impacts (based on regions) and provide benefits to people. Research the suitability of various tree species for their carbon locking properties in designing various forestry programs keeping in mind other environmental and socio-economic functions.
- Study the scope of carbon credit under REDD+ and invest, if appropriate, in restoration of degraded reserve forests
- Carry out research to assess need for changes in silvicultural treatments (e.g. thinning, pruning and vine-cutting) in the context of climate change and prescribe accordingly.

Afforestation, reforestation and restoration programs:

(A) Adaptation:

- Provide support to existing and new coastal afforestation programs taking into account the change in the climatic conditions and expand and maintain the current afforestation programme and create a continuous green belt as a protection against sea borne storms. Through management interventions, create favourable conditions for the fast growth of the planted trees.
- Expand the area under tree cover, in forests, barren lands, suitable hilly and outside forest areas to facilitate the creation of a larger carbon sink, sources of forest products and, and ecosystem services. Plant climate resilient species adopted to different conditions and involve local planting, protection and other related activities.

- Establish, expand and properly manage the PAs to conserve biodiversity especially the vulnerable species and significant habitat types.
- Based on research and vulnerability analysis, develop adaptation plans for important but vulnerable tree species like sundri.
- Support awareness-raising and training exercises and carry out programmes for forest officials to promote monitoring and the early detection of climate change impacts on trees, ecosystem and management of pest and disease outbreaks
- Encourage the re-introduction, natural regeneration, assisted regeneration, and maintenance of mixed-species forest to increase resistance to pest invasion and resilience
- In areas where slash-and-burn agriculture poses a fire risk, generate awareness and encourage complete ban, or modification of burning practices (e.g. restrict burning to seasons where the risk of fire is low)

(B) Mitigation

- Improve technology, use high quality planting materials of climate resilient species and modern planting practices followed by strictly followed management and protection regimes to ensure high levels of success in plantation establishment.
- Maintain the area under forest by reducing deforestation / degradation and by promoting forest asset building, conservation and protection measures;
- Increase the area under forest through approaches appropriate for local conditions, sites and other considerations. Increase carbon density at the applicable management unit (beat / range / division) and landscape scales by focusing on increasing areas under tree cover and avoiding any degradation so that, on average, carbon stocks remain constant or increase over time, through the restoration of degraded forests;
- Make necessary management interventions to ensure that tree composition, age, healthy undergrowth are promoted and secured. Reduce evapo-transpiration and competition for water by vegetation management (e.g. thinning, pruning and planting deciduous species)

Landscape & livelihood Programs:

(A) Adaptation:

- Comprehensive and participatory planning and investment for climate resilience against erosion in income, employment and human health in coastal, char, hilly and wetland regions
- Implement an extensive programme to protect settlements in coastal areas and other vulnerable areas from the onslaughts of cyclones and other natural hazards.
- Design roadside, embankment, coastal plantations and social forestry programmes at a landscape level in such a way in order to minimize high wind including multi-layered

canopies and root system, increased carbon sequestration, ability to withstand salinity/dryness/rainfall, has biodiversity value and accrues benefit to the local communities.

- Maintain landscape connectivity and establish corridors through restoration and reforestation
- Promote and facilitate alternative off-forest income generating activities to forest dependent communities, especially women and children engaged in fuel wood collection.
- Identify steep and unstable slopes (with or without settlements) and develop best practices and guidelines for steep slopes and other areas prone to landslides and erosion. Maintain mandatory continuous vegetation cover on steep and unstable slopes
- Protect or increase freshwater inputs to protect Sundarbans ecosystem through regional cooperation.

(B) Mitigation

- Use a set of species suitable for homestea*d and social* forestry programmes in various land types. Promote the cultivation of medicinal plants, suitable fruit trees and other trees in demand, like Agar in these programmes.
- Improve the knowledge of vulnerable communities, particularly the women and children on climate change mitigation issues,
- Mainstream women's participation in coastal and social forestry programmes.
- Review and implement relevant forestry laws and rules to ease the stringent conditions applied to the trees outside forests.
- Provide support to existing and new homestead and social forestry programmes and enhance carbon sequestration.
- Support the development and implementation of field projects and programs demonstrating landscape approaches on the ground in different contexts.
- Develop climate resilient agro-forestry techniques and models for hills, coastal and central zones.
- Increase fuel wood and timber stock in landscape area so as to minimize demand from forested areas.
- Monitor production and adjust harvesting schedules for the social forestry plantations
- Promote use of improved cook stoves, bio-gas plants and solar cookers in homesteads, educational institutions, and business units for proper utilization and reducing demand for fuel wood.

8.3 Supportive Strategies

The success and effectiveness of the above programmes shall depend on the progress in respect of certain systemic changes and developments required in the forestry sector institutions, approaches and working environment. The strategies to improve the effectiveness of the programmes shall be as follows:

8.3.1 Reforming institutions and enhancing the capacity

The Context and Rationale

Apart from many other urgent issues, BFD is immediately faced with an alarming situation in terms of its manpower situation, where almost 50% of the professional positions are now vacant and there is no replacement in the pipeline. In addition, as most of the senior officers are retiring in the next one year or so and there is virtually nobody to replace them as the next lot of officers have not put in enough length of service to qualify for some of the senior most positions in the department. As the recruitment of 2016 batch of cadre officials is stuck in legal and administrative wrangling, this leaves only around 30-40 cadre officers who joined service in 2003 and after and some promoted from the ranks of Forest Rangers, who again are holding the positions of Assistant Conservators. So, when all the seniors recruited in 1986 retire in the next two years, less than 50 cadre officials will be in positions to hold responsible positions. The situation in the technical/sub-ordinate service is no better. Direct recruitment at the Ranger level, which is a vital position in the forest administration has been discontinued and more than 75% of the currently serving Forest Rangers will retire in next 3-4 years. While, recruitments at Forester and Forest Guards levels are being undertaken in large number to fill vacant positions, such quick fixes are not possible in the cases to Assistant Conservators and Forest Rangers. The conflict of seniority and the resulting litigations and other complexities between cadre and non-cadre officers, who were recruited under projects and were retained after the projects ended, lack of young rangers, absence of a clearly planned regular annual inductions into the service, lack of organisational emphasis on supporting TOF, poor logistics, inadequate laws/rules etc. are the other problems plaguing the BFD. The situation at the BFRI, BNH and BFIDC are even worse. While large number of posts are vacant in all the institutions, in the case of BFIDC there is a shortage of qualified personnel, and in the cases of the two research institutions, bureaucratic problems associated with recruitments to fill vacant positions, a lack of a clear path of career progression are among major issues.

The Proposition and Actions

In view of the above, it is recommended that the following major institutional reforms, be undertaken to ensure effective functioning of the forestry sector institutions:

- Implementation of a comprehensive plan for filling up all vacancies in BFD and other institutions, in a time bound manner without causing long term distortions in various cadres.

- Formulation of an elaborate manpower and human resource development (HRD) plan within two years, in accordance with the emerging needs, and shall take steps for its implementation after government approval.
- Devolution of authority for recruitment to the sector institutions, particularly the research institutions to ensure simplification of recruitment process
- Preparation of a phased out plan for recruitment by all sector organisations to avoid the recurrence of the current situation.
- Restrict all new recruitment in cadre and technical/subordinate services only to forestry and wildlife graduates and diploma holders to reduce the induction period to fill all vacant and new positions. Arrangements for entry level training for all new recruits in the department, after up gradation and modernization of the current curricula for basic training for different.
- Organisation of specialized training for forestry officials so that they can undertake jobs like handling information and knowledge management, climate change issues, forest economics related topics including valuation of ecosystem services and payment for ecosystem services, forest statistics, growth and yield forecasts, remote sensing and geographical information system, to ensure that the Forest Department has the required in-house capacity and is not dependent on external experts.
- Enhance expertise in government agencies, the private sector and civil society organizations, on various areas of forestry through targeted short and long term courses, capacity building and awareness creation.
- Commissioning a high powered committee, who will make binding recommendations to resolve the administrative discords, anomalies and litigations arising out of the recruitment of non-cadre Assistant Conservator of Forests and some field level officials out of turn.
- Amend current service rules to modify service length qualifications to enable the existing cadre officers to occupy senior posts when required. The amended rules should also provide for the induction of non-cadre officers into the cadre below the existing cadre officers, so that the future recruits automatically become junior to the existing non-cadre officers.
- Appoint specialised staff with modern skills in GIS, remote sensing, database administration, computer operators etc. on contract rather than keeping these posts vacant. There should be adequate IT support staff in the field offices to facilitate transition to modern management.
- Provisions for special allowances for BFD and BFRI officials posted in non-family and other inhospitable/remote places.
- Carrying out of assessment of organizational structure and manpower requirement based on workload analysis, emerging challenges once every five years

- Introduction of time scale based incentives as assured career progression to scientists in BFRI and BNH
- Reintroduction of direct recruitments for the positions of Forest Rangers to ease the situation of very acute shortage of officials at that level. There must be a minimum of 50% quota for direct recruitment for rangers (as against the current proposal of 30%).
- Assess the feasibility of the creation of an independent Department of Social Forestry or Forestry Extension with a clear mandate to develop the ToF sector through intensive extension support, and until this becomes a reality, a wing within the BFD with clearly defined authority and resources, will support TOF programmes.
- High priority to the development of IT infrastructure and management information systems (MIS) in all organizations in order to improve efficiency, transparency and accountability.
- Development of information technology and communication infrastructure at all levels, down to the beat level, shall be undertaken at a priority. All monitoring of resources and management shall be made online and web-based.
- Strengthening and upgrading of the RIMS unit of BFD to the level of a Wing under a DCCF in order to improve the generation and management of relevant information. This wing shall also be responsible for spearheading the modernization of the IT infrastructure, strengthening of monitoring and evaluation of all forestry activities, Information management and capacities of the BFD down to the field level.
- Recruitments for some positions like those under RIMS and the training institutions, where personnel with specialized training/background is required, provision for a clear career progression for non-cadre specialists.
- Until such time when the required manpower can be put in place for outsourcing RIMS activity to an appropriate agency can be considered. Arrangements can be such that this agency will work out of Forest Department office in Dhaka, upgrade RIMS, train Forest department staff members and operate RIMS till such time the Forest Department staff are ready to take over and run the system independently.
- Creation of a Wildlife Wing with a clear mandate for strengthening the conservation of wildlife and management of protected areas.
- Digitization of all existing land records and historical documents under charge of senior officer, preferably a DCCF with a set up to support the task created at the field levels.
- Responsibility of spearheading the development of forest industries in the country, after due strengthening and reorganisation vested with the BFIDC.
- Weaknesses of the following weaknesses of the forest laws and other related legal instruments within one year:

    a. *Revision of the notifications no. 2404, 2405 and 2406 of 26.12.1956, which*

invest only gazetted forest officers with powers under section 72 of the Forest Act 1927, (related to dealing with forest offences) to confer these powers on deputy rangers, foresters and forest guards also.

b. *Revision of the notification no. 2396 dated 26.12.1956 regarding the appointment of Forest Officers under section 2 of the Forest Act, 1927 to include all newly created designations such as wildlife guards, wildlife inspectors, wildlife rangers etc.*
c. *Amendment of the Wildlife (Conservation and Security) Act 2012 to confer powers of arrest on forest officers, among many other amendments that the Act urgently needs.*
d. *Promulgation of all the necessary rules and issue all the notifications required under the Wildlife (Conservation and Security) Act, 2012 to make it operational.*

8.3.2 Consolidating and expanding Community Participation

The Context and Rationale

As explained in the previous chapters, the wellbeing of communities and their neighbouring forests are interdependent. Strengthening community stakes in forests ensures the long term survival of the forests as against wanton destruction. Communities have come forward to participate in social forestry in Bangladesh and it is proposed that this participation be further expanded and consolidated under the new FMP.

The Proposition and Actions

- In view of the critical role that community participation can play in the conservation of state forests and development of the TOF sector, following steps shall be taken to strengthen community participation in forestry:
- Selection of social forestry participants shall be made more transparent and in strict compliance with the rules.
- All new coastal plantation programs shall have an inbuilt fund to provide AIGAs (Alternate Income Generation Activities) to the beneficiaries.
- The prevailing Co-Management approach that is being practiced at present by the BFD, especially for the PAs, should be reviewed to ensure and strengthen the participation of the incumbents in the protection of natural resources.
- The disputes about community rights in forest lands in CHT area shall be resolved, by recognizing their traditional rights on the lines of the systems prevailing in north east India which has a close affinity with the CHT situation. The relevance of bringing in a new law on the lines of “Tribal and Other Dwellers (Recognition of Forest Rights) Act 2006” of India shall be examined for adaptation in Bangladesh.
- Community livelihoods shall be made a strong component of all forest rehabilitation programs in the country in order to secure local buy-in from the people.

- Credible development of environmental NGOs shall be encouraged to undertake social forestry and agroforestry programs by building a national coordination forum for social forestry and especially for the TOF areas.
- A mass awareness campaign shall be launched to apprise the people of the state of their natural resources and the role they can play in rectifying the situation. The campaign shall specially target women, children and communities living in and around the forests.

8.3.3 Developing public private partnerships (PPP) for reforestation

The Context and Rationale

Reforestation of the denuded and degraded hill forests (nearly 300000 ha) is a huge task but needs to be accomplished quickly in view of the importance of the hill forests to the ecological and economic security of the people. As, government is unlikely to be able to provide the required funds, even with donor support, it is necessary to explore the possibility of restoring these forests with the help of the private sector, by way of PPP. Despite the reservation of many foresters and conservationists on the subject, there seems to be no other way of securing these lands for re-vegetation. While the denuded lands are fast degrading as they lose topsoil, they are extremely vulnerable to encroachments and other forms of alienation as well. If these lands are demanded by other agencies for developmental purposes, arguments against such a proposal shall be very week if the land is bare and unproductive. Bangladesh has already passed the PPP Act 2015 and has created a PPP Authority in the office of the Prime Minister to facilitate and fast track PPP projects in core sectors of economy.

The Proposition and Actions

Following steps shall be taken, in consultation with the PPP Authority to initialise and institutionalise PPPs in Bangladesh forestry:

- A public sector corporate body, tentatively called Bangladesh Forest Improvement Corporation (BFIC) shall be set up to implement this proposal.
- The BFIC shall plan and delineate forest units to be offered for PPP in close consultation with the BFD, local people, potential investors and other stakeholders and create a legal (develop rules) and policy framework to implement PPP in forestry, based on consultations.
- Among other things, the regulation framework and terms of the contract shall provide the lessee/contractor a reasonably long tenure over the forest land which he would reforest using his own resources and will share the proceeds with the government and stakeholder communities, in accordance with an agreed formula. The lessee shall never be allowed to bring any part of the given “forest land” under any type of non-forestry activities.
- The project design shall be such that while it is profitable to the lessee, local communities start getting benefits as early as possible, either through intercropping agricultural and medicinal crops, thinnings or through short rotation trees etc.

- The treatment plan for the area shall be based on a vision document prepared for the region and vetted by an expert committee, in accordance with the need for climate resilience and other ecological and socioeconomic imperatives.

8.3.4 Strengthening of monitoring, evaluation and database facilities

The Context and Rationale

It is well known that what cannot be measure and monitored, cannot be managed. Forests of Bangladesh have virtually disappeared without the country taking a serious notice because there is no regular assessment of the state of the forests. BFD does not have the manpower, funds and the technical strength to regularly monitor the state of the forests. Similarly monitoring of management inputs and outcomes is also not properly conducted because the lack of technology as well as resources. There on system of creating any kind of databases to enable decision making based on facts. It is therefore proposed that a strong emphasis shall be given to the development of this capability.

The Proposition and Actions

Following actions shall be taken to strengthen the monitoring and evaluation capabilities of the BFD:

- The existing RIMS unit shall be suitably strengthened and upgraded to the level of a wing of the BFD, to be headed by a DCCF, with line function officers at least up to forest division levels, to enable it to carry out this important task efficiently. The new unit shall be mandated to carry out all monitoring work on behalf of BFD and maintain a fully functional database which can generate important reports on demand.
- Immediate action shall be taken to set up a Forest Resources Monitoring and Assessment (FRMA) and Forest Resources Management Information System (FRMIS) program as proposed under CRPARP package BFD/S-4.
- The status of forest and tree resources of the country shall be assessed every five years in the form of national forest inventory (NFI) following uniform procedures and protocols.
- Apart from other measures, smart patrolling approaches and tools shall be used for generating continuous field data on the condition of the forests and important field events such as encroachments, forest offences, fires, etc.

8.3.5 Ensuring basic amenities and logistic support for FMP implementation

The Context and Rationale

Basic amenities like proper housing, access to safe medical facilities or even drinking water are often not available to frontline field staff. In addition, their mobility is often restricted by the lack of departmental transport, adequate funds for fuel or rented transport or travel allowances. This is a serious situation and needs to be addressed. Assessment of the current needs for amenities and logistic support will be made and the following will be considered:

The Proposition and Actions

1. Transports (motor launches, speed boats, trawler boats, jeeps, pickups, motorcycles, etc.),
2. Operational costs of transport.
3. Adequate housing for the field staff,
4. Office equipments and expendables (computers, printers, projectors, map printers, photocopiers, document storage facilities, stationary etc.)
5. Adequate allocation for covering travel allowances of field level staff.

Based on the above assessment a programme will be undertaken to complete the task of providing the recommended amenities and logistics within 3 years.

8.3.6 Putting in place necessary institutional arrangements for implementation of FMP

Proposition and actions

A dedicated, fully equipped, office under a DCCF shall be created to direct and monitor the implementation of the FMP. This office shall be responsible, in collaboration with other wings, for proactively preparing projects to implement the recommendations of the FMP and monitor their progress and report to the government. This wing will also explore possibilities for procuring funds from various sources within or outside the government to implement the projects, Five year implementation plans, in alignment with the five year plans of the government, shall be prepared and respective wings shall report their progress to the FMP implementation office as per an agreed schedule.

8.4 Facilitating achievement of Sustainable Development Goals (SDGs) through FMP

The Sustainable Development Goals were adopted in 2015 as part of the “2030 Agenda for Sustainable Development”. Seventeen SDGs have been defined of which goal 15 is of direct concern to the forestry sector: “Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss”. Under this goal, the following topics are most relevant:

- By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and dry lands, in line with obligations under international agreements. (15.1)
- By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally. (15.2)
- Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species. (15.5)

- Take urgent action to end poaching and trafficking of protected species of flora and fauna and address both demand and supply of illegal wildlife products. (15.7)
- By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts. (15.9).

FMP programmes and strategies have been designed to contribute to the achievement of the SDG objectives, individually as well as collectively. Although it is unlikely that full progress will be made by 2020 in this direction, in view of the enormity of the task and shortage of capacity and resources, FMP shall be able to set the course, by 2020, so that faster progress can be made if resources are available.

Apart from goal 15, FMP will also contribute towards the achievement of many other goals, such as goal 1 (No Poverty), goal 2 (Zero Hunger), goal 3 (Good health and well-being), goal 7 (Affordable and Clean Energy), goal 8 (Decent Work and Economic Growth) and goal 9 (Industry, Innovation and Infrastructure). Important guiding instruments of the forestry sector such as the Social Forestry Rules and the National Forestry Policy (draft) emphasise gender equality in forestry operations and benefit distribution and, thus, also contribute to the achievement of goal 5 (Gender Equality), More specifically, the following FMP programmatic activities have a direct relevance for, and bearing on the above SDG goals and targets:

Table 8-3: An Illustration of the Functional Links between relevant SDGs and FMP programmes

SDG Goals and Targets	Addressed by FMP programmes	Concerned FMP Strategies
Goal 15: "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss"	• Formulation of forest management plans. • Reforestation of degraded forests. • Management of PAs and protection of wildlife • Promotion of firewood saving devices and technologies. • Afforestation outside forests, including USF. • Livelihood support to communities. • Control on forest encroachments.	• Institutional reforms and capacity building. • Strengthening community participation • Strengthening monitoring, evaluation and database facilities.

SDG Goals and Targets	Addressed by FMP programmes	Concerned FMP Strategies
	• REDD+ and other climate change related programmes.	
By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements. (15.1)	do Full achievement by 2020 not possible.	do Full achievement by 2020 not possible.
By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally. (15.2)	• Formulation of forest management plans. • Reforestation of degraded forests. • Management of PAs • Promotion of firewood saving devices and technologies. • Afforestation outside forests, including USF. • Livelihood support to communities. • Control on forest encroachments. REDD+ and other climate change related programmes.	Do
Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of	do	do

SDG Goals and Targets	Addressed by FMP programmes	Concerned FMP Strategies
biodiversity and, by 2020, protect and prevent the extinction of threatened species. (15.5)		
Take urgent action to end poaching and trafficking of protected species of flora and fauna and address both demand and supply of illegal wildlife products. (15.7)	Implementation of Wildlife Action Plan (2015), which includes the establishment of a Wildlife Crime Control Unit and a forensics laboratory, among many other things. Promulgation of new CITES rules, implementation of the Wildlife (Conservation and Security) Act 2012.	Promulgation of new CITES rules, implementation of the Wildlife (Conservation and Security) Act 2012.
By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts. (15.9).	Strengthening forestry research.	Strengthening monitoring evaluation and database facilities.
Goal 1 (No Poverty),	Reforestation of degraded forests. Afforestation outside state forests. Livelihood support to forest dependent communities. Promotion of firewood saving devices and technologies.	PPP in forestry Strengthening community participation in forestry
Goal 2 (Zero Hunger),	do	do
Goal 3 (Good health and well-being),	do	do

SDG Goals and Targets	Addressed by FMP programmes	Concerned FMP Strategies
Goal 7 (Affordable and Clean Energy),	Promotion of firewood saving devices and technologies (renewable energy).	--
Goal 8 (Decent Work and Economic Growth)	Reforestation of degraded forests. Afforestation outside state forests. Livelihood support to forest dependent communities. Promotion of firewood saving devices and technologies. Promotion of forest based industries	PPP in forestry Strengthening community participation in forestry
Goal 9 (Industry, Innovation and Infrastructure).	Promotion of forest based industries.	Strengthening of ICT infrastructure of BFD. Strengthening database facilities of BFD. PPP in forestry

8.5 Potential new project ideas for implementing FMP

New projects need to be developed on the following themes in order to make progress towards achieving the objectives of the FMP. The list is only indicative and should be further developed as new opportunities and challenges are identified.

- Watershed management and reforestation of denuded hill forests.
- Community–based conservation of hill forests.
- Development of a PPP framework and a pilot project for the reforestation of the denuded hill forests of Bangladesh.
- Charland afforestation and completion of coastal greenbelt in Bangladesh.
- Community-based conservation of sal forests of Bangladesh.
- Development of a network of timber markets for promoting homestead forests in Bangladesh.
- Assessment of the status and issues facing homestead forests and other private

plantations in Bangladesh.

- Assessment of the status of forest products based industries and occupations and issues faced by the industry in Bangladesh.
- Conservation of NTFPs and development of sustainable businesses based on NTFPs.
- Strengthening of forestry extension services aimed at the development of homestead forests in Bangladesh.
- Internalising climate change impacts, mitigation and adaptation in Bangladesh Forest Department (Climate change education for foresters).
- Sustainable livelihoods for forest dependent communities in Bangladesh.
- Renewable and alternative energy programme for the conservation of forests in Bangladesh.
- Rejuvenation of lost plantations in the hill forests of Bangladesh through community participation.
- Development of infrastructure for the conservation of forests in Bangladesh.
- Sustainable management and conservation of the remaining natural forests in sal and hill regions of Bangladesh.
- Preparation of sustainable forest management plans (working plans) for Bangladesh.
- Reducing deforestation and forest degradation (REDD+) through community based conservation of forests in Bangladesh.
- Strengthening forest management monitoring and evaluation in Bangladesh through an online, web-based, Forest Resources Monitoring and Assessment (FRMA) and Forest Resource Management Information System (FRMIS).
- Development of a forest nursery certification system for improving the planting stock for homestead forests in Bangladesh.
- An assessment of the level of wildlife trade and consumption in Bangladesh and development of an integrated approach to conserve wildlife.
- Conservation and restoration of natural forests through community based, professionally run, ecotourism.
- An assessment of the forest land tenure issues in CHT and options to resolve the stalemate.
- Development of the infrastructure, organisational structure and professional capacity of BFRI scientists with a view to combat climate change impacts.
- A critical assessment of the organisational structure, workflow and capacity of BFD with a view to its reorganisation for meeting the emerging challenges and responsibilities.

- Development of an HRD Plan for BFD in view of the emerging challenges and opportunities.

9 Financial Resources Requirement & Mobilization

The master plan is a long term planning framework and has to provide for inevitable uncertainties and probabilities of capacities and resources that the sector shall encounter during the next 20 years. Forestry programmes in Bangladesh are funded by various combinations of government's own resources and external aid, both in the form of credit as well as development grant, from a variety of development partners. Traditionally, formal investments in the forestry sector have been seen as synonymous with the conservation and development of state forests and/or strengthening of the forestry sector government organisations and institutions. However, much more investments now go into the growing of trees outside forests (ToF), by rural communities. Funds invested in developing and operating forest products based industries and occupations are also substantial. These investments do not come out of the government exchequer. Therefore, it is difficult to keep track of these investments although their volume may be much more than the formal investments by the government in the forestry sector. In view of this difficulty, the following discussion does not include private investments. The planning period is taken as 20 years, starting with the financial year 2017-18.

9.1 Scenarios of financial requirements and availability

Although the forestry sector institutions also include BFRI, BNH and BFIDC, but only BFD gets any development budget on a regular basis. All other institutions, except BFIDC, generally receive grants only out of the revenue budget which primarily caters to the maintenance of the institutions and has very limited amount for any new work or asset creation. Even BFD's development budget has fluctuated wildly in the past, depending on donor participation, from year to year. However, the allocations have steadied a little in the last five years as shown below:

Table 9-1: Development finance availability to BFD (cr. Taka)

Financial Year	Revised ADP*	Expenditure (Net Grant)	Project Aid
2011-12	221.8	207.5	59.1
2012-13	154.1	119.9	76.1
2013-14	263.4	211.1	192
2014-15	302.44	294.9	216.43
2015-16	292.04	269.1	224.52
Average	246.75	220.5	153.63

*ADP = Annual Development Programme

Thus, the average availability of development funds to BFD in the last five years has been to the tune of approximately Tk. 246.75 cr. per annum, out of which nearly 62% has been project aid received from various development partners. Moreover, it has been seen that after some years of good flow of resources, there are years when no or very little donor funding is available. For

example, after five years of hyperactivity, there is no significant project to carry out afforestation/reforestation in the current year. Therefore, the potential scenarios of financial availability in future shall have to be created on the basis of this experience, adjusted for expected inflation, both in allocations as well as expenditures. The current rate of inflation in the country is approximately 6% per annum. The same rate is presumed for future for making projections. On the basis of discussions held with BFD, future investments in the forestry sector are envisioned in the following three scenarios:

Scenario 1: Investments based on GoB's own fiscal resources and current level of institutional capacity i.e. Tk. 93 cr. per annum. As per this scenario, total amount available during the plan period is likely to be nearly Tk. 3600 crores.

Scenario 2: Investments based on current level of donor support and current level of institutional capacity i.e. Tk. 247 cr. per annum, with some additional availability of resources due to the unique (though unenviable) position of Bangladesh as the most climate vulnerable country in the world. Thus, expected availability of funds during the FMP period, adjusted for potential inflation, is presumed to be Tk. 9631 crores. However, we can plan for an estimated availability of Tk 10000 crores.

Scenario 3: Investments without any resource or capacity constraints depending on estimated requirements. This scenario will incorporate the possibility of tapping non-traditional sources of funding, such as public private partnerships (PPP) or institutional finance.

Although scenario 2, that is, annual availability of approximately Tk. 500 crores (inflation adjusted) as annual development budget, seems to be the most likely scenario, the real goal of BFD and other sectoral oragnisations must be to move as close to scenario 3 as possible. Only under scenario 3, BFD can hope to reforest all the degraded forests and create a permanent coastal shelterbelt against the sea storms and cyclones. In view of the recent recognition of forestry as an important mitigation and adaptation tool against the impacts of looming climate change, recognition of Bangladesh as one of the most vulnerable countries, and the enhanced availability of international resources for dealing with climate change related issues, there is the possibility of an improvement in the situation although it will take serious effort from BFD and GOB to be able to benefit from these opportunities..

Based on these three potential scenarios of finance availability, programme-wise allocations during the planning period are envisaged as given below.

Table 9-2: Programmes and indicative costs in scenario 1

Sr. No.	Programmes	Physical Targets		Financial Targets (crores Taka)	Remarks
		Units	Extent		
1	Preparation of forest management plans	No.	40	208.8	

Sr. No.	Programmes	Physical Targets		Financial Targets (crores Taka)	Remarks
		Units	Extent		
2	Conservation of Natural Forest: Sal	ha	18,000	21.6	Extent: all surviving forest
3	Conservation of Natural Forest: Hill	ha	1,00,000	108	Extent: all surviving forest
4	Conservation of Natural Forest: SRF	ha	4,00,000	180	Extent: all surviving forest
5	New Plantations: All types	ha/km	82,682	1728	
7	Promotion of TOF sector (Forestry Extension)	ha	20,00,000	180	
8	Protected areas and wildlife management	ha	3,00,000	198	
9	Management and Protection of existing plantations	ha	70,000	39.6	
10	Promotion of Firewood saving devices and technologies	NA	Multiple Activities	10.8	
11	NTFP Development	NA	Multiple Activities	54	
12	Development of Forest industries	NA	Multiple Activities	7.2	
13	Strengthening forestry research	NA	Multiple Activities	223.2	
14	Strengthening community participation and rural livelihoods	NA	Multiple Activities	180	
15	Management of forest encroachments	NA	Multiple Activities	43.2	
16	Supporting REDD+ Programme	NA	Multiple Activities	18	
17	Institutional reforms and capacity building	NA	Multiple Activities	180	
18	Promotion of PPP for reforestation	NA	Multiple Activities	3.6	

Sr. No.	Programmes	Physical Targets		Financial Targets (crores Taka)	Remarks
		Units	Extent		
19	Strengthening of monitoring and evaluation (Development of FRMA/FRMIS)	NA	Multiple Activities	144	
20	Civil works, vehicles, boats etc.	NA	Multiple Activities	72	
	Total			3600	

In the above table, the estimated cost of plantations and other activities have been calculat3d with 6% annual escalation. The average cost of plantations depends on the nature of the plantation mix (block plantations, strip plantations, coastal plantations etc.) and may vary if the relative proportion of different types changes. In the present mix, the average cost per ha comes to Tk 209070/ha including maintenance for 3 years over a 20 year period. As mentioned before all costs include an annual escalation of 6% due to anticipated inflation and market contingencies.

Thus, in case the state is unable to get any significant external resources, the maximum cost of programmes will have to be limited to an close to Tk. 3600 crores over 20 years or Tk. 180 cr. per annum, if the allocations match the current rate of inflation. The *inter se* priorities between various items shall have to be decided on the basis of available resources from year to year, although broadly they may remain as indicated here. However, as stated before, this is a rather unlikely scenario as donor interest in the sector has seen a spurt in the recent years and the trend is likely to continue, with some gaps here and there. Therefore, no further elaboration of this scenario is being attempted here.

Table 9-3: Programmes and indicative costs in scenario 2

Sr. No.	Programmes	Physical Targets		Financial Target (Crore Taka)	Remarks
		Units	Extent		
1	Preparation of forest management plans	No.	120	580	
2	Conservation of Natural Forest: Sal	ha	18000	60	Extent all surviving forests
3	Conservation of Natural Forest: Hill	ha	100000	300	Extent all surviving forests
4	Conservation of Natural Forest: SRF	ha	400000	500	Extent all surviving forests

Sr. No.	Programmes	Physical Targets		Financial Target (Crore Taka)	Remarks
		Units	Extent		
5	New Plantations: All types	ha	229588	4800	
7	Promotion of TOF sector (Forestry Extension)	ha	2000000	500	
8	Protected areas and wildlife management	ha	300000	550	
9	Management and Protection of existing plantations	ha	100000	110	
10	Promotion of Firewood saving devices and technologies	NA	Multiple Activities	30	
11	NTFP Development	NA	Multiple Activities	150	
12	Development of Forest industries	NA	Multiple Activities	20	
13	Strengthening forestry research	NA	Multiple Activities	620	
14	Strengthening community participation and rural livelihoods	NA	Multiple Activities	500	
15	Management of forest encroachments	NA	Multiple Activities	120	
16	Supporting REDD+ Programme	NA	Multiple Activities	50	
17	Institutional reforms and capacity building	NA	Multiple Activities	500	
18	Promotion of PPP for reforestation	NA	Multiple Activities	10	
19	Strengthening of monitoring and evaluation (Development of FRMA/FRMIS)	NA	Multiple Activities	400	
20	Civil works, vehicles, boats etc.	NA	Multiple Activities	200	
	Total			10000	

Note: Details of actual activities to be undertaken under each programme shall be worked out after allocation of funds on the basis of broad criteria as used above. The list of activities proposed under each programme is indicated in the respective programmes in the relevant chapters of the FMP.

Thus, an investment of Tk. 10000 crores is proposed over the 20 year plan period, which is not much higher than the amount estimated to be available based on the current trend in donor interest and local funding, if inflation rates are taken into account. As mentioned before, this is the most plausible future scenario and shall be elaborated further in subsequent sections.

Table 9-4: Programmes and indicative costs in scenario 3

Sr. No.	Programmes	Physical Target		Financial (crores Taka)	Remarks
		Units	Extent		
1	Preparation of forest management plans	No.	120	580	
2	Conservation of Natural Forest: Sal	ha	18000	60	Extent: All surviving forests
3	Conservation of Natural Forest: Hill	ha	100000	300	Extent: All surviving forests
4	Conservation of Natural Forest: SRF	ha	400000	572	Extent: All surviving forests
5	New Plantations: All types	ha	620200	16896	
7	Promotion of TOF sector (Forestry Extension)	ha	2000000	714	
8	Protected areas and wildlife management	ha	300000	2985	
9	Management and Protection of existing plantations	ha	70000	125	
10	Promotion of Firewood saving devices and technologies	NA	Multiple Activities	357	
11	NTFP Development	NA	Multiple Activities	179	
12	Development of Forest industries	NA	Multiple Activities	242	
13	Strengthening forestry research	NA	Multiple Activities	680	
14	Strengthening community participation and rural livelihoods	NA	Multiple Activities	640	

Sr. No.	Programmes	Physical Target		Financial (crores Taka)	Remarks
		Units	Extent		
15	Management of forest encroachments	NA	Multiple Activities	120	
16	Supporting REDD+ Programme	NA	Multiple Activities	100	
17	Institutional reforms and capacity building	NA	Multiple Activities	11136	
18	Promotion of PPP for reforestation	NA	Multiple Activities	410	
19	Strengthening of monitoring and evaluation (Development of FRMA/FRMIS)	NA	Multiple Activities	400	
20	Civil works, vehicles, boats etc.	NA	NA	1000	
	Total			37495	

This is nearly an ideal scenario in which the sector gets adequate money it needs to achieve its objectives and has the capacity to utilize the resources effectively and efficiently. In this scenario, maximum expenditure is proposed on afforestation/reforestation in addition to institution reforms and capacity building. Afforestation and reforestation at this scale shall be possible only if some non-traditional sources of finance, such as PPP or institutional finance, are tapped. A large part of the institutional expenses proposed above shall in fact have to come from the revenue or normal budget as they pertain to salaries and allowances of the vacant posts likely to be filled up. In case a revised set up is approved for BFD, as proposed, the pressure on the revenue budget shall be much higher than what is shown above. Same applies to other sectoral organisations. Although it seems to be a difficult goal at the moment, but concerted efforts on the part of the BFD can take them significantly closer this financial goal.

9.2 Phasing of the financial requirements, aligned with five year plans

Phasing of physical and financial targets over the plan period is proposed as follows:

Phasing of financial targets

The plan period encompasses 5 five year plans (FYP) starting in the second year of the ongoing 7th FYP and ending in the first year of the 11th FYP. The allocations are likely to rise with each successive FYP as a result of the effect of inflation and perhaps better realisation of the importance of the sector, Based on this broad principle, phasing of financial inputs in the plan are proposed as follows:

Table 9-5: Phasing of scenario 2 expenditure (Crore Taka)

Sr. No.	Programme	Total Allocation	FYP 7	FYP8	FYP9	FYP10	FYP11
			2017-2020	2021-2025	2026-2030	2031-2035	2036
1	Preparation of management plans	580	69	112	150	201	48
2	Conservation of Natural Forest: Sal	60	7	12	16	21	5
3	Conservation of Natural Forest: Hill	300	36	58	78	104	25
4	Conservation of Natural Forest: SRF	500	59	97	129	173	41
5	New Plantations: All	4800	571	929	1243	1663	395
7	Promotion of TOF (Extension)	500	59	97	129	173	41
8	PAs and wildlife management	550	65	106	142	191	45
9	Protection of existing plantations	110	13	21	28	38	9
10	Firewood saving devices and technologies	30	4	6	8	10	2
11	NTFP Development	150	18	29	39	52	12
12	Forest industries	20	2	4	5	7	2
13	Strengthening forestry research	620	74	120	161	215	51
14	Strengthening community participation and rural livelihoods	500	59	97	129	173	41
15	Management of Encroachments	120	14	23	31	42	10
16	Supporting REDD+ Programme	50	6	10	13	17	4
17	Institutional reforms and capacity building	500	59	97	129	173	41
18	Dev. Of PPP for reforestation	10	1	2	3	3	1
19	Strengthening of M&E (FRMA/FRMIS)	400	48	77	104	139	33

Sr. No.	Programme	Total Allocation	FYP 7	FYP8	FYP9	FYP10	FYP11
			2017-2020	2021-2025	2026-2030	2031-2035	2036
20	Civil works, vehicles, boats etc.	200	24	39	52	69	16
	Total	10000	1189	1935	2589	3465	822

Phasing of physical targets

Physical targets under various items are phased on the same principles as above. Physical targets are primarily of three types:

- Repetitive targets which do not change from year to year, such as the protection of plantations, protected area management, conservation of natural forests etc.
- Additive targets which change from year to year on the basis of available funds, such as raising new plantations.
- Lumpsum targets consisting of multiple activities, such as improvement of monitoring and evaluation capacity, development of PPP policy and projects, promotion of forest industries and promotion of ToF sector and so on. These programmes consist of several sub-components and activities which may have annual targets but the entire programme cannot be described in terms of physical targets.

Accordingly, various kinds of plantations which shall be raised during the FMP period, along with their phasing, aligned with five year plans is given below:

Table 9-6: Plantation types and phasing of plantation activity under scenario 2

Plantation Type (ha/km)	FYP 7	FYP8	FYP9	FYP10	FYP11	Total Plantation
	2017-2020	2021-2025	2026-2030	2031-2035	2036	
Hill Forest (including reed land)	16632	20790	20790	22038	4158	84408
Plain land sal forest	170	212	212	225	42	861
Agroforestry on encroached lands	1482	1852	1852	1963	370	7520
Enrichment plantations with Assisted Natural Regeneration (hills and sal)	6937	8671	8671	9192	1734	35206

Plantation Type (ha/km)	FYP 7	FYP8	FYP9	FYP10	FYP11	Total Plantation
	2017-2020	2021-2025	2026-2030	2031-2035	2036	
Agor Plantation	1665	2081	2081	2206	416	8449
Bamboo, cane and Murta plantations (overlapping)	1413	1766	1766	1872	353	7171
Strip plantations (Seedling kilometres)	1215	1518	1518	1609	304	6164
Mangrove plantation- ha.	9790	12238	12238	12972	2448	49686
Enrichment planting, coastal-ha.	132	165	165	175	33	670
Non-mangrove coastal plantations	2667	3334	3334	3534	667	13535
Casuarina, palms along sandy beaches	656	821	821	870	164	3331
Golpata plantation-km.	559	699	699	741	140	2836
Plantation along Road/embankment sides, Homestead/institutional planting-seedling km/ha	1215	1518	1518	1609	304	6164
Inland char plantations	707	883	883	936	177	3586
Seedling sale/distribution	65406453	81758066	81758066	86663550	16351613	331937748
Total plantation area	45239	56549	56549	59942	11310	229588

Although the cost of plantations varies from type to type, the average cost per ha/km comes to Tk. 209070/ ha over the entire plan period of 20 years.

Plantations in different scenarios

Table 9-7: Extent of plantations proposed under different financial scenarios

Plantation Type	Target Scenario 1 (ha, km)	Target Scenario 2 (ha, km)	Target Scenario 3 (ha, km)
Hill Forest (including reed land)	30387	84408	300000

Plantation Type	Target Scenario 1 (ha, km)	Target Scenario 2 (ha, km)	Target Scenario 3 (ha, km)
Plain land sal forest	310	861	1200
Agroforestry on encroached lands	2707	7520	20000
Enrichment plantations with Assisted Natural Regeneration (hills and sal)	12674	35206	50000
Agor Plantation	3042	8449	10000
Bamboo, cane and Murta plantations (overlapping)	2582	7171	10000
Strip plantations (Seedling kilometres)	2219	6164	100000
Mangrove plantation- ha.	17887	49686	68000
Enrichment planting, coastal- ha.	241	670	5000
Non-mangrove coastal plantations	4873	13535	27000
Casuarina, palms along sandy beaches	1199	3331	5000
Golpata plantation- km.	1021	2836	4000
Plantation along Road/embankment sides, Homestead/institutional planting- seedling km/ha	2219	6164	20000
Inland char plantations	1291	3586	5000
Seedling sale/distribution (million)	119	332	500
Total plantation area	82652	229588	620200

As can be seen, nearly all the vacant/denuded land can be covered with trees only under scenario 3

9.3 National and international sources of finance

9.3.1 National sources

Government of Bangladesh provides regular budgetary grants to various forestry sector organisations for maintenance and for some limited development work. Most of this money comes in the form of “revenue budget”. All the development work in BFD is now done in the form of projects funded either by the state itself or by external donor/lender agencies. However, looking at the growing needs of the sector, some non-traditional sources of funds can also be explored as indicated below.

Bangladesh Climate Change Trust Fund

The GoB has created Bangladesh Climate Change Trust Fund (BCCTF) under the climate change Act to finance climate change mitigation and adaptation activities, since 2010. BCCTF is resourced entirely from the government's own budget. The Government has allocated BDT 3100 crores (US$ 400 million approximately) to CCTF so far. As of June 2016, 440 projects have been undertaken. 377 projects are being implemented by government, semi-government and autonomous agencies, while 63 projects are being implemented by NGOs under the supervision of PKSF. Although forestry is a key sector which is impacted by climate change while also being a high-potential mitigation tool, no significant forestry projects have been supported by BCCTF so far, although the fund's website lists "144.20 million trees have been planted and 4971 hectares of forest land have been brought under afforestation; 7800 biogas plants have been installed; 528000 improved cook-stoves have been distributed" among its achievements. This fund holds some potential for financing core forestry activities as well and possibilities of access should be seriously explored.

Public Private Partnerships (PPP)

As indicated before, GoB in partnership with development partners and international financial institutions (IFIs), invests funds in taking care of the state forest lands and promotion of TOF sector, research and other programmes of common public interest, while people invest in planting and maintaining trees on their personal lands. However, in view of the persistent inability of GoB to find enough funds to meet the sectoral requirements, despite continued donor/lender support, particularly for reforestation of degraded forest lands, it is important to look beyond the traditional sources of forestry finance. Governments across the globe, including Bangladesh, are resorting to PPP modes of financing public programmes in a way that the programme becomes profitable as a business to a private investor while serving public purpose as well. In August 2010, the Government of Bangladesh issued the "Policy and Strategy for Public Private Partnership (PPP)" to facilitate the development of core sector public infrastructure and services vital for the people of Bangladesh. The PPP program is part of the Government's Vision 2021 goal to ensure a more rapid, inclusive, growth trajectory, and to better meet the need for enhanced, high quality, public services in a fiscally sustainable manner.

Under this new national policy, the PPP Authority was established as a separate, autonomous office in the Prime Minister's Office to support line ministries to facilitate identification, development and tendering of PPP projects to international standards. A PPP Unit under the Ministry of Finance was established to foster an environment of fiscal responsibility and sustainability in PPP projects.[24] Bangladesh Public Private Partnership (PPP) Act, 2015 is in place to regulate the PPP projects. A provision for providing viability gap funding (VGF) to social sector projects which do not have inherent potential for profit is already there. So far forestry sector has not explored the PPP option to finance projects. BFD should start discussions with the PPP Authority to bring forestry sector into the ambit of PPP. As reforestation projects have a high element of social benefit and may not be highly profitable, they will often need VGF

[24] http://www.pppo.gov.bd/

support. If a proper policy environment for facilitating PPP in forestry, particularly in reforestation of degraded hill forests, is created, achieving the tree-cover targets (20% of geographical area), along with all the concomitant benefits, will become much easier for the country. Despite the serious land tenure issues in CHT, where most of the degraded forests lie, which may need to be resolved before any PPP projects are implemented, this is an avenue that must be explored in view of the dire needs of the country.

Institutional finance

Developing degraded forests by using commercially borrowed money from Banks and non-banking financial institutions is another option available to the forestry sector. India set up a series of state level Forest Development Corporations (FDCs) to channelize institutional finance into forestry in the sixties and seventies. These corporations undertook large scale commercial plantations of teak and other species, in forest lands allotted to them, which are now maturing and giving them substantial returns. The possibility of a similar approach can be evaluated for Bangladesh. A commercial body like an FDC can use both, PPP and commercial borrowings, to reforest hill forests. Projects undertaken through borrowed money will also need VGF support which can be provided at par with the PPP projects, to make the repayment of loans easier.

Corporate social responsibility (CSR)

Industries and businesses spending funds on social and environmental causes is a global practice and is growing. Most companies tend to invest in social and environmental programmes, in the name of CSR, either as a sense of responsibility towards common causes or as a political or business compulsion (their customers desiring it). CSR in Bangladesh is not big at present but it is likely to grow with industrial development and improving economy. Therefore, BFD should interact with major industrial houses, preferably export oriented, to help them plan their CSR inputs in the forestry sector. At present, most companies focus their CSR work on sectors like community livelihoods, health, sanitation and education etc. Tree planting is generally done at a limited level. However, as forestry has a strong stake in community livelihoods, attracting these inputs towards forest-side communities can be a direct contribution to forestry.

At present, Bangladesh does not have any law related to CSR but sooner or later such a law will be passed, as in most other countries. These laws oblige all big corporates to spend a part of their earnings (2-3%) on social causes. It is important that whenever such a law is passed, forestry is one of the eligible sectors to benefit from CSR. CSR support to forestry may never be big at the national level but, whatever inputs come, they can often make a difference at the local level.

9.3.2 Development partners

As stated before, forestry in Bangladesh has traditionally been heavily dependent on external assistance. Whereas the GoB finances the maintenance of the department in the form of salaries and other core liabilities, very limited development work has been done on the strength of purely local resources. Institutions other than BFD, in the forestry sector, hardly get any development budget, national or international. The international financial assistance to

Bangladesh is provided by various bilateral and multilateral agencies called Development Partners (DPs). Bangladesh receives international assistance from a large number of development partners, such as the World Bank, Asian Development Bank (ADB), United Nations Development Programme (UNDP), Food and Agricultural Organisation (FAO), UNESCO, Global Environment Facility (GEF) etc. and bilateral donor agencies such as USAID, SIDA, DFID, GIZ and EU.

There have been a large number of internationally funded projects in the country and a fair amount of international finance has been flowing into the forestry sector of the country. There have been virtually no blank years for a long time. While several large projects have been completed, new ones are being discussed and a considerable amount of funds have been lined up for the next few years.

Various donors have recently established new funding programmes to support developing countries to undertake mitigation or adaptation projects in the forestry sector, mostly focusing on up-front financing of REDD+ readiness activities prior to the availability of results-based finance. Some examples of such bilateral opportunities are through:

- **Norway International Climate and Forest Initiative** – NICFI has provided large amounts of money to several countries, including the highly publicized USD 1 billion pledges to Brazil and Indonesia, with smaller but still substantial amounts going to Guyana and Tanzania. NICFI is also a major donor to the UN-REDD Programme and IFI programmes.[25]
- **Germany REDD Early Movers Program** – The REM supports REDD+ pioneer countries who are taking initiatives in forest conservation for climate change mitigation. The programme rewards the climate change mitigation performance of those countries by buying up verified emission reductions and promotes sustainable development for the benefit of small-scale farmers as well as forest-dependent and indigenous communities, through fair benefit sharing. Technical support is provided by GIZ and finance is managed by KfW.[26]
- **United States USAID, Forest Service and Tropical Forest Alliance 2020 (TFA)** – The United States is providing substantial support to forestry operations through the Tropical Forestry Alliance 2020. In addition, its regular forestry programmes through USAID and the Forest Service are strongly focused on REDD+.
- **Global Climate Change Alliance** – The GCCA was established by the European Union (EU) in 2007 to strengthen dialogue and cooperation with developing countries, in particular least developed countries (LDCs), and small island developing States (SIDS). By fostering effective dialogue and cooperation on climate change, the Alliance helps to ensure that poor developing countries most vulnerable to climate change

[25] https://www.regjeringen.no/en/topics/climate-and-environment/climate/climate-and-forest-initiative/id2000712/
[26] https://www.giz.de/en/worldwide/33356.html

increase their capacities to adapt to the effects of climate change, in support of the achievement of the Millennium Development Goals (MDGs). Where this benefits their poverty reduction objectives, the Alliance also helps such countries to participate in the global climate change mitigation effort.

- **Forest Carbon Partnership Facility** – The Forest Carbon Partnership Facility (FCPF) is a global partnership of governments, businesses, civil society, and Indigenous Peoples focused on reducing emissions from deforestation and forest degradation, forest carbon stock conservation, the sustainable management of forests, and the enhancement of forest carbon stocks in developing countries (activities commonly referred to as REDD+). The FCPF has two separate but complementary funding mechanisms — the Readiness Fund and the Carbon Fund — to achieve its strategic objectives. Both funds are underpinned by a multi-donor fund of governments and non-governmental entities, including private companies that make a minimum financial contribution of $5 million.
- **Bangladesh Climate Change Resilience Fund (BCCRF)** — The GoB has created the Bangladesh Climate Change Resilience Fund resourced by funds pledged and provided by developed countries or groups. BCCRF is a coordinated financing mechanism by the Government of Bangladesh, development partners and the World Bank, to address the impacts of climate change. The fund was established in May 2010 with financial support from Denmark, European Union, Sweden and United Kingdom. Switzerland, Australia and United States subsequently joined the fund. This mechanism has enabled the Government to channel in over US$188 million grant funds to build people's resilience to the effects of climate change. This fund also supports forestry activities in the form of projects such as CRPARP. However, this fund is scheduled to close in June 2017 and may not be relevant in future unless an alternative system is put in place.

9.3.3 Climate finance options for forestry under the UNFCCC

The various options that are available through the UNFCCC process are presented in more detail in Table below.

Table 9-8: Climate finance options for forestry in Bangladesh

Mechanism	Characteristics
CDM – Clean Development Mechanism	
Overview	The CDM of the Kyoto protocol has as objective to reduce emissions of GHG through provision of financial and technical assistance from Annex I countries to non-Annex I countries in the establishment of projects. Under the CDM Scope 14 is for Afforestation and Reforestation. CDM has fairly elaborate administrative, reporting and validation requirements, reasons why afforestation and reforestation projects have not been many because the overhead costs erode the financial viability of the project. As a result, small scale activities were allowed, with reduced administrative requirements and hence lower overhead costs. More interestingly, a

Mechanism	Characteristics
	Programme of Activities (PoA) can be defined which acts as an umbrella for multiple small projects in a country, with its concomitant benefits of scale. For instance, a PoA for social forestry could include all new plantations on degraded RF land throughout the country and then be registered as a single CDM project.
Scope	For afforestation projects only that land can be included which did not support actual forest in the past 50 years. For reforestation projects only that land can be included which did not support actual forest since 1 January 1990. The minimum area would be several tens of thousands of hectares[27] for the project to be financially viable.
Requirements	Bangladesh needs to formally submit the CDM proposal to the UNFCCC. Local stakeholders need to be consulted and detailed assessments need to be made of additionality, persistence and leakage.
Financing	CDM projects always need a donor country that provides technology and financing of the project. Any issued Certified Emission Reduction (CER) certificates will be assigned to the donor countries to offset their domestic GHG emissions with the reductions achieved in Bangladesh.
Feasibility	The Kyoto Protocol, of which the CDM is part, is currently in its second commitment period and it is doubtful if the Kyoto Protocol will be extended following the adoption of the new climate agreement at COP-21 in December 2015 and which will become operational from 2020 onwards. Individual afforestation and reforestation projects are not likely to be financially viable, but bundling them into a PoA is a more tenable option. Nishorgo developed a CDM project for the Chunoti Wildlife Sanctuary in 2007, but this has not been submitted to the UNFCCC.
REDD+ – Reducing emissions from deforestation and forest degradation	
Overview	The REDD+ mechanism was proposed in 2005 to enable the incorporation of GHG emission reductions from natural forests in non-Annex I countries into mitigation programmes. The REDD+ mechanism is still under negotiation as of June 2016, although most elements of the mechanism have been defined in a series of decisions from the Conference of the Parties to the UNFCCC. The REDD+ mechanism has five eligible activities: 1. Reducing emissions from deforestation

[27] A regular CDM project should have a minimum projected annual emission reduction of 16 $ktCO_2e/yr$ (decision 9/CMP.3), for a small-scale CDM project the amount is less than that. Given the administrative overhead and low price of Certified Emission Reduction certificates, projects tend not to be financially viable unless much higher annual emission reductions are achieved.

Mechanism	Characteristics
	2. Reducing emissions from forest degradation 3. Conservation of forest carbon stocks 4. Sustainable management of forests 5. Enhancement of forest carbon stocks
Scope	If Bangladesh opts for the REDD+ mechanism then all Forest Land[28] in Bangladesh will have to be included in the National REDD+ Programme. The only exceptions will be made for forests included in other climate finance agreements, such as the CDM, FCPF, FIP, etc.
Requirements	Decision 1/CP.16 defines the four required elements of a National REDD+ Programme: 1. A national strategy or action plan 2. A national forest reference emission level and/or forest reference level, in accordance with national circumstances 3. A robust and transparent national forest monitoring system for the monitoring and reporting of the eligible activities, in accordance with national circumstances 4. A system for providing information on how the safeguards are being addressed and respected throughout the implementation of the eligible activities In effect, the safeguards require Bangladesh to have *full and effective* engagement of all local stakeholders, specifically also *indigenous peoples and local communities* in all relevant aspects of any activities implemented under the National REDD+ Programme.
Financing	Bangladesh has to prepare a Technical Annex to the National Communication with full details of the REDD+ Programme and activities. This Technical Annex will be assessed through the International Consultation and Analysis process organized by the UNFCCC Secretariat. If the Technical Annex is found to be compliant with UNFCCC decisions, then Bangladesh can apply for "results-based finance" at the Green Climate Fund. The current (June 2016) price for REDD+ GHG emission reductions is approximately USD 5 – 5.50 per tCO_2e. Any amounts awarded would accrue directly to Bangladesh and are expected to be applied towards the operation of the National REDD+ Programme and otherwise be distributed to the stakeholders of the REDD+ activities in a form deemed appropriate by the government.

[28] "Forest Land" is a land use category under the IPCC Guidelines. In principle it contains all land that is currently forested, but it should also include land that is designated as forest even though it is not currently forested, such as degraded RF land and land accretion in RF areas.

Mechanism	Characteristics
Feasibility	Once the system is properly set up it is rather straightforward and many current programmes and activities could be brought under the National REDD+ Programme with limited additional work, such as the social forestry programme. However, establishing the reference (emission) levels and the national forest monitoring system are complex undertakings and a continuous system for forest resources assessment has to be set up and maintained. Bangladesh is actively participating in various REDD+ initiatives and a project is currently being implemented with support from the UN-REDD Programme.
NAMA – Nationally Appropriate Mitigation Actions	
Overview	Under the NAMA mechanism non-Annex I countries like Bangladesh can develop projects that reduce GHG emissions enhance removals of GHGs from the atmosphere and register these with the UNFCCC Secretariat to solicit funding for further development and/or implementation
Scope	There are limited guidelines on the scope of projects that can be proposed, implying that a wide range of projects and activities is eligible.
Requirements	There are no specific requirements for NAMA proposals or projects. Reporting on NAMAs is largely voluntary but emissions reductions or enhanced removals should be accounted for in national greenhouse gas accounts.
Financing	Donor countries or IFIs can browse the NAMA registry and decide to support a proposal for further development and/or implementation. Otherwise there are no standards, guidelines or requirements for financing.
Feasibility	In the forestry sector Bangladesh has not developed any NAMA proposals. While such proposals can be developed and submitted, there is no guarantee of financing.
INDC – Intended Nationally-determined Contributions	
Overview	In decisions 1/CP.19 and 1/CP.20 the UNFCCC invited all Parties to communicate to the Secretariat their Intended Nationally-determined Contributions well in advance of COP-21 where the new climate agreement, of which the INDCs are part, was to be adopted. The INDCs are an intention of the Parties to reduce GHG emissions and enhance GHG removals. Individual activities identified in the INDC of non-Annex I countries can attract funding from Annex I countries or IFIs.
Scope	The INDCs are completely open-ended.
Requirements	There are no specific requirements for INDC activities.
Financing	Donor countries or IFIs can browse the INDC Portal and decide to support a proposal for further development and/or implementation. Otherwise there are no standards, guidelines or requirements for financing.
Feasibility	Bangladesh submitted its initial INDC in September 2015 with the following

Mechanism	Characteristics
	mitigation activities for the forestry sector: • Coastal mangrove plantation • Reforestation and afforestation in the reserved forests • Plantation in the island areas of Bangladesh • Continuation of Social and Homestead forestry In adaptation the priority activity of "Biodiversity and ecosystem conservation" has been identified.

Box 9-1: UN-REDD Bangladesh Programme overview.

Bangladesh is a Partner Country of the UN-REDD Programme, a collaboration between FAO, UNDP and UNEP[29]. Over the period June 2015 – March 2018 the national programme will be implemented with a USD 2.3 million grant. By February 2016 the programme had not yet started due to delays in the development and approval of the Technical Project Proposal.

The outcomes of the programme are:

1. Improved stakeholder awareness and effective stakeholder engagement
2. National REDD+ strategy preparation supported
3. Capacities to develop and test National Forest Reference Emission Level (REL) and/or Forest Reference Level (RL) are in place
4. National Forest Information System can be used to develop a National Greenhouse Gas Inventory for the Forest Sector

When the above outcomes have been realized, Bangladesh should have all the skills and capacities in place to produce the materials necessary to comply with the requirements of the UNFCCC for participation in the REDD+ mechanism (see information on REDD+ mechanism above).

Apart from the above, there are several other funds operated by UNFCCC to assist developing countries in mitigation of, and adaptation to, climate change impacts. Forestry is one of the activities envisaged for funding under these programmes. For example,

Special Climate Change Fund (SCCF)

The Special Climate Change Fund (SCCF) was established under the Convention (UNFCCC) in 2001 to finance projects relating to: adaptation; technology transfer and capacity building;

[29] In Bangladesh the UNEP is not participating in the National REDD+ Programme.

energy, transport, industry, agriculture, forestry and waste management; and economic diversification. This fund should complement other funding mechanisms for the implementation of the Convention.

Adaptation Fund

The Adaptation Fund (AF) was established in 2001 to finance concrete adaptation projects and programmes in developing country Parties to the Kyoto Protocol that are particularly vulnerable to the adverse effects of climate change. The Adaptation Fund is financed with a share of proceeds from the clean development mechanism (CDM) project activities and other sources of funding. The share of proceeds amounts to 2 per cent of certified emission reductions (CERs) issued for a CDM project activity. As CDM is currently not doing well, this fund is being supplemented by other sources as well.

Least Developed Countries Fund

The Least Developed Countries Fund (LDCF) was established to support a work programme to assist Least Developed Country Parties (LDCs) carry out, inter alia, the preparation and implementation of national adaptation programmes of action (NAPAs). LDCF provides support to eligible countries for the implementation of NAPAs, providing guidance with regards to priority areas, and provisions on full-cost funding and a co-financing scale.

9.3.4 Climate finance options for forestry through IFIs

The International Finance Institutions (IFIs) are also providing climate-related financial instruments for forestry projects, in particular in support of the REDD+ mechanism. Bangladesh is not currently participating in any of these programmes, although the Forest Investment Program (FIP) administered by the World Bank awarded a grant of USD 250,000 to Bangladesh in July 2015 to develop a Forest Investment Plan which may lead to further financing. World Bank is likely to finance a project worth USD 50-80 million under FIP and GCF.

The Green Climate Fund (GCF) acts as the finance institution of the UNFCCC and has been allocated funds to provide assistance to developing country Parties to undertake mitigation and adaptation projects. For REDD+ programmes, this is the main conduit of results-based finance, but other forestry activities might also be eligible for funding, especially in the area of adaptation to climate change. By June 2016, the GCF had not yet published its modalities for financing mitigation and adaptation projects. The fund has a target of collecting USD 100 billion by 2021.

Pilot Program for Climate Resilience (PPCR)

The $1.2 billion Pilot Program for Climate Resilience (PPCR), is a funding window of the Climate Investment Funds (CIF). Using a two-phase, programmatic approach, the PPCR assists national governments in integrating climate resilience into development planning across sectors and stakeholder groups. Second, it provides additional funding to put the plan into action and pilot innovative public and private sector solutions to pressing climate-related risks.

The PPCR empowers countries to approach climate resilience in a programmatic manner. Moving beyond project-by-project activities that have limited potential to effect national or sector wide transformations, the PPCR programmatic approach entails a long-term, strategic

arrangement of linked investment projects and activities to achieve large-scale, systematic impacts and take advantage of synergies and co-financing opportunities.

Giving priority to highly vulnerable least developed countries, including small island developing states, the PPCR provides grants and highly concessional financing (near-zero interest credits with a grant element of 75%) for investments supporting a wide range of activities, such as, water resource management, urban development, infrastructure, enabling environment, coastal zone management, climate information systems and disaster risk management, and agriculture and landscape management.

9.3.5 Voluntary carbon market

In anticipation of the conclusion of the negotiations on REDD+ at the UNFCCC, the voluntary carbon market has developed methodologies for REDD+ projects in any country in the world.[30] Project proposals can apply these methodologies and apply for registration with certification bodies such as Voluntary Carbon Standards (VCS).[31] Projects have to be verified by independent auditors and, if successful, carbon credits can then be registered on an international market for purchase by others, usually companies or public entities in industrialized countries who want to reduce their own net carbon emissions as part of their corporate social responsibility.

The supply of carbon credits in the voluntary carbon market has been growing rapidly in recent years, but there is an imbalance with demand, leading to uncertainties for project developers and a reduced market price for carbon credits, which in 2014 reached a historical low of USD 3.8 per tCO_2e.[32]

9.4 Conclusion: available financial resources

It is obvious from the above account that several diverse sources of funds for the forestry sector are available for the future. Apart from the normal budget of the government, projects worth nearly Tk. 1500 crores, for the next five years, have either been approved or are under discussion with various donors. In addition, World Bank is looking for an additional opportunity to invest approximately USD 50-80 million (at least Tk. 400 crores in five years) under FIP. This indicates an average ADP size of approximately Tk. 300-400 crores which is significantly below the projected requirement for scenario 2 of the FMP, but indicates some increase from the previous trend. If this trend persists, scenario 2 targets should be possible to achieve with some effort while reaching the dream figure of Tk. 37500 crores, for a scenario 3 level of investment, to implement the FMP, will not be easy even if concerted and persistent efforts are made by the GoB and BFD.

[30] Technically speaking, projects in the voluntary carbon market cannot be REDD+, because the decisions by the UNFCCC define REDD+ as a national programme with requirements that can not be met by project-based activities.
[31] http://www.v-c-s.org
[32] *State of the Voluntary Carbon Markets 2015*, Forest Trends. http://forest-trends.org/releases/uploads/SOVCM2015_FullReport.pdf

It is also obvious that a large number of hitherto unexplored international avenues for concessional funding for forestry are available for Bangladesh, both as a least developed country (LDC) as well as for being the most climate-vulnerable country in the world. The country has to develop the institutional capacity to access these resources. Therefore, BFD should create a dedicated unit to develop expertise in developing suitable proposals/projects...

9.5 Other resources required

Apart from funds, manpower, technical capacity and equipment, a forestry enterprise requires many other kinds of resources from time to time, such as land, water, nutrients, labour etc.

The national target of 20% tree covered area envisages the use of nearly 2.95 million ha land, while 2.49 million ha area is already under tree cover (10% or more canopy density). Thus, the country needs to bring another half a million (460,000 to be precise) ha of land under tree cover to meet the national target. Out of this, nearly 300,000 ha of degraded land is available for reforestation in the hill forests while another one lac ha is available for coastal plantations as per the FIGNSP 2013 report. Thus, the country shall have to increase the tree-cover on private lands, homesteads, unused wasteland and cultivated lands, to the extent of 40000-50000 ha to make up for the shortage of land in government custody. Going by the perceived trends in the growth of TOF, increase in TOF seems to be quite likely, as it is driven by private capital and economic interest. The real question is whether GoB shall be able to garner the resources to reforest its own state forests.

In forestry, irrigation is required primarily for raising nurseries. Although irrigated plantations do show higher growth rate, the economics of irrigation in forestry is often unattractive. Irrigation may be important in arid or semi-arid areas, but not in a high rainfall area like Bangladesh. In Bangladesh, most of the plantations are going to be raised in the hill areas which receive the highest rainfall in the country, and in the chars which will be inundated, often daily. Thus, they are not going to need any irrigation support. There are plenty of opportunities to set up site-level nurseries near perennial rivers. Although ground water table is receding even in Bangladesh, due to lowering recharge rates and high extraction rates, finding enough ground water for nurseries is not going to be difficult, if need be.

Again, the economics of fertilization of forestry plantations is still debatable, although nutrient supplementation in the nurseries is a standard practice. All the commonly used fertilizers, particularly NPK based preparations, are easily available in the markets and their availability is not likely to be an issue.

Although Bangladesh is a labour surplus country, timely availability of labour can be affected by festival seasons and alternative employment opportunities available locally. With the rate at which Bangladesh is urbanising, labour shortages in the rural areas may be experienced in future. Moreover, as plantation work is going to be concentrated in a few tracts, i.e. hill areas and coastal areas, local shortage of labour may affect operations here and there. Quite often forestry operations are afflicted with labour shortages as the working season coincides with some festival or the other. In general, however, availability of labour may not be an issue in forestry operations in Bangladesh if they are implemented in a planned manner.

10 Conclusions

This master plan document clearly indicates that all institutions in the forestry sector are suffering from serious shortcomings and deficiencies, which include shortage of resources, manpower, lack of knowledge and access to modern technologies, inadequate legal cover and poor enforcement, large scale decimation of forest resources and encroachment of forest land, little ability of addressing new challenges like climate induced factors and many other anomalies. These need immediate elaborate reviews to identify the causes and possible remedies. A revision of the National Forestry Policy has been completed addressing all the aforementioned issues and other important matters and submitted to the Ministry of Environment and Forests for necessary approval and follow up actions.

The sector does not have the required financial resources or the required and qualified manpower and other necessary tools to implement the plan and given the annual budgetary allocations, will require massive infusion of funds from external sources to implement the recommended programmatic interventions.. However, the whole sector is currently in a catch 22 situation, where donors will only extend support when they feel that their resources will be efficiently utilised in a timely manner. So, a comprehensive programme for institutional development covering manpower recruitment and development, innovate approaches to it, at least in the short run will have to be initiated immediately, legal and regulatory tolls including revisions of laws, legal and administrative rules will have to be revised and updated.

The recruitment of a large number of ACFs and field staff against projects and their retention after the project periods were over and failure to clarify their status in the Forest department has created an unique anomaly, which the Department has failed to resolve completely over the last two decades or so. Litigations, injunctions and other related issues have led to a situation, where no recruitment of cadre ACFs has taken place since 2004. The situation has deteriorated so much that in the next three years, there will not be enough officials available to hold even 20% of the currently approved positions. The consequences for the Forest Department will be very serious unless this issue is completely resolved, which will require an intervention from the highest level overriding all other considerations. The recruitment at the Forest Ranger's level has been discontinued for the last two decades and the number of incumbents for placement will be reduced to less than 20% of the sanctioned positions in less than four years from now.

Bangladesh Forest research Institute and the Bangladesh National Herbarium are suffering from an acute shortage of manpower, equipment and resources necessary to undertake regular and needed research programmes. Recruitment rules are outdated and processes highly bureaucratic. Promotions are slow and there is very little other incentive to work at these institutions. Forestry programmes in the universities in Chittagong, Khulna and Sylhet have a large number of highly qualified faculty and have been undertaking impressive forestry research with assistance from their students and have made several publications in international journals. Some of the other government run universities have well qualified faculty who have been conducting research in various aspects of flora and fauna, as well as social and economic issues associated with forestry sector. These need to be promoted.

Forest Industries Development Corporation is suffering from an array of serious problems. It is losing money every year and some of their major enterprises are regularly in the red! The performance of different enterprises run by BFIDC need to be reviewed immediately and drastic decisions about the regularly non-performing enterprises need to be taken. In addition as a forest industries development corporation, it has no role in the development forest industries in the country. The organisation needs to reorient its activates and include promotion of forest industries in the private sector as a major focus of its programme. Private sector industries need attention and incentives and these need to be looked into.

The forestry sector institutions are on the verge of collapse and need immediate attention from the concerned authorities. Without which, most of the sector organisations will crash within a few years!

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List of Annexes

1. Task report 1: 9 sectoral reports on the state of forests and forestry.
2. Task report 2: Strategies, programmes and resources.
3. Task report 4: Climate change projections, impacts and vulnerability analysis.
4. Task report 5: Sustainable forest management practices.
5. Task report 6: Forestry policies, institutions and resources for the FMP implementation.
6. Task report 7: Monitoring of socioeconomic and ecosystem services impact indicators.