ANNUAL RESEARCH PROGRESS: 2016 – 2017

Government of the people's Republic of Bangladesh
Bangladesh Forest Research Institute
Chittagong
2018

Contents of the Research Progress : 2016 – 17

Forest Botany Division

1.	**Study**	:	On-going
1.1	**Programme Area**	:	Biodiversity and Conservation
1.2	**Title of the Study**	:	Floristic composition and restoration of village common forest of Kapru Para, Bandarban Hill District

1.3 **Justification :** Kapru Para is a Murang village situated down site of Nilgiri and on western site of Bandarban Thanchi Road under Bandarban Hill District. It is 54 km away from the Bandarban District town. The Murang community maintains and conserves the village common forest (VCF) around their paras or villages as tradition, which is known as para ban or khowa ban. VCF has linked with their life for water resources and become as a part of their culture and heritage and maintained by traditional norms and rules. Besides water supply the VCF also protects village from fires, habitat of wild life and maintain the local environment. Once the VCF is very rich with the native of flora and fauna and considered as the remnant hotspots of natural forests Bandarban. Now this type of forest is becoming extinct due to land scarcity, shifting cultivation, urbanization and loss of social norms. On the other hand, some VCF are converted production cultivation system with fruit trees. So, the study was taken to assess the floristic composition of the VCF and will helps for restoration of ecology, sustainable land use and biodiversity management.

1.4 **Objective(s)** :

1.4.1 To assess the qualitative and quantitative floristic composition of common village forest of Kapru Para.

1.4.2 To motivate the local people for restoration of the village common forest.

1.5 **Expected output :**

Data base on plant diversity and status of the community forest reserve will be known and this will help in future conservation and biodiversity changes

Awareness among the local people about values of local biodiversity and their conservation will be strengthened for future conservation.

Motivation of community people for restoration for their perennial water source and better livelihoods.

l) BFRI herbarium will be enriched with voucher specimens of the VCF.

1.6	**Study Period**	:	
1.6.1	Starting year	:	2013-2014
1.6.2	Completion year	:	2016-2017
1.7	**Personnel**	:	
1.7.1	Project Leader:	:	Mohammed Mohiuddin, D.O
1.7.2	Associates	:	A.H. M. Jahangir Alam, R.O ; Syedul Alam RA-1
1.8	**Progress**		

1.8.1 Previous years, if any: Two discussions meeting were conducted with the karbari and community people for biodiversity conservation. Total 30 sample plots having 10 m x10 m size were lay out in three different slopes (Upper, medium, lower hill portion and along the jhiri) for data collection and vegetation analysis. Listing of available plant species in each plot was done. *Lepidagathis incurve*, *Holarrhena antidysenterica, Aprosa dioica, Baccaurea ramiflora, Litsea glutinosa* and *Ficus hispida* were most common species in all sample plots. Eighty two botanical samples were collected from the sample plots, processed

and preserved in the herbarium. Total 45 botanical samples were identified comparing with the authentic plant samples of the BFRI herbarium. About 5000 seedlings of sixteen indigenous species have been distributed to kaprupara and Sita pahar para for enrichment plantation in the community reserve. The distributed species were garjan (*Dipterocarpus* sp.), champa (*Michelia champaca*), chikrassi (*Chukrasia tabularis*), kadam (*Anthocephalus chinensis*), chapalish (*Artocarpus chaplasha*), neem (*Azadirachata indica*), kainjalbhadi (*Bischofia javanica*), telsur (*Hopea odorata*), mahogany (*Swietenia mahagoni*), haldu (*Adina cordifolia*), chakua-koroi (*Albizia chinensis*), bohera (*Terminalia bellirica*), kalo jam (*Sygygium cumini*), amloki (*Phyllanthus emblica*), arjun (*Terminalia arjuna*), and haritaki (*Terminalia chebula*).

1.8.2 This year   :

Activities of the study	Progress
a. Three group discussion meeting with local people and Kabaries.	a. Three group discussions meeting were carried out with the karbaries (local leaders) and community people at Kapru para and Sitapahar para in Bandarban Hill District for biodiversity conservation.
b. Laying out new sample plots in different sites.	b. Total 11 sample plots of 10 m x 10 m size were lay out representing various slopes (Upper, medium, lower hill portion and along the jhiri) for data collection and vegetation analysis.
c. Botanical samples collection and processing.	c. Seventy two botanical samples were collected from the sample plots. Collected samples processed and preserved in the BFRI herbarium. Collected samples were classified into trees, shrubs, herbs and climbers species.
d. Identification of species and data analysis.	d. A total of 56 species under 26 genera of 18 families have been identified comparing with the authentic samples of the BFRI herbarium. Among them 26 trees, 14 shrubs, 7 herbs and 9 climbers species. Mounting, leveling and family wise arranged of 22 identified samples for preservation in the BFRI herbarium. The quantitative data for the floristic composition have collected.
e. Motivate the local people for conservation of indigenous tree seedlings and enrichment planting with supplied indigenous species.	e. Total 6500 seedlings of fourteen indigenous tree species have been distributed to community people of Kaprupara and Sitapahar para for enrichment plantation in the VCF. The supplied seedlings were neem (*Azadirachata indica*), chapalish (*Artocarpus chaplasha*), mahogany (*Swietenia mahagoni*), champa (*Michelia champaca*), chikrassi (*Chukrasia tabularis*), telsur (*Hopea odorata*), garjan (*Dipterocarpus* sp.), chakua-koroi (*Albizia chinensis*), kainjalvhadi (*bischofia javanica*), arjun (*Terminalia arjuna*), kadam (*Anthocephalus chinensis*), amloki (*Phyllanthus emblica*), bohera (*Terminalia bellirica*), kalo jam (*Sygygium cumini*), haritaki (*Terminalia chebula*), bans, and bet.
f. Data processing and report writing	f. Scientific reports have been completed.

1.9   **Achievement (s), if any :**
1.10   Financial statement   :
1.10.1 Total cost   : Tk. 5,00,000.00
1.10.2 Cost of the year   : Tk. 1,99,490.00
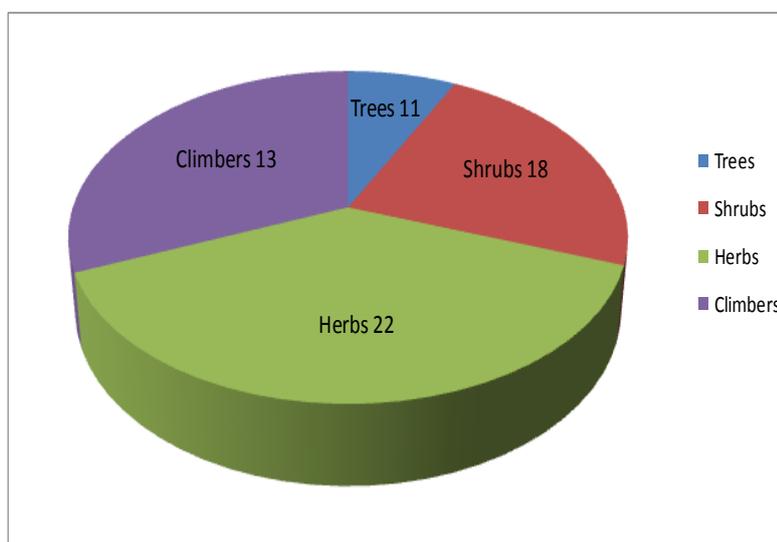1.10.3 Expenditure of the year   : Tk. 1,99,490.00
1.10.4 Source of fund   : GOB
1.11   **Beneficiaries:** Forest Departments, Academic Institutes, NGOs, and Communities.
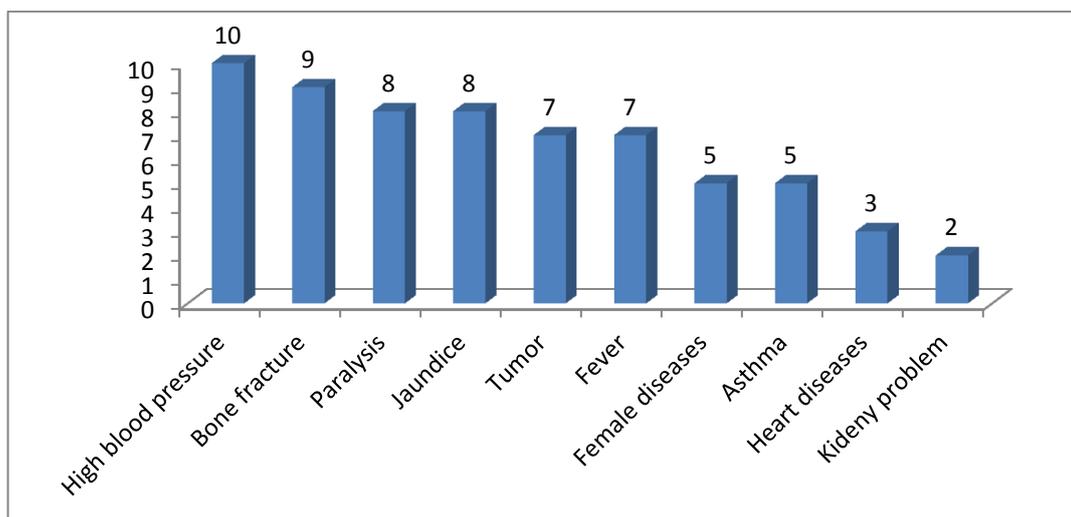
2.   **Study**   : On-going
2.1   **Programme Area**   : Biodiversity and Conservation
2.2   **Title of the Study**   : Studies on ethno-botanical plants used by the Chakma community of
                                   Rangamati and Khagrachari Hill District
2.3   **Justification** : Rangamati and Khagrachari are the hill districts situated in the south east corner of the country. The floristic composition of these two districts is very rich. Thirteen ethnic groups people are living there for long time using the natural resources of fthe hills. The Chakma community is the largest community of CHT and dominating in Rangamati and Khagrachari.   The Chakma tribe has very good traditional medicine knowledge and they used a good number of plant species as herbal medicine. Many of them still depend on local medicinal plants for the treatment of different disease. It is alarming that, in recent year the medicinal plant species and traditional knowledge system is becoming extinct due to innovation modern medicine, development of good communication, lack of interest of new generation towards the medicinal plants and habitat destruction. The knowledge of traditional use of medicinal plant by the Chakma tribe is likely to be lost in near future for scarcity of plants due to habitat destruction. There is no data base about the use of the medicinal plants by the Chakma community people. Therefore the study is taken collect and documents the traditional plants and their potential uses. The study will be helpful to preserve the centuries old traditional knowledge and documentation for future utilization.

2.4   **Objective(s)**   :
2.4.1 To collect the ethno-botanical plants and their information used by the Chakma tribe of Rangamati and Khagrachari Hill District.

2.4.2 To find out conservation strategy and to develop data base for ethno medicinal plants.

2.5   **Expected output :**
      Information on use of the species, habit, habitat, parts used and mode of preparation medicinal formulas of ethno-medicinal plants used by the Chakma tribe will be documented.
      BFRI herbarium will be enriched with ethno-botanical samples of the Rangamati and Khagrachari hill district.

2.6   **Study Period**   :
2.6.1 Starting year   **:** 2013-2014
2.6.2 Completion year   **:** 2016-2017
2.7   **Personnel**   :
2.7.1 Project Leader: **:** Mohammed Mohiuddin, D.O
2.7.2 Associates   **:** Asim Kumar Paul, S.R.O.; Syedul Alam RA-1
2.8   **Progress**
2.8.1 Previous years, if any: Three group discussions meeting with the local herbal healers and local people of Duluchari, Rangamati and Guimara, Khagrachari area were conducted to know the present situation of medicinal plant of the area. The natural habitat of the medicinal plants has degraded and converted different land uses. Total 295 ethno-medicinal plants were collected from the Matiranga, Guimara and Gorgoria of Khagrachari and Duluchari, Badalchari, Kutubchari and Kaptai Kolabunia para of Rangamati hill district forests area. Among the collected species there were 22 trees, 68 shrubs, 113 herbs and 92 climbers. Total 198 species were identified comparing with the authentic samples of the BFRI herbarium. Collected samples were processed and preserved in the BFRI herbarium. Information on use of the species, habit, habitat, parts used and mode of preparation were documented with the help of herbal healer. A total of 20 plant species are used to body ache followed by 18 species for paralysis, 17 bone fracture, 16 tumor/boils, 16 for heart disease, 15 species for skin disease,14 species for female disease, 14 for diabetes, 14 species for cold, 13 species for high blood pressure, 12 species for kidney/urinary problem, 12 species for jaundice, 12 for tooth ache, 11 species for snake bite, 11 for fever, 11 for diarrhoea, and 10 species for blood purifier, 10 for breathing problem, 10 for asthma, 9 species for eye problem, 8 species for constipation, 7 species for stomach pain, 6 species for head ache, 5 species for dysentery and 4 species for piles. Most of the plant species used for different diseases. Leaves are the major part of the plant used in the treatment of diseases.

2.8.2 This year　　　　　:

Activities of the study	Progress
a. Four group discussions meeting with herbal healers.	a. Four group discussions meeting with the local herbal healers and local people of Kutubchari, Duluchari and Khamar para in Rangamati district and Shilatuk para, Dharmaghar in Khagrachari district area were conducted to know the present situation of medicinal plant of the area and awareness buildup for threatened medicinal plant conservation.
b. Transect walk and collection of information on parts of uses, local name, disease name, medicine preparation and habitat of plant growing.	b. Most of the plants collected from natural vegetation and few of them collected from home gardens. Total 36 ethno-medicinal plants were collected from the Kutubchari, Badalchari, Budchari, Duluchari, Khamar para in Rangamati district and 28 ethno-medicinal plants species were collected from the Alutila, Shilatuk para, Dharmaghar and Shajek in Khagrachari hill district forests area. Among the collected species were 11 trees, 18 shrubs, 22 herbs and climbers 13 species. Total 52 species were identified comparing with the authentic samples of the BFRI herbarium. Collected samples were processed and preserved in the BFRI herbarium.
c. Collection of ethno-botanical samples and identification of the collected samples.	c. All the collected ethno botanical plants were classified with scientific name, family name, Chakma name and local names. Information on use of the species, habit, habitat, parts used and mode of preparation were documented with the help of herbal healer. A total of 10 species for high blood pressure followed by 09 plant species are used to bone fracture, 08 species for paralysis, 08 species for jaundice, 07 tumor/boils, 07 for fever,05 species for female disease, 05 for asthma, 03 for heart disease and 02 species for kidney/urinary problem. Most of the plant species used for different diseases. Leaves and roots are the major part of the plant used in the treatment of diseases.
d. Collection of local peoples view for conservation strategy. Collection of information on conservation strategy.	d. Conservation strategy related indigenous knowledge was gathered from formal and informal interviews to local people and elder resource persons.
e. Data processing and report writing.	e. A draft report is in progress.

Habit of medicinal plant species

No. of medicinal plants used for different diseases

2.9 **Achievement (s), if any :**

2.10 **Financial statement :**

2.10.1	Total cost	:	Tk. 4,00,000.00
2.10.2	Cost of the year	:	Tk. 2,00,400.00
2.10.3	Expenditure of the year	:	Tk. 2,00,400.00
2.10.4	Source of fund	:	GOB

2.11 **Beneficiaries:** Forest Departments, Academic Institutes, NGOs, and Communities.

3.	**Study**	:	On-going
3.1	**Programme Area**	:	Biodiversity and Conservation
3.2	**Title of the Study**	:	Documentation of the Angiospermic Flora of Hazarikhill Wildlife Sanctuary in Chittagong, Bangladesh

3.3 **Justification :** Hazarikhill Wildlife Sanctuary (WS) is situated the 45 km north of Chittagong port in south-east Bangladesh. Hazarikhill forest area was declared as a Wildlife Sanctuary in 2010. It is situated in the Ramgarh- Sitakunda forests of Chittagong. It comprises an area of about 1177.53 ha. The hilly forest of Sitakunda- Hazarikhill is floristically and geographically more related to Indo-China than to any other part of the Indian sub-Continent (Khan 1990). It has a unique territory with mountains and beautiful landscapes. This Wildlife Sanctuary is a national wild animal's recreational centre. It also helps offers feeding, nesting sites and breeding ground of a large number of wild animals for the human being. A Wildlife Sanctuary is provide various opportunities of education, research, tourism and associates employment. But there is no systematic taxonomic study on the angiospermic flora of this Sanctuary. The findings of the study will provide valuable information for the preparation of taxonomic report and the monitoring of vegetation dynamics of Hazarikhill Wildlife Sanctuary. Therefore, it is necessary to take the study for the assessment of status of the angiospermic flora of this Sanctuary.

3.4 **Objective(s) :**

3.4.1 To prepare a checklist of forest trees, woody shrubs and climbers of Hazarikhill Wildlife Sanctuary.

3.4.2 To describe taxonomic, phonological and ecological characters, synonyms, vernacular name for the compilation for the Forest Flora of Bangladesh.

3.5 **Expected output :**

a. Angiospermic flora and their taxonomically account of Wildlife Sanctuary will be documented which will be helpful in future conservation.

b. BFRI Herbarium will be enriched with reference collection of botanical specimens of the study area.

3.6   **Study Period**   :
3.6.1 Starting year   : 2015-2016
3.6.2 Completion year   : 2017-2018
3.7   **Personnel**   :
3.7.1 Project Leader: : Mohammed Mohiuddin, D.O
3.7.2 Associates   : Asim Kumar Paul, S.R.O.; Syedul Alam RA-1
3.8   **Progress**
3.8.1 Previous years, if any: New Study
3.8.2 This year   :

Activities of the study	Progress
a. Transect walk and quadrate prepared for data collection.	a. Total 19 sample plots of 10 m x 10 m size were lay out representing various slopes (Upper, medium, lower hill portion and along the jhiri) for data collection and vegetation analysis.
b. Listing of the existing plant species in the WS.	b. Listing of 120 plant species of the existing plants in the WS. Among the listed species were 55 trees, 35 shrubs, 20 herbs and 10 climber species.
c. Botanical specimens voucher collection and note in their morphological character.	c. Total 66 botanical samples were collected from the WS and documented their morphological character. Collected samples were classified into trees, shrubs, herbs and climbers.
d. Processing and identification of the collected botanical specimen.	d. Collected samples processed and persevered in the BFRI herbarium. Total 53 species have been identified comparing with the authentic samples of the BFRI herbarium. Mounting, leveling and family wise arranged of 18 identified samples for preservation in the BFRI herbarium.
e. Up to date taxonomic report on collected botanical samples.	e. A draft of taxonomic report is in progress.

3.9   **Achievement (s), if any :**
3.10   **Financial statement**   :
3.10.1 Total cost   : Tk. 5,00,000.00
3.10.2 Cost of the year   : Tk. 1,99,210.00
3.10.3 Expenditure of the year   : Tk. 1,99,210.00
3.10.4 Source of fund   : GOB
3.11   **Beneficiaries:** Forest Departments, Academic Institutes, NGOs, and Communities.

4.   **Study**   : On-going
4.1   **Programme Area**   : Biodiversity and Conservation
4.2   **Title of the Study**   : Regeneration status and floristic composition of Kaptai National Park
4.3   **Justification :** Kaptai National Park is situated in the Rangamati Hill District, which falls between the Karnaphuly and Kaptai Mountain Ranges. The park is adjacent to Kaptai Bazar in the north-eastern corner of the Kaptai Upazila. It is about 57 kilometer from Chittagong town. Kaptai National park is being managed under CHT South Forest Division. It was established in 1999 and its area is 5,464.78 hectares (13,498.0 Acres). Prior to declaration of the national park it was Sitapahar Reserve. It comprises with two Ranges namely Kaptai Range and Karnaphuly Range. It is historically important because of first time Teak (*Tectona grandis*) plantation in Bangladesh was started from this area. It forest type is mixed evergreen forest. There are a huge collection of plants in Kaptai National Park. It provides various opportunities of education, research, tourism and associates employment. But there is no systematic study of regeneration status and plant species diversity of the National Park. Therefore, the study has taken to get regeneration status and plant species diversity of the national park.

4.4 **Objective(s)** :

4.4.1 To prepare a checklist of forest trees, woody shrubs and climbers of Kaptai National Park.

4.4.2 To observe the regeneration status of tree species in different habitats in Kaptai National Park.

4.5 **Expected output :**

Plant species diversity of Kaptai Nation Park will be documented which will be helpful in future conservation.

Data base of regeneration status will be developed.

BFRI Herbarium will be enriched with reference collection of botanical specimens of the study area.

4.6 **Study Period** :

4.6.1 Starting year **:** 2016-2017

4.6.2 Completion year **:** 2018-2019

4.7 **Personnel** :

4.7.1 Project Leader: **:** Asim Kumar Paul, S.R.O.

4.7.2 Associates **:** Mohammed Mohiuddin, D.O; A.H.M. Jahangir Alam, R.O.; Syedul Alam RA-1

4.8 **Progress**

4.8.1 Previous years, if any **:** New Study

4.8.2 This year **:**

Activities of the study	Progress
a. Review of literatures	a. Pertinent literatures have been consulted and information collected.
b. Transect walk and listing of the existing plant species in the National Park.	b. Listing of 82 plant species of the existing plants in the Kaptai National Park. Among the listed species there were 36 trees, 22 shrubs, 12 herbs and 12 climber species.
c. Data collection on tree seedlings regeneration.	c. Total 19 sample plots of 10 m x 10 m size were lay out representing various slopes (Upper, medium, lower hill portion and along the jhiri) for data collection and vegetation analysis.
d. Botanical specimens voucher collection and note in their morphological character.	d. Total 36 botanical samples were collected from the Kaptai National Park and documented their morphological character. Collected samples were classified into trees, shrubs, herbs and climbers.
e. Processing and identification of the collected botanical specimen.	e. Collected samples processed and persevered in the BFRI herbarium. Total 28 species have been identified comparing with the authentic samples of the BFRI herbarium. Mounting, leveling and family wise arranged of 12 identified samples for preservation in the BFRI herbarium.
f. Compilation of reports.	f. A draft of taxonomic report is in progress.

4.9 **Achievement (s), if any** :

4.10 **Financial statement** :

4.10.1 Total cost **:** Tk. 6,00,000.00

4.10.2 Cost of the year **:** Tk. 1,50,000.00

4.10.3 Expenditure of the year **:** Tk. 1,50,000.00

4.10.4 Source of fund **:** GOB

4.11 **Beneficiaries:** Forest Departments, Plant taxonomists, Biodiversity researcher, Academic Institutes, NGOs, and Farmers.

Forest Economics Division

1. **Study** : On-going
1.1 **Programme Area** : Forest Inventory and Economics
1.2 **Title of the Study** : Impact of participatory forestry on financial and livelihood of local people in northern region of Bangladesh

1.3 **Justification :** Participatory forestry is a mission that aims to ensuring ecological, economic and social benefits to the rural people. The rural people, mainly who are living below poverty line, specifically by involving the beneficiaries' right from the raising plantation. Poverty is a major problem and is acute due to natural disaster and climate change frequently throughout the country. The government has given priority to maximize land productivity through the planting of fuel wood plantation and timber species in all marginal lands like those along feeder roads, highways, railway lines and canal embankment areas where most of the poor people live in. So, the participatory programmed is to generate productive employment for the poor, and to provide a source of income from tree and tree product. The creation of additional forest resource would be based for livelihood and environmental development of the country. Now, it is high time to assess the sources of income and change of the livelihood of local people due to forestation and its' economic viability in northern region of the country which is contributing to the national economy. Moreover, impact assessment of southern region (Coastal) participatory forestry and its' socioeconomic aspect have recently been evaluated. So, results of the selected study will be effective for future planning and documentation of the comparative pictures of species diversity and various types of generated forest resources between south (low land areas or coastal) and northern region (up land areas) of the country.

1.4 **Objective(s)** :
1.4.1 To find out production system through intercropping of seasonal and/or annual crop in the forest floor of strip plantation in northern region of Bangladesh

1.4.2 To assess income generation of local people

1.4.3 To make financial analysis of selected year of strip plantation

1.4.4 To estimate the sequestrated carbon in the selected years of plantations

1.5 **Expected output :** Generation of employment & income, production system, input-output ratio of local people and the economic profitability of participatory forestry in northern region of Bangladesh.

