

Agricultural Research Priority : Vision- 2030 and beyond

Sub-sector :Forestry

Farid Uddin Ahmed
Executive Director
Arannayk Foundation
and
Dr. A.F.M. Akhtaruzzaman
Former Director
Bangladesh Forest Research Institute

Bangladesh Agricultural Research Council
Farmgate, Dhaka 1215

March 2010

Acronyms

ADP	Asian Development Bank
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
BCSIR	Bangladesh Council of Scientific & Industrial Research
BFRI	Bangladesh Forest Research Institute
CBO	Community Based Organisation
DNMS	District Nursery Malik Samity
DoE	Department of Environment
DU	Dhaka University
FD	Forest Department in Bangladesh
GDP	Gross Domestic Product
IFESCU	Institute of Forestry and Environmental Science, Chittagong University
IPCC	Intergovernmental Panel of Climate Change
KU	Khulna University
MoEF	Ministry of Environment and Forest
NTFP	Non-timber forest products
USF	Unclassed State Forest

A Vision for Agricultural Research in Bangladesh

Sub-sector :Forestry-2030

Executive Summary

This study is undertaken at the initiative of Bangladesh Agricultural Research Council (BARC) as a part of preparing a Vision Document for 2030 in Agricultural Research in Bangladesh. At the beginning, an overview of the present status and future trends in the sector is given. It is observed that the forest area is declining at an alarming rate. The estimated forest land stands at 1.738 million ha in 2020 and 1.60 million ha in 2030, against 2.53 million ha in 2007. There is already a large gap in demand –supply of forest resources. The situation will be much bleak in the years to come. The estimated shortage of wood comes at 14.44 million m³ in 2020 and 23.88 million m³ in 2030. The demand – supply gap of bamboo is projected as 390.78 million culms in 2020 and 497.24 million culms in 2030. On analyzing the problems/constraints, the opportunities in the sector have been explored. There are potentials to overcome the crisis to a great extent. All vacant lands including barren Un-classed State Forest should immediately be brought under tree cover either through afforestation under the umbrella of social forestry or just by protection of the forests to encourage natural regeneration. Marginal private land should also be made more productive through agroforestry. Afforestation and conservation of forests and biodiversity makes significant contribution in both adaptation and mitigation of climate change. There is a urgent need for the country to undertake appropriate measures to plant appropriate species in all vacant land. The priority matrix has identified future research needs to support massive afforestation and conservation of forests and biodiversity.

1. Introduction

This study is undertaken at the initiative of Bangladesh Agricultural Research Council (BARC) as a part of preparing a Vision Document for 2030 in Agricultural Research in Bangladesh. The document is expected to generate the outlook of research of the forestry sector in the country till 2030. This will facilitate in structuring research with an aim to improve the situation of the sector. Thus, the vision must take into account the forestry production, the demand-supply status, the challenges, problems and opportunities, and make a balance between the environment and development.

1.1. Background

Bangladesh is a small country with an area of 147,570 km² (1). It is a thickly populated country. According to the latest census in 2001, the population of the country was 130 million. With the population growth rate of 1.48% (Statistical Year Book 2004, Bangladesh Bureau of Statistics (BBS)), the present population stands as 141.98 million. Thus, the population density is around 962/km². This is one of highest figure globally. As a result, there is a tremendous pressure on the natural resources of the country. Consequently, poverty has become a serious issue. It is fortunate to learn that recently human poverty trends (deprivation in health, education and nutrition) have shown faster improvement than poverty income trends (ERD, Government of Bangladesh 2005 quoted by (2)).

There is, naturally, a crying demand for wood for the swelling population. Considering the two dominant development paths –rapid economic growth through industrialization and agriculture, forests are continuously deleted at an alarming rate. Mangrove forests are encroached for shrimp culture. This provides a quick economic return at the cost of complex coastal ecosystem that protects the people from cyclone and tidal surges. Hill forests are being cleared to increase visibility in order to control insurgencies during last two decades. In addition, some serious natural problems like top dying of sundri trees in the Sundarbans and dieback of sissoo, and bamboo blight in village forests have also contributed to the depletion of forest resources. On the contrary, the yield of forests is very low. A bulk of the wood produced after long gestation period is lost due to improper post harvest technologies.

The people in general, with a low level of literacy of 32.4 in 1996% (1), are little aware of forest and environment. Such lack of awareness has definitely a negative impact on forestry in Bangladesh. The high demand of wood coupled with the lack of awareness of the mass people generates a very high pressure for causing illicit felling. The overall poor socio economic conditions of the people lead them to harvest or collect wood especially fuel-wood, mostly for cooking from the forest areas of the government. All these factors also contribute to depletion of the resources. In addition degraded law and order situation, natural calamities, pollution, etc., also contribute to depletion of forest resources.

The problems are not unique to Bangladesh. Every country takes appropriate measures to combat the problems through strengthening forestry activities including undertaking need-based priority research and development in this sector. To this end, this study is aggressively warranted. This will give a guideline to the present and future actors to address the issues in a planned approach.

1.2. Key Questions to be Addressed

The main objective of this vision document is to make an outline of the research needs to meet the challenges of the forestry sector in augmenting the demand of forest resources of the country till the year 2030. To this context, the following may be some of the relevant questions that may be looked at:

- i) The current trend in production of forest resources
- ii) The present and future demand and supply of forest resources
- iii) Analyse the supply and demand gap of the resources
- iv) Analysis of the problems, constraints and opportunities in the forestry sector
- v) Technological interventions required in the context of the country's need

1.3. Methodology

The major process in preparing this document are, but not limited to were as follows:

- Review of relevant documents and collect all possible information and data.
- Visit the useful internet website and collect possible information and data.
- Recall outcome of various seminars, workshops and meetings with expert groups as well as beneficiaries.
- Discussion with relevant stakeholders

- Sharing of information and experience with the experts at various times during the study.
- Analyzing the comments/opinions of the workshop on the draft report and incorporation of the justified suggestions in preparing the final report.
- Further sharing of the outcome of the study for validation of the findings.

2. Current Trend and Status of Forest and Production of Forest Resources

It is estimated that about 5,000 plant species with 15% tree, 35% shrub and woody climbers, and 50 % herb species exist in Bangladesh. In term of number there are 750 – 800 tree species in the country (3). There are over 300 fresh water wetland floral species in Bangladesh. The major wildlife species of Bangladesh includes 125 mammals, 750 birds, 500 fishes, 125 reptiles and 9 amphibians. At present 27 plants, 40 mammals, 41 birds, 54 fishes, 58 reptiles and 8 amphibians are extinct, threatened and/or vulnerable (4, 5). Forest covered area declined at 3.3% annually (6) since the past two decades. The wetland area declined at a faster rate due to infrastructure development and faulty water management interventions. Eco-environment degradation caused a resultant depletion of biological resources and affected the poor stratum of the population who depend more on these resources. The poorly planned development efforts thus affected the fishermen, woodcutters, boatmen and other forest dependent professional communities. The main causes of depletion of the forest resources in the country are noted in the Background of this report above.

2.1. Status of Forest

According to the information of Forest Department (FD) in Bangladesh in 2007 cited by Choudhury and Hossain (2) the total forest area in Bangladesh is 2.53 million hectare as noted in Table 1

Table 1. Total forest area in Bangladesh (2)

Forest Category	Area in million hectares (According to FD)	Area in million hectares (According to Forestry Master Plan)
Hill Forest	1.4 ¹	0.4
Sal Forest	0.12	0.12
Village Forest	0.27	N.A.
Mangrove Forest	0.74 ²	0.48
Total	2.53	

¹ 0.67 million ha under FD and 0.73 million ha under USF (of this 0.02 million ha under FD)

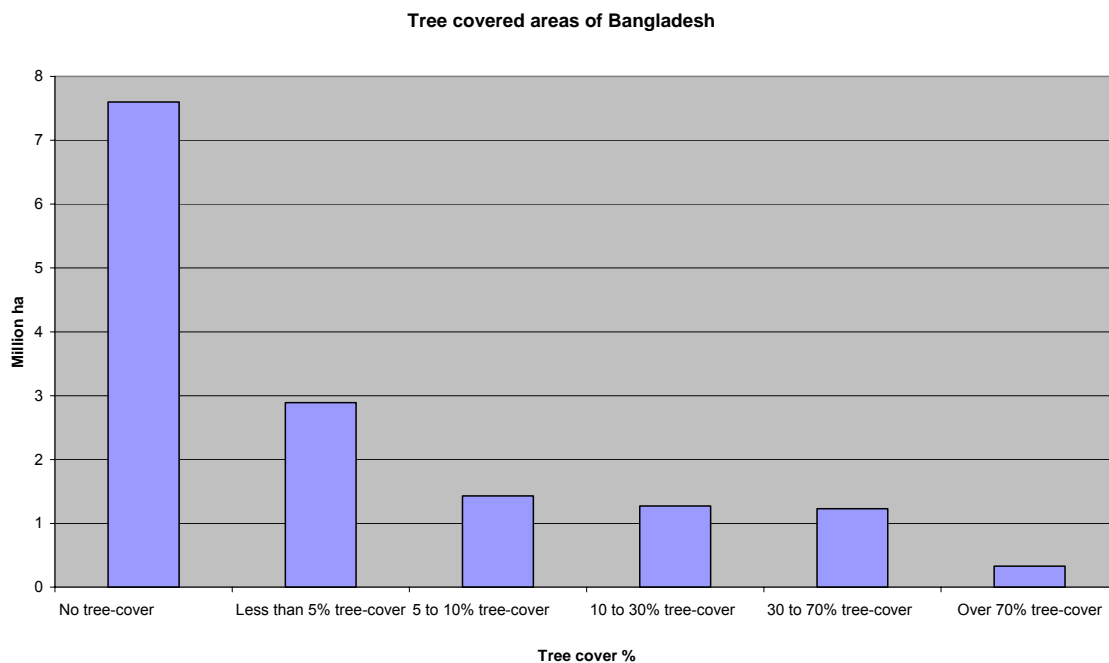
² 0.6 million ha in Sundarbans and 0.15 million ha under mangrove afforestation

Out of 2.53 million hectares of forests area in Bangladesh, FD manages 1.53 million hectares. The 1.53 million hectares of land, under the management and direct control of the FD, is legally defined as forestland; but does not necessarily carry tree cover. Regarding forest cover, FAO in collaboration with FD conducted a national forest inventory in Bangladesh. It shows that about 48% of the country possesses vegetative

cover in some form or the other. According to tree cover categories used in this inventory the distribution is as under:

<i>Tree cover</i>	<i>Area (million ha)</i>
No tree-cover	7.60
Less than 5% tree-cover	2.89
5 to 10% tree-cover	1.43
10 to 30% tree-cover	1.27
30 to 70% tree-cover	1.23
Over 70% tree-cover	0.33
Total	14.75

Figure 1. Shows the tree covered areas of Bangladesh.



As regards wood volume or growing stock in Bangladesh, it is difficult to give accurate information on it. ADB (1993 quoted by (2)) reported that the government forest carries a growing stock of about 30 m³/ha. In 1980 there were about 71 million m³ of wood as growing stock in the government forests, which declined to its two third by the year 1990 (2).

According to the Master Plan of Bangladesh Forest Research Institute (BFRI) the growing stock of wood in the country amounts to 102.37 million m³ (7) as shown in (Table 2). This volume stands mostly up to 1991.

Table 2. Growing stock of wood in Bangladesh

Forest type	Location	Growing stock million m³	Stock density m³ / ha
Mangrove a) Sunderbans b) Coastline	South- West Coastline	13.19 5.05	23.1 45.9
Hill forest a) Managed forest b) Unclassed State Forest	Eastern Part Hill Tracts	28.32 denudes	42.3 denuded
Plain land forest	central and northern west region	1.13	0.94
Village forest	Spread over the country and homesteads	54.68	202.5

It is observed from the table that village forest is the largest contributor of wood resources. The condition of state owned of forests is very disappointing. The main factors undermining the production and sustainability of the state forests may be due i) poor management, ii) scarcity of fund to materialize of the long-term visions and commitments, iii) serious manpower shortage both in forest administration and research, iv) Disparity of FD with general administrative setup and poor linkage of research with FD, v) poor monitoring and evaluation, vi) land dispute, vii) Low acceptance of FD personnel to community at large, viii) corruption and policing behavior amongst of FD personnel, etc.

Choudhury and Hossain (2) collected data of Reserved Forest, Protected Forest, Acquired Forest and Un-classed State Forest from 1975 to 1995 from the Year Books of BBS. They made a regression analysis with the accumulated data and found a straight line relationship of forest area as follows:

$$Y = -0.0138 X + 29.614$$

where Y=Forest Area and X=Year)

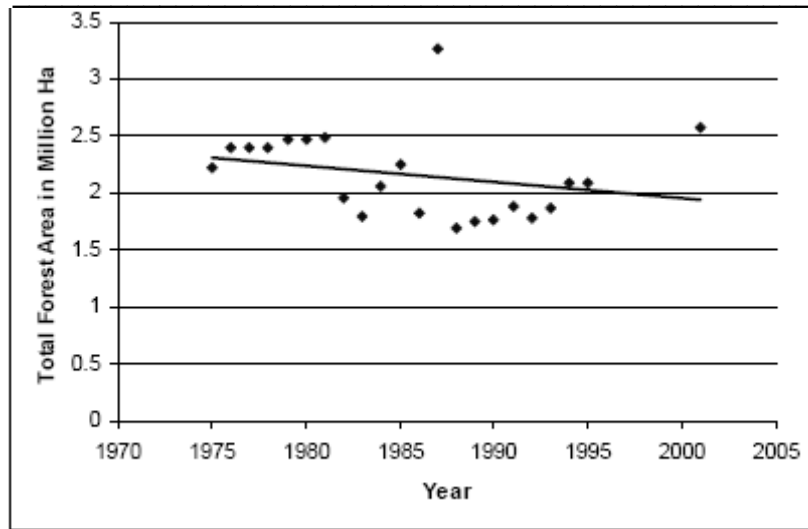


Fig.1. Total forest area (excluding village forest) in Bangladesh against the given year (2)

The relationship of forest area is shown graphically in Fig.1. According to this, Reserved Forest, Protected Forest, Acquired Forest and Un-classed State Forest in the country is estimated as 1.738 million ha in 2020, and those in 2030 as 1.1.60 million ha.

The main causes for change of forest area in the Asia-Pacific regions has been analysed by FAO (8) as demonstrated in Fig.2. Expansion of large-scale commercial crops will be the most important driver of deforestation to meet the for food grain prices rise.

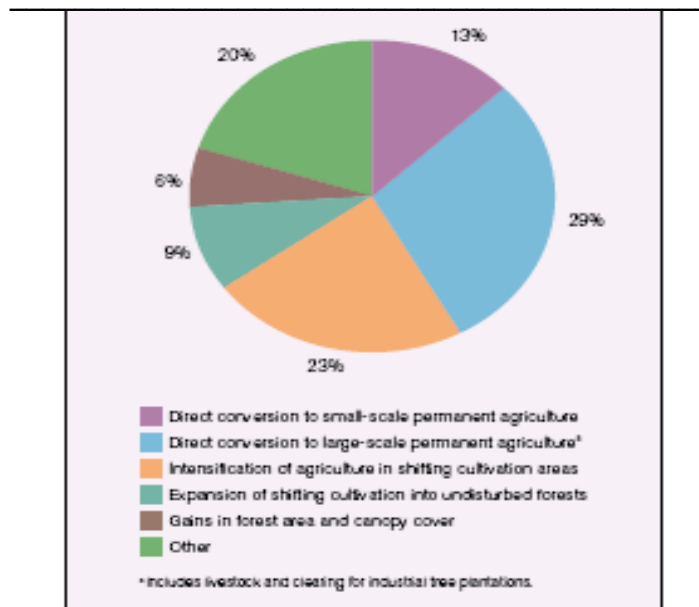


Fig.2. Direct causes of forest area changes in tropical Asian and Pacific countries, 1990 – 2000 (8)

In addition, in the more populous countries, especially those in South Asia, forest degradation will stem from unsustainable collection of wood and non-wood forest products and from grazing. The situation is no different in Bangladesh.

2.2. Production of Forest Resources

2.2.1. Production of Wood

Wood in this document means fuel wood and timber. It is well recognised that the wood production declined seriously since 1972. This is mostly because of imposition of moratorium on the extraction of wood till about 2001, when the felling of the plantations was started. The production of wood since then is increasing. This increase will depend largely on the availability of fund for new social forestry plantations involving participants.

Besides these over 10 million homesteads in about 88 thousand villages across the country possess a large quantity of trees. These homesteads are the major suppliers of wood for the nation. The role of the homesteads in growing stock is clearly seen in Table 2. In the following is given the projected volume of wood from village forest (Table 3).

Table 3. Growing stock and production of wood from homesteads (data used from (2))

Year	Corresponding growing stock of wood in homesteads (million m ³ with a growth rate of 2.62 million m ³ /year)	Wood production, m ³ /year (5.8% of growing stock)
1981	54.8 (Hammermaster fig)	
1993	86.24 (Projected)	5.00 projected
2000	104.58 (Projected)	6.07 projected
2006	120.38 (Projected)	6.98 projected
2020	183.18 (Projected)	10.62 projected

Choudhury and Hossain (2) also estimated production of timber and fuel till 2020 (2). Thus the total estimated wood production till 2020 is given in Table 4.

Table 4. Estimated wood production till 2020

Year	Wood production (Gov't forest), million m ³	village wood production, million m ³	Total wood production, million m ³
1990	0.87	4.01	4.88
2000	0.18	6.07	6.25
2010	1.10	7.86	8.96
2020	3.62	10.62	14.24

Table 4 shows that the rate of production of wood grows at a faster rate in the village groves than in the forest. The community people have become more conscious of their wood requirement, especially fuel wood. This has encouraged them to utilize their homesteads more effectively. There is further opportunity in boosting the production by using modern technology and strengthening management practices.

2.2.2. Production of Bamboo

Bamboo is another non-wood forest produce next to wood. It is regarded as poor man's timber, and is used from cradle to grave. Bamboo grows both in the forest as well as village groves. An estimate of bamboo production in the forest is given in Table 5.

Table 5. Estimate of bamboo production in government forest (2)

Year	Predicted yield of bamboo , million culms
1990	70.51
2000	78.61
2010	63.45
2020	65.68

The trend analyses conducted with these data indicate that in year 2020 the production of bamboo from government forest land would be about 65.68 million culms. In 2000 the number was 78.61 million culms. It declined seriously in 2004 amounting production of 44.34 million culms (2). Since then it is gradually increasing. Bamboo is generally harvested every 4th year. In absence of long time series data it could not be ascertained if the variation of the yearly yield is because of the variations of the area under harvest. However, since the growing stock of bamboo is directly proportional to the yield, it can be stated that the bamboo stock was declining but since the recent past it has started to pick up.

It is seen in Table 5 that in year 2020 the yield of bamboo will be 65.68 million culms from the government forests. The National Forest Assessment conducted by FAO in 2004-05 (the report is not yet published) indicates that in Bangladesh 66% bamboo grow in the villages, 16% in the forest and 17% in cultivable land. This means that that production of total bamboo in the country 410.5 million culms. This is, however, conservative compared to the estimate done by Banik (9). According to him the production of bamboo in the country in 2013 is projected as 576.9 million culms.

3. Demand and Supply of Forest Resources

3.1. Demand and Supply of Wood

Table 6 depicts that the speculated demand of wood in 2020 stands as $\{(30.51+27.27)/2\}= 28.89$ million m^3 . Against this the speculated supply comes as about 14.45 million m^3 . Of this 10.62 million m^3 is expected to come from homesteads. Thus there will be enormous gap of about $(28.89 - 14.45) = 14.44$ million m^3 between demand and supply in year 2020. Likewise the projected demand in 2030 appears as $\{(49.70 + 44.42)/2\} = 47.07$ million m^3 against the supply of 23.54 million m^3 . Then the gap becomes more gigantic.

Table 6. Demand and Supply of wood (data up to 2020 from (2) and those for 2030 computed in this study)

	Item	million m ³					
		1981	1993	2003	2007 (projected using 5% GDP growth)	2020 (project ed using 5% GDP growth)	2030 (projected using 5% GDP growth)
Demand	Demand of timber, million m ³		1.8 ¹		3.56	6.72	10.95
	Demand of timber, million m ³			3.2 ²	3.89	7.33	11.94
	Demand for fuel wood, million m ³			8.7 ¹	10.58	19.94	32.48
	Demand for timber + fuel wood, million m ³	7.41 ³			16.18	30.51	49.70
	Demand for timber + fuel wood, million m ³			11.9 ¹	14.46	27.27	44.42
Supply	Supply of timber, million m ³			1.2 ¹			
	Supply of fuel wood, million m ³			3.5 ¹			
	Supply of timber and fuel wood, million m ³					14.45 ⁴	23.54

¹From ADB report 1993

²From FD's report

³Comuted from the report of Douglas

⁴Supply from homesteads – 10.62 million m³ and 0.21 from FSP

Such demand- supply gap will further culminate in illicit felling of trees and force to imports. Hence production of wood must be augmented through utilization of modern technology generated by aggressive research, intensive management practices, enhanced investment in the forestry sector, etc.

The trend in import of wood is shown in Fig.3. It is observed from the figure that the import of wood is growing sharply with a slope of 9.44 thousand ton/year. The import of wood in 2020 is estimated as 265,000 m³. The figure in 2030 becomes 454,000 m³ against the import of only 9,500 m³ in 1990.

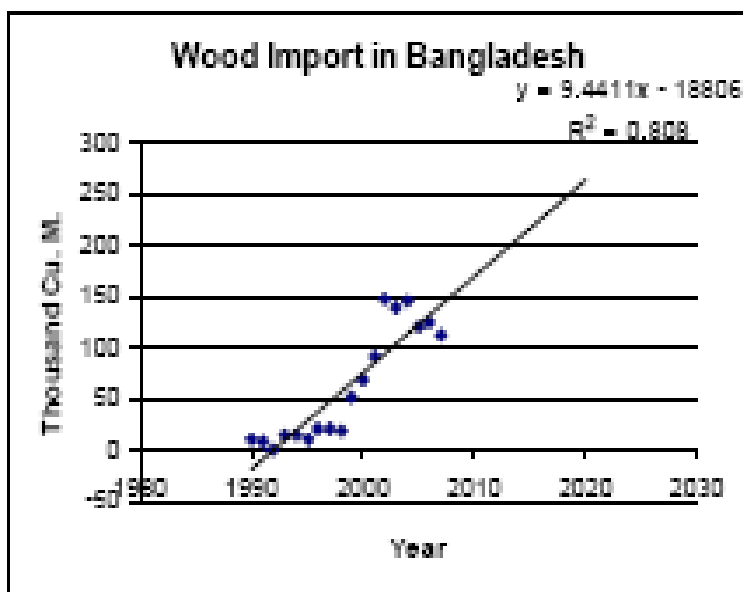


Fig.3. Projected import of wood in Bangladesh (2)

3.2. Demand and Supply of Bamboo

The data base on bamboo production and demand is very scarce. It is more limited for village grown bamboo. However, Banik (9) made an estimate of supply and demand of total bamboo, i.e., bamboo produced in the forest and the village. Thus, data recorded by him was used for making further projection till 2030 as given in Table 7.

Table 7. Demand and supply of total bamboo (forest + village) in Bangladesh in various years (data up to 2013 are from (9))

	(Million culms)						
	1993	1998	2003	2008	2013	2020	2030
Demand	706.29	761.12	815.52	868.11	901.50	981.80	1109.03
Supply	656.2	679.8	755.8	637.8	576.9	591.02	611.79

In making the projection for the demand, annual growth was calculated using the data in the table from 1993 to 2013. The computed growth rate was 1.226/per year. The situation with the supply estimate is rather complex. An abnormally large supply was anticipated in 2003. According to Banik (9) this is due to availability of additional bamboo as a result of gregarious flowering of muli bamboo (*Melocana baccifera*). The flowering of muli bamboo declined the supply of bamboo in 2008 and 2013. However, following this natural phenomenon, the bamboo production is gradually rising. As a result, forest bamboo production has been estimated to grow in 2010 and 2020 (Table 2) after the recession in 2004. Thus, the supply growth rate was calculated from the data of 2010 and 2020 in Table 2. It was found to be 0.346, and was used to workout the estimated supply of bamboo in 2020 and 2030 in Table 7. The table shows that the demand of bamboo is gradually increasing. But the supply remains almost the same. Unless the

tremendous demand-supply gap is narrowed down, 80% population living in the villages will seriously suffer.

4. Problems and Constraints, and Opportunities in the Forestry Sector

4.1. Problems

Chapter 3 above clearly demonstrates that there is an enormous gap between demand and supply of wood and bamboo in Bangladesh. The total forest in the country is insufficient not only to meet the growing demand of our people but also to maintain a balanced ecosystem. The forest land is constantly being utilized for homestead, urbanization, agricultural expansions and aqua-culture. The forest area and the tree composition are not evenly distributed throughout the country. In addition, the natural forest, the plantation and the village groves are disturbed and encroached by human population.

The meagerness of our forest resource makes it imperative that maximum utilization of forest land is made for better productivity and, at the same time, ensure judicious and optimum use of our forest resources. We need to look not only for sound use of timbers and other forest products in their traditional forms, but also consider them for new and more beneficial end uses. Furthermore, to broaden the use of scarce resources we must introduce non-traditional species and other fiber sources for forest based industries.

The major problems in the forestry sector have been drawn in the Master Plan of BFRI for 2000 – 2005 (7), in a workshop presentation by Akhtaruzzaman (10), and also during a discussion in the workshop on prioritization of research by Ahmed (11). The problems are synthesized based on these sources. These are enumerated below.

a) The yield of forest of Bangladesh is one of the lowest in the world. Even within the country the yield of forests managed by Forest Department ($2.0-2.5 \text{ m}^3/\text{ha}/\text{yr}$) is less than village forests ($5.0 \text{ m}^3/\text{ha}/\text{yr}$) (10). **The productivity is low** due to illicit felling, poor management practices, low initial survival, incompatible species composition, low soil efficiency, etc. The high and rapidly growing population in the country is forcing the people to indulge in illicit felling to meet their demand. Because of low literacy rate (32.4% (1) in 1996)) in the country, people are not fully aware of the impact of indiscriminate felling of the resources. Hence, social forestry activity and co-management of forest with participation of local people should be strengthened. In these activities people will receive a share of the resources. Thus, they will be a party in the ownership. Once they feel the benefits, they will look for the sustainability of such activities. Then they will not only remain passive supporters of conservation, but will also become vocal opponent to any destruction or illegal felling.

The other problems in low productivity call for addressing appropriate management practices including improving the nursery techniques, selection of site specific species, using quality planting materials, controlling pests and diseases, applying appropriate silviculture practices, etc.

b) Denudation of forest land and upsetting the natural soil cause severe siltation of the river basin. Consequently, flash flood is a common phenomenon in the country. Interesting information on denudation of forest on soil erosion is reported in 1938 Annual

Report of US Department of Agriculture. It was reported that in California 38,000 to 51,000 m³ of soil was eroded by a single heavy shower in one square mile (2.59 km²) of forest land damaged by fire (12). On the other hand, only 2.3 m³ of soil was eroded from nearby one square mile forest land with tree cover. **Flash flood and siltation of river basin** is an acute problem that is closely related with the forestry activity. Thus, this problem should be seriously taken care of. Therefore, proper management practices with appropriate species in such kinds of eroded land should be sought.

c) Bamboo and other non-timber forest products (NTFP), viz, cane, patipata, etc., are immensely important to the villagers. Bamboo is heavily used by the villagers in construction of rural housing. It is also the only local source of long fiber in paper making in the Karnafuly Paper Mills. These non-timber products are easily perishable. The short longevity of these materials also influences the perpetual demand. It is observed in Table 7 that there is a large gap between demand and supply of bamboo. Concerted efforts are warranted to mitigate the **scarcity of bamboo and other NTFPs**.

d) Herbal medicine is becoming popular in the country. It is also scientifically acceptable. But there is no planned cultivation of the plants. Till now herbal industries in Bangladesh are largely dependent on import of raw materials from neighbouring countries. Local production is mostly limited to wild collection from homesteads. There is a large potential to grow medicinal plants in degraded forestland or as lower storey crops under plantation, marginal strip land, homestead and other marginal land, unused land in tea garden and private hilly waste land. Then, there will be enhanced land coverage as well as the resource to develop small scale industries. However, there is a long way to go. Development and release of commercially important medicinal plants and their conservation technique should be made. Unfortunately, systematic study on the assessment of active ingredients of plants grown in different agroecological zones is totally lacking. Though few species are identified as priority species for herbal sector of Bangladesh identification or development of right genotype for **of important medicinal plants** in the country is lacking.

e) The forest area and tree composition are not evenly distributed throughout the country. The localized existence of forest is there due to climatic, topographic and demographic factors. The issues are therefore versatile to address with **uneven distribution of forest**.

f) Bangladesh is blessed with about 5,000 plant species with 15% tree, 35% shrub and woody climbers, and 50 % herb species. In term of number there are 750 – 800 tree species in the country (3). The major wildlife species of Bangladesh includes 125 mammals, 750 birds, 500 fishes, 125 reptiles and 9 amphibians. At present 27 plants, 40 mammals, 41 birds, 54 fishes, 58 reptiles and 8 amphibians are extinct, threatened and/or vulnerable (4, 5). Biodiversity depletion in the country is due to over exploitation, poor management and habitat destruction of natural resources, and degraded law and order situation, natural calamities, pollution, etc. As a result there is a serious impact on the nature causing further degradation of forest.

In the recent past, people are getting more and more aware about the biodiversity. The awareness on this environmental issue, led the people and policymakers think that monoculture of exotics such as *Acacia auriculiformis*, *Eucalyptus*, etc., is dangerous leading the forest to dreadful conditions. Since last couple of years Forest Department is facing criticisms, off and on, for raising pure plantations of single species including

such exotics. The impact of monoculture especially the exotics should be scientifically established. It must be recognised that **loss of biodiversity** is a severe threat.

g) The forestry experts insist that there exists **inadequate availability, reliability, and quality of data and information** relating to the forestry should be a major concern for policymakers and scientists. Serious problems exist not only in the quality of the data, but also in the uses to which these data are put. Examples of problem areas include:

There is no reliable assessment of the growing stock of trees. Other deficits include a lack of data on different products from forests and a lack of increment and biomass data. It is difficult to make economic assessments and set policies without quality data and information on both the tangible and intangible benefits of forests. Trees outside forests, mostly growing on private lands, are a major resource in the country. Indeed, about 70 % of all timber produced in Bangladesh comes from non-forest areas under private ownership. However, there is no efficient inventory for “trees outside forests” also. Many deficits in the forestry inventory are due to the ongoing degradation of forest resources. Experts suggest that socioeconomic developments have brought forest management, in very large parts of the country, to a standstill. Large tracts are devastated within short periods of time. But these degraded areas are not monitored nor are inventories updated. Among NTFPs, bamboo is already in high demand. Other NTFPs, especially herbal medicine, are of growing importance. Yet there are many data gaps with respect to the production and consumption of NTFPs. Moreover, data are not collected in a uniform fashion. There are scarcely of data and statistics on ecotourism, either in terms of demand or supply. To develop the forest-related ecotourism, an inventory of areas of potential interest to ecotourists is needed.

h) The loss in processing of wood for different products in the country is very high. The people have a tendency to use solid wood in stead of plywood, particle board, cement bonded board, etc. Even there is lack of due importance of using seasoned wood in reality. Awareness on extended durability of forest produces is totally absent. Therefore, **post harvest loss due inefficient conversion losses and improper uses** contribute to a higher demand of forest produce.

i) Because of higher demand, naturally there is **scarcity of industrial raw material**, making the industries to run under capacity. Development of proper physical and chemical methods, replacement of the conventional raw material, etc., can lessen the crisis of industrial raw material significantly and at the same time reduce dependence on import of wood and the product as well.

j) Intergovernmental Panel of Climate Change (IPCC) estimated that with a “Business as usual” scenario of greenhouse gases emissions, the world would be 3.3⁰C warmer by the end of 21st century (2) . Apart from desertification, this unprecedented rise in temperature may create havoc with melting of polar ice and ice caps in the mountains, expansion of sea water as it heats up and consequent rise in sea water level. The rise in temperature may cause the sea water level to swell by 0.3 – 0.5 m by 2050, and about 1 m by 2100 (3). A rise in sea water level of 45 cm may inundate about 11% area of the country making 5% of the population under threat. The sea level rise of 1 m is estimated to inundate about 21% area of the country affecting 14% of the population (3). This is an alarming indication.

Global Climate Change is likely to threaten the delicate balance. In fact, the climate is changing far more quickly than was initially projected. A team of scientists writing in the journal 'Nature' estimated that the world needs to derive half its energy from non-carbon sources by 2018 to prevent a quadrupling of atmospheric carbon levels (13). That kind of increase in heat-trapping "greenhouse" gases would be clearly catastrophic. We have a very short window of time to act on this issue.

The southern part of Bangladesh has a substantial growth of mangroves. The Sundarbans extending over an area of about 620,000 hectares is very close to the sea level. Moreover, an area 170,000 ha is under mangrove plantation lies in the sea coast (14). With sea level rise, this forest may eventually get lost. In near future with the higher tides and increased salinity the structure and composition of the vegetation is likely to change substantially. This forest is already exhibiting top dying of Sundri (*Herieteria fomes*). This will intensify further.

Beside these, the climate change will alter the rainfall pattern. There may be some seasonal change with respect to summer, spring, winter, etc. Such change will affect the phenology of the trees. The flowering and fruiting seasons may change than what it is now. In such case the seed collection time may get changed. Consequently, the nursery and afforestation schedules will have to be reformulated. All these together, in future, are likely to bring many serious problems for the foresters and scientists in Bangladesh to address. **Climate change** is a very important recurrent issue. There is tremendous need for the country to under take appropriate measures to face the escalating issue.

k) Extension of research outcome to the extension agencies and the end users is the key to use modern technologies for the development of the country. Unfortunately, there is poor linkage in transfer of technology in almost all sectors in Bangladesh. The policy makers in the country generally do not feel the value of scientific achievements. Rather, they think that their ideas are above all sciences, and they impose their ideas to implement. This is a strong blow to science as whole. As such there is seldom any value to scientific findings. Then, the scientists are strongly discouraged for innovative research. They are poorly paid with little opportunities in career advancement. Consequently, there is grave exodus of brain drain creating a large vacuum in technological back up to the problems in the country.

Poor technology transfer is more prevalent in the forestry sector. There are many innovative researches in this sector. These are sometimes in use, but without giving any ownership to the research findings. As in other sectors, the extension personnel also think that they are 'jacks of all trades. Such attitude to keep away science is extremely harmful to the development of the country. Therefore, for the benefit of the country a congenial system must grow for us to exist.

Based on the analyses above, the main problems of the forestry sector is summarised below:

- Low forest productivity.
- Flash flood and siltation of river basin
- Scarcity of bamboo and other NTFP
- Lack of importance on medicinal plants
- Uneven forest distribution

- Loss of biodiversity
- Inadequate availability ,reliability, and quality of data
- Post harvest loss
- Scarcity of industrial raw materials
- Climate change
- Poor technology transfer

4.2. Constraints

Forest meets the requirement of round wood, fuel wood, rural construction materials, industrial raw material, etc, and is the largest single sector to keep ecological balance of the country. In spite of this, forestry sector has not been given adequate priority over decades by the government. As a result, huge constraints have accumulated. Some of these are underlined below:

a) There is no denying the fact that the forestry activity in the country has increased many folds. A great awareness for afforestation in the country has been created. More people are involved the activity. The present **manpower of FD is too meager** to handle the need of FD itself and public at large. In 2009, the number of sanctioned Class-1 posts is 293. Of these, 100 posts are vacant (personal communication with FD). While all other Departments expanded significantly, FD remained in the pigeonhole. It is simply impossible to conduct extension work only with one or two professional foresters (Class-1 post) sitting mostly in the district headquarters. In such placements, the professionals can do only administrative functions, what is now in practice. The Department of Agriculture has several professionals, the Departments of Fisheries and Livestock one professional each at the upazila level with Class-1 status. The Department of Agriculture has sub professionals up to the union level. Unless a qualified professional forester (Class-1 post) is available at the upazila, meaningful forestry activity cannot reach to the people. Because of dearth post for career advancement there remains strong dissatisfaction among the serving persons. This is another impediment for congenial work. The disparity between the cadre and non cadre staffing in FD is also a barrier in smooth accomplishment of activities.

The foresters claim that the forestry activities are technical in nature. But **their capacity to handle technical issues has declined sharply**. Previously, the foresters of FD used to write the management plans, too. Now they have become highly dependent on foreign consultants since the FD staff lack training. Many of them are aware of the newer forestry techniques. The capacity of the FD personnel must be enhanced so that they maintain proper data base, prepare the management plans by themselves and can implement them in proper manner. A scientific approach has to be on board.

b). People view that the **approach of the foresters is colonial with policing behavior**. During conducting a field study (15) the people expressed that they are very scared of the Forest Department. They think FD staff are discourteous in their behavior and put the people in unnecessary harassment. As such there is a sort of disbelief in the people regarding FD. As foresters are located far away from the people, there is less opportunity to keep themselves in close contact of the people. Days have changed. So, their behavior must have to change. They should think that they are service providers, not policeman. The government should also make opportunities to make them available

to closer proximity of the people as in the Department of Agriculture, Fisheries, Livestock, etc.

c) It is noted earlier that **linkage between research and extension is alarmingly poor**. This is more dominant in the forestry sector. In the situation, the research outcomes do not reach to extension people. On the other hand, the researchers also remain in darkness about the researchable problems. As far as it is known there is one meeting or workshop annually in BFRI to adopt its research programme. It is, however, represented by 2 or 3 midlevel officials from the FD, who generally give some opinions of their own without record, but not of the department. Actually, for meaningful function BFRI should be intrinsically involved in programme planning of FD with representation at the highest level. Similarly, FD should be represented in BFRI's programme planning at the highest level. The line Ministry should ensure that these two organisations work with mutual commitments for the development of the forestry sector.

d) **Forest land in the country** is only 17% that **is too meager to produce the output required**. Hence, every corner of land must be scientifically utilized to get maximum production. About 1.51 million ha of land is available for agroforestry (1). Intensive agroforestry activities will greatly enhance the resources.

Over 0.71 million ha of USF land in the country, under the direct control of the civil administration (Deputy Commissioner), is getting degraded every day quite alarmingly. In the past, some of such land was allocated to private entrepreneurs for rubber plantation. The land was allotted under some terms and conditions to establish private rubber plantations. These allottees mostly abused such allocations and added enhanced degradation of those sites. Some thing has to be done to these USF land. It is suggested that these land should be brought under some sort of community management system so that the steep slopes get tree covered and continue to remain under vegetative cover for the benefit of the communities and bring benefit for the nation at large.

e) As in other government organisations, the **monitoring and evaluation is very poor**. It is limited just to write an annual report. Then the work is deemed to done. There is no accountability of the work. The donors are happy with external evaluation in projects funded by them. Such mentoring and evaluation mostly involve in quantities achievements. There no practice of analyzing qualitative achievement, that means what changes have been achieved as a result of the interventions. Modern monitoring encompasses participatory monitoring and evaluation, joint evaluation, self evaluation, most significant changes, etc. These take care of the qualitative changes on which the country is gazing at. Without an intensive and effective monitoring system, no program will bring in the desired benefits. The internal monitoring cells in FD and BFRI are absolutely ineffective. The monitoring systems in FD and BFRI have to be improved to ventilate true societal achievements.

f) BFRI is one of the oldest research organisations in the country established in 1954. Over the past it generated commendable contribution in research. Some of them are selection of appropriate species for mangrove plantation, setting seed orchards for important forest species, selecting site specific species for plantation, vegetative propagation of bamboo, yield increasing process in pulping, developing a process for making value added pulp from inferior grade jute, solar seasoning, extending durability wood and bamboo, etc. However, its contribution in the present decade is unfortunately

very bleak. This has resulted due to **grave shortage of qualified and effective scientist in BFRI.**

Once BFRI could claim pride in the talent of its scientists. With the retirement of these scientists, the recruitment process was very slow. There has been no attraction for entrants with brilliant academic record. Lack of opportunity for their capacity building added fuel in the dismay. Over and above, the status of BFRI is yet to be determined. The head of the organisation is designated as Director, although he holds a NPS Grade II post. This is equivalent to Director General in other government organisations. The situation makes the Director humiliated. Even the district administration treats the Director as junior to Deputy Commissioner . BFRI should be declared as a full-fledged Department with re-designation of the Director as the Director General. This will involve no extra expenditure. It is a crying need that the government should look into the constraints of BFRI and resolve these on a priority basis. It must be reiterated that no development can be successful without scientific backup.

g) **Both FD and BFRI suffer from inadequate funding.** This seriously jeopardizes to execute the planned activities.

The above pen picture summaries the following, but not limited to, constraints in the forestry sector that need immediate attention of the government:

- Manpower of FD is too meager. and opportunity of capacity building of manpower is inadequate
- Approach of the foresters is colonial with policing behavior
- Linkage between research and extension is alarmingly poor
- Forest land in the country is too meager to produce the output required
- Monitoring and evaluation is very poor
- Shortage of qualified and effective scientist in BFRI is very grave
- Both FD and BFRI suffer from inadequate funding

4.3. Opportunities

We have problems and constraints. These are, in no manner, the stumbling blocks to go ahead. Where 'there is will there is way'. We will have to overcome the problems and constraints. We must have the sense that we have to increase production, and reduce the indiscriminate wastage of forest resources for our existence. We have the opportunities, too in this direction. These are discussed below.

a) Bangladesh is a populous country. This can be a blessing if the people are effectively utilized. There is large prospect to involve them in social forestry.

Social forestry has recently become a sort of household term in the rural development circle in Bangladesh as well as in other developing countries in Asia, Africa and Latin America. It is interchangeably known as "participatory forestry". Popularly social forestry is forestry "of the people, by the people and for the people". Social forestry practices involve man, land, water, crops, livestock, tree, fodder, fruit, appropriate vegetables and appropriate environment. The basic principle of social forestry is integration of local

people in afforestation activity. The objectives of social forestry are manifold depending on different situations. However some of the specific objectives of social forestry are three folds (16) as follows:

- **Ecological:** It improves environmental stability, reduces soil erosion, counteracts the process of deforestation, enhances the beauty of the landscape for amenities and recreational efforts.
- **Economic:** It ensures sustainable production optimizing the use of degraded/marginal land and promotes production of food, fodder, timber, fuel, etc, for cash and subsistence of the rural poor.
- **Social:** It provides direct and indirect social benefits in rural areas where people depend on forests for their livelihood. Social forestry provides them employment – as source of income leading toward a better healthy life. It enhances their confidence of skill and knowledge, and changes their attitude and perception upon their self reliance and self employment. Social forestry stabilizes and strengthens rural communities and institutions with participation in every stage of social forestry. People also enjoy human rights.

Social forestry must be anchored on felt needs and problems of target beneficiaries. It should not be based on fixed and perceived ideas that tend to be unrealistic. Thus, people's participation in the activities is the key principle of social forestry. For the success of social forestry an effective awareness program has to be launched and participatory forestry or co-management management of forest resources has to be undertaken in a wider scale.

If these are done the following will unfold one after the other in the sequence as mentioned below (2)

- The people in general and the people living nearby the forests in particular, will be fully aware of the environmental values of the forests and shall understand its role not only at local level but also at national level.
- Once they acquire this awareness they will oppose the illegal felling from the forests.
- As the local people will become participants of forests and forestry, they will start receiving some material gain. Thus they will get into the ownership. Once that is there, they will look for its sustainability.
- At this stage they will not only remain passive supporters of conservation but will also become vocal opponent to any destruction or illegal felling.
- This will stop all sorts of illegal felling from the forests of the country and the existing strength (number of manpower) FD personnel will be able to protect the forest.

Bangladesh has bright prospects to **increase production of forest resources through intensive practice of social forestry**. The ball is already rolling. In making the programme successful there is no alternative to extensive scientific support. The foresters should also change their behavior to become people-friendly.

b) It is noted earlier that 1.51 million ha of land is available for agroforestry in the country. Due to better management at the small land owner level, homestead agroforestry supplies about 70% of wood and 80% bamboo from only 0.27 million ha of land (7). Thus, scientific coverage of the 1.51 million ha land under **agroforestry offers a large potential to boosting our forest resources**. This calls for availability of need based knowledge, information and services at the door step of the people.

c) Beside other causes in low productivity, the question of seed quality cannot be ignored. There is potential for doubling the yield both in the village forests and the forests managed by Forest Department through **using better quality seeds**. BFRIL has initiated a modest attempt to establish seed orchards of 12 commercially important species. There is need for strengthening quality seed production of species in demand both in homestead and forest land. In this regard joint efforts of BFRI and FD will reinforce to overcome the shortcomings.

d) People are gradually habituated to use herbal medicines. At present there is scarcity of herbal plants in the country. So in addition to import of the medicines, local manufacturers are mostly dependant on importing the plants also Identification of active medicinal ingredients, development of proper preservation techniques , and **scientific and planned cultivations of medicinal plants will greatly enrich the resources** of the country.

e) The Sunderbans and the coast line, apart from other problems, are threatened to be submerged due to rise in sea water level. **Plantation of these areas with disease resistant and site specific species to tolerate water logging will enhance production**.

f) With the scarce supply of solid wood, composite wood is getting gradually popular. Thus, use of composites instead of solid will save wood. Extended service life of the nondurable wood and bamboo through chemical preservative treatment, yield increasing pulping processes, alternative raw materials in pulping, etc., will grow. **Non traditional and more scientific use will to cut down loss of the resources and conserve them**.

g) The government will have to seriously recognize the importance of forestry for congenial living. Thus, FD and BFRI will have to be reorganized without lapse of any time. The capacity building of these organisations is of urgent necessity. Provision of reasonable financial allocation will ameliorate many problems and constraints to minimize the demand-supply gap of forest resources.

The outline of the opportunities is listed below:

- Production of forest resources will increase through intensive practice of social forestry
- Agroforestry offers a large potential to boosting our forest resources
- Doubling of yield is foreseen through using better quality seeds
- Scientific and planned cultivations of medicinal plants will greatly enrich the resources
- Non traditional and more scientific use will to cut down loss of the resources and conserve them
- Reorganization and reasonable financial allocation to FD and BFRI will address many problems and constraints to minimize the demand-supply gap of forest resources

5. Technological interventions required in the context of country's need

Strong technological backup is of fundamental importance in ameliorating the problems toward minimizing the demand-supply gap. Being the only national research organisation in forestry in the country, the primary responsibility goes to BFRI in generation of demand-driven technology. Although the universities in Bangladesh mainly concentrate on class-room education, their role cannot be ignored, as they conduct research to some extent. Nevertheless, the liability of FD is not overlooked. It must have to provide all support and cooperation in conducting research. In some cases, there are scopes for FD to be involved in generation of new knowledge and information.

A guideline of technological interventions needed to overcome the problems in the march to minimize the demand-supply gap is specified in Table 8 as an example. Further specific needs can arise depending on the situation.

Table 8. Priority research areas in FORESTRY

RESEARCH AGENDA: Forests and Biodiversity conservation

<i>Problem/ Constraints</i>	<i>Research Title/ Key Words</i>	<i>% of beneficiary</i>	<i>Probability of success</i>	<i>Priority Ranking</i>	<i>Research Tenure</i>		
<i>High rate of deforestation and loss of biodiversity</i>	● Study the drivers of deforestation and develop appropriate participatory approaches for forests and biodiversity conservation	100	80	1		√	
	● Study the biodiversity resources (flora and fauna including soil microbes) of different forest types including homegarden	90	100	1	√		
	● Inventory and assessment of wildlife species and their keystone species in different forests (and wetland areas) of Bangladesh	50	60	1	√		
	● Assessment of ecological impacts of different exotic spp. species including rattan in forests	60	60	1	√		

	<ul style="list-style-type: none"> Ecosystems analysis of mangrove forests and developing measures for preserving their ecosystem. 	30	50	2	√		
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RESEARCH AGENDA: Forest productivity enhancement

Problem/ Constraints	Research Title/Key Words	% of beneficiary	Probability of success	Priority Ranking	Research Tenure		
					Long	Med	Short
Low Productivity	<ul style="list-style-type: none"> Identification of best provenances/ clones of commercial species of trees and establishment of their breeder seed orchards 	100	80	1	√		
	<ul style="list-style-type: none"> Establishment of a seed bank for sustained supply of quality planting stock 	100	80	1		√	
	<ul style="list-style-type: none"> Collection and testing of seeds collected from plus trees and mother trees, and develop storage techniques in seed bank 	100	90	1			√
	<ul style="list-style-type: none"> Development of high yielding clones of bamboo and cane (rattans) 	100	80	1	√		
	<ul style="list-style-type: none"> Establishment of germplasm centre of endangered indigenous species in different ecological regions 	70	70	1	√		
	<ul style="list-style-type: none"> Identification/ standardization of control measures for major insect pests and diseases of important tree species in the forests and homestead areas 	100	90	1	√		

● Development and screening of diseases and pests resistant tree species	80	80	1	√		
● Development and screening of stress tolerant varieties of trees	70	70	2	√		
● Coordinated regional program for controlling common diseases and pests of forest tree species	60	60	2	√		
● Development of nursery practices of endangered indigenous species	70	70	2	√		
● Identification of pests and diseases of nurseries and their control	100	80	1	√		
● Assessment of wood production trends and consumption pattern in forests and non-forest or poorly forested areas	60	60	2	√		
● Conservation of soil and soil fertility in hilly areas	70	60	2	√		
● Identification and economic analysis of existing (traditional, introduced, farmer-innovated) agroforestry practices in Bangladesh and development of improved agroforestry practices	90	80	1		√	
● Development of agroforestry model for newly accreted land	80	80	1	√		
● Development of agroforestry practices for forest land	70	50	1	√		

	<ul style="list-style-type: none"> ● Development of improved shifting cultivation in the hilly areas 	30	50	1	√		
	<ul style="list-style-type: none"> ● Development improved management technique for degraded forest land 	80	80	1	√		

RESEARCH AGENDA: Mitigation and adaptation to climate change

<i>Problem/ Constraints</i>	<i>Research Title/ Key Words</i>	<i>% of beneficiary</i>	<i>Probability of success</i>	<i>Priority Ranking</i>	<i>Research Tenure</i>		
<i>Adverse effect of Climate Change</i>	<ul style="list-style-type: none"> ● Development of appropriate social forestry techniques for forest land 	80	80	1	√		
	<ul style="list-style-type: none"> ● Mitigation of impact of climate change on food security of forest dependent people 	80	80	1	√		
	<ul style="list-style-type: none"> ● Assessment of carbon stock in different forest land 	50	50	2	√		
	<ul style="list-style-type: none"> ● Assessment of climate change impact on forests using remote sensing and GIS 	80	80	1	√		
	<ul style="list-style-type: none"> ● Investigating possible impacts of climate change and sea level rise on different forest types with particular emphasis on the mangrove forests 	80	80	1	√		
	<ul style="list-style-type: none"> ● Investigating water quality and quantity under different forest types and forest composition 	50	50	2	√		

RESEARCH AGENDA: Livelihood improvement

<i>Problem/ Constraints</i>	<i>Research Title/ Key Words</i>	<i>% of beneficiary</i>	<i>Probability of success</i>	<i>Priority Ranking</i>	<i>Research Tenure</i>		
<i>Poor livelihood</i>	● Exploring forest resources and livelihood linkages in different forest regions with socioeconomic, quantitative and qualitative data	50	50	2	√		
	● Development of IGA for improving livelihood	60	60	2	√		
	● Development of community based eco-tourism in forest areas for forest conservation inter alia poverty alleviation, women empowerment and creating environmental awareness	40	50	2	√		

RESEARCH AGENDA: Non-timber forest products including medicinal plants

<i>Problem/ Constraints</i>	<i>Research Title/ Key Words</i>	<i>% of beneficiary</i>	<i>Probability of success</i>	<i>Priority Ranking</i>	<i>Research Tenure</i>		
<i>Inadequate production of non-timber forest products including medicinal plants</i>	● Selection of appropriate varieties of commercially important medicinal plants for their best medical efficacy and higher yield.	70	70	1	√		
	● Development of mass propagation techniques including tissue culture of commercially important medicinal plants	70	70	1	√		
	● Development of end-use specific silvicultural/ agronomic management packages for commercial	70	70	1	√		

	production of important medicinal plants						
	<ul style="list-style-type: none"> Development of appropriate technologies (processes, equipment) for processing of commercially important medicinal plants 	50	50	1	√		
	<ul style="list-style-type: none"> Screening of effective bio-pesticides for medicinal plants and other crops 	50	50	1	√		

RESEARCH AGENDA: Post harvest technology

<i>Problem/ Constraints</i>	<i>Research Title/ Key Words</i>	<i>% of beneficiary</i>	<i>Probability of success</i>	<i>Priority Ranking</i>	<i>Research Tenure</i>		
<i>Improper post-harvest techniques</i>	<ul style="list-style-type: none"> Development of better conversion and utilization methods 	50	50	2	√		
	<ul style="list-style-type: none"> Development of marketable products from waste woods and wood products 	50	40	2	√		
	<ul style="list-style-type: none"> Reducing dependency on forest produce 	50	50	1	√		

RESEARCH AGENDA: Technology transfer

<i>Problem/ Constraints</i>	<i>Research Title/ Key Words</i>	<i>% of beneficiary</i>	<i>Probability of success</i>	<i>Priority Ranking</i>	<i>Research Tenure</i>		
<i>Weak technology transfer</i>	<ul style="list-style-type: none"> Packaging mature technologies 	80	80	1		√	
	<ul style="list-style-type: none"> Dissemination of the technologies to the clientele through training, advisory services and information supply 	70	70	1		√	
	<ul style="list-style-type: none"> Mass communication and sharing information with peer groups 	20	80	1			√

6. Recommendations

The forest land in Bangladesh is inadequate to maintain a balanced ecosystem. The yield of forest resources in the country is much low in the global perspective. There is already a wide demand -supply gap of the resources. In 2030, it will grow to an alarming state. In addition, the climate will be more hostile. In view of these circumstances, the following recommendations are made to enhance our forest resources by alleviating the problems and constraints:

- Every piece of forest land, including the USF, must come under forest cover.
- Unutilized homesteads, marginal strip land, tea garden surplus land and other unproductive small private land should be used for exhaustive agroforestry.
- Social forestry concept, with the participation of the public in general, should widely replace the traditional forestry perception.
- Present infrastructure of FD is inadequate to meet the challenges of the future. Already an acute dearth of professionals prevails in the department. FD therefore needs rational strengthening and reorganization.
- There is no alternative to rigorous research back up for intensive afforestation, scientific management of forest, careful conservation and judicious use of the resources.
- On retirement of vastly qualified and experienced scientists, there exists a deep depression in research in BFRI. The present scientists are unable to address the research needs of the country. A crash programme is urgently warranted to recruit bright scientists with better facilities, and adequately train them for specialisation. However, they will also need at least 10 years to cope up to address the issues effectively.
- BFRI also lacks a regular technology transfer unit. Without it, technologies generated are difficult to reach the users.
- The infrastructure of BFRI calls for immediate strengthening and reorganization.
- Effective linkage between BFRI and FD must be established.
- Research should be demand-driven with an achievable outcome.
- It should be mandatory for BFRI to promote participatory research programme development, participatory research execution and participatory innovation development with the involvement of the relevant stakeholders.
- Strict monitoring and evaluation (M&E) must be done in FD and BFRI against pre set measurable indicators.
- In addition to external M&E, participatory monitoring & evaluation with all the relevant parties should be obligatory to understand 'who is where'.
- The proposed research interventions should be revisited and up-dated at an interval of 3 years.
- Adequate fund should be allocated to FD and BFRI

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