1.6 **Study Period** :
1.6.1 Starting year **:** 2016-2017
1.6.2 Completion year **:** 2018-2019

1.7 **Personnel** :
1.7.1 Project Leader: **:** M.A Taher Hossain; RO
1.7.2 Associates **:** M.A.H. Shah Jalal; DO, Md. Melon; FI, Forzana Yasmin; RA-1
1.8 **Progress**
1.8.1 Previous years, if any:
1.8.2 This year **:**

Activities of the study	Progress
a. Selection of study areas and plantation participants with the help DFO office of Rajshahi SFD	a. The strip plantation raised during 2000-01 to 2004-05 in two upazilla namely; Bagatipara and Damairhat were selected as study areas under the Social Forest Division (SFD) of Rajshahi. Group discussions were arranged in each upazilla with local participants. The participants that are having benefited directly or indirectly from the selected strip plantations. A number of 25 participants from each upazilla were selected for interview regarding their yield of crops, employment and income.

b. Data collection and analysis.	b. The required number of sample plots as sample size for the study areas were determined as 65 plots (area 100 sq. meters) at 7.5% margin of error. These sample plots were allocated stratum (plantation year basis) wise for required data collection. The collected information were GBH/DBH of trees, number of tree species per plot, nursery and management cost, species and girth size wise tree round log prices, fuel wood price etc. The Stratified Random Sampling method was followed to assess the number of tree stocking, volume and biomass of trees and forest carbon storing in the strip plantation raised during 2000-01 to 2004-05 in two upazillas under Rajshahi SFD. Based on estimated various forest resources, financial and economic assessment were made for the strip plantations of the study areas.

The results of statistical and economic analysis for the strip plantations raised during 2000-01 to 2004-05 are in tables 1, 2, 3, 4, 5, 6 & 7.

Table -1. Establishment of strip plantations in two Upazilas (Damaihat & Bagatipara) under Rajshahi SFD

Planted year	Areas (Seedling km)
2000-01	9
2001-02	15
2002-03	35
2003-04	59.3
2004-05	51
Total	169.3

A total of 169 (68 ha) seedling km strip plantations were established during 2000-01 to 2004-05 in two upazilas under Rajshahi SFD. The maximum (59.3-seedling km) plantations raised were in 2003-04 and minimum (9 seedling km) in the year of 2000-01.

Table-2 GBH class wise trees distribution (nos./ha) of the strip plantation raised during 2000-01 to 2004-05 in study areas.

Species name	Girth at Breast Height (GBH) class wise no. of trees							Total	Species (%)
	<=44	45-59	60-89	90-119	120-149	150-179	180-209		
Akashmoni	9	15	70	55	5	3		156	17%
Mahagani	24	24	45	6				100	11%
Minjiri	3	11	70	17				100	11%
Ipil-ipil	2	6	61	29				97	11%
Babla	9	27	47	8				91	10%
Rain tree		3	15	18	21	11	2	70	8%
Euclyptus	21	18	15	11	2	2		68	8%
Sissoo		8	20	26	6			59	7%
Arjun	9	8	17	18	3			55	6%
Bokain	9	11	5					24	3%
Kadam		2	5	8				14	2%
Gamar	2	5	8					14	2%
Krishnachura			3	5	2	3		12	1%
Others*	2	8	15	5	3	2		33	4%

* Tree number below 10 of same species is included in the column of others.

The number of tree species and its' girth at breast height (GBH) in class interval wise distribution per hectare of the study areas were estimated. The maximum tree percent was akashmoni (17%) and minimum krishnachura (1%), and that were within existing major species of the study areas. GBH wise number of trees maximum (394) and minimum (2) were observed in the class interval of 60-89 and 180-209 cm respectively.

Table- 3. Estimation of tree resources ha^{-1} in various categories in the year selected plantation.

Plantation Year	Interim Crops		Resources ha^{-1} of tree plantations				
	Arhor pulse (ton)	Fuelwood (ton)	Existing tree Stocking (no.)	AG-Biomass (ton)	Commercial Wood(m3)	O-C assimilated (ton/year)	CO$_2$ absorption (ton/year)
2000-01	0.16	4.28	1150	449.07	516.47	16.03	58.84
2001-02	0.14	3.16	735	308.18	331.45	12.41	45.53
2002-03	0.21	5.49	1025	351.14	353.82	14.83	54.41
2003-04	0.20	5.19	1093	361.50	395.27	16.37	60.06
2004-05	0.22	5.80	760	299.33	312.41	15.14	55.56

Various types of forest resources like interim crops (arhor pulse, branch cutting & pruning as fuelwood at 5th and 8th of year of plantation), tree stocking, above ground (AG) biomass, commercial wood, organic carbon (O-C) and CO$_2$ absorption per hectare were estimated. Arhor pulse and fuelwood as interim crops were maximum (0.22 and 5.80 metric ton) in 2004-05 and minimum (0.14 ton and 3.16 ton) in 2001-02. The number of existing trees was found highest (1150) in 2000-01 and lowest (735) in 2001-02. A metric ton of AG biomass was maximum (449) in 2000-01 and minimum (299) in 2004-05. The volume of trees maximum was (516 m^3) in 2000-01 and minimum (312 m^3). Organic carbon assimilation and CO$_2$ absorption were maximum (16 and 59 metric ton) in 2003-04 and minimum (12 and 46 metric ton) in 2001-02 per hectare per year respectively.

Table-4. Results of the direct and indirect total resources on strip plantations of the study areas under Rajshahi SFD.

Parameters	Estimated. (Total)	Standard Error
Number of Tree Stocking ("000")	64.34	±4.95
Tree volume ("000" m3)	24.55	±2.56
Tree Biomass ("000" ton)	23.06	±2.27
O-C Flux ("000" ton)	11.53	±1.14
O-C Sequestration ("000" ton)	13.70	±1.14
CO2 Assimilation ("000" ton)	50.27	±4.17

The stocking number of total trees with standard error was estimated as 64 (SE ± 5) thousand and the total volume of commercial wood was about 25 (SE ± 3) thousand cubic meter. Total of tree biomass, O-C flux, O-C sequestration and CO2 assimilation were estimated as 23 (SE±2), 12 (SE±1), 14 (SE±1) and 50 (SE ±4) thousand metric ton respectively for the plantations of study areas.

Table-5. Results of financial & economic parameters for the selected plantation years.

Planted Year	Financial				Economic		Beneficiaries sharing ("000"Tk/ha)	
	PVC ("000"Tk/ha)	NPVB ("000"Tk/ha)	FRR	B-C ratio	NPV ("000"Tk/ha)	ERR	Interim crops & 55% Net profit	Generated Income
2000-01	207	266	23%	2.28	378	33%	187	859
2001-02	200	261	24%	2.30	346	33%	181	756
2002-03	193	242	25%	2.26	343	36%	174	659
2003-04	295	482	33%	2.63	590	44%	305	1052
2004-05	312	466	38%	2.42	558	48%	297	849

Financial and economic parameters for the selected year of plantations were determined. The present value of financial cost (PVC) and net present value of benefit (NPVB) estimated were highest (Tk.3.12 lakh/ha and 4.82 lakh/ha) in 2004-05 and 2003-04 and lowest (Tk.1.93 lakh/ha and 2.42 lakh/ha) in 2002-03 respectively. The financial rate of return (FRR) and benefit cost (B-C) ratio highest were (38% and 2.63) in 2004-05 and 2003-04 and lowest were (23% and 2.26) in 2000-01 and 2002-03 respectively. The economic NPVB and ERR were highest (Tk.5.90 lakh/ha and 48%) in 2003-04 and 2004-05, lowest (Tk.3.46 lakh/ha and 33%) in 2001-02 respectively. So, the generation of income in current price for the beneficiaries were maximum (Tk. about 11 lakh/ha) in 2003-04 and minimum (Tk. about 7 lakh/ha) in 2002-03.

Table-6. Land Expectation Value (LEV) and Equal Annual Income (EAI) ha^{-1} on the basis of strip plantations age.

Age of Plantation	LEV ("000" Tk.)	EAI npv ("000" Tk.)
15	84	35
14	93	35
13	99	34
12	225	71
11	251	72

Land expectation values (LEV) and equal annual income (EAI) were assessed in respect of the plantation age. LEV and EAI estimated were maximum (Tk. about 3 lakh and 72 thousand) at the age 11 year and minimum (Tk. 84 thousand and Tk. 34 thousand) at the age 15 and 13 year of strip plantation.

Table-7. Financial achievement of the raised plantations during 2000-01 to 2004-05 in two upazillas of Rajshahi SFD

Plantation Year	Planted areas(ha)	Present Value in Million Tk.		Share of participants (Tk. In million)	
		PVC	NPVB	Interim crops value & 55% Net Benefit in PV	*Generated income in current price
2000-01	4	0.75	1.0	0.67	3.09
2001-02	6	1.20	1.6	1.09	4.54
2002-03	14	2.70	3.4	2.43	9.23
2003-04	24	6.99	11.4	7.23	24.95
2004-05	20	6.37	9.5	6.07	17.31
				Total :	59.12

Plantation year wise total income in current price of the beneficiaries was assessed. The generation of total income in current price was about Tk. 6 crore in the study areas of 68 ha strip plantations in two upazilas (Damairhat and Bagatipara) under Rajshahi SFD.

* Generated income of local participants were 55 percent shared from sales proceeds of final tree harvest and in addition to 100 percent of all others benefits from interim crops that were arhor, thinning and pruning materials at the age of 5th and 8th year the respective plantation year.

Remarks: An estimated amount near about 6 crore taka would be the standing income for the local poor participants from the selected plantations year in study areas. Moreover, 13.7 thousand metric ton of Organic carbon (O-C) are sequestered and that are equivalent to 50 thousand metric ton of CO_2 gas mitigation in reducing compromise of climate change by the strip plantations established from 2000-01 to 2004-05 in two upazillas (Bagatipara & Damairhat) under Rajshahi SFD.

1.9   **Achievement (s), if any**   :
1.10   **Financial statement**   :
1.10.1 Total cost   :   Tk. 4,20,000.00
1.10.2 Cost of the year   :   Tk.   72,490.00
1.10.3 Expenditure of the year   :   Tk.   72,490.00
1.10.4 Source of fund   :   GOB
1.11   **Beneficiaries:** FD, Private Planters, NGOs etc

2.   **Study**   :   On-going

2.1   **Programme Area**   :   Forest Inventory and Economics

2.2   **Title of the Study** :   Impact of Co-management on forest resources and livelihood of forest dependent people in chunati wildlife sanctuary (CWS), Chittagong

2.3   **Justification :** The chunati wildlife sanctuary is a semi-evergreen forest in Bangladesh, situated at about 70 km south of Chittagong city on the west side of Chittagong-Cox's bazzar high way. The GPS positions for the sanctuary are $21^0 40^/$ N and $92^0 07^/$ E. It comprises an area of 7764 ha. The Sanctuary was divided into two forest ranges Jaldi and Chunati, 7 forests beats namely Chunati, Harbeng, Aziznagar, jaldi, Puichari, Chambol and Noapara. There are 7 mouzas, divided into 25 villages and further divided into settlements which are locally called para. Among the paras about 48% is located inside and the edges of the forest and rest of the outside, but adjacent to near forests

The sanctuary was originally Garjan dominated forest with natural associates of different tree species. The associate trees include rakton, jam, uriam, chapaklish, simul, koroi and wide variety of other species. Besides this various species of trees, bamboo and grasses were also profuse in the sanctuary. However, due to various reasons like unauthorized cutting an indiscriminate felling the species are the forest become with poor stocking. Due to pressure by surrounding people of the sanctuary like land encroachment for expansion of settlement and agriculture, tree poaching, hunting, collection of fuel wood, bamboo and cane and other forest products are the major causes for the degradation of forest and its resources. Poor forest management, deterioration of law and order situation, adverse role of the local influential people, operation of brickfield and saw mills, unemployment and poverty are the major underlying factors that contribute to the forest degradation. Considering the facts Forest Department take a number of initiatives to restore the resources of Chunati wildlife Sanctuary involving local people like Nishiorgo Support Project, Co-management etc. Due to several initiatives it is imperative to assess the socio-economic situation of local people and also the forest resources of chunati wild life sanctuary. Aiming this, the present study has undertaken to fulfill the following objectives:

2.4   **Objective(s)**   :
2.4.1 To assess the forest resources of the sanctuary.
2.4.2 To assess the socio-economic condition of the forest dependent people.
2.5   **Expected output :** Situation of the forest resource and status of forest dependent people will be known.
2.6   **Study Period**   :
2.6.1 Starting year   : 2016-2017
2.6.2 Completion year   : 2017-2018
2.7   **Personnel**   :
2.7.1 Project Leader: : M.A.H. Shah Jalal; DO,
2.7.2 Associates   : Dr. Rafiqul Haider DO, MFP, M.A Taher Hossain; RO, Md. Melon; FI, Forzana Yasmin; RA-1
2.8   **Progress**
2.8.1 Previous years, if any:
2.8.2 This year   :

Activities of the study	Progress
a. Arrangement of group discussion with local people.	a. Group discussion were done in Chunati, Azijnagar and Harbang beat under Chunati forest range.
b. Data collection and analysis	b. Data on forest tree spices were collected from 45 no. plots (20mx20m) from Chunati, Azijnagar and Harbang beats. Data on socio-economic aspect from 135 nos. family of CPG, VCF and control (not under co-management) from three beats. Result are given below (Table 1-13).

Table-1. Species composition in Chunati Forest Range

Sl.no.	Local name	Scientific name
1	Achargula	*Grewia nervosa*
2	Akashmoni	*Acacia auriculiformis*
3	Acacia Hybrid	*Acacia hybrid*
4	Arjun	*Terminalia arjuna*
5	Am	*Mangifera indica*
6	Amloki	*Phyllanthus emblica*
7	Bohera	*Terminalia bellerica*
8	Bara jam	*Syzygium formosum*
9	Barta	*Artocarpus lacucha*
10	Batil / Batilata	*Pothos scandens*
11	Bydal	
12	Bormala	*Callicarpa arborea*
13	Bael	*Aegle marrnelos*
14	Bottejam	*Syzygium oblatum*
15	Boroi	*Ziziphus mauritiana*
16	Batna	*Lithocarpus acuminata*
17	Cilana	
18	Chapalish	*Artocarpus chaplasha*
19	Chatim	*Alstonia scholaris*
20	Cow	*Garcinia cowa*
21	Chickrassia	*Chukrasia tabularis*
22	Dhaki jam	*Syzygium grandis*
23	Dharmara	*Sterospermum personatum*

24	Dumur	*Ficus hispida*
25	Dakrom	*Mitragyna parvifolia*
26	Elana	Antidesma acidum
27	Essi	*Senna occidentalis*
28	Eucalyptus	*Eucalyptus camaldulensis*
29	Garjan	*Dipterrocarpus turbinatus*
30	Gamar	*Gmelina arborea*
31	Horina	*Vitex peduncularis*
32	Horitaki	*Terminalia chebula*
33	Jarul	*Lagerstroemia speciosa*
34	Jam	*Syzygium cumini*
35	Jalpai	*Elaeocarpus rogusus*
36	Jambura	*Citrus maxima*
37	Kanthal	*Artocarpus heterophyllus*
38	Khuruj	*Holarrhena antidysenterica*
39	Kallanyful	
40	Kechua	*Glochidion lanceolarium*
41	Madarmosol	*Actinodaphne angustifolia*
42	Mahegony	*Swietenia macrophylla*
43	Naricha /jibon	*Trema orientalis*
44	Puti jam	*Syzyginm fruticosum*
45	Peyara	*Psidium guajava*
46	Phaching	
47	Raintree	*Samanea saman*
48	Suruj	*Toona ciliata*
49	Sheori	*Anogeissus acuminata*
50	Sal	*Shorea robusta*
51	Simul	*Bombax ceiba*
52	Tejpata	*Cinnamomum tamala*
53	Teak	*Tectona grandis*
54	Vadi	*Garuga pinnata*

Status of Forest Resources:
- Total number of species 54 nos.
- Average number of tress/ha. 333 nos. (dbh > 5cm)
- Average number of sapling/ha. 1484 nos. (height >1m, dbh 1-5cm)
- Average number of seedling/ha. 2500 nos. (height < 1m, dbh < 1cm)
- 90% trees lies in GBH class 15.70 cm-80.00cm.

Socio-economic condition of the forest dependent people in (CWS), Chittagong.

Table 2: Basic information of family head

Variable	CPG	VCF	Control	Chunati Range
Average age	43	42	41	42
Male (%)	73	42	79	64
Female (%)	27	58	21	36
Education status (%)				
Signature	33	40	31	35
Primary	38	38	33	36
Secondary	24	20	31	25
College	4	2	5	4

Occupation status (%)				
Agriculture	38	24	33	32
Wage labour	18	9	18	15
Business	20	13	8	14
Services	2	7	10	6
Others	22	47	31	33

Table- 3. Basic information of family members

Variable	CPG		VCF		Control		Chunati Range	
	Average	Percentage	Average	Percentage	Average	Percentage	Average	Percentage
Male	3.13	49.65	2.87	50.99	2.36	51.21	2.79	50.54
Female	3.18	50.35	2.76	49.01	2.24	48.79	2.73	49.46
Family size	6.31		5.62		4.60		5.51	
Education satus (%)								
Not-school going	4.96		5.53		9.18		6.33	
Signature	12.77		15.42		15.94		14.56	
Primary	39.01		42.29		48.31		42.72	
Secondary	37.59		33.60		23.19		32.21	
College	5.67		3.16		3.38		4.18	

Table- 4. Son and Daughter per family and their Occupation

Variable	CPG		VCF		Control		Chunati Range	
	Average	Percentage	Average	Percentage	Average	Percentage	Average	Percentage
Son	1.87	47.73	1.89	52.80	1.51	43.59	1.76	48.07
Daughter	2.04	52.27	1.69	47.20	1.96	56.41	1.90	51.93
Total	3.91	100	3.58	100	3.47	100	3.65	100
Occupation status (%)								
Variable	Student		Income holder					
Age			0-14		15-20		21+	
CPG	69		2		11		18	
VCF	65		2		11		22	
Control	73		5		12		11	
Chunati Range	69		3		11		17	

Table 5: Age wise marital status (%)

Variable	0-14		15-20		21+	
	Unmarried	Married	Unmarried	Married	Unmarried	married
CPG	51	0	21	3	7	17
VCF	47	0	16	4	8	25
Control	67	1	18	4	7	3
Chunati Range	54	0	18	4	7	16

Table- 6. House conditions (%)

Variable	Mud wall+ tin roof	Mud wall+ Sun grass roof	Bamboo wall + tin roof	Bamboo wall + Sun roof	Semi paka	Paka
CPG	71	9	9	0	9	2
VCF	64	18	7	0	9	2
Control	33	41	18	5	3	0
Chunati Range	57.36	21.71	10.85	1.55	6.98	1.55

Table- 7. Land use pattern (ac.)

Variable	CPG		VCF		Control		Chunati Range	
	Average	Percentage	Average	Percentage	Average	Percentage	Average	Percentage
Agricultural	0.64	39.73	0.20	21.38	0.13	18.44	0.32	29.83
Homestead	0.27	16.64	0.15	16.42	0.15	20.07	0.19	17.35
Hill	0.03	2.15	0.02	1.94	0.02	2.46	0.02	2.16
Leased land	0.67	41.47	0.55	60.25	0.43	59.02	0.55	50.67
Total	1.61		0.91		0.72		1.08	

Table- 8. Monthly income (Tk.)

Variable	CPG		VCF		Control		Chunati Range	
	Average	Percentage	Average	Percentage	Average	Percentage	Average	Percentage
Agriculture	4478	27	4376	29	2489	20	3781	26
Wage labor	3511	21	2700	18	2287	18	2833	19
Business	3433	21	3800	25	1111	9	2781	19
Livestock	881	5	446	3	261	2	529	4
Service	2667	16	1467	10	2822	22	2319	16
Forest resources	9	0	0	0	0	0	3	0
Home garden	177	1	133	1	167	1	159	1
Others	1208	7	2236	15	3611	28	2351	16
Total	16363		15157		12748		14756	

Table- 9. Expenditure (Tk./month)

Variable	CPG		VCF		Control		Chunati Range	
	Average	Percentage	Average	Percentage	Average	Percentage	Average	Percentage
Family	11478	80	11656	84	9333	84	10822	83
Medical	996	7	858	6	658	6	837	6
Education	1318	9	969	7	647	6	978	7
Others	481	3	418	3	431	4	443	3
Total	14272		13900		11069		13080	

Table- 10. Forest resources extraction (Tk./month)

Variable	CPG		VCF		Control		Chunati Range	
	Average	Percentage	Average	Percentage	Average	Percentage	Average	Percentage
Fuel W.	504	52	418	53	342	55	421	53
Leave/B.	433	45	358	45	283	45	358	45
Bamboo	32	3	4	1	0	0	12	2
Straw	0	0	8	1	0	0	3	0
Broomgrass	0	0	7	1	0	0	2	0
Total	969		795		625		796	

Fuel Wood used (Kg./day)	CPG	VCF	Control	Chunati Range
	6	5	4	5

Table- 11. Facility received from co-management (%)

Variable	Cash	Lon	Training	Tube well	D. Chula	Sanitation	Aw. Tanning	seed/seedling
CPG	100	100	100	4	60	49	100	100
VCF	100	100	100	2	64	53	100	100
Chunati Range	100	100	100	3	62	51	100	100

Table- 12. Forest dependent (%)

Variable	CPG	VCF	Control	Chunati Range
Before	83	84	84	84
Present	16	15	16	16

Table- 13. Species composition in home garden of Chunati Range.

Sl.no.	Local name	Scientific name	Percentage
1	Kanthal	*Artocarpus heterophyllus*	75
2	Am	*Mangifera indica*	
3	Akashmoni	*Acacia auriculiformis*	62
4	Amra	*Spondias pinnata*	59
5	Peyara	*Psidium guajava*	55
6	Amloki	*Phyllanthus emblica*	47
7	Litchi	*Litchi chinensis*	43
8	Boroi	*Ziziphus mauritiana*	40
9	Labu	*Citrus aurantifolia*	38
10	Jam	*Syzygium cumini*	37
11	Jalpai	*Elaeocarpus rogusus*	
12	Narkel	*Cocos nucifera*	36
13	Acacia Hybrid	*Acacia hybrid*	32
14	Bans	*Bambusa longispiculata*	
15	Jambura	*Citrus maxima*	29
16	Safeda	*Manilkara zapota*	
17	Kola	*Musa paradisiaca*	26
18	Supary	*Areca catechu*	24
19	Gamar	*Gmelina arborea*	23
20	Papaya	*Carica papaya*	22
21	Bael	*Aegle marrnelos*	
22	Kamranga	*Averrhoa carambola*	18
23	Tetul	*Tamarindus indica*	16
24	Mahegony	*Swietenia macrophylla*	15
25	Sal	*Shorea robusta*	14
26	Chalta	*Dillenia indica*	
27	Teak	*Tectona grandis*	10
28	Tellya garjan	*Dipterrocarpus turbinatus*	9
29	Bohera	*Terminalia bellerica*	4
30	Neem	*Azadirachta indica*	3

31	Anarash	*Ananas comosus*	
32	Cane		
33	Chapalish	*Artocarpus chaplasha*	
34	Kala-koroi	*Albizia lebbeck*	2
35	Raintree	*Samanea saman*	
36	Sissoo	*Dalbergia sissoo*	
37	Sajna	*Moringa oleifera*	
38	Telsur	*Hopea odorata*	
39	China orange		
40	Dalim	*Punica granatum*	1
41	Mangium	*Acacia mangium*	

Maximum 23 species and Minimum 3 species of a family.

Remarks: Total number of forest species was recorded 54 nos. in Chunati Wildlfe Sanctuary (CWS). Average number of tress/ha. 333 nos., sapling/ha. 1484 nos., seedling/ha. 2500 nos. Ninety Percent (90%) trees lies in GBH class 15.70-80.00cm. In homestead garden maximum 23 species and minimum 3 species were found of a family. Socio-economic data given in above, all the variable except monthly income (Tk. 14,756) are higher (negative) than national variable. Due to Co-management practice alternative income sources are not increase an expectation of the local people. From the preliminary observation it is apparent that co-management tools dose not work properly. So the objectives of the co-management interns of forest resources as well as Socio-economic conditions of the forest dependent people in CWS is not desired level.

1.9 **Achievement (s), if any :**
1.10 **Financial statement :**
1.10.1 Total cost **:** Tk. 4,50,000.00
1.10.2 Cost of the year **:** Tk. 1.38,490.00
1.10.3 Expenditure of the year **:** Tk. 1.38,490.00
1.10.4 Source of fund **:** GOB
1.11 **Beneficiaries:** FD, Private Planters, NGOs etc

Forest Inventory Division

1. **Study** : On-going
1.1 **Programme Area** : Forest Inventory, Growth and Yield
1.2 **Title of the Study** : Growth and yield assessment of akashmoni (*Acacia auriculiformis*) and mahogany (*Swietenia macrophylla*) through establishment of permanent sample plots (PSPs) (2nd Phase)
1.3 **Justification : NA**
1.4 **Objective(s) :**
1.4.1 To generate information on growth and yield of the akashmoni and mahogany in plantation forests of Bangladesh.
1.4.2 To set the physical rotation of these species.
1.5 **Expected output :**
 a. Site indices curves for the species grown in the plantation forests will be available.
 b. Growth and yield of the species at different plantation sites will be available.
 c. Physical rotation of these species will be determined.
1.6 **Study Period :**
1.6.1 Starting year **:** 2015-2016
1.6.2 Completion year **:** 2019-2020

1.7　**Personnel**　　　　**:**
1.7.1 Project Leader:　　**:** Mohammed Shahid Ullah, D.O
1.7.2 Associates　　　　**:** Mofizul Islam Khan, FI and Abul Kalam Azad, RA (Grade-1).
1.8　**Progress**
1.8.1 Previous years, if any: Data on DBH and height growth of akashmoni and mahogany trees from 70 PSPs (12 nos. at Chittagong, 15 nos. at Cox's Bazar and 43 nos. at Faridpur & Rajbari Forest Divisions) have been recording and compiled for the last six years.

1.8.2 This year　　　　**:**

Activities of the study	Progress
a. Re-measurement of akashmoni and mahogany trees from 70 PSPs at Chittagong, Cox's Bazar, Faridpur and Rajbari Forest divisions	DBH and height growth data of akashmoni trees from 27 PSPs in Chittagong and Cox's Bazar and mahgoni trees from 43 PSPs in Faridpur and Rajbari Forest Division were recorded.
b. Summarization of collected data.	Field data were summarized as shown in table 1, 2 and 3.

Table-1. Growth increment of akashmoni trees at Ukia and Ramu under Cox's Bazar forest division.

Plot Number	Year of Plantation	Age (year)	Number of Trees	Average DBH (cm)	Average Height (m)	Mean Annual Increment	
						DBH (cm)	Height (m)
1(A)	2008	09	23	11.51	10.50	1.28	1.17
2(A)	2008	09	13	14.60	10.69	1.62	1.19
3(A)	2008	09	23	10.71	9.52	1.19	1.06
4	2006	11	12	17.40	17.38	1.58	1.58
5	2006	11	08	15.48	16.19	1.41	1.47
6	2006	11	21	13.78	16.60	1.25	1.51
7	2005	12	37	11.94	14.34	0.99	1.19
8	2005	12	21	15.37	15.71	1.28	1.31
9	2005	12	21	15.70	15.10	1.31	1.26
10(A)	2011	06	59	7.96	9.49	1.33	1.58
11(A)	2011	06	38	9.46	10.04	1.58	1.67
12(A)	2011	06	46	7.83	8.04	1.30	1.34
13	2007	10	19	15.77	14.26	1.58	1.43
14	2007	10	18	15.30	15.28	1.53	1.53
15	2007	10	11	16.37	13.14	1.64	1.31

Table-2. Growth increment of akashmoni trees at Hiako and Andhermanik under Chittagong Forest Division.

Plot Number	Year of Plantation	Age (year)	Number of Trees	Average DBH (cm)	Average Height (m)	Mean Annual Increment	
						DBH (cm)	Height (m)
1	2007	10	56	8.47	9.01	0.85	0.90
2	2007	10	36	12.33	9.85	1.23	0.98
3	2006	11	09	19.49	15.94	1.77	1.45
4	2006	11	08	17.56	13.06	1.60	1.19
5	2006	11	09	19.80	14.56	1.80	1.32
6	2005	12	08	19.65	14.88	1.64	1.24
7	2005	12	08	21.50	16.69	1.79	1.39
8	2004	13	22	15.34	12.36	1.18	0.95
9	2004	13	15	16.69	14.40	1.28	1.11
10	2004	13	12	17.89	13.17	1.38	1.01
11	2003	14	20	15.04	12.95	1.07	0.93
12	2003	14	16	19.50	14.22	1.39	1.02

Table- 3. Growth increment of mahogany trees at Faridpur and Rajbari Forest Division

Plot Number	Year of Plantation	Age (year)	Number of Trees	Average DBH (cm)	Average Height (m)	Mean Annual Increment DBH (cm)	Height (cm)
1	2000	17	40	14.27	14.08	0.84	0.83
2	1998	19	30	17.21	14.67	0.91	0.77
3	2000	17	31	18.32	14.32	1.08	0.84
4	2004	13	34	18.88	14.16	1.45	1.09
6	1991	26	58	12.68	12.22	0.49	0.47
7	2008	09	51	13.69	14.09	1.52	1.57
8	2002	15	24	22.40	15.54	1.49	1.04
9	1996	21	27	28.98	17.13	1.38	0.82
10	2000	17	25	21.23	16.80	1.25	0.99
11	2000	17	31	15.65	12.23	0.92	0.72
12	1997	20	15	21.68	14.87	1.08	0.74
13	1997	20	34	16.32	15.38	0.82	0.77
14	1994	23	06	28.73	15.17	1.25	0.66
15	1998	19	26	15.83	12.50	0.83	0.66
16	1994	23	22	23.79	14.33	1.03	0.62
17	1994	23	21	23.65	15.62	1.03	0.68
18	2008	09	32	13.31	8.58	1.48	0.95
19	2008	09	26	11.28	7.92	1.25	0.88
20	1995	22	30	19.68	14.43	0.89	0.66
21	1995	22	38	20.58	15.68	0.94	0.71
22	2005	12	20	17.25	14.80	1.44	1.23
23	2007	10	39	15.73	11.26	1.57	1.13
24	2007	10	35	12.77	12.14	1.28	1.21
25	2007	10	39	12.10	10.50	1.21	1.05
26	1994	23	14	13.12	10.61	0.57	0.46
27	1994	23	08	11.77	9.94	0.51	0.43
28	2007	10	25	14.49	10.92	1.45	1.09
29	2007	10	30	13.82	10.88	1.38	1.09
30	1993	22	15	17.94	17.37	0.82	0.79
31	1995	22	28	19.17	17.34	0.87	0.79
32	2002	15	35	14.34	12.14	0.96	0.81
33	2008	09	28	13.33	10.96	1.48	1.22
34	1990	27	15	19.21	14.83	0.71	0.55
35	1995	22	31	16.29	14.31	0.74	0.65
36	1995	22	44	13.59	13.19	0.62	0.60
37	2005	12	44	11.24	11.13	0.94	0.93
38	2002	15	48	14.69	14.69	0.98	0.98
39	2001	16	44	13.82	11.34	0.86	0.71
40	1997	20	21	19.89	15.95	0.99	0.80
41	1995	22	26	19.13	13.87	0.87	0.63
42	1995	22	43	15.41	12.22	0.70	0.56
43	1995	22	16	17.77	16.06	0.81	0.73
44	2001	16	24	17.67	15.27	1.10	0.95

1.9   **Achievement (s), if any :**

a. Prepared growth and yield tables for akashmoni and mahogany in the plantations and village groves based on temporary sample plots (TSPs).

b. Prepared growth and yield tables for mahogany planted on the crops land.

1.10 **Financial statement :**
1.10.1 Total cost **:** Tk. 5,00,000.00
1.10.2 Cost of the year **:** Tk. 49,995.00
1.10.3 Expenditure of the year **:** Tk. 49,995.00
1.10.4 Source of fund **:** GOB
1.11 **Beneficiaries:** Forest Department (FD), Policy Maker, Researchers, Forestry Professionals, BFIDC, Timber traders, Universities and NGOs.

2. **Study** : On-going
2.1 **Programme Area** : Forest Inventory, Growth and Yield
2.2 **Title of the Study** : Growth and yield of mangrove species through establishment of permanent sample plots (PSPs) in coastal plantation of Bangladesh (1st Phase)
2.3 **Justification :NA**
2.4 **Objective(s) :**
2.4.1 To generate information on growth and yield of mangrove species planted as under plantation in the costal belt of Bangladesh.

2.4.2 To estimate diameter/girth increment rates of these species.

2.4.3 Setting physical rotation of these species.

2.5 **Expected output :**

. Survival rates, diameter/girth and height increment rates of the mangrove species planted as under planting will be known.

. Site indices curves for the species grown as under planting will be available.
. Physical rotation of these species will be determined.
2.6 **Study Period :**
2.6.1 Starting year **:** 2015-2016
2.6.2 Completion year **:** 2019-2020
2.7 **Personnel :**
2.7.1 Project Leader: **:** Mohammed Shahid Ullah, D.O
2.7.2 Associates **:** Mofizul Islam Khan, FI and Abul Kalam Azad, RA (Grade-1).
2.8 **Progress**
2.8.1 Previous years, if any: New study.
2.8.2 This year **:**

Activities of the study	Progress
a. Re-measurement of mangrove trees from existing 53 PSPs established in the plantations of Patuakhali and Bhola Coastal Afforestation Division.	a. DBH and height of all trees in the 49 plots of three species (17 of sundri, 23 of gewa and 9 of passur) were measured.
b. Summarization of collected data.	b. Field data were summarized as shown in Table 4 and 5.

Table 4. Growth increment of gewa, passur and sundri trees collected from under planting trial plots in coastal plantation of Rangabali, Patuakhali.

Plot Number	Year of Plantation	Species	Number of Trees	Age (year)	Average DBH (cm)	Average Height (m)	Mean Annual Increment	
							DBH (cm)	Height (cm)
1	1994	Passur	34	23.50	7.41	8.33	0.32	0.35
2	1994	Passur	46	23.50	7.42	6.92	0.32	0.29
3	1994	Passur	30	23.50	7.83	7.07	0.33	0.30
4	1994	Gewa	42	23.50	11.19	11.63	0.48	0.49

5	1994	Gewa	55	23.50	9.28	9.90	0.39	0.42
6	1994	Gewa	48	23.50	8.01	8.71	0.34	0.37
7	1994	Sundri	28	23.50	4.95	6.23	0.21	0.27
8	1994	Sundri	38	23.50	4.26	4.34	0.18	0.18
9	1994	Sundri	55	23.50	4.48	6.43	0.19	0.27
10	1993	Gewa	50	24.50	10.70	10.37	0.44	0.42
11	2000	Sundri	54	24.50	4.17	5.53	0.17	0.23
12	1997	Passur	37	24.50	5.25	4.72	0.21	0.19
13	1997	Gewa	65	24.50	8.18	9.38	0.33	0.38
14	1993	Sundri	67	24.50	3.12	4.29	0.13	0.18
15	1993	Passur	29	24.50	6.47	6.23	0.26	0.25
16	1994	Passur	14	26.50	5.28	4.68	0.20	0.18
17	1994	Gewa	41	26.50	7.51	8.91	0.28	0.34
18	2008	Gewa	30	26.50	8.02	9.67	0.30	0.36
19	2008	Gewa	33	26.50	7.95	37.42	0.30	1.41
20	1995	Passur	08	26.50	6.93	6.81	0.26	0.26
21	1995	Passur	09	26.50	6.36	6.28	0.24	0.24
22	2005	Sundri	27	26.50	4.94	6.21	0.19	0.23
23	2007	Sundri	30	26.50	4.63	5.38	0.17	0.20
24	2007	Gewa	30	25.50	9.17	7.63	0.36	0.30
25	2007	Gewa	72	25.50	7.17	8.81	0.28	0.35
26	1994	Gewa	76	25.50	8.69	9.28	0.34	0.36
27	1994	Passur	24	25.50	10.66	10.02	0.42	0.39
28	2007	Sundri	18	25.50	5.83	5.69	0.23	0.22
29	2007	Sundri	13	25.50	6.94	7.73	0.27	0.30
30	1993	Gewa	40	20.50	8.42	8.23	0.41	0.40
31	1995	Gewa	29	20.50	7.51	7.69	0.37	0.38
32	2002	Sundri	19	20.50	7.47	7.45	0.36	0.36
33	2008	Sundri	16	20.50	5.38	5.47	0.26	0.27

Table 5. Growth increment of gewa, passur and sundri trees collected from under planting trial plots in coastal plantation of Kukrimukri, Bhola.

Plot Number	Year of Plantation	Species	Number of Trees	Age (year)	Average DBH (cm)	Average Height (m)	Mean Annual Increment	
							DBH (cm)	Height (cm)
1	1990	Sundri	27	27	6.00	6.39	0.22	0.24
2	1990	Gewa	40	27	12.09	11.58	0.45	0.43
3	1993	Gewa	45	24	10.82	8.90	0.45	0.37
4	1993	Sundri	27	24	4.58	4.22	0.19	0.18
5	1997	Gewa	24	19	10.81	9.42	0.57	0.50
7	1991	Gewa	69	25	7.48	9.29	0.30	0.37
8	1991	Sundri	23	25	4.95	6.52	0.20	0.26
9	1994	Gewa	26	22	6.54	7.31	0.30	0.33
10	1994	Gewa	24	22	6.33	7.04	0.29	0.32
12	1990	Sundri	17	26	8.61	7.03	0.33	0.27
13	1990	Gewa	51	26	12.72	11.74	0.49	0.45
14	1991	Gewa	56	25	9.22	9.91	0.37	0.40
15	1991	Sundri	12	25	4.28	5.67	0.17	0.23
17	1993	Gewa	41	26	9.66	8.16	0.37	0.31
18	1993	Sundri	24	26	3.62	3.58	0.14	0.14
20	1997	Gewa	44	19	9.73	7.86	0.51	0.41

2.9 **Achievement (s), if any : NA**

2.10 **Financial statement** **:**

2.10.1 Total cost **:** Tk. 4,30,000.00

2.10.2 Cost of the year **:** Tk. 80,000.00

2.10.3 Expenditure of the year **:** Tk. 80,000.00

2.10.4 Source of fund **:** GOB

2.11 **Beneficiaries:** Forest Department, development policy maker, researchers, forestry professionals, students, trainees and trainers, BFIDC, timber traders, universities and NGOs.

3. **Study** : New

3.1 **Programme Area** : Forest Inventory, Growth and Yield

3.2 **Title of the Study** : Preparation of volume tables of *Acacia* hybrid, hijol (*Barringtonia acutangula)*, karoj *(Pongamia pinnata)* and jarul (*Lagerstroemia speciosa).*

3.3 **Justification (For new study)**: *Acacia* hybrid is a very fast growing tree species. It occurs naturally through crossing of *Acacia auriculiformis* and *Acacia mangium*. *Acacia* hybrid is available sporadically in the plantations of *A. auriculiformis* and *A. mangium* raised throughout the country. It shows promising growth in Bangladesh in comparison to *A. auriculiformis* and *A. mangium*. *Acacia* hybrid is one of the most important tree species preferred by the Forest Department, non-government organizations (NGOs) and private planters for large scale plantation in Bangladesh. *Barringtonia acutangula* is an evergreen tree species of moderate size, native to coastal wetlands in Southern Asia. In Bangladesh it is known as hijol. *Pongamia pinnata* is a medium–sized glabrous tree popularly known as karoj in bengali and indian beech in english. It is slightly tolerant to saline conditions and alkalinity. *Lagerstroemia speciosa,* in bengali known as jarul is a small to medium sized semi-deciduous tree (7–21m tall) with wide spreading crown. It is a common ornamental tree planted along roadsides, gardens and in parks of Bangladesh. All the three species are very common to grow in the low lying areas of Bangladesh especially in haor areas of greater Sylhet district.

A total 732 volume equations were developed for 40 different forest tree species at different locations in Bangladesh. Volume tables of above mentioned four species are needed to estimate the quantity of harvest which is necessary for sustainable forest management system, carbon assessment and economic analysis. However, accurate volume equations of these species are not available. The aim of this study is to develop equations for predicting total volume and merchantable volume of individual tree for *Acacia* hybrid, hijol, karoj & jarul.

3.4 **Objective(s)** **:**

3.4.1 To prepare volume tables of *Acacia* hybrid, hijol (*Barringtonia acutangula)*, karoj *(Pongamia pinnata)* and jarul (*Lagerstroemia speciosa).*

3.4.2 To estimate diameter/girth increment rates of these species.

3.5 **Expected output :** Volume table of *Acacia* hybrid, hijol, karoj and jarul will be available.

3.6 **Study Period** **:**

3.6.1 Starting year **:** 2016-2017

3.6.2 Completion year **:** 2018-2019

3.7 **Personnel** **:**

3.7.1 Project Leader: **:** Mohammed Shahid Ullah, D.O

3.7.2 Associates **:** Mofizul Islam Khan, FI and Abul Kalam Azad, RA (Grade-1).

3.8 **Progress**

3.8.1 Previous years, if any: NA.

3.8.2 This year :

Activities of the study	Progress
a. Literature review and preparation of detailed work plan.	a. Reviewed literature and prepared detailed work plan.
b. Reconnaissance survey and site selection.	b. Made reconnaissance survey and selected sites for data collection.
c. Collection of data on DBH and height from 1200 individual trees (300 trees of each species) from plantations of *Acacia sps.* at Chittagong, Cox's bazar, Mymensing and from existing hijol, karoj & jarul plantations/natural forest of Sylhet division.	c. Collected data on DBH and total height of 800 (297 of jarul tree from Lawachara, Moulavibazar; 251 of hijol tree from Ratargul, Sylhet and 252 of karoj tree from Tahirpur, Sunamgonj. Measured bark thickness and diameter at one meter interval of height from all trees.
d. Summarization of collected data.	d. Summarization of collected data.

Table-6. Stand table of collected volume table data of hijol from Ratargul, Sylhet.

Girth class (cm)	No. of trees under different Height Class (m)							Total
	2.5-3.5	3.5-4.5	4.5-5.5	5.5-6.5	6.5-7.5	7.5-8.5	8.5-9.5	
20-40	5							5
40-60	5	15	10	3				33
60-80	1	23	52	32	3			111
80-100		4	29	28	13	3	2	79
100-120				7	10	1	1	19
120-140			1		2		1	4
Total	11	42	92	70	28	04	04	251

Table-7. Stand table of collected volume table data of Jarul from Lawachara, Moulavibazar.

Girth class (cm)	No. of trees under different Height Class (m)					Total
	5-10	10-15	15-20	20-25	25-30	
20-40	4					04
40-60	15	18	1			34
60-80	5	31	23			59
80-100		11	64	08		83
100-120			38	30		68
120-140			13	19		33
140-160				10	01	11
160-180				02	03	5
Total	24	61	139	69	04	297

Table-8. Stand table of collected volume table data of Karoj from Tahirpur, Sunamgonj.

Girth class (cm)	No. of trees under different Height Class (m)					Total
	5-7	7-9	9-11	11-13	13-15	
20-40	4	2				06
40-60	3	16	6	3		28
60-80	1	20	21	6	2	50
80-100	6	37	34	14	3	94
100-120	2	10	20	9	2	43
120-140		6	9	5	5	25
140-160			2	3	1	06
Total	16	91	92	40	13	252

3.9   **Achievement (s), if any : NA**
3.10   Financial statement   :
3.10.1 Total cost   : Tk. 4,30,000.00
3.10.2 Cost of the year   : Tk. 2,00,000.00
3.10.3 Expenditure of the year   : Tk. 2,00,000.00
3.10.4 Source of fund   : GOB
3.11   **Beneficiaries:** Forest Department, development policy maker, researchers, forestry professionals, students, trainees and trainers, BFIDC, timber traders, universities and NGOs.

Forest Protection Division

1.   **Study**   : On-going
1.1   **Programme Area**   : Forest Pests and Diseases
1.2   **Title of the Study** : Major pests and diseases of commercially important medicinal plants and their management
1.3   **Justification :** From the pre-historic time people of this locality would collect medicinal plants from nature for their use. Due to high technological development in pharmaceutical fields, now a day's number of ingredient have been collected from plant product. So, commercial values of medicinal plants have got much attention both in industrial and farming sector. By this time some NGO's and Government of Bangladesh have taken some programme to extent cultivation of medicinal plants organizing low income group and marginal farmers of northern part of Bangladesh. Due to high demand of raw materials of medicinal plants and also market assurance of some reputed pharmaceutical companies, the farmers of the northern districts of Bangladesh especially the Natore, Gaibandha, Naogaon, Rangpur, Bogra and Joypurhut districts have come forward to cultivate some commercially important medicinal plants. By this time a number of farmers have been facing insects and pathogenic problems in their cultivated field. During our visit to the northern districts of Bangladesh we have collected some diseases samples of some medicinal plants and also got demands for training on pests and diseases management techniques. Cultivation of medicinal plant is a new practice in our country and a number of farmers are engaged in this field. So, due to demands of farmers Forest Protection Division is working on pests and diseases of medicinal plants for the last few years.
1.4   **Objective(s)**   :
1.4.1 To identify pests and pathogens of commercially important medicinal plants.
1.4.2 To determine the nature and extent of damage by each pest and pathogen.
1.4.3 To know the biology and ecology of key pests and pathogens.
1.4.4 To develop/adapt suitable management techniques for key pests/pathogens.
1.5   **:** Increased production of commercially important medicinal plants will be ensured.
1.6   Study Period   :
1.6.1 Starting year   : 2012-2013 (2nd Phase)
1.6.2 Completion year   : 2016-2017
1.7   **Personnel**   :
1.7.1 Project Leader: : Md. Rafiqul Islam, DO.
1.7.2 Associates   : Dr, M. A. Rahman, S.R.O.; M. Junayed, R.O.; Md. Zillur Rahman, RA. (Gr-1); Kazi Ashad-uz-zaman, FI. and Shameema Nasreen, FI.
1.8   **Progress**
1.8.1 Previous years, if any:

1.8.2 This year   :

Activities of the study	Progress
a. Collection of samples	a. Disease samples of *Aloe indica*, *Ocimum sanctum*, *Adhatoda vasica*, *Andrograpis peniculata* were collected during field visit from, Gaibandha, Natore, Rangpur and Chittagong region. Mite & aphid of Ashwagandha (*Withania somnifera*) were collected from FPD nursery at BFRI campus.
b. Rearing/culture and identification of key pests and pathogens	b.1. Sap sucking insect (*Aphis nerii*) of Akanda is identified from FPD nursery. b.2. The causal organism of root rot of Tulsi caused by *Fusarium* sp., Leaf spot and root rot of Ashwagandha caused by *Alternaria alternata* and *Fusarium* sp. were isolated and identified.
c. Management of diseases through plant extracts and bio control agents in *in vitro* and *in vivo* condition	c.1. Five *Trichoderma* strains were evaluated to control the root rot disease of Ashwagandha in *in vitro* condition and the ***T. harzianum* IMI-392432 showed best performance.** c.2. Neem oil was applied (4 ml/L) to control the sap sucking insect (*Aphis nerii*) of Akanda. The result showed that **Neem oil controlled the pest (65%) effectively.**
d. Nursery raising and management of medicinal plants at BFRI campus.	d. Basok (*Adhatoda vasica*), Ashwagandha (*Withania somnifera*), Tulsi (*Ocimum sanctum*), Kalomeagh (*Andrographis paniculata*), Sarpogandha *(Rauwolfia serpentina)*, Ghritokanchon (*Aloe indica*) and Sotomoly (*Asparagus racemosus) were* cultivated and maintained at FPD nursery for natural pest/disease infestation /infection.

1.9   **Achievement (s), if any :** Five *Trichoderma* strains were used to control *Fusarium solani* causing the root rot disease of ashwagandha in *in vitro* condition where ***T. harzianum* IMI-392432 showed the best performance.** For controlling red mite of ashwagandha was applied Urea (26%), Neem oil (66%), Sulphur (87%), Turmeric powder (92%) and Omite (98%) under field condition. The result showed that Omite was most effective to control red mite.

1.10   **Financial statement**   :
1.10.1 Total cost   : Tk. 10,00,000.00
1.10.2 Cost of the year   : Tk.   4,00,000.00
1.10.3 Expenditure of the year   : Tk.   4,00,000.00
1.10.4 Source of fund   : GOB.
1.11   **Beneficiaries:** FD, NGOs and Farmer.

2.   **Study**   : On-going
2.1   **Programme Area**   : Forest Pests and Diseases
2.2   **Title of the Study**   :   Major pests and diseases of *Hevea* Rubber and their management
2.3   **Justification (for new study) :** Rubber is one of the most important cash crops, with multipurpose uses. It yields latex which is commercially the most important source of natural rubber (NR). The British planters first introduced it in Bangladesh in the early twentieth century. But commercial plantation was started in 1961 by the government in Chittagong and Sylhet hilly regions. Later on, plantations were expanded in Chittagong Hill Tracts and Madhupur by the government and public enterprises. The British and some other private companies also planted rubber in the fellow lands of tea estates. At present about 25,000 hectare of land is under rubber plantation in Bangladesh, and annual production is about 7,500 tons against 20,000 tons country's total demand of natural rubber (NR). Considering high productivity, storage, transportation and marketing facilities, the government encouraged its plantation with financial support; land allotment and foreign technical assistance. Public and private enterprises established plantations in different hilly regions and commercial exploitation started successfully within seventh years of plantation. Pest and diseases have had a

major impact on rubber production in Bangladesh. Recently, a number of insect and pathogenic problem have been reported from different Rubber cultivated area in Bangladesh. Pests include plant parasites such as *Loranthus* spp., nematodes such as *Helicotylenchus cavenessi*, *H. dihystera*, *H. erythrinae* and *Meloidogyne incognita* acrit. Insect pests include scale insects (*Aspidiotus cyanophylli* and *Parasaissetia nigra*) and white ants. Rubber cultivation is under a constant threat of attack by native as well as exotic pathogenic fungal diseases. Leaves, stems,and roots of *Hevea* are susceptible to fungal pathogens. Leaf diseases are caused by *Oidium heveae, Colletotrichum* spp., *Phytophthora* spp., *Corynespora cassiicola*, and *Microcyclus ulei*. The above pathogens cause abnormal leaf fall or leaf spot of young as well as mature leaves of *Hevea*. Among stem infections, pink disease, caused by *Corticium salmonicolor*, is the most important, capable of infecting young as well as mature trees. Dry rot caused by *Ustulina deusta*, patch canker caused by *Phytophthora palmivora*, and black stripe caused by *P palmivora, P meadii*, or *P botryose*, are other important diseases affecting the stem. White root rot caused by *Rigidiporus lignosus*, brown rot caused by *Phellinus noxius*, and red rot caused by *Ganoderma philippii*are notable diseases of roots. Among the above diseases, South American leaf blights (SALB), caused by *Microcyclus ulei*, is the most devastating. This disease caused several serious epidemics, almost leading to cessation of planting of *Hevea* in Brazil. For the last few years rubber plantations has increased due to the advancement of government (BFIDC) and private planters in the country. Bangladesh Forest Industries Development Corporation has also taken large scale plantations programme for the last 3-4 decades. It is known that rubber tree is highly susceptible of a number of pests and diseases. Initially, there are some primary works on pathogenic problem by the Forest Protection Division (FPD) of BFRI. Recently, a number of complaints are coming from different private planters and government organization on pest and disease of rubber. So, intensive studies on pest and diseases are very important need. The study will help to find out the suitable pest and diseases management technique in order to increase productivity of rubber.

2.4   **Objective(s)**   :
2.4.1 To survey the incidence and assess the present status of pest and disease infestation in rubber nurseries and plantation from different areas of Bangladesh.
2.4.2 To study nature and extent of damage by insect-pest and pathogens.
2.4.3 Isolation and identification of major pest and pathogens and proving pathogenicity.
2.4.4 Morphological and cultural studies of major pathogens.
2.4.5 To study the biology and ecology of the causal agent(s).
2.4.6 To develop suitable management techniques for controlling pest and disease.
2.5   : Plant protection operations will be ensured for healthy growth and economic production of *Hevea*.
2.6   **Study Period**   :
2.6.1 Starting year   : 2015-2016
2.6.2 Completion year   : 2019-2020
2.7   **Personnel**   :
2.7.1 Project Leader: : Md. Rafiqul Islam, DO.
2.7.2 Associates   : Dr, M. A. Rahman, S.R.O.*;* M. Junayed, R.O.; Md. Zillur Rahman, RA-(Gr-1); Kazi Ashad-uz-zaman , FI. and Shameema Nasreen, FI.
2.8   **Progress**
2.8.1 Previous years, if any: A survey was conducted in Sylhet, Moulvibazar, Habiganj, Chittagong and Chittagong Hill Tract regions of Bangladesh. The highest insect infestation and disease prevalence was found in Sylhet areas. The lowest insects and disease prevalence was recorded in Chittagong Hill Tract regions. Leaf fall disease, Eye spot disease were recorded from rubber tree. Termite (*Odontotermes* spp., *Microtermes* spp., *Microcerotermes* spp.), Hemipteran bug, grass hopper, Beetle and caterpillar were found in different rubber garden. *Corynespora* leaf fall disease caused by *Corynespora cassiicola* is identified. Bird's Eye Spot disease caused by *Drechslera heveae* is identified.
Termite (*Odontotermes* spp., *Microtermes* spp., *Microcerotermes* spp.), Hemipteran bug, grass hopper, Beetle were identified. Ruber plants have been cultivated and maintained at FPD rubber nursery of BFRI campus for to observe natural pest/disease infestation /infection.

2.8.2 This year   :

Activities of the study	Progress
a. Survey the incidence and assess the present status of pest and disease	a. A survey was conducted in Sylhet, Shayestagonj Moulovibazar, Vatera, Habiganj. Modupur in Tangail. Chittagong and Chittagong Hill Tract and Cox's Bazar regions of Bangladesh. The highest disease prevalence was found in Sylhet areas. The lowest insects and disease prevalence were recorded in Chittagong Hill Tract regions.
b. Nature and extent of damage by insect-pest and pathogens.	b. Leaf blight (55%), die back (45%), leaf fall(25%) and root rot (35%) disease were recorded from rubber nursery. Termite (30%) (*Odontotermes* spp., *Microtermes* spp., *Microcerotermes* spp.), Hemipteran bug (5%), grass hopper (5%), Beetle(2%),Aphid(40%) were also recorded.
c. Isolation and identification of major pest and pathogens	c.1. *Corynespora* leaf fall disease caused by *Corynespora cassiicola* was identified. c.2. Leaf blight disease caused by *Colletotrichum* sp. identified. c.3. Root rot disease caused by *Fusarium solani* was isolated and identified. c.4. Termite (*Odontotermes* spp., *Microtermes* spp., *Microcerotermes* spp.), Hemipteran bug, grass hopper, Beetle were identified.
d. Nursery raising and management of medicinal plants at BFRI campus.	d. Ruber nursery have been raised and maintained at BFRI campus for natural pest/disease infestation /infection.

2.9   **Achievement (s), if any :** There are different fungicides (13) used to control the *Colletotrichum gloeosporioides* in lab condition. viz.: Indol M-45, Knowing, Ridomil gold, Oxyvit 50WP, Cupravit 50WP, Aimcozim, Champion, Sunvit, Diathane M-45, Thiovit 80WG, LM-45, Sulphosearch Ges and Rovral. Of them Knowing is the best performance to inhibit the growth of mycelia and spore germination.

2.10   **Financial statement**   :
2.10.1 Total cost   : Tk. 10,00,000.00
2.10.2 Cost of the year   : Tk.   4,00,000.00
2.10.3 Expenditure of the year   : Tk.   4,00,000.00
2.10.4 Source of fund   : GOB.
2.11   **Beneficiaries:** FD, NGOs and Farmer.

Mangrove Silviculture Division

1.   **Study**   : On-going
1.1   **Programme Area**   : Breeding and tree improvement
1.2   **Title of the Study** : Vegetation dynamics and regeneration pattern in relation to salinity and siltation of the Sundarban
1.3   **Justification :** The Sundarbans, like other mangrove ecosystems, is dynamic and complex. Changes in this ecosystem are occurring continuously. To ascertain these changes, regular collection of relevant data from the forests on a long-term basis is a prerequisite. Continuous forest inventory through Permanent Sample Plots (PSPs) are useful to record changes in the various parameters associated with the stand density, species composition, structure and species shifts. The Sundarban forest is dependent on natural regeneration in order to be managed under a sustainable yield basis. The main problem of the forest is inadequacy of natural regeneration. So, the present study will help to record past and present regeneration and vegetation status of the forest that could improve the management system of the Sundarban.
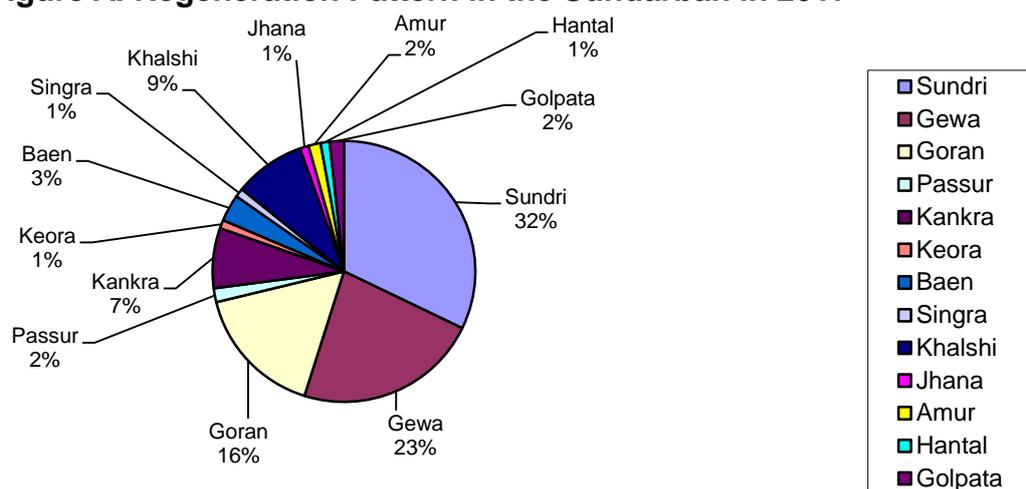
1.4   **Objective(s)**   :
1.4.1 To determine the species composition.
1.4.2 To determine the natural regeneration status of major mangrove species.
1.4.3 To understand the vegetation dynamics in the Sundarban over time.
1.4.4 To assess the impact of salinity and siltation on the change of vegetation.
1.5   **Expected output :** Species composition, vegetation dynamics and regeneration status of major mangrove species in the Sundarbans.
1.6   **Study Period**   :
1.6.1 Starting year   : 2016-2017 (2nd Phase)
1.6.2 Completion year   : 2020-2021
1.7   **Personnel**   :
1.7.1 Project Leader: : Dr. M. M. Rahman, DO
1.7.2 Associates   : Dr. A. S. M. Helal Siddiqui, SRO
1.8   **Progress**
1.8.1 Previous years, if any: Thirty Permanent Sample Plots(PSPs) were maintained. Data on species composition, number of trees of different species, height, DBH, regeneration of the seedlings recruitment of mangrove species were recorded from 30 PSPs. Seedlings recruitment of major mangrove species were recorded from the PSPs since inception of the study. Average seedlings recruitment in the year 2016 was found 27,333/ha/year. Among them, Heritiera fomes constituted 30%, Excoecaria agallocha 24%, Ceriops decandra 12%, Bruguiera sexangula 11%, Avicennia officinalis 9%, Aegiceras corniculatum 7%, Xylocarpus mekongensis4 %, Amoora cuculata 1% and rest other species 2%. Height and DBH class of Sundri and Gewa were analysed. Highest number of sundri trees (51%) was found under DBH class >5<=10cm and only 3.5% Sundri trees was found above 30cm DBH. Highest number of gewa trees (74%) was found under DBH class >5<=10cm and only 1.5% gewa trees was found above 20cm DBH. Highest number of sundri trees (41%) was found under heihgt class >5<=10m and only 2.3% sundri trees was found above 15m height. Highest number of gewa trees (47%) was found under height class >5<=10m and only 14% gewa trees was found above 10m height.
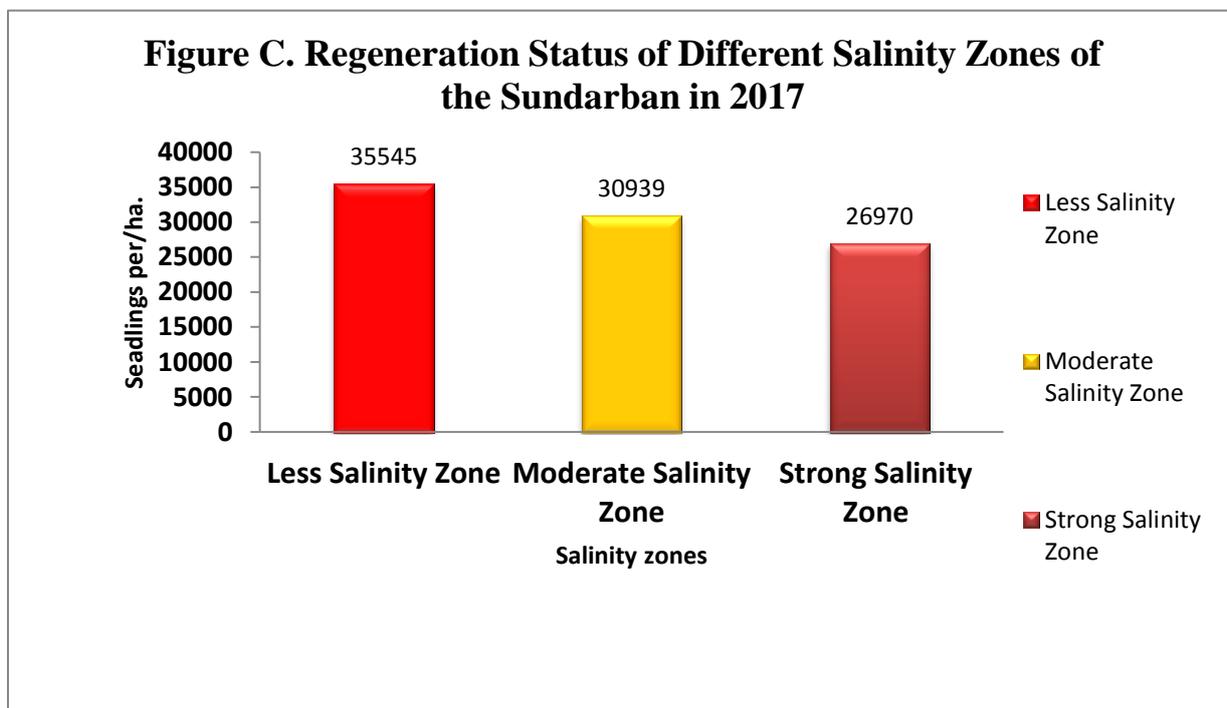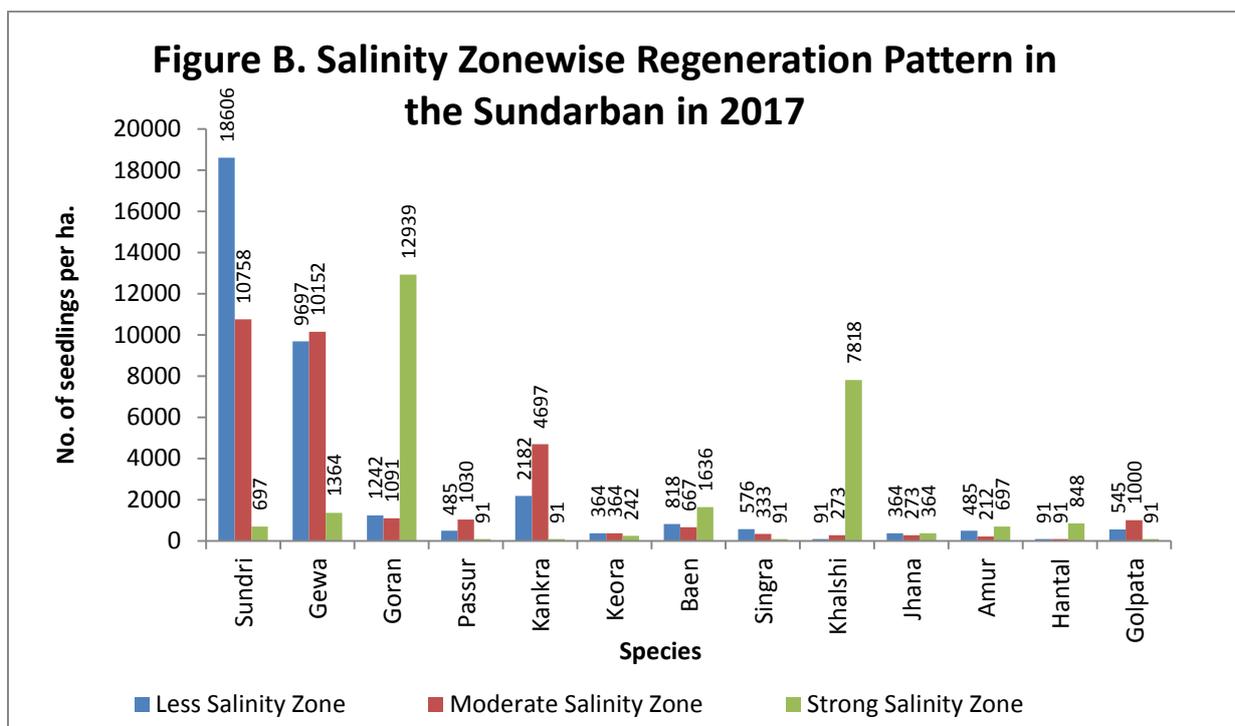
1.8.2 This year   :

Activities of the study	Progress
a. Maintenance (Demarcation of plots, replacement of damaged signboards, number-plates, jungle cutting etc.) of 30 PSPs in different salinity zones throughout the Sundarban.	a.Thirty PSPs in different salinity zones (10 PSPs in each saline zone) of the Sundarban were maintained (Table-1).
b. Establishment of three more Permanent Sample Plots (PSPs) in three salinity zones of the Sundarbans.	b. Three new Permanent Sample Plots (PSPs) in three salinity zones of the Sundarbans (PSP No. 33, Compartment No. 04; PSP No. 32, Compartment No. 21 and PSP No. 31, Compartment No. 41) were established.
c. Collection of data on regeneration, salinity and siltation data from the PSPs.	c. Data on regeneration, salinity and siltation data from the PSPs were collected.
d. Compilation and analysis of data.	d. Data on regeneration of major mangrove species were recorded from 30 PSPs. Average seedlings recruitment in the year 2017 was found 31,152/ha/year. Among them, *Heritiera fomes* constituted 32%, *Excoecaria agallocha* 23%, *Ceriops decandra* 16%, *Bruguiera sexangula* 7%, *Avicennia officinalis* 3%, *Aegiceras corniculatum* 9%, *Amoora cuculata* 2%, *Nypa fruticans* 2% and rest other species 6% shown in Fig. A. Regeneration of the Sundarban in three salinity zones (seedlings/ha/year) shown in Fig. B and salinity wise regeneration pattern of mangrove species in 2017 shown in Fig. C.

Table- 1. Salinity wise PSPs in the Sundarban

Salinity Zone	Sl no.	Location	No. PSP's	No. of Compt.
Less Saline Zone	1.	Nandabala	1	26
	2.	Jongra	3	30
	3.	Supoti(East)	4	3
	4.	Supoti(West)	5	5
	5.	Sarankhola	26	24
	6.	Mirgamari	25	28
	7.	Bagi	6	1
	8.	Dhangmari	13	31
	9.	Koramjol	14	31
	10.	Mora bhola	28	2
	11.	Supoti Khal	33	04
Moderate Saline Zone	12.	Charaputia	2	15
	13.	Baniakhali	7	35
	14.	Kashiabad	8	36
	15.	Alkidives(East)	15	17
	16.	Alkidives(West)	16	17
	17.	Bosboja(East)	22	37
	18.	Bosboja(West)	23	37
	19.	Kalabogi	24	32
	20.	Katka	27	7
	21.	Bhadra	29	29
	22.	Charaputia	32	21
Strong Saline Zone	23.	Gewakhali(W)	11	38
	24.	Sonamukhi khal	12	41
	25.	Ball River	17	41
	26.	Kadamtala	18	46
	27.	Chunkuri(East)	19	47
	28.	Chunkuri(West)	20	47
	29.	Kateshor	21	46
	30.	Koikhali	30	47
	31.	Burigoalini	9	46
	32.	Gewakhali(E)	10	20
	33.	Andermanik	31	41

Figure A. Regeneration Pattern in the Sundarban in 2017

Sundri 32%
Gewa 23%
Goran 16%
Khalshi 9%
Kankra 7%
Baen 3%
Passur 2%
Amur 2%
Golpata 2%
Jhana 1%
Singra 1%
Keora 1%
Hantal 1%

Legend: Sundri, Gewa, Goran, Passur, Kankra, Keora, Baen, Singra, Khalshi, Jhana, Amur, Hantal, Golpata

Figure B. Salinity Zonewise Regeneration Pattern in the Sundarban in 2017

Figure C. Regeneration Status of Different Salinity Zones of the Sundarban in 2017

| 1.9 | **Achievement (s), if any :** Thirty Permanent Sample Plots (PSPs) were established in different salinity zones throughout the Sundarban |

1.10   **Financial statement**   :
1.10.1 Total cost   : Tk. 20,00,000.00
1.10.2 Cost of the year   : Tk.   3,00,000.00
1.10.3 Expenditure of the year   : Tk.   3,00,000.00
1.10.4 Source of fund   : GOB.
1.11   **Beneficiaries:** FD

2.   **Study**   : Completed
2.1   **Programme Area**   : Biodiversity and conservation
2.2   **Title of the Study**   : Development of nursery and plantation techniques of khalshi (*Aegiceras corniculatum*) in the coastal zone of Bangladesh
2.3   **Justification :** Khalshi (*Aegiceras corniculatum*) is an important honey producing mangrove species in the Sundarban. Nursery and plantation techniques of this species are most essential for conservation of the species in the Sundarban because the natural population of the species has declined in a large scale.

2.4   **Objective(s)**   :
2.4.1   To develop nursery and plantation techniques of Khalshi.
2.4.2   To conserve and extension of the species.
2.5   : Development of nursery and plantation techniques of Khalshi. Extension and conservation of the species, honey production, employment and income generation.

2.6   **Study Period**   : 2012-2017
2.6.1   Starting year   : 2012-2013
2.6.2   Completion year   : 2016-2017
2.7   **Personnel**   :
2.7.1   Project Leader: : Dr. M. M. Rahman, DO
2.7.2   Associates   : Dr. A. S. M. Helal Siddiqui, SRO
2.8   **Progress**
2.8.1   Previous years, if any: A total number of 25,000 propagules (seeds) of khalshi were collected from the Sundarban and 12,000 seedlings were raised for experimental plantations in three salinity zones of the Sundarban in different years. Data on soil pH, water salinity, light intensity, inundation and siltation in the selected sites were recorded. Germination of the seeds, survival and growth performance of the seedlings in the nursery were recorded.

2.8.2   This year   :

Activities of the study	Progress
Raising experimental plantations with the previously raised seedlings.	An area of 1.2ha experimental plantations were raised in three salinity zones of the Sundarban with the previously raised seedlings.
Maintenance of previously raised experimental plantations. Collection of survival and growth data from the experimental plantations twice a year.	Previously raised experimental plantations in different locations of the Sundarban were maintained as well as survival & growth data from the experimental plantations were collected twice a year.
Collection of data on soil pH, water salinity, light intensity, inundation and siltation in the selected sites.	Data on soil pH, water salinity, light intensity, inundation and siltation in the selected sites were collected.
Data analysis and reporting.	Data were analyzed and two research papers were published, entitled "Development of nursery and plantation techniques of *Aegiceras corniculatum* (L.) Blanto and its site suitability in the Sundarban of Bangladesh" & "Khalshi (*Aegiceras corniculatum*) – An important honey producing plant and its cultivation in the Sundarban of Bangladesh". A completion report of the study has been prepared.

Table- 1. Propagule morphology and Germination performance of *Aegiceras corniculatum* in different salinity zones of the Sundarban

Sl. No.	Parameter	Salinity Zone		
		Less saline zone	Moderate saline zone	Strong saline zone
1.	Propagule collecting time	September-Oct	September-Oct	September-Oct
2.	No. of seeds/fruit	1	1	1
3.	No. of propagule/kg	1,150-1,300	1,000-1,100	1,250-1,500
4.	Length of propagule (cm)	5.0	6.5	4.0
5.	Propagule storage time (days)	26	20	32
6.	No. of propagules sown	3000	3000	3000
7.	Initiation of germination (days)	12	14	18
8.	Completion of germination (days)	24	28	35
9.	Germination percentage (%)	76	85	79
10.	Average height after 9 months(cm.)	24	44	36

Table- 2. Growth performance of *Aegiceras corniculatum* in different saline zones of the Sundarban

Age (year)	Strong saline zone (Compt.-46)		Moderate saline zone (Compt.-31)		Less saline zone (Compt.- 24)	
	Mean total height (m) ±SE	Mean survival (%)	Mean total height (m) ±SE	Mean survival (%)	Mean total height (m) ±SE	Mean survival (%)
1	0.47±0.06	100	1.27±0.07	94	0.33±0.01	63
2	0.63±0.03	97	1.75±0.03	94	0.38±0.03	62
3	1.37±0.02	97	2.40±0.06	94	0.68±0.02	62
4	1.52±0.02	97	2.95±0.23	94	0.82±0.03	62
5	1.59±0.03	97	3.88±0.03	94	0.99±0.02	62
Mean annual height increment (m)	0.32	–	0.78		0.20	–
Growth Rate (Regression Co-efficient)	0.313	–	0.641	–	0.176	–
Plantations between strong and moderate saline zone	$t_{.05}\ (8) = 2.61^*$		-		-	
Plantations between moderate and less saline zone	-		$t_{.05}\ (8) = 3.85^*$		-	
Plantations between less and strong saline zone	-		-		$t_{.05}\ (8) = 1.85$	
Analysis of variance (ANOVA)	$F_{.05}\ (2)\ = 9.67^*$					

In our experiment we observed that the best growths were recorded in moderate saline zone and significantly lower growths were recorded in strong saline zone of the Sundarban. They occur in estuaries and along rivers and prefer more silty-clay habitats rather than thick mud that lack oxygen. They have special adaptations for growing in low moisture and high salt conditions. In estuarine and coastal environments, salinity levels of interstitial and flooding waters are often widely variable being affected by tidal fluctuations, seasonal rainfall and river flows. *Aegiceras corniculatum* is a salt secretor mangrove which can afford a moderate level of salinity.

2.9   **Achievement (s), if any :** Three experimental plantations of Khalshi (*Aegiceras corniculatum*) were raised at three locations of the Sundarban.

2.10   **Financial statement**   **:**
2.10.1 Total cost   **:** Tk. 12,00,000.00
2.10.2 Cost of the year   **:** Tk.   2,95,000.00
2.10.3 Expenditure of the year **:** Tk.   2,95,000.00
2.10.4 Source of fund   **:** GOB.
2.11   **Beneficiaries:** FD, NGOs.

3.   **Study**   : On-going
3.1   **Programme Area**   : Plantation Technique and Forest Management
3.2   **Title of the Study**   : Growth performance of mangrove and non-mangrove experimental plantations in the Sundarban
3.3   **Justification :** There are poorly stocked less productive areas in the Sundarban. The Mangrove Silviculture Division studied the growth performance of mangrove and non-mangrove species in poorly stocked less productive areas of the Sundarbans since 1988. Those are all preliminary results of planted mangrove and non-mangrove species. So, monitoring or continuous investigation up to several years are to be needed to find out the actual performance of mangrove species with a view to study the survival, establishment and growth of these mangrove species.
3.4   **Objective(s)**   :
3.4.1 To determine the growth performance of mangrove and non-mangrove experimental plantations in the Sundarban
3.5   **Expected output :** Determination of growth and yield of the planted mangrove species over poorly stocked areas and non mangrove species on the raised lands of the Sundarban and to increase the productivity of the mangrove forest.

3.6   **Study Period**   : 2016-2020
3.6.1 Starting year   : 2016-2017 (2nd Phase)
3.6.2 Completion year   : 2019-2020
3.7   **Personne**l   :
3.7.1 Project Leader: **:** Dr. M. M. Rahman, DO
3.7.2 Associates   **:** Dr. A. S. M. Helal Siddiqui, SRO
3.8   **Progress**
3.8.1 Previous years, if any: A total of 3.5 ha mangrove and 3.5 ha non-mangrove species plantations were maintained. Growth data of one non-mangrove (Jarul- *Legerstroemia speciosa*) and eight mangrove species (Sundri- *Heritiera fomes*, gewa- *Excoecaria agallocha*, goran- *Ceriops decandr,* kirpa- *Lumnitzera racemosa*, passur (*Xylocarpus mekongensis*), kankra (*Bruguiera gymnorrhiza),* amur *(Amoora cucullata),* khalshi *(Aegiceras corniculatum)* were recorded and analyzed. Growth performance of Jarul is very promising in the raised land of the Sundarban. Average survival percentage of jarul was 83 and average height was 6.9m & average DBH 12.2cm at the age of 15 years at Khatakhali in the less saline zone of the Sundarban. The average of survival of sundri, gewa and kirpa were 21%, 70% and 63% as well as average height of those species were 1.8m, 5.0m and

5.5m respectively at the age of 14 years at Burigoalini in the strong saline zone. The average of survival of jhana and gewa were 26% and 86% as well as average height of those species were 5.6m and 3.2m respectively at the age of 11 years at Khashitana in the strong saline zone of the Sundarban. The average of survival of gewa and goran were 61% and 55% as well as average height of those species were 2.1m and 1.6m respectively at the age of 10 years at Andermanik in the strong saline zone of the Sundarban.

3.8.2 This year   :

Activities of the study	Progress
a) Maintenance of 3.5 ha mangrove and 3.5 ha non-mangrove experimental plantations.	a) A total of 3.5 ha mangrove and 3.5 ha non-mangrove species plantations were maintained
b) Collection of growth data (Survivability, height, dbh, bole height, etc.) from the experimental plantations.	b) Survival and growth data (Survivability, height, dbh, bole height, etc.) have been recorded from the experimental plantations.
c) Compilation and analysis of data.	c) Growth performances of different mangrove and non-mangrove species planted in different years in the Sundarbans are shown in Table-1, 2, 3, 4, 5 and 6.

Table-1. Growth Performance of Jarul planted at Katakhali and Bogi

Research Station	Year of Plantation	Spacing	Mean Ht. (m)	Mean DBH (cm)	Survival (%)
Dhangmari	1996	1.5mX1.5m	12.34	18.05	70.00
		1.75mX1.75m	13.28	19.18	80.00
		2.0mX2.0m	13.90	19.18	95.00
Bogi	1993	1.5mX1.5m	13.69	15.69	65.00
		1.75mX1.75m	12.35	13.99	85.00
		2.0mX2.0m	13.30	16.07	90.00

Table-2. Growth Performance of different mangrove species at Burigoalini in different years of the Sundarban

Name of Location	Year of Plantation	Name of species	Mean Ht. (m)	Mean DBH (cm)	Survival (%)
Burigoalini	95	Sundri	2.93	-	26.00
	95	Gewa	3.54	4.93	63.00
	95	Kirpa	4.60	5.82	34.00
	99	Lal Kankra	2.91	6.07	18.00
	99	Khalshi	4.16	5.68	72.00

Table-3. Growth Performance of mangrove species at different locations in the Sundarban

Name of Location	Year of Plantation	Name of species	Mean Ht. (m)	Mean DBH (cm)	Survival (%)
Andermanik	1999	Gewa	3.05	5.78	59.00
		Goran	1.67	-	57.00
Kadamtala	2000	Sundri	1.25	-	42.00
		Gewa	3.83	5.31	80.00
		Amoor	1.00	-	20.00
Khasitana	1997	Gewa	3.96	4.90	68.00
		Goran	2.12	-	50.00
		Jhana	8.22	10.13	24.00
	1999	Sundri	1.20	-	28.00
	1998	Gewa	3.37	5.02	46.00

Table-4. Growth Performance of different mangrove species at Munshigonj in different years of the Sundarban

Name of Location	Year of Plantation	Name of species	Mean Ht. (m)	Survival (%)
Munshigonj	2010	Kirpa	2.76	60.00
	2011	Sundri	1.24	35.00
		Goran	1.18	58.00
	2013	Jhana	1.93	84.00
		Passur	1.24	36.00
		Sundri	0.77	84.00
		Goran	0.65	86.00

Table-5. Growth Performance of different mangrove species at Dhangmari in different years of the Sundarban

Name of Location	Year of Plantation	Name of species	Mean Ht. (m)	Survival (%)
Nowsher Johala	2010	Sundri	1.63	55.00
		Kankra	4.15	68.00
Hularchar	2011	Sundri	1.43	88.oo
		Passur	1.52	36.00
		Kankra	2.40	88.00
		Khalshi	1.43	74.00
		Goran	1.56	60.00
	2012	Sundri	1.88	66.00
		Passur	2.07	60,00
		Kankra	1.43	65.00
		Goran	0.91	46.00
		Khalshi	2.76	74.00
	2013	Sundri	1.12	85.00
		Passur	1.24	88.00
		Kankra	1.29	90.00
		Khalshi	2.06	88.00
		Jhana	1.50	87.00

Table-6. Growth Performance of different mangrove species at Bogi in different years of the Sundarban

Year of Plantation	Name of species	Mean Ht. (m)	Survival (%)
2010	Sundri	3.35	80.00
	Passur	3.12	25.00
	Singra	1.14	56.00
2011	Sundri	3.45	96.00
	Passur	3.22	70.00
	Khalshi	2.09	79.00
2012	Sundri	1.97	94.00
	Passur	2.53	20,00
	Khalshi	1.93	76.00
2013	Sundri	1.05	44.00

3.9 **Achievement (s), if any :** Plantations of 3.5 ha mangrove and 3.5 ha non-mangrove species were established in the Sundarban.

3.10 **Financial statement** :
3.10.1 Total cost : Tk. 14,00,000.00
3.10.2 Cost of the year : Tk. 3,00,000.00
3.10.3 Expenditure of the year : Tk. 3,00,000.00
3.10.4 Source of fund : GOB.
3.11 **Beneficiaries:** FD, NGOs.

4. **Study** : On-going
4.1 **Programme Area** : Biodiversity and conservation
4.2 **Title of the Study** : Centralization and conservation of mangrove vegetation in three salinity zones of the Sundarban.
4.3 **Justification :** The conservation, management and use of mangrove germplasm maintained in gene banks poses a number of challenges to the researchers dedicated to the investigation of plant genetic resources. Common problems include, for example, the development of strategies for sampling representative individuals in natural populations, the improvement of tools and technology for long-term conservation. The characterization of the accessions maintained in the collection and the examination of the genetic relationship between them is important for the sustainable conservation and increased use of mangrove genetic resources. Germplasm characterization of plant accessions deposited in gene banks has been limited and is probably a major cause for the limited use of accessions in tree improvement programs. The most important challenges in the near future are certainly the identification of useful variation (real or potential) in germplasm and its use in guiding conservation decisions. Knowing the presence of useful genes and alleles would help in making decisions on the multiplication of accessions and the maintenance of seed/propagule stocks when responding to an expected higher demand for materials. Such information may also help in making decisions on heterogeneous accessions where only some genotypes may possess useful alleles. The gene bank curator may have to decide on maintaining the original material as is and separating a subpopulation carrying the desirable alleles as well as giving it new accession numbers and management protocols. This will facilitate germplasm use and add value to the collections. The effective use of mangrove genetic resources stored in gene banks for tree improvement program will be increased. The integration of genomic technology and the characterization of germplasm banks will play an important role in the sustainable conservation and increased use of mangrove genetic resources. Mangrove germplasm is the foundation of all mangrove ecological restoration activities. Based on the existing literatures and our own experiences, and by using different methods, the mangrove germplasm will be developed in the Sundarban, which could provide guidance for the integrated management of mangrove ecosystems. As a part of mangrove conservation, establishment of a mangrove museum is very much essential for preservation and demonstration of the flora and faunal specimens of the Sundarban to the students, researchers and general people of the country which will create awareness and will help protect and preserve the Sundarban ecosystem. The museum will act as a hub for conservation training for adults, and educating children about the value of mangroves.

4.4 **Objective(s)** :

4.4.1 To conserve mangrove species in their natural habitat.
4.4.2 To centralize threatened mangrove species.
4.4.3 To observe the flora-fauna interaction over time.
4.4.4 To demonstrate flora and fauna in natural habitat in the Sundarban.

4.5 **Expected output :** Conservation of mangrove species and improvement of biodiversity in the Sundarban.

4.6   **Study Period**   **:** 2016-2020
4.6.1 Starting year   **:** 2016-2017 (2nd Phase)
4.6.2 Completion year   **:** 2019-2020
4.7   **Personnel**   **:**
4.7.1 Project Leader: **:** Dr. M. M. Rahman, DO
4.7.2 Associates   **:** Dr. A. S. M. Helal Siddiqui, SRO
4.8   **Progress**
4.8.1 Previous years, if any: Three conservation plots covering an area of sixty hectares were established at Dhangmari (Com. No. 31), Bogi (Com. No. 24) and Munshiganj (Com. No. 46) in three salinity zones of the Sundarban. Initially it was recorded that there are thirty seven species at Bogi in the less saline zone, thirty one species at Dhangmari in the moderate saline zone and twenty two species at Munshigang in the strong saline zone of the conservation plots. Dhundhul (1.5 ha), kirpa (1.8 ha), passur (0.9 ha), jhana (0.6 ha), khalshi (0.9 ha), Bakul Kankra (0.9 ha), shingra (0.9 ha) and Maricha Baen (0.9 ha) species were centralized in three conservation plots in different saline zones. Growth and survival of those planted species in the conservation plots in different years have been recorded and maintained.

4.8.2 This year   **:**

Activities of the study	Progress
Surveying existing plant resources in the proposed Mangrove Germplasm areas of the Sundarban by establishing TSPs and fitting-fixing name plates.	Surveying existing plant resources were conducted in the Mangrove Germplasm areas of the Sundarban by establishing TSPs.
Preparation of demarcation line by clearing jungle and painting of trees.	Boundary lines of three conservation plots by clearing jungle and painting of trees were demarcated.
Collection and preservation of fleshy fruits, plant parts and available faunal specimens from the Sundarbans and Forest Department.	Fleshy fruits and plant parts of major mangrove species' specimens and twelve fish specimens have been collected from the Sundarban and preserved in the museum.
Maintenance of previously collected flora and faunal specimens in the museum.	Previously collected flora and faunal specimens in the museum were maintained.
Data compilation and reporting.	Data were analyzed and a research article was published, entitled "*Ex Situ* Conservation of *Rhizophora mucronata* Lam. in the Sundarban Mangrove Forest of Bangladesh".

Table-1. Growth performance of kirpa at two locations in the Sundarbans

Name of Location	Year of Plantation	Spacing								
		1.5mx1.5m			1.75mx1.75m			2mx2m		
		Mean Height (m)	Mean Dbh (cm)	Mean Survival (%)	Mean Height (m)	Mean Dbh (cm)	Mean Survival (%)	Mean Height (m)	Mean Dbh (cm)	Mean Survival (%)
Munshigonj	2006	2.34	-	56.00	1.88	-	65.00	2.05	-	70.00
	2004	3.88	5.52	40.00	4.02	6.06	65.00	4.14	5.87	90.00
Dhangmari	2004	7.11	5.65	65.00	8.02	6.60	70.00	8.28	6.75	88.00
	2006	4.35	6.38	70.00	4.70	6.38	68.00	5.32	6.61	75.00

Table-2. Growth performance of different mangrove species planted in 2008 in the Sundarbans

Name of Location	Name of species												
	Passur		Khalshi		Jhana								
	Spacing (1mx1m)		Spacing (1mx1m)		Spacing (2.5m x 2.5m)			Spacing (2m x 2m)			Spacing (1.5m x 1.5m)		
	Mean Ht. (m)	Mean Survi. (%)	Mean Ht (m)	Mean Survi. (%)	Mean Ht. (m)	Mean Dbh (cm)	Mean Survi. (%)	Mean Ht. (m)	Mean Dbh (cm)	Mean Survi. (%)	Mean Ht. (m)	Mean Dbh (cm)	Mean Survi. (%)
Dhangmari	2.42	82	4.65	82	8.41	7.07	85	7.40	5.95	80	7.05	5.97	74
Bogi	-	-	4.03	14	-	-	-	-	-	-	-	-	-

Table-3. Growth performance of different mangrove species planted in 2009 in the Sundarbans

Name of Location	Name of species								
	Baen		Singra		Amur		Jhana		
	Mean Height (m)	Mean Survival (%)	Mean Height (m)	Mean Survival (%)	Mean Height (m)	Mean Survival (%)	Mean Height (m)	Mean Dbh (cm)	Mean Survival (%)
Dhangmari	6.18	53.00	-	-	1.54	65.00	-	-	-
Munshiganj					2.45	35.00	5.00	6.10	30.00
Bogi	-	-	1.47	88	2.20	71.00	-	-	-

Table-4. Growth performance of different mangrove species planted in 2011 in the Sundarbans

Name of Location	Name of species			
	Lal kankra		Amdhekur	
	Mean Height (m)	Mean Survival (%)	Mean Height (m)	Mean Survival (%)
Dhangmari	-	-	1.80	55.00
Munshiganj	1.75	59	1.30	25.00

Table-5. Growth performance of different mangrove species planted in 2012 in the Sundarbans

Name of Location	Name of species												
	Kankra		Dhundul		Bhatkathi								
	Spacing (1mx1m)		Spacing (1mx1m)		Spacing (1mx1m)			Spacing(1.5mx1.5m)			Spacing (2mx2m)		
	Mean Ht. (m)	Mean Survi. (%)	Mean Ht. (m)	Mean Survi. (%)	Mean Ht. (m)	Mean Dbh (cm)	Mean Survi. (%)	Mean Ht. (m)	Mean Dbh (cm)	Mean Survi. (%)	Mean Ht. (m)	Mean Dbh (cm)	Mean Survi. (%)
Dhangmari	2.17	94.00	2.25	44.00	3.31	2.64	40.00	3.34	3.09	65.00	3.35	3.96	90.00

Table-6. Growth performance of different mangrove species planted in 2013 in the Sundarbans

Name of Location	Name of species					
	Lal Kankra		Dhundul		Singra	
	Mean Height (m)	Mean Survival (%)	Mean Height (m)	Mean Survival (%)	Mean Height (m)	Mean Survival (%)
Dhangmari	1.29	51.00	1.38	30.12	-	-
Bogi	-	-	-	-	0.79	82.00

Table-7. Growth performance of different mangrove species planted in 2015 in the Sundarbans

Name of Location	Name of species							
	Khalshi		Jhana		Passur		Singra	
	Mean Height (m)	Mean Survival (%)	Mean Height (m)	Mean Survival (%)	Mean Height (m)	Mean Survival (%)	Mean Height (m)	Mean Survival (%)
Dhangmari	1.19	88.00	1.18	62.00	1.40	82.00	-	-
Munshiganj	0.36	82.00	1.43	60.00	0.77	70.00	-	-
Bogi	-	-	-	-	-	-	0.80	82.00

Table-8. Growth performance of different mangrove species planted in 2016 in the Sundarbans

Name of Location	Name of species											
	Khalshi		Jhana		Passur		Singra		Lal Kankra		Dhandul	
	Mean Ht. (m)	Mean Survi. (%)	Mean Ht. (m)	Mean Survi. (%)	Mean Ht. (m)	Mean Survi. (%)	Mean Ht. (m)	Mean Survi. (%)	Mean Ht. (m)	Mean Survi. (%)	Mean Ht. (m)	Mean Survi. (%)
Dhangmari	0.28	90.00	1.54	60.00	0.65	95.00	0.35	90.00	-	-	0.74	90.00
Munshiganj	0.32	66.00	1.18	12.00	0.92	94.00	-	-	0.69	98.00	0.86	86.00
Bogi	0.26	62.00	-	-	0.65	95,00	0.63	82.00	-	-	1.13	74.00

4.9   **Achievement (s), if any :** Three conservation plots (Twenty hectares at each saline zone) were established at Dhangmari (Com. No. 31), Bogi (Com. No. 24) and Munshiganj (Com. No. 46) in the Sundarban. Five mangrove species were centralized in the three conservation plots of the Sundarban.

4.10   **Financial statement**   **:**
4.10.1 Total cost   **:** Tk. 35,00,000.00
4.10.2 Cost of the year   **:** Tk. 3,55,000.00
4.10.3 Expenditure of the year   **:** Tk. 3,55,000.00
4.10.4 Source of fund   **:** GOB.
4.11   **Beneficiaries:** FD, Universities, NGOs, Researchers, Visitors, Students.

5.   **Study**   : On-going
5.1   **Programme Area**   : Breeding and Tree Improvement
5.2   **Title of the Study**   : Selection and development of the top dying tolerant sundri (*Heritiera fomes*) trees in the Sundarban.
5.3   **Justification :** A lot of sundari trees have been dying due to a disorder known as top dying. Studies have been conducted but actual cause for the disorder has not yet been ascertained. So, a study for improvement of the species is necessary.

5.4 **Objective(s)** :
5.4.1 To develop a pure line of top dying tolerant sundri trees.
5.5 **Expected output :** Conservation of mangrove species and improvement of biodiversity in the Sundarban.

5.6 **Study Period** : 2016-2019
5.6.1 Starting year : 2016-2017 (2nd Phase)
5.6.2 Completion year : 2018-2019

5.7 **Personnel** :
5.7.1 Project Leader: : Dr. M. M. Rahman, DO
5.7.2 Associates : Dr. A. S. M. Helal Siddiqui, SRO

5.8 **Progress**
5.8.1 Previous years, if any: Forty numbers (10 nos. in each location) of healthy (disease free) sundari trees have been selected for development of pure line in the Sundarban. Forty numbers (10 nos. in each location) of healthy (disease free) sundari trees have been selected for development of pure line in the Sundarban. The water salinity of Bholarpar (compt. No. 24), Bojbaja (compt. No. 37), Kalabogi (compt. No. 33) and Kalabogi Khal (compt. No. 32) were recorded 1ppt, 25ppt, 18ppt and 23ppt respectively in May, 2016. The soil pH of Bholarpar (compt. No. 24), Bojbaja (compt. No. 37), Kalabogi (compt. No. 33) and Kalabogi Khal (compt. No. 32) were 4.5, 5.6, 6.1 and 6.4 respectively. Inundation was regular in all the experimental sites. Siltation / erosion gauge have been placed in each location. Growth performance of sundari at different locations in different years of the Sundarban was recorded.

5.8.2 This year :

Activities of the study	Progress
a) Planting of previously raised seedlings of selected sundari trees at three locations of the Sundarban.	a) An area of 1.2ha experimental plantations were raised with the seedlings of selected sundari trees at three locations of the Sundarban.
b) Maintenance of previously raised experimental plantations. Collection of survival and growth data from the experimental plantations twice a year.	b) Previously raised experimental plantations were maintained as well as survival & growth data from the experimental plantations were collected twice a year.
c) Collection of data on soil pH, water salinity, light intensity, inundation and siltation in the selected sites.	**c)** Data on soil pH, water salinity, light intensity, inundation and siltation in the selected sites were recorded.
d) Collection of seeds from the selected trees.	d) A total number of 9,000 seeds from the selected trees were collected.
e) Raising seedlings at Munshiganj, Bogi and Dhangmari Research Stations for next year plantations.	e) A total number of 6,000 seedlings at Munshiganj, Bogi and Dhangmari Research Stations were raised for next year experimental plantations.
f) Observation on germination of the seeds, survival and growth performance of the seedlings in the nursery.	f) Germination success of the seeds, survival and growth performance of the seedlings were recorded in the nursery.
g) Data compilation.	g) Data have been analyzed.

Table-1. Growth performance of sundri in different locations of the Sundarban

Year of Plantation	Spacing	Location	Compartment No.	Mean Height (m)	Mean Dbh (cm)	Mean Survival (%)
2010	1mX1m	Bogi	1	3.96	5.49	93.83
		Malleh Chattar	31	2.47	-	3.70
2011		Bogi	1	2.03	-	74.07
		Takimari	31	1.74	-	14.81
2012		Bogi	1	2.02	-	69.14
		Hular Char	31	1.59	-	8.40
2013		Bogi	1	1.18	-	74.07
		Malleh Chattar	31	1.46	-	13.33
2015		Bogi	1	1.35	-	64.20
		Hular Char	31	0.59	-	14.72
2016		Bogi	1	1.22	-	98.77
		Hular Char	31	0.36	-	95.00
		Munshinjong	46	0.97	-	0.30

5.9 **Achievement (s), if any :** Forty numbers (10 nos. in each location) of healthy (disease free) sundari trees have been selected for development of pure line in the Sundarban.

5.10 **Financial statement :**
5.10.1 Total cost : Tk. 15,00,000.00
5.10.2 Cost of the year : Tk. 2,50,000.00
5.10.3 Expenditure of the year : Tk. 2,50,000.00
5.10.4 Source of fund : GOB.
5.11 **Beneficiaries:** FD, NGOs

6. **Study** : On-going
6.1 **Programme Area** : Biodiversity and conservation
6.2 **Title of the Study** : Improvement and Popularization of Plantation Techniques for Threatened Mangrove Species in the Sundarban
6.3 **Justification :** More than one in six mangrove species worldwide are in danger of extinction due to coastal development and other factors, including climate change, logging and agriculture, according to the first-ever global assessment on the conservation status of mangroves for the IUCN Red List of Threatened Species. The loss of mangroves will have devastating economic and environmental consequences. They also have the ability to store large amounts of carbon from the atmosphere. These ecosystems are not only a vital component in efforts to fight climate change, but they also protect some of the world's most vulnerable people from extreme weather and provide them with a source of food and income.

A threatened species is any plant or animal species that is risk of extinction. Different categories are allocated to threatened species depending on the degree of risk. These categories are based on a number of criteria including, trends in population size, health and distribution. A species may become threatened/endangered and eventually extinct when death rate exceeds birth for a prolonged duration. The reasons may be natural and anthropogenic. Anthropogenic activities are now-a-days prominent and causing extinction of many plant species of ecological and economic significance. Many species are facing tremendous pressure and are on the verge of extinction in the Sundarban. In the present peace of research work, we suppose to study the conservation

requirement of three mangrove species of the Sundarban *viz. Rhizophora mucronata, Kandelia candel,* and *Xylocarpus granatum*. Natural populations of these species have been depleted due to over-harvesting of mature trees and climate change effects. The populations of these species are also very poor in nature which culminates with poor natural regeneration. Therefore, *ex-situ* conservation in plantations of these species will be suggested for effective conservation of the species.

6.4 **Objective(s)** :
6.4.1 To develop standard nursery and plantation techniques for endangered mangrove species.
6.4.2 To determine better silvicultural techniques for each endangered mangrove species
6.4.3 To establish and conserve the plantations of endangered species for seed source.
6.5 **Expected output :** Knowledge on the nursery raising technique, proper methods for plantations and suitable site for threatened mangrove species in the Sundarban. Increased the productivity of forests through use of appropriate nursery and plantation techniques of these species, protect and preserve the forest ecosystem, biodiversity conservation and sustainable production.

6.6 **Study Period** : 2016-2020
6.6.1 Starting year : 2016-2017
6.6.2 Completion year : 2019-2020
6.7 **Personnel** :
6.7.1 Project Leader: : Dr. M. M. Rahman, DO
6.7.2 Associates : Dr. A. S. M. Helal Siddiqui, SRO
6.8 **Progress**
6.8.1 Previous years, if any: NA
6.8.2 This year :

Activities of the study	Progress
a) Collection of seeds/propagules of jhana, bhatkathi and dhundul from the Sundarban.	a) A total number of 15,000 seeds/propagules of jhana, bhatkathi and dhundul from the Sundarban were collected.
b) Raising 10,200 seedlings of jhana, bhatkathi and dhundul in polybags.	b) A total number 10,200 seedlings of jhana, bhatkathi and dhundul were raised in polybags.
c) Raising experimental plantations of dhundhul at 3 salinity zones at 1m x 1m, 1.5m x 1.5m and 2.0m x 2.0m spacings in Randomised Complete Block Design.	c) An area of 1.2ha experimental plantations of dhundhul at 3 salinity zones at 1m x 1m, 1.5m x 1.5m and 2.0m x 2.0m spacings in Randomised Complete Block Design were raised.
d) Data compilation and reporting.	d) Data has been compiled.

Table-1. Germination performance of *Xylocarpus granatum* at different nurseries of the Sundarban in 2016

Sl. No.	Location	No. of seeds	Initiation of germination (days)	Completion of germination (days)	Germination percentage (%)	Average height at the age of 7 month (cm)
1	Bogi	3,000	09	51	70	76
2	Dhangmari	3,000	11	47	80	70
3	Munshigonj	3,000	12	55	80	68

6.9 **Achievement (s), if any :**
6.10 **Financial statement** :
6.10.1 Total cost : Tk. 20,00,000.00
6.10.2 Cost of the year : Tk. 3,00,000.00
6.10.3 Expenditure of the year : Tk. 3,00,000.00
6.10.4 Source of fund : GOB.
6.11 **Beneficiaries:** FD, NGOs

Minor Forest Products Division

1. **Study**   : New
1.1 **Programme Area**   : Bamboo and Non-timber Economic Crops.
1.2 **Title of the Study** : Growth performance of common rattans in Bangladesh and its popularization
1.3 **Justification :** Rattan is one of the most important non-timber forest products of Bangladesh. This natural resource has been used as raw materials in cottage industries. Once the country was rich in rattan resources but the resources has been declining over the last few decades due to improper management and over exploitation. In recent years, attention has been focused on research and development concerning various aspects of this valuable renewable resource in most rattan growing countries. Bangladesh Forest Research Institute has worked on phenology, seed biology and problems related to propagation, plantation and management aspects. Simultaneously Bangladesh Forest Department successfully planted 2.7 million seedling, rhizomes and wildings over an area of 2488.24 ha lands in seven rattan growing forests areas during 1985-2002 and it is still in progress. However, very little information is available regarding its growth performance and management practices. Considering the fact the study was taken for gathering information on growth and to develop a management system and also popularizing the rattans among the common people.

1.4 **Objective(s)**   :

1.4.1 To determine the growth performance of common rattan species

1.4.2 To determine the optimum harvesting cycle and appropriate management system for maintaining sustainable production of different rattan species

1.4.3 To distribute quality planting materials of different rattan species to the interested government/non-government organization and private planters

1.4.4 To create awareness among the common people about rattan species

1.5 Increased production of commercially important medicinal plants will be ensured.

1.6 **Study Period**   :
1.6.1 Starting year   **:** 2015-2016
1.6.2 Completion year   **:** 2017-2018
1.7 **Personnel**   :
1.7.1 Project Leader: **:** Md. Sah Alam, RO
1.7.2 Associates   **:** Dr. Rafiqul Haider, DO
1.8 **Progress**

1.8.1 Previous years, if any: Growth performance data for common rattan species were collected from Tangail, Mymensingh and Naogaon. It is evident that growth performance of available rattan varies from location to location and also from species to species with the age. In general 10-14 years plantation of three common rattan species showed the better performance in the studied area.

1.8.2 This year   :

Activities of the study	Progress
Survey for selecting the study sites and the study will be conducted through systematic sampling	Three sites were selected (Tilaghor beat, Khadimnagar beat and Ratargul beat in Sylhet region.
Data on number of shoot per clump, length/height and diameter of the main shoot	Data on number of shoot per clump, height and diameter of the main shoot, width per clump were recorded and given in Table. 1.1.
Seed collection of different rattan species from different locations.	Collected 30 kg rattan seeds (jail, kerak and golla) from Chittagong University and BFRI campus.

Raising 10,000 seedlings of different rattan species (jali, kerak and golla) for establishment of conservation plots and remaining seedlings for distribution on payment basis.	Raised 10,000 seedlings of jali, kerak and golla bet in the nursery. Distributed 9,500 seedlings to the interested farmers and different organizations including TMSS, Bogra.
Organize two (02) awareness program in Mymensingh/Tangail and Khulna region	Organized two motivation/awareness programmes with the local people at Hinguli Research Station and Adampur, Kalinji Punjii. Total 80 people were participated in these awareness programmes and distributed 400 cane seedlings among the participants.
Data compilation and report writing.	

Table1.1. Growth performance of Rattans in Sylhet areas

Location	Species	Supporting tree	Age (Year)	Width per clump (cm)	Shoot no. per clump	Height of main shoot(m)	Diameter (cm)
Khadimnagar beat, Sylhet	Jali	Champa, Segun and Garjan	08	120	12	10	1.2
			12	180	20	15	1.5
			16	200	32	25	1.5
	Kerak		08	60	10	7	1.7
			12	90	15	10	1.9
			16	100	18	15	2.2
	Golla		08	220	20	12	2.5
			12	250	25	17	2.9
			16	280	35	28	3.2
Tilaghar beat, Sylhet	Jali	Champa and Garjan	08	125	18	12	1
			12	200	20	20	1.2
			16	220	32	24	1.5
	Golla		08	200	15	10	2.4
			12	220	22	15	2.7
			16	250	30	27	3.1
Ratargul swamp forest, Sylhet	Jali	Hizol, Karaj and Pitali	08	100	15	8	1
			12	150	20	12	1.2
			16	180	28	20	1.4

1.9 **Achievement (s), if any :**
1.10 **Financial statement** :
1.10.1 Total cost : Tk. 4,50,000.00
1.10.2 Cost of the year : Tk. 1,50,000.00
1.10.3 Expenditure of the year : Tk. 1,50,000.00
1.10.4 Source of fund : GOB.

1.11 **Beneficiaries:** FD, NGO's, Private planters, Farmers, Educational Institute, Rattan industries and BSCIC.

2.   **Study**   : Ongoing

2.1 **Programme Area** : Bamboo and Non-timber Economic Crops.

2.2 **Title of the Study** : Nursery and plantation techniques of five selected medicinal plants: iswarmul *(Aristolochia indica)*, kurchi (*Holarrhena pubescence*), gajpipul (*Scindapsus officinalis*) antamul (*Tylophora indica)* and chandan (*Santalum album.*)

2.3 **Justification :** From the time immemorial plants with therapeutic properties play an important role in disease treatment (Khan et al. 2005). Proper exploration of medicinal plants in the country and their stock assessment were not thoroughly carried out. Gani (1998) reported 450 to 500 plants growing in Bangladesh have therapeutic value. Yusuf et al. 2009 reported 747 plants have therapeutic value which is used in Ayurvedic, Unani and other system of medical treatments. In Bangladesh the people who living in the remote areas particularly in hilly areas rely on herbal medicines (Ara et al. 1997). Owing to its potentiality demand of raw materials for production of herbal medicines increased in Bangladesh. About six thousand metric tons of medicinal plants are required annually by the relevant industries for producing traditional medicines (Motaleb et al. 2011). In absence of organized cultivation and lack of proper propagation techniques medicinal plant species, local manufacturers imported huge amount of pharmaceutical raw materials including medicinal plants and their semi processed products to feed their industries (Ghani 2003). Bangladesh Forest Research Institute (BFRI) initiated the research on different aspects of medicinal plants and generates considerable information since its inception. In continuation of these following five important medicinal plants are included for standardizing nursery and plantation techniques in the study.

2.4 **Objective(s)**   :

2.4.1 To develop nursery techniques for production of planting materials.

2.4.2 To develop plantation and management techniques for sustained yield.

2.4.3 To popularize cultivation and use of those medicinal plants.

2.5   : Appropriate nursery, plantation and management techniques of selected five medicinal plants will be known.

2.6 **Study Period**   :

2.6.1 Starting year   **:** 2014-2015

2.6.2 Completion year   **:** 2016-2017

2.7 **Personnel**   :

2.7.1 Project Leader: **:** Md. Sah Alam, RO

2.7.2 Associates   **:** Dr. Rafiqul Haider, DO

2.8 **Progress**

2.8.1 Previous years, if any:

2.8.2 This year   :

Activities of the study	Progress
Collection of seed / propagating materials and raising 1000 seedlings (200 for each species) of five medicinal plants such as, iswarmul *(Aristolochia indica)*, kurchi (*Holarrhena pubescence*), gajpipul (*Scindapsus officinalis*), antamul (*Tylophora indica)* and chandan(*Santalum album*).	Seeds were collected from different places of Bangladesh and raised 1,000 seedlings.
Recording information on germination percentage, germination period and seedlings growth in the nursery.	Best germination percentage of the selected species recorded as gajpipul 78-82 %, kurchi 98%, antamul 70%, chandan 60-64% and iswarmul 95%. However, details data provided in table 2.1.
Maintenance of seedlings in the nursery	Seedlings were maintained in the nursery.

Establishment of 0.50 hectare experimental plantations with five selected medicinal plants in Hinguli Research Station.	Established 0.50 hectare experimental plantations with 10 medicinal plants in Hinguli Research Station. (ritha, kurchi, agar, arjun, neem, amloki, horitaki, bohera, bakul and mahua).
Collection of survival and growth data from raised plots of BFRI Headquarter and Hinguli Research Station.	Survival percentage and growth performance data of selected species at BFRI Headquarter nursery was collected and given in figure- 1.
Report writing and printing	

Table- 1. Germination and related data of selected medicinal plant

Name of the species	Treatment	Germination %	Germination period	Average height (cm) (1 month)	Average height (cm) (3 months)
Antamul	Control	40	10-18	9	34
	Soaked in tap water for 4 hrs	40	8-16	7	33
	Soaked in tap water for 6 hrs	70	8-14	10	35
	Soaked in tap water for 08 hrs	55	10-16	9	32
	Soaked in tap water for 10hrs	52	10-17	8	32
	Soaked in tap water for 12 hrs	35	10-18	8	31
Gajpipul	Control	78-82	35-42	10	40
	Soaked in tap water for 6 hrs	50	40-44	8	36
	Soaked in tap water for 12 hrs	55	38-48	8	32
	Soaked in cow dung slurry for 6 hrs	48	40-50	6	31
Kurchi	Control	85	6-11	15	48
	Soaked in tap water for 6 hrs	98	5-10	18	50
	Soaked in tap water for 12 hrs	76	6-12	12	42
	Soaked in tap water for 18 hrs	68	6-12	11	40
	Soaked in tap water for 24 hrs	66	8-15	14	40
Chandan	Control	25	52-80	5	16
	Soaked in tap water for 12 hrs	40	48-80	6.5	14
	Soaked in tap water for 24 hrs	45	45-75	7	18
	Soaked in tap water for 36 hrs	60-64	32-68	8	21
	Soaked in tap water for 48 hrs	48	35-70	7	20
Ishwarmul	Control	80	75-90	18	42
	Soaked in tap water for 3 hrs	95	60-75	20	50
	Soaked in tap water for 6 hrs	82	70-82	16	38
	Soaked in tap water for 12hrs	60	75-85	15	40

2.9 **Achievement (s), if any :**
2.10 **Financial statement   :**
2.10.1 Total cost   **:** Tk.   3,50,000.00
2.10.2 Cost of the year   **:** Tk.   1,29,000.00
2.10.3 Expenditure of the year **:** Tk.   1,29,000.00
2.10.4 Source of fund   **:** GOB.
2.11   **Beneficiaries:** FD, NGO's, Private planters, Farmers,' Educational Institutions, Rattan industries and BSCIC.

3.   **Study**   : Ongoing
3.1   **Programme Area**   : Bamboo and Non-timber Economic Crops.
3.2   **Title of the Study** : Germplasm conservation and management practices of different medicinal plants
3.3   **Justification :** Once Bangladesh was rich in floral diversity. It is estimated that about 5,700 angiosperm found in Bangladesh. Out of these 747 medicinal plants which have tremendous impact on the treatment of disease, specially people dwelling in the forests areas or near by forests. This resource is becoming scarce day by day due to habitat loss, anthropogenic pressure and indiscriminate exploitation. To revamp/regain the depleting medicinal plant resources, it is necessary to conserve either in-situ or ex-situ condition. That will serve as Germplasm centre or gene pool and will be useful for its propagation, improvement and conservation.
3.4   **Objective(s)**   :
3.4.1   To authenticate correct identification of medicinal plants.
3.4.2   To conserve medicinal plants for scientific study and demonstration.
3.4.3   To develop a gene pool of medicinal plants species for propagation purposes.
3.4.4   To popularize the cultivation and use of medicinal plants.
3.4.4   To determine management techniques for maximum yield of medicinal plants.
3.5   **Expected output :** Genetic sources for quality planting materials will be enriched. Management techniques for maximum yield of medicinal plants will be developed**.**
3.6   **Study Period**   :
3.6.1   Starting year   **:** 2015-2016
3.6.2   Completion year   **:** 2019-2020
3.7   **Personnel**   :
3.7.1   Project Leader: **:** Md. Sah Alam, RO
3.7.2   Associates   **:** Dr. Rafiqul Haider, DO
3.8   **Progress**
3.8.1   Previous years, if any: Propagating materials of 07 medicinal plants namely gynura (*Gynura procumbens*), gingko (*Gingko biloba*), damas (*Conocarpus lencifolius*), ashphal (*Dimocarpus longan*), raktagola (*Hematocarpus* spp.) alubokhara (*Prunus salicina*) and quasia (*Cinchona* spp.) were collected from different locations and conserved them at BFRI HQs nursery.
3.8.2   This year   :

Activities of the study	Progress
Action plan as per annual research programme	Progress
Collection of propagating materials for 12 (annual and perennial) medicinal plants from different parts of the country.	Propagating materials of 12 medicinal plants namely tokma, gima sak, rakta-chandal, kali-chandal, bon-chandal, rahu-chandal, doilas, aista, rakta-drone, hing, avocado and arboroi were collected from Natore, Kaptai and Dhaka tree fair.
Raising 4,000 seedlings of different medicinal plants for establishing conservation plots and left over seedling for distribution.	4,000 seedlings of 38 species namely kumbi, menda, bel, ata, lotkon, box-badam, kao, bokul, khair, tetul, rakta-chandan, chalmugra, tamal, ashphal, khona, ashok, mahua, arjun, bahera, haritaki, tulsi, neem, agar, amloki, satamuli, kalomegh, aswagundha, nayontara, pepul, brahmi, basak, turuk-chondal, talmul, polaopata, datura, oparajita, dontimul and tulsi were raised.
Re-establishment of conservation plots for 90 annual medicinal plants and establishment of conservation plots with 05 perennial medicinal plants at BFRI Headquarter.	Re-established 90 annual and newly established medicinal plants namely tokma, gima sak, rakta-chandal, kali-chandal, bon-chandal, rahu-chandal, doilas, aista, rakta-drone, hing, avocado and arboroi at BFRI Headquarter.

Establishment of 1.5 hectare experimental plantations with selected medicinal plants in Hinguli Research Station.	Established 1.5 hectare experimental plantations with 10 medicinal plants at Hinguli Research Station like (Kalojam, kumbi, champa, menda, lotkon, jigni, ashphal, tentul, kao and ashok).
Maintenance of existing and new conservation plots at BFRI campus and Hinguli Research Station.	About two hectare old conservation plots of both annual and perennial plants were maintained at BFRI Headquarter nursery and Hinguli Research Station. Survival and growth performance of selected medicinal species at Hinguli Research Station are given in Figure 1, 2 and 3.

Table- 1. Survival and growth performance of some selected medicinal plants species at Hinguli Research Station.

Year of plantation	Name of the species	Av.Initial height (cm)	June-2015		June-2016		June-2017	
			Av. Survival (%)	Av. Height (m)	Av. Survival (%)	Av. Height (m)	Av. Survival (%)	Av. Height (m)
2013	Amlaki	34	71	1.10	70	2.16	70	3.05
	Arjun	37	60	1.02	60	2.63	60	3.10
	Horitoki	43	66	1.15	60	2.02	60	2.70
	Tamal	40	55	0.68	50	1.44	50	1.80
	Bel	35	50	0.71	50	1.09	50	1.50
	Ritha	50	60	0.94	60	1.28	60	1.90
2014	Amlaki	38	70	0.63	80	1.72	80	2.20
	Horitoki	35	65	0.60	80	1.64	80	2.05
	Bahera	37	50	0.59	75	1.54	75	2.10
	Arjun	33	55	0.60	70	1.50	70	2.50
	Jalpai	36	70	0.52	90	1.50	90	2.40
2015	Agar	57			80	0.77	80	1.10
	Ashok	27			65	0.36	65	0.58
	Kuchila	44			60	0.54	60	0.80
	Kurchi	90			60	1.20	60	1.50
	Neem	35			70	0.45	70	0.75
	Horitoki	69			60	0.82	60	1.30

Table-.2. Survival and growth performance of ten medicinal plants species at Hinguli Research Station planted in 2106.

Name of the species	Av.Initial height (cm)	June-2017	
		Av. Survival (%)	Av. Height (cm)
Box Badam	56	90	85
Mahua	42	80	60
Amloki	64	75	105
Horitoki	80	70	95
Bahera	57	75	82
Agar	55	60	75
Kurchi	64	60	90
Arjun	60	75	110
Ritha	46	70	58
Neem	42	65	60

Table- 3. Survival and growth performance of ten medicinal plants species at Chittagong University planted in 2106

| Name of the species | Av.Initial height (cm) | June-2017 | |
		Av. Survival (%)	Av. Height (m)
Arjun	75	75	1.33
Amloki	42	70	0.56
Horitoki	80	75	1.44
Neem	42	70	0.59
Bahera	65	75	1.00
Agar	50	60	0.65
Kurchi	75	60	1.19
Khair	90	75	1.62
Jam	46	70	0.61
Ritha	35	65	0.42

3.9   **Achievement (s), if any :**

- Conserve 190 medicinal plants at MFP nursery as a permanent source of propagating materials out of which 109 perennial and 81 annual.

- Some of the noted perennial medicinal plants are ashphol, alubokhra, daruchini, lotkon, nagmoni, passion fruit, kakrashing, koasia, jayphol, akonadi, shymlota, bor-akanda, ghritoakanchan, pipul, sarpagandha, choijal, anantamul, salpani, panbilash, buikumra, polash, karpur, all-spices, jayanti, naglingom, ayapana, tespata, mehedi, khair, chandan, kuchila, kurchi, dhup, ritha, uriam.

- Among the annual medicinal plants some noted ones are keu, brammi, mohabingharaj, kalokeshi, alkushi, aswagandha, ekangi, misridana, turukchandal, ulatchandal, punarnava, dhutura, shankhamul, muktajhuri, bhuiamla.

3.10   **Financial statement**   :
3.10.1 Total cost   : Tk.   6, 80,000.00
3.10.2 Cost of the year   : Tk.   1, 95,000.00
3.10.3 Expenditure of the year : Tk.   1, 95,000.00
3.10.4 Source of fund   : GOB.
2.11   **Beneficiaries:** FD, NGO's, Private planters, Farmers,' Educational Institutions, Rattan industries and BSCIC.

4.   **Study**   : Ongoing
4.1   **Programme Area**   :   Bamboo and Non-timber Economic Crops.
4.2   **Title of the Study**   :   Study on nursery and plantation technique of dhup (*Canarium resiniferum*)
4.3   **Justification :** Dhup (*Canarium resiniferum*) is a medium to big sized evergreen tree. It is used to prevent the water infiltration in boat and launch, it is also used in preparing varnish and of medical purpose for plastering. Its wood may be used as veneer and ply woods. Its blackish to brown color gum (oleoresin) used as dhup in dry condition. It is also used for the treatment of indolent ulcer as ointment and treatment of swelling due to rheumatic fever. Traditionally dhup powder is used as mosquito repellent in the village area of Bangladesh, creating smoke during the sunset. The Hindu community people used dhup for their religious purposes. It is very important species in terms of medicinal and religious value. The species is naturally grown in the forest of Chittagong, Cox's bazaar and Sylhet. However, now the species is becoming rare. It may be due to physiological stress condition to regenerate. So, it is needful to conserve the species. With a view to this, it is necessary to develop its nursery and planting techniques. Considering the facts the study has been under taken. To fulfill the following objectives

4.4 **Objective(s)** :

4.4.1 To observe the phenological character of dhup

4.4.2 To standardize nursery techniques of dhup.

4.4.3 To develop plantation techniques of dhup

4.5 **Expected output :** Improved nursery and plantation technique of dhup will be available

4.6 **Study Period** :

4.6.1 Starting year : 2011-2012

4.6.2 Completion year : 2016-2017

4.7 **Personnel** :

4.7.1 Project Leader: : Dr. Rafiqul Haider, DO

4.7.2 Associates : Md. Sah Alam, RO

4.8 **Progress**

4.8.1 Previous years, if any: Phenology (flowering, fruiting, leaf shedding etc.) germination percentage, germination period of seeds and root-shoot ratio of seedlings were studied. Twelve hundred seedlings have conserved at BFRI campus and different location of the country.

4.8.2 This year :

Activities of the study	Progress
Action plan as per annual research programme	Progress
Collection of seeds from Moulvibazar district	35 kg seeds were collected from Adampur, Moulvibazar.
Raising 500 seedlings and maintenance at MFP Headquarter nursery for raising experimental plantation at suitable locations	Raise 1,200 seedlings at MFP Headquarter nursery for experimental plantation.
Raising plantation of 0.5 ha with dhup seedlings and maintenance of previously raised experimental plantation.	Experimental plantations of dhup were raised at Hinguli Forest Research Station. Plantation was completed at 2.0 X 2.0 m., 2.5 X 2.5 m and 3.0 X 3.0 m spacing with 03 replications.
Collection of growth from experimental plantations	Growth performance was provided in Table 1 and 2.

Table- 1. Survival and growth (height) of dhup plantation at different locations planted in 2015

Year of Plantation	Locations	Av.initial height of seedling (cm)	June 2016		June 2017		Remarks
			Av. survival (%)	Av. height (m)	Av. survival (%)	Av. height (m) 2.9	
2015	BFRI Headquarter campus	43	96	2.10	96	3.2	Partial shade
	Mirpur Botanical Garden, Dhaka		96	2.3	96	3.4	
	Sitakunda Eco-park		60	1.7	50	2.5	Disturbed by dear
	Islamic University, Kumira		65	2.0	60	2.7	
	Jahangirnagar University		70	2.2	60	2.8	

Table-2. Survival and growth performance dhup at different locations planted at 2016

Locations	Spacing	Av. Initial height (cm)	June -2017		Remarks
			Av. survival (%)	Av. Height (m)	
Hinguli Research Station	2 m x 2 m		70	0.92	Affected by cattle, Full sunlight
	2.5 m x 2.5 m		75	1.02	
	3 m x 3 m		65	0.98	
Keochia Research Station	2 m x 2 m		94	0.87	Partial shade
	2.5 m x 2.5 m	61	96	1.00	
	3 m x 3 m		96	1.15	
Chittagong University	2 m x 2 m		70	1.00	Full sunlight
	2.5 m x 2.5 m		75	0.95	
	3 m x 3 m		70	0.98	

4.9 **Achievement (s), if any :** Documented phenological characteristics of dhup and developed nursery raising technique.

4.10 **Financial statement :**
4.10.1 Total cost **:** Tk. 2,50,000.00
4.10.2 Cost of the year **:** Tk. 1,30,000.00
4.10.3 Expenditure of the year **:** Tk. 1,30,000.00
4.10.4 Source of fund **:** GOB.
4.11 **Beneficiaries:** FD, NGOs, private planters, Farmers, Educational Institutes, Herbal drug producers etc.

5. **Study** : Ongoing
5.1 **Programme Area** : Biodiversity and Conservation
5.2 **Title of the Study** : Study on ethnomedicinal plants used by the *Khasia* community of Moulvibazar district
5.3 **Justification :** The *Khasia* community is the dominant tribe of the greater Sylhet areas, particularly in Moulvibazar district. The community people used a good number of plant species for the treatment of illness as herbal medicine. The plant species and the inherited knowledge of *Khasia* people are becoming eroded with the dominance of modern medicine and habitat destruction. So far there is no ethnobotanical information on the herbal medicine of the *Khasia* tribe in Bangladesh. Considering the fact the study has been undertaken with aiming the following objectives.
5.4 **Objective(s)** :
5.4.1 To collect the ethnomedicinal plants and their information used by the *Khasia* community of Moulvibazar district.
5.4.2 To find out the conservation strategy and to develop database for ethnomedicinal plants.
5.5 **Expected output :** Ethnomedicinal plants used by the *Khasia* community will be documented. Germplasm conservation of ethnomedicinal plants will be enriched.

5.6 **Study Period** :
5.6.1 Starting year **:** 2014-2015
5.6.2 Completion year **:** 2016-2017
5.7 **Personnel** :
5.7.1 Project Leader: **:** Dr. Rafiqul Haider, DO
5.7.2 Associates **:** Md. Sah Alam, RO
5.8 **Progress**
5.8.1 Previous years, if any: 40 formulations of ethnomedicinal plant uses were collected from the Khasia community of Moulvibazar district.

5.8.2 This year :

Activities of the study	Progress
Action plan as per annual research programme	Progress
Three group discussion with herbal practioners and *Khasia* people	Three group discussion meetings were arranged with Khasia people and herbal practitioner of the Khasia community. A total of 120 participants took part in these discussion meeting.
Collection of ethnomedicinal samples and conservations	Five (05) plant specimens were collected for identification
Collection of information on conservation strategy	Local people do not think about conservation strategy.
Documentation of medicinal uses of plant species	Almost similar type of information collected like previous year. However, formulations were validated from that group discussion.
Report preparation	

5.9 **Achievement (s), if any :** A scientific paper titled "Ethnomedicinal plant used by the Khasia community people in Moulvibazar district of Bangladesh" accepted by International Journal of Ethnonobiology and Ethnomedicine.

5.10 **Financial statement** :
5.10.1 Total cost : Tk. 2,50,000.00
5.10.2 Cost of the year : Tk. 96,000.00
5.10.3 Expenditure of the year : Tk. 96,000.00
5.10.4 Source of fund : GOB.
5.11 **Beneficiaries:** FD, NGOs, private planters, Farmers, Educational Institutes, Herbal drug producers etc.

Plantation Trial Unit Division

1. **Study** : Completed.
1.1 **Programme Area** : Plantation technique and forest management
1.2 **Title of the Study** : Introduction of major bee foraging mangrove plant species in the coastal belt of Bangladesh.
1.3 **Justification: The** floristic composition of the natural Sundarbans is rich compared to many other mangroves of the world. Chaffey and Sandom (1985) presented a list of 66 species in the Bangladesh Sundarbans. There are some important nectar and pollen yielding mangrove flora in this forest. These are khalshi, baen, goran, gewa, keora, choyla, hantal, passur, dhundul etc. The Sundarbans is the major natural habitat of the wild indigenous giant honeybee, *Apis dorsata*. Honeybees are well known for their highly preferential selection of the plant species for collection of nectar and pollen. The important bee foraging mangrove plant species can be planted in the coastal belt of Bangladesh to enrich the coastal vegetation. This could be the source of nectar and pollen yielding mangrove plants which can provide support in natural and artificial apiculture. Therefore, this study has been undertaken for developing plantation techniques of major bee foraging mangrove plant species.
1.4 **Objective(s)** :
1.4.1 To develop better silvicultural techniques for each bee foraging mangrove plant species.
1.4.2 To provide the sources of honey plants.
1.5 **Expected output:** Knowledge on the proper methods and suitable sites for plantations for different bee foraging mangrove species in the coastal belt; and providing sources of honey. There will be a scope for introducing apiculture with bees.

1.6 **Study Period** :
1.6.1 Starting year : 2010-2011
1.6.2 Completion year : 2014-2015 (original), 2016-17 (2nd Phase)
1.7 **Personnel** :
1.7.1 Project Leader: : S. A. Islam, DO
1.7.2 Associates : M.M. Alam, RO; M.A. Habib, FI; M. G. Rasul, FI; M.A.Q. Miah, FI
1.8 **Progress**
1.8.1 Previous years, if any: A total of 7,200 seedlings of khalshi, 2,400 of gewa, 4,800 of goran, 4,800 of passur and 2,400 of baen were raised at Rangabali, Char kukri-Mukri, Sitakundu and Char Osman Research Stations. Four hectares mixed plantations of khalshi, gewa, goran, passur and choyla were raised at 4 Research Stations. Data were collected and compiled.

1.8.2 This year :

Activities of the study	Progress
a) Collection of seeds of khalshi, gewa, goran, passur, dhundul, Choyla, hantal and baen.	Seeds of khalshi, gewa, goran, passur, dhundul, choyla, hantal and baen were collected.
b) Raising 14,000 seedlings of these species at Rangabali, Char Kukri-Mukri, Sitakundu and Char Osman Research Stations.	A total of 14,000 seedlings of these species were raised at Rangabali, Char Kukri-Mukri, Sitakundu and Char Osman Research Stations.
c) Raising 4.0 ha experimental mixed plantations at 4 Research Stations.	A total of 4 ha mixed plantations of these species have been raised at 4 Research Stations.
d) Maintenance of previously raised 15.0 ha experimental plantations.	Fifteen ha experimental plantations have been maintained by performing silvicultural practices.
e) Collection and analysis of data, and writing of report.	Data have been collected and compiled.

Table 1. Growth performance of some bee foraging mangrove species planted in 2011 and 2012 at Char Kukri-Mukri and Rangabali island.

Species	Planted in 2011				Planted in 2012			
	Char Kukri-Mukri		Rangabali		Char Kukri-Mukri		Rangabali	
	Surv. %	Ht.(m)	Surv. %	Ht.(m)	Surv. %	Ht.(m)	Surv. %	Ht.(m)
Khalshi	39.32	1.59	27.77	1.60	38.08	0.65	27.59	0.76
Gewa	70.55	1.79	62.50	1.80	78.05	1.72	67.49	1.27
Goran	19.37	0.81	15.09	0.80	19.62	0.52	16.78	0.58

Table 2. Growth performance of some bee foraging mangrove species planted in 2013 in the coastal areas of Bangladesh.

Species	Rangabali		Char Kukri-Mukri		Sitakundu	
	Survival %	Height(m)	Survival %	Height(m)	Survival %	Height(m)
Passur	49	0.56	49	0.57	72	2.36
Khalshi	49	0.56	65	0.56	50	0.36
Goran	37	0.52	39	0.50	42	0.36
Gewa	54	0.58	54	0.57	70	0.86
Baen	46	0.60	47	0.60	75	0.78
Keora	-	-	-	-	60	2.50

Table- 3. Growth performance of some bee foraging mangrove species planted in 2014 in the coastal areas of Bangladesh.

Specis	Rangabali		Char Kukri-Mukri		Sitakundu		Char Osman	
	Survival %	Height (m)	Survival %	Height (m)	Survival %	Height (m)	Survival %	Height (m)
Khalshi	57	0.54	56	0.54	52	0.62	16	0.37
Goran	39	0.47	45	0.54	45	0.59	10	0.32
Gewa	61	0.56	64	0.55	71	1.25	45	0.52
Baen	45	0.56	26	0.49	75	0.89	51	0.69
Passur	54	0.60	60	0.66	80	1.52	41	0.58
Sundri	-	-	-	-	90	0.89	25	0.42

1.9   **Achievement (s), if any:** Totals of eight bee foraging mangrove species were tried in 4 Research Stations. Among them gewa, khalshi and passur showed good survival rate. But all the species showed slow height growth in all Research Stations. It is due to severe grazing by buffalos and cows.

1.10   **Financial statement**   **:**
1.10.1 Total cost   **:** Tk.   15,00,000.00
1.10.2 Cost of the year   **:** Tk.   2.75,000.00
1.10.3 Expenditure of the year   **:** Tk.   2.75,000.00
1.10.4 Source of fund   **:** GOB.
1.11   **Beneficiaries:** Forest Department and adjacent coastal dwellers.

2.   **Study**   :   Completed.
2.1   **Programme Area**   :   Biodiversity and Conservation
2.2   **Title of the Study**   :   Ecological succession in the man-made coastal forests in relation to age and other related factors.
2.3   **Justification :** There is 710 km long coastal belt in Bangladesh along the Bay of Bengal. There are numerous islands of varying sizes. Continuous siltation and sedimentation are forming newly accreted lands throughout coastal belt gradually. The Forest Department initiated mangrove afforestation in 1966 mainly with the primary objective of saving life and properties of the people living in the area from cyclone and tidal bore. About 1, 92,000 ha coastal plantations have been raised till to date. The pioneer mangrove tree species keora (*Sonneratia apetala*) and baen (*Avicennia officinalis*) appear promising for accelerating the process of siltation and soil stabilization. Out of these 90% are keora plantations. This coastal man-made forest faces serious threat due to geomorphic changes, ecological succession and inadequate regeneration of other mangrove species. Succession refers to orderly change in the communities of species. Geomorphic changes in the mangrove environment are rapid. Succession is the outcome of the interaction of a number of factors. Sufficient studies in this direction have not been made. Therefore, this study has been taken to determine the changes of vegetations and the factors responsible for this process for the sustainable management of coastal mangrove forests.

2.4   **Objective(s)**   :
2.4.1 To observe the changes of vegetation and natural regeneration in the coastal man-made forests.
2.4.2 To determine the impact of related climatic factors, which are responsible for the ecological succession in the coastal forest.
2.4.3 To increase coastal forest resources of the country.
2.5   **Expected output:** Knowledge on the changes of vegetation, geomorphology and natural generation in the coastal man-made forests will be developed for the sustainable management of coastal forests.
2.6   Study Period   :
2.6.1 Starting year   :   2012-2013
2.6.2 Completion year   :   2016-2017

2.7 **Personnel**   :
2.7.1 Project Leader: : M.M. Alam, RO
2.7.2 Associates   : S. A. Islam, DO; M.A. Habib, FI; M. G. Rasul, FI; M.A.Q. Miah, FI
2.8 **Progress**
2.8.1 Previous years, if any: Totals of 108 Temporary Sample Plots (TSP) were maintained at 20 chars in the man-made coastal forests. Data on siltation, soil erosion, soil/water salinity, inundation frequency etc. were recorded. Data on the status of natural regeneration were recorded.
2.8.2 This year   :

Activities of the study	Progress
a) Remarking of previously established 108 TSP plots by replacing poles and painting of trees.	Previously established 108 TSP plots were remarked by replacing poles and painting of trees.
b) Maintenance of 108 TSPs.	A total of 108 TSPs plots were maintained by fencing and plot remarking.
c) Recording data on siltation, soil erosion, soil/water salinity, inundation frequency etc.	Data on siltation, soil erosion, soil/water salinity, inundation frequency have been recorded.
d) Collection of growth data of the older plantations and newly recruited natural regeneration.	Data on the status of existing natural regeneration have been recorded.

Tabl- 1. Regeneration of different mangrove species (number per hectare) inside *Sonneratia apetala* forest in the western coastal belt of Bangladesh.

species	Char Kukri-Mukri Island					Rangabali Island				
	Seedling	Sapling	Pole	Tree	Total	Seedling	Sapling	Pole	Tree	Total
Gewa	79096	24178	2237	590	106101	77852	19467	1970	1007	100296
Keora	46607	2607	-	-	49214	60681	711	-	-	61392
Baen	12148	1363	59	89	13659	14237	3777	88	-	18102
Sundri	3444	3318	1511	311	8584	785	281	15	44	1125
Kankra	859	148	-	-	1007	1837	222	-	15	2074
Passur	504	59	-	-	563	844	207	-	-	1051
Khalshi	3392	740	-	-	4132	9007	726	59	15	9807
Hantal	163	89	-	-	252	4266	2222	-	-	6488
Shingra	-	-	-	-	-	88	44	-	-	132
Choyla	11392	163	-	-	11599	5066	-	-	-	5066
Golpata	44	15	-	-	59	-	-	-	-	-
Karanja	267	148	-	-	415	2103	353	-	-	2456
Amur	548	178	-	-	726	-	-	-	-	-
Bola	2963	459	-	-	3422	-	-	-	-	-
Sonboloi	59	29	-	-	88	992	385	-	-	1377
Total	161486	33494	3807	1034	199821	177758	28395	2132	1081	209366

Table- 2. Regeneration of different mangrove species (number per hectare) inside *Sonneratia apetala* forest in the eastern coastal belt of Bangladesh.

Species	Sitakundu					Hatiya Island				
	Seedling	Sapling	Pole	Tree	Total	Seedling	Sapling	Pole	Tree	Total
Gewa	67170	13689	1141	370	82370	400	1333	6000	2637	10370
Baen	148	0	0	0	148	-	-	-	-	-
Passur	0	15	0	0	15	-	-	-	-	-
Khalshi	1422	59	0	0	1481	-	-	-	-	-
Hantal	59	178	0	222	459	-	-	-	-	-
Nona Jhau	2430	281	89	0	2800	-	-	-	-	-
Goran	4415	3304	0	0	7719	-	-	-	-	-
Total:	75644	17526	1230	592	94992	400	1333	6000	2637	10370

Table- 3. A comparative regeneration status in 2014 and 2017 in the coastal belt of Bangladesh.

Location	Study year	Total no. of species	Gewa	Keora	Baen	Khalshi	Sundri	Kankra	Passur	Others	Total
Rangabali	2014	6	50725	-	162	-	1687	161	103	325	53163
	2017	12	100296	61392	18102	9807	1125	2074	1051	15519	209366
Char Kukri	2014	9	28309	-	2577	11821	1568	310	428	2293	47306
	2017	14	106101	49214	13659	4132	8584	1007	563	16561	199821
Sitakundu	2014	7	51747	-	700	1392	-	-	14	8087	61940
	2017	7	82370	-	148	1481	-	-	15	10978	94992
Hatiya	2014	1	17820	-	-	-	-	-	-	-	17820
	2017	1	10370	-	-	-	-	-	-	-	10370

2.9   **Achievement (s), if any:** In the established keora plantations of the coastal belt, the number of planted trees ranged between 311-2178 trees per hectare area. According to the assessment of 2014, totals of 6, 9, 7 and 1 mangrove species were regenerated inside keora forests at Rangabali, Char Kukri-Mukri, Sitakundu and Hatiya sites respectively. On the other hand totals of 12, 14, 7 and 1 mangrove species have been generated in 2017 at the same sites. The number of species has increased at Rangabali and Char Kukri-Mukri. The most abundant regenerated species is gewa in all along the coastal belt. One scientific article has been published.

2.10   **Financial statement   :**

2.10.1 Total cost   : Tk.   20,00,000.00

2.10.2 Cost of the year   : Tk.   1,00,000.00

2.10.3 Expenditure of the year   : Tk.   1,00,000.00

2.10.4 Source of fund   : GOB.

2.11   **Beneficiaries:** Forest Department, planers and NGOs

3.   **Study**   : Ongoing

3.1   **Programme Area**   : Plantation technique and forest management

3.2   **Title of the Study**   : Monitoring and maintenance of existing trial plantations in the coastal areas of Bangladesh.

3.3   **Justification :** The Forest Department started mangrove afforestation in the coastal belt of Bangladesh from 1966. About 1,92,000 ha of coastal plantations have been raised in Bangladesh till to date. Among them keora and baen occupied more than 90% area of the coastal forest. These plantations encountered a number of problems. Morphological changes, species succession and insect infestation threatening the sustainability of coastal forest. No regeneration appeared under keora plantations due to rising of forest floor, compactness of soil and non-availability of seed source of other mangrove species. Therefore, after harvesting of matured keora trees, there will be no second rotation crops for sustainability of this forest. In order to maintain a continuous forest cover in the coastal belt, trial plantations of 11 major mangrove species under keora plantations were initiated from 1991-1995 in different char lands of the coastal belt. The growth performance of those species was recorded over time. By this time, some scientific reports were published in some renowned journals. The trial plantations are now 16-21 years old. It was observed that flowering and fruiting of these species were started in 8-10 years old stands. After falling seeds to the muddy ground huge seedlings of some species were appeared in and around plantation areas. Natural regeneration mainly of gewa, sundari and hantal were observed in and around trial plots both at Rangabali and Char Kukri-Mukri areas. So, these plantations serve as valuable mangrove seed sources in the coastal char lands. This becomes an opportunity to develop second rotation vegetation naturally in the man-made keora forests. Similarly, some non-mangrove species in the raised lands were undertaken in different coastal islands. The present study is aimed to preserve and maintained these trial plots for the development and sustainability of coastal forests.

3.4 **Objective(s)** :

3.4.1 To assess the growth performance and phenology of different mangrove and non-mangrove species at different char lands.

3.4.2 To develop future seed sources for sustainable coastal forest management.

3.5 **Expected output:** Growth performance and phenological behavior of mangrove and non-mangrove species will be determined over time. Older trial plots will be maintained and conserved of for future seed sources for sustainable management of coastal forest.

3.6 **Study Period** :

3.6.1 Starting year : 2013-2014

3.6.2 Completion year : 2017-2018

3.7 **Personnel** :

3.7.1 Project Leader: : S. A. Islam, DO

3.7.2 Associates : M.M. Alam, RO; M.A. Habib, FI; M. G. Rasul, FI; M.A.Q. Miah, FI

3.8 **Progress**

3.8.1 Previous years, if any: A total of 30.0 ha of older trials of mangrove (25.0 ha), non-mangrove (4.0 ha) and palm (1.0 ha) species were maintained by silvicultural practices. Growth and survival data of mangroves and non-mangrove species were recorded from the experimental plantations raised in different islands under Rangabali, Char Kukri-Mukri and Sitakundu Research Stations.

3.8.2 This year :

Activities of the study	Progress
a) Conservation and maintenance of 30.0 ha existing trials of mangrove (25.0 ha) and non-mangrove (5.0 ha) species by weeding, cleaning, climber cutting, fence repairing etc. in different islands of Rangabali, Char Kukri-Mukri, Char Osman and Sitakundu Research Stations.	A total of 30.0 ha existing trials of mangrove (25.0 ha) and non-mangrove (5.0 ha) plantation were maintained by weeding, cleaning, climber cutting, barbed wire fence repairing, etc. at different islands under Rangabali, Char Kukri-Mukri, Char Osman and Sitakundu Research Stations.
b) Maintenance of 15.0 ha trials of mangrove and non-mangrove species for 2nd time at Rangabali and Char Kukri-Mukri Research Stations.	A total of 15.0 ha existing trial plots of mangrove and non-mangrove species were maintained 2nd time in different islands of Rangabali and Char Kukri-Mukri Research Stations.
c) Collection of flowering and fruiting data from 120 trees of keora. baen, gewa, sundri, passur and khalshi.	Flowering and fruiting data from 120 trees of keora. baen, gewa, sundri, passur, kakra have been collected and compiled.
d) Collection of growth data from the experimental plantations once a year.	Growth data have been collected and compiled.
e) Compilation and analysis of data.	Data on height, DBH, canopy diameter, bole height, etc. have been collected from the experimental plantations once a year.
f) Preparation of scientific reports/ articles.	One scientific paper has been published in the *Bangladesh Research Publications Journals.*

Table-1. Growth performance of 4 mainland tree species in a mixed plantation raised in 2012 (4 years old) at Bogachatar, Chittagong.

Species	Survival%	Mean Height (m)	MAI height (m)	Mean dbh (cm)	MAI in dbh (cm)
Jhao	99	12.21	3.05	9.14	2.28
Payra	95	6.58	1.64	5.32	1.33
Babla	93	5.78	1.44	7.08	1.77
Karanja	97	4.28	1.07	4.76	1.19

Table-2. Growth performance of 4 mainland tree species in a mixed plantation raised in 2013 (3 years old) at Bogachatar, Chittagong.

Species	Survival%	Mean Height (m)	MAI height (m)	Mean dbh (cm)	MAI in dbh (cm)
Jhao	100	6.38	2.12	7.21	2.40
Payra	76	3.96	1.32	3.44	1.14
Babla	96	4.67	1.55	5.22	1.74
Karanja	82	5.04	1.68	4.86	1.62

Table- 3. Growth performance and fruits production of 7 mangrove species in the coastal areas of Bangladesh.

Species	Location	Plantation age (year)	Height (m)	DBH (cm)	Bole ht. (m)	Crown dia. (cm)	Fruits /tree (kg)	No. of fruits/ kg
Keora	Char Kukri	12	16.68	18.80	9.45	4.84	-	-
	Rangabali	-	-	-	-	-	-	-
Baen	Char Kukri	32	20.20	31.72	7.20	6.60	-	-
	Rangabali	20	21.78	45.31	10.45	12.77	-	-
Sundri	Char Kukri	26	7.7	7.29	3.15	3.58	4.25	35
	Rangabali	21	11.38	7.83	5.33	3.98	6.10	36
Kankra	Char Kukri	27	14.68	16.87	6.35	5.03	9.95	47
	Rangabali	21	5.47	9.25	2.24	3.87	7.77	36
Gewa	Char Kukri	26	15.13	16.46	9.95	4.77	1.12	347
	Rangabali	38	20.40	29.81	8.25	8.75	2.33	345
Khalshi	Char Kukri	-	-	-	-	-	-	-
	Rangabali	21	7.22	8.66	2.77	2.58	-	-
Passur	Char Kukri	26	9.03	14.90	4.30	4.47	4.47	-
	Rangabali	21	9.74	12.10	5.71	5.43	6.50	-

Table- 4. Flowering time of 7 mangrove species in two locations of the coastal belt of Bangladesh.

Species	Locations	Months											
		J	F	M	A	M	J	J	A	S	O	N	D
Keora	Kukri			■	■								
	Rangabali												
Baen	Kukri				■	■							
	Rangabali				■	■							
Sundri	Kukri			■	■								
	Rangabali			■									
Kankra	Kukri			■	■								
	Rangabali			■									
Gewa	Kukri			■	■								
	Rangabali			■									
Passur	Kukri			■									
	Rangabali			■									
Khalshi	Kukri												
	Rangabali		■	■									

Table 5. Fruiting time of 7 mangrove species in two locations of the coastal belt of Bangladesh.

Species	Locations	Months											
		J	F	M	A	M	J	J	A	S	O	N	D
Keora	Kukri					▓	▓	▓					
	Rangabali												
Baen	Kukri						▓	▓	▓				
	Rangabali						▓	▓	▓				
Sundri	Kukri				▓	▓	▓	▓					
	Rangabali				▓	▓	▓	▓					
Kankra	Kukri				▓	▓	▓	▓	▓				
	Rangabali				▓	▓	▓	▓	▓				
Gewa	Kukri				▓	▓	▓						
	Rangabali				▓	▓	▓						
Passur	Kukri				▓	▓	▓						
	Rangabali				▓	▓	▓						
Khalshi	Kukri												
	Rangabali				▓	▓	▓	▓					

3.9   **Achievement (s), if any :** Till to-date, a total of 30.0 ha experimental plantations of mangrove (25.0 ha) and non-mangrove (5.0 ha) species have been established at different sites of Rangabali, Char Kukri-Mukri, Char Osman and Sitakundu Forest Research Stations. Some major mangrove species *viz.* sundri, gewa, passur, hantal, khalshi, shingra and golpata have been found promising for sustainable development of coastal mangrove forests. Similarly, in the raised lands of coastal areas, promising performance among non-mangrove species has been recorded for raintree, jhao, payra, babla, sada koroi and kala koroi. Moreover, jhao, payra, babla and karanja showed promising growth performance in a mixed model plantations in the coastal raised land. Two scientific papers were published in 2016.

3.10   **Financial statement   :**
3.10.1   Total cost   :   Tk.   15,00,000.00
3.10.2   Cost of the year   :   Tk.   3,85,000.00
3.10.3   Expenditure of the year   :   Tk.   3,85,000.00
3.10.4   Source of fund   :   GOB.
3.11   **Beneficiaries:** FD; Local Farmers and NGO.

4.   **Study**   : Ongoing
4.1   **Programme Area**   : Plantation technique and forest management
4.2   **Title of the Study**   : Selection of salt tolerant fruit and medicinal tree species in the coastal areas of Bangladesh.
4.3   **Justification :** The coastal region of Bangladesh covers an area of about 47,201 km^2 extending along the Bay of Bengal. The zone constitutes 20% of the area and 28% of the population of Bangladesh. The coastal and offshore areas include tidal, estuaries and river floodplains in the south along the Bay of Bengal. There are numerous old and new islands of varying sizes accreted in the estuaries of the big rivers and the Bay of Bengal. There are 32.07 million homesteads in Bangladesh and over 74% of the population lives in the rural areas. Approximately 7% area (0.53 million ha) of the total 8.4 million hactare of cultivable land in Bangladesh is occupied by homesteads which is extremely productive. Homesteads represent a land use system involving deliberate management of multipurpose trees and shrubs in limited association with seasonal vegetables. Homesteads play a vital role in providing timber, fuelwood, fodder, and fruits. About 70 different kinds of fruit are grown in Bangladesh and about 90% fruits come from the homesteads. On the other hand, many medicinal plant species including trees, shrubs and herbs are grown in Bangladesh. The

diversity and distribution pattern of the plant species is influenced by macro and micro environmental factors. Most fruit trees are relatively sensitive to salinity with little exception and few other species believed to be moderately salt tolerant. It is generally believed that growth and yield of woody crops suffer from both osmotic effect and toxicities caused by chloride or sodium accumulation. The vegetation coverage is reducing due to increasing soil salinity in different countries. But there are some terrestrial plants that can grow well in saline soil. To address the situation selection and breeding programme can be imitated to identify salt tolerant fruit and medicinal tree species. Adaptability of the species to a particular site in stressed condition is very important for species selection. In this study, emphasis has been given only tree species. In this regard, communication was made to Bangladesh Agricultural Research Institute and Horticultural base in Barisal region. But no systematic research on the selection of salt tolerant fruit tree species in the coastal areas were undertaken in the field level by them. Therefore, the present study has been undertaken to select suitable fruit and medicinal tree species in the coastal belt of Bangladesh.

4.4 **Objective(s)** :
4.4.1 To select suitable salt tolerant fruit and medicinal tree species in the coastal areas of Bangladesh.
4.4.2 To observe the growth performance of different fruit and medicinal tree species in different sites.
4.4.3 To assess the production of fruits in different fruit tree species.
4.5 **Expected output** : Site-suitable fruit and medicinal tree species will be selected in the coastal areas of Bangladesh.
4.6 **Study Period** :
4.6.1 Starting year : 2013-2014
4.6.2 Completion year : 2017-2018
3.7 **Personnel** :
4.7.1 Project Leader: : S. A. Islam, DO
4.7.2 Associates : M.M. Alam, RO; M.A. Habib, FI; M. G. Rasul, FI; M.A.Q. Miah, FI
4.8 **Progress**
4.8.1 Previous years, if any: A total of 200 farmers were selected for planting fruit tree species in their homesteads. Totals of 9000 seedlings of coconut, mango, jackfruit, black berry, guava, tamarind, ber, pummelo, hog plant, litchi, elephant apple, indian olive, velvety apple and amloki were distributed and planted in the coastal homesteads. Four hectares plantations of 10 medicinal tree species were raised at 4 Research Stations.
4.8.2 This year :

Activities of the study	Progress
a) Organizing two awareness meetings with rural people for cultivating fruit and medicinal tree species in the coastal homesteads at Char Kukri-Mukri and Sitakundu Research Stations.	Two awareness meetings with rural people for cultivating fruit and medicinal tree species in the coastal area/homesteads were organized at Sitakundu and H/Q Research Stations.
b) Selection of 125 farmer's homesteads (25 from each research station) for planting fruit trees in their home gardens at Rangabali, Char Kukri-Mukri, Char Osman, Sitakundu and Head Quarter Research Stations.	A total of 150 homesteads were selected for planting fruit tree species at Rangabali, Char Kukri-Mukri, Char Osman, Sitakundu and Head Quarter Research Stations.
c) Raising/purchasing 9000 seedlings of some major fruit tree species such as coconut (narikel), mango (am), jackfruit (kanthal), black berry (kalojam), guava (peyara), tamarind (tentul), ber (kul), pummelo (jambura), hog plant (amra), litchi (letchu), elephant apple (chalta), indian olive (jalpai), velvety apple (bilati gab), wood apple (bel) and aonla (amloki) for 125 homesteads.	A total of 9,000 seedlings of some major fruit tree species such as coconut, mango, jackfruit, black berry, guava, tamarind, ber, pummelo, hog plant, litchi, elephant apple, indian olive, velvety apple and amloki were raised/purchased for 150 homesteads.

d) Raising 18,000 seedlings of medicinal tree species such as neem, arjun, simul, bohera, gora neem, khoer, kathbadam, kadam, sonalu, pitraj, satian and bot.	Totals of 18,000 seedlings of 12 medicinal tree species such as neem, arjun, simul, bohera, gora neem, khoer, kathbadam, kadam, sonalu, pitraj and satian were raised.
e) Raising 4.0 ha experimental plantations of medicinal tree species and fencing with wooden post at 4 Research Stations.	Four hectares experimental plantations of these medicinal tree species have been raised at 4 Research Stations.
f) Distribution and planting of seedlings of fruit tree species in the selected homesteads.	Seedlings of different fruit tree species (6045 nos.) have been distributed, planted in 150 coastal homesteads at 5 Research Stations.
g) Maintenance of previously raised 8.0 ha plantations of medicinal plants at 4 Research Stations.	A total of 8.0 ha experimental plantations have been maintained at 4 Research Stations.
h) Collection of survival and growth data from the experimental plots.	Growth data have been recorded from experimental plantations.
i) Analysis of data and preparation of a scientific paper.	One scientific paper has been published in the *Journal of Bioscience and Agriculture Research*.

Table- 1. Growth performance of ten woody medicinal species planted in 2014 (2 years old) at Bogachater, Sitakundu, Chittagong.

Common name	Survival %	Height (m)	Collar dia. (cm)	DBH (cm)	Stem length (m)	No. of branch
Neem	70	1.67	2.53	1.62	1.23	5
Gora neem	42	1.67	2.19	1.98	1.45	4
Arjun	**78**	1.89	4.27	2.17	0.93	9
Bohera	66	1.12	2.25	-	0.95	3
Kathbadam	**89**	1.82	3.12	2.02	1.50	6
Shimul	54	1.93	4.23	2.16	1.44	5
Khoer	45	3.06	4.97	3.67	1.49	17
Kadam	64	2.63	5.93	3.72	2.21	12
Sonalu	49	1.21	1.76	-	0.72	3
Pitraz	37	1.07	2.44	-	0.75	6

Table- 2. Growth performance of ten medicinal tree species planted in 2015 (1 year old) at Bamansunder, Chittagong.

Common name	Survival %	Height (m)	Collar dia. (cm)	Stem length (m)	No. of branch
Neem	36	0.63	0.69	0.50	1
Gora neem	17	0.88	0.95	0.70	1
Arjun	88	0.93	1.45	0.65	4
Bohera	68	0.52	0.89	0.44	2
Kathbadam	74	0.70	1.00	0.64	2
Shimul	78	0.99	1.73	0.93	2
Khoer	43	0.94	0.67	0.56	4
Kadam	60	0.92	2.08	0.85	3
Sonalu	51	0.64	0.85	0.44	2
Pitraz	40	0.78	1.07	0.68	1

Table- 3. Growth performance of eleven medicinal tree species planted in 2014 (3.5 year old) at Char Kukri-Mukri and Rangabali coastal areas.

Species	Char Kukri-Mukri				Rangabali			
	Survival %	Ht. (m)	DBH (cm)	Crown dia (m)	Survival %	Ht. (m)	DBH (cm)	Crown dia (m)
Aurjun	65	6.48	7.23	1.20	67	2.19	5.40	0.23
Shimul	46	4.02	5.74	0.93	47	1.56	4.97	0.65
Bohera	46	2.52	3.28	0.97	48	1.24	2.66	0.60
Khoier	66	3.45	5.75	1.07	84	3.46	3.50	2.67
Ghoraneem	56	4.27	3.96	0.74	55	1.62	2.16	0.55
Kathbadam	47	5.89	5.90	1.04	48	1.60	3.21	0.76
Kadam	65	3.08	4.64	0.94	78	2.32	2.05	1.01
Neem	60	2.31	3.40	0.96	46	3.61	2.30	0.92
Pitraj	38	1.56	1.66	0.52	44	1.72	1.89	0.24
Sonalu	49	2.65	2.55	0.50	53	1.46	1.56	0.36
Horitoki	42	1.49	2.05	0.48	60	1.45	1.16	0.45

Table- 4. Growth performance of some fruit tree species planted in different years at Char Osman Forest Research Station, Noakhali.

Species	Planted in 2014			Planted in 2015			Planted in 2016	
	Survival %	Height (m)	DBH (cm)	Survival %	Height (m)	DBH (cm)	Survival %	Height (m)
Narikel	67	2.51	-	80	2.03	-	95	1.16
Jambura	4	1.05	-	58	1.55	2.70	41	0.72
Amra	35	3.49	6.41	36	2.85	5.25	50	1.13
Tentul	22	1.45	-	48	1.52	2.69	-	-
Aam	65	2.25	3.40	88	1.77	2.39	70	1.26
Kanthal	61	2.49	3.60	32	1.75	3.01	27	0.97
Lichu	48	1.70	2.91	44	1.42	2.38	33	0.95
Payara	72	2.26	2.69	78	1.94	2.48	56	1.25
Amloki	37	3.12	5.43	64	2.99	5.27	38	1.24
Bel	35	1.52	3.56	53	1.49	2.69	23	0.54
Kalojam	17	2.28	8.28	35	1.67	2.64	44	0.97
Chalta	7	1.07	-	-	-	-	52	0.89
Jolpay	13	1.93	-	16	1.40	-	15	0.66
Bilati gab	-	-	-	37	0.94	-	49	0.56
Kul	4	2.8	-	48	1.91	-	35	0.96

4.9 **Achievement (s), if any :** A total of 6,745 seedlings of different fruit tree species have been distributed among 150 farmer. Totals of 8.0 ha plantations of different medicinal tree species have been raised at 4 Research Stations. Some of the species from young plantations e.g. arjun, shimul. khoer, kathbadam, and kadam showed promising growth performance. One scientific paper has been published.

4.10 **Financial statement** :
4.10.1 Total cost : Tk. 20,00,000.00
4.10.2 Cost of the year : Tk. 5,18,000.00
4.10.3 Expenditure of the year : Tk. 5,18,000.00
4.10.4 Source of fund : GOB.
4.11 **Beneficiaries:** Forest Department, coastal farmers, planers and NGOs.

5.   **Study**   : New
5.1   **Programme Area**   : Plantation technique and forest management
5.2   **Title of the Study**   : Growth performance of bamboo and rattan in the coastal raised
                                   lands of Bangladesh.
5.3   **Justification :** The coastal belt of Bangladesh is 710 km long extending along the Bay of
      Bengal. There are numerous chars and offshore islands of varying sizes. The Forest Department
      has raised about 1,92,000 ha of mangrove plantations in the coastal belt with the primary
      objective to protect the lives and properties of coastal population. Among them keora occupies
      more than 90% area of the coastal forests. These plantations encounter a number of problems.
      Morphological changes, species succession and insect infestation threaten the sustainability of
      coastal forests. Massive development of pneumatophores in the planted species causes increase
      in the deposition of silts and rapidly rises of the forest floor. The geomorphic changes affect
      regular inundation in the forest floor and growth of keora plantations. The raised lands become
      unsuitable for the optimum growth of keora and baen species. As a result, the growth of keora is
      stunted and huge gaps are created due to mortality. Other mangrove species do not grow and
      survive in this situation. So, the feasibility of bamboo and rattan inside older keora forests can be
      tested. About 15-17 bamboo species are cultivated in the village groves in Bangladesh. At
      present, 80% of supplies of bamboos come from village lands and the rest from natural forests.
      On the other hand, there are 10 species of rattan grown in Bangladesh. Due to over-exploitation
      and intensive logging of rattan, the natural population is reducing drastically. The demand of raw
      materials is increasing day by day and the existing stock of rattan resource is not enough to meet-
      up the present requirement. In the coastal areas, bamboo and rattan population are very poor.
      Moreover, people are not aware to cultivate bamboo and rattan in their home gardens. Therefore,
      this study is undertaken to introduce site-suitable bamboo and rattan species inside coastal keora
      forests for the sustainable production of coastal forests.
5.4   **Objective(s)**   :
5.4.1 To investigate the possibility for introduction of bamboo and rattan inside the older keora plantations.
5.4.2 To select suitable bamboo and rattan species in the coastal areas.
5.4.3 To increase the productivity of bamboo and rattan in the coastal areas.
5.5   **Expected output:** Production of bamboo and rattan in the coastal areas will be increased.
5.6   **Study Period**   :
5.6.1 Starting year   : 2016-2017
5.6.2 Completion year   : 2020-2021
5.7   **Personnel**   :
5.7.1 Project Leader: : S. A. Islam, DO
5.7.2 Associates   : M.M. Alam, RO; M.A. Habib, FI; M. G. Rasul, FI; M.A.Q. Miah, FI
5.8   **Progress**
5.8.1 Previous years, if any: New
5.8.2 This year   :

Activities of the study	Progress
a) Collection of seeds of rattan (*Calamus tenuis*) for raising 1200 seedlings.	Seeds of rattan (*Calamus tenuis*) were collected for raising 1200 seedlings at Rangabali and Char Kukri-Mukri research stations.
b) Collection of bamboo (*Bambusa balcooa* and *B. vulgaris*) branchs for raising 2500 seedlings from branch cuttings.	Bamboo branches have been collected (*Bambusa balcooa* and *B. vulgaris*) for raising 2500 seedlings from branch cuttings.
c) Raising 1200 seedlings of rattan and 2500 seedlings of bamboo at Rangabali, Char Kukri-Mukri, Char Osman and Sitakundu Research Stations.	Totals of 1200 seedlings of rattan and 2500 seedlings of bamboo were raised at Rangabali and Char Kukri-Mukri, Research Stations.

d) Raising 2.14 ha experimental plantations of bamboo and rattan inside keora forests.	A total of 1.07 ha experimental plantations of bamboo and rattan inside keora forests have been raised at Rangabali and Char Kukri-Mukri Research Stations.
e) Fencing with barbed wire around the plots at 4 research stations.	Fence with barbed wire has been prepared around the experimental plots.
f) Collection of data from nursery and plantations.	Data have been collected from nursery.

5.9 **Achievement (s), if any:** A total of 1.07 ha bamboo and rattan plantation have been raised inside older keora forests.

5.10 **Financial statement** :

5.10.1 Total cost : Tk. 20,00,000.00

5.10.2 Cost of the year : Tk. 2,22,000.00

5.10.3 Expenditure of the year : Tk. 2,22,000.00

5.10.4 Source of fund : GOB.

5.11 **Beneficiaries:** Forest Department, coastal farmers, planers and NGOs.

6. **Study** : New

6.1 **Programme Area** : Plantation technique and forest management

6.2 **Title of the Study** : Plantation techniques of some understoried mangrove associates inside keora plantations in the coastal belt of Bangladesh.

6.3 **Justification**: The forest Department started mangrove afforestation in the coastal belt of Bangladesh since 1966. About 1,92,000 ha of coastal plantations have been raised in Bangladesh till to date. Among them, keora and baen occupy more than 90% area of the coastal forests. The monoculture plantations encounter a number of problems. Morphological changes, species succession and insect infestation threaten the sustainability of the coastal forests. Regeneration except gewa is not appeared under keora plantations due to rising of forest floor and non-availability of seed sources of other mangrove species. In the natural mangroves of the Sundarbans of Bangladesh, there are some important understoried mangrove species such as *Amoora cucullata* (amur), *Excoecaria indica* (batla), *Ficus* sp. (jir bot), *Hibiscus tiliaceous* (bola), *Tamarix indica* (nona jhao), *Thespesia populnea* (sonboloi), *Calophyllum inophyllum* (punial), *Cynometra ramiflora* (shingra), *Rhizophora mucronata* (jhana) and pani kapila. These species along with other major mangrove species create dense forest coverage. The dense forest can protect human habitation, lives, properties and agricultural crops from extreme weather events resulting from climate change. But, these understoried mangrove species have never tried in the coastal areas. Hence, the proposed study has been undertaken with a view to evaluate suitable species for the development of multistoried coastal mangrove forests.

6.4 **Objective(s)** :

6.4.1 To develop better techniques for raising nursery and plantations of some important understoried mangrove species inside keora plantations.

6.4.2 To select suitable mangrove species for coastal areas of Bangladesh.

6.5 **Expected output** : Suitable understoried mangrove species will be selected for planting inside keora plantations.

6.6 **Study Period** :

6.6.1 Starting year : 2016-2017

6.6.2 Completion year : 2020-2021

6.7 **Personnel** :

6.7.1 Project Leader: : S. A. Islam, DO

6.7.2 Associates : M.M. Alam, RO; M.A. Habib, FI; M. G. Rasul, FI; M.A.Q. Miah, FI

6.8 **Progress**

6.8.1 Previous years, if any: New study

5.8.2 This year　　　　　　　　**:**

Activities of the study	Progress
a) Collection of seeds of *Amoora cucullata* (amur), *Excoecaria indica* (batla), *Ficus* sp. (jir bot), *Hibiscus tiliaceous* (bola), *Tamarix indica* (nona jhao), *Thespesia populnea* (sonboloi), *Calophyllum inophyllum* (punial), *Cynometra ramiflora* (shingra), *Rhizophora mucronata* (jhana) and pani kapila for raising 20,000 seedlings.	Seeds of amur, batla, jir bot, bola, nona jhao, sonboloi, punial, shingra, jhana and pani kapila for raising 20,000 seedlings.
b) Raising 20,000seedlings of these species at Rangabali, Char Kukri-Mukri, Char Osman and Sitakundu Research Stations.	A total of 20,000 seedlings of these species were raised at Rangabali and Char Kukri-Mukri Research Stations.
c) Raising 4.0 ha experimental plantations inside keora forests.	Two ha experimental plantations have been raised inside keora plantations at Rangabali and Char Kukri-Mukri Research Stations.
d) Collection of data from nursery and plantations	Data have been collected from nursery and compiled.

6.9　　**Achievement (s), if any :** Totals of 2.0 ha plantations of 10 understoried mangrove species have been raised at Ranabali and Char Kukri-Mukri.

6.10　**Financial statement**　　**:**

6.10.1 Total cost　　　　　　**:** Tk.　20,00,000.00

6.10.2 Cost of the year　　　　**:** Tk.　　2,00,000.00

6.10.3 Expenditure of the year　**:** Tk.　　2,00,000.00

6.10.4 Source of fund　　　　　**:** GOB.

6.11　**Beneficiaries:** Forest Department, coastal farmers, planers and NGOs.

SEED ORCHARD DIVISION

1.　　**Study**　　　　　　　　: On-going

1.1　**Programme Area**　　: Breeding and Tree improvement

1.2　**Title of the Study**　　:　Establishment and management of seed orchards

1.3　**Justification :** Collection of seeds from plus trees is costly and difficult as long distance has to travel for the collection of seeds. Abundant and easily harvested seeds could be make available for the plantation and nursery programme when a seed source as seed orchard is developed using the genetic materials from plus trees (PTs). Proper management of the established orchards would ensure higher productivity of the orchard trees. Genetic worth of the seeds harvested from seed orchards are also higher than the seeds collected from PTs or seed production areas (SPAs). Therefore, the study has been undertaken in order to establish the seed orchard as quality seed source.

1.4　**Objective(s)**　　　　**:**

1.4.1 To establish and manage superior quality seed sources from selected clones or progenies.

1.4.2 To preserve better genetic stocks under ex situ condition from the natural stands and plantations for future breeding and tree improvement programme.

1.4.3 To develop suitable techniques for mass production of clonal planting materials.

1.4.4 To screen best clones/progenies.

1.4.5 To supply quality seeds to related stakeholders.

1.5 **Expected output :** Permanent source of quality seeds and improved planting materials will be available for the planters.

1.6 **Study Period** :

1.6.1 Starting year : 2014-2015 (5th Phase)

1.6.2 Completion year : 2018-2019

1.7 **Personnel** :

1.7.1 Project Leader: : Dr.Hasina Mariam, DO.

1.7.2 Associates : Md. ArifurRahaman, SRO; Md. Mezan-Ul-Haque, RO.; A.K.M Azad, RO.; S.M. Kamal Uddin, RO.

1.8 **Progress**

1.8.1 Previous years, if any: 4700 kg seeds of teak, gamar, pine, telsur and eucalyptus were collected from different seed orchards and distributed. 1,03,000 seedlings were raised for clonal seed orchards of teak, mahogany, gamar, garjan, eucalyptus, akasmoni, dhakijam. 71.0 ha. seedling seed orchard of teli-garjan, dholi-garjan (*Dipterocarpus alatus)*, dhakijam, chapalish, eucalyptus sp, akashmoni and gamar and 45.5 ha clonal seed orchard of teak, gamar, and mahogany were established.

1.8.2 This year :

Activities of the study	Progress
a) Collection of 50 kg. teak seeds and 20 kg. gamar seeds from Kaptai; 10 kg. telsur seeds from Ichamati; 2 kg akasmoni and 5 kg. acacia hybrid seeds from Haynko; 1 kg. eucalyptus seeds from Salna Seed Orchard Centre (SOC)for seedling raising and supply.	50 kg. teak seeds and 20 kg. gamar seeds from Kaptai; 10 kg. telsur seeds from Ichamati; 2 kg akasmoni and 5 kg. acacia hybrid seeds from Haynko; 1 kg. eucalyptus seeds from Salna Seed Orchard Centre (SOCs) were collected.
b) Collection of 185kg seeds from plus trees for plantation at 7 Seed Orchard Centers (SOCs) and distribution to Forest Department (FD), District Nursery Malik Samitee (DNMS) and other tree planters.	185 kg seeds of 23different forest tree species were collected from plus trees and supplied to private planters, DNMS and other private organizations which is shown in Table 1.
c) Raising and maintenance of 7500 seedlings (polybag size 5″ X 7″) for the establishment of 2.0 ha seedling seed orchard (SSO) (viz. agar1000, teligarjan 1000, baittyagarjan 1000, dholigarjan 1000, dhakijam 500, telsur 500, neem500, goda 500, gutguttya500, civit 500, boilam500) and raising 2500 root stock (polybag size12″ X 9″) of teak 1500 teligarjan500 dhakijam500 for the establishment of 3.5 ha clonal seed orchard (CSO) at Kaptai, Hyanko, Ichamati, Dulahazara and Salna SOCs.	7,500 no. seedlings (1,500 seedlings in each centre, viz. agar1000, teligarjan 1000, baittyagarjan 1000, dholigarjan 1000, dhakijam 500, telsur 500, neem500, goda 500, gutguttya500, civit 500, boilam500) were raised at Dulahazara, Hyanko, Salna, Ichamati, and Kaptai SOCs and maintained the seedlings for the establishment of SSO for the next year. Raised 2,500 no. root stocks of teak 1500 teligarjan500 dhakijam500 at Kaptai, Hyanko, Ichamati, Dulahazara and Salna (500 in each centre) SOCs.
d) Preparation of 1250 ramets (teak 500, dhakijam 375 and teligarjan 375) for the establishment of clonal seed orchard at Dulahazara , Hyanko, Ichamati, Kaptai, and Salna SOCs.	1250 no. teak ramets were prepared at Dulahazara (250), Hyankoo (250), Ichamoti(250), Salna(500), & Kaptai (250) SOCs.
e) Establishment of 1.25 ha seedling seed orchard of dholigarjan (0.25 ha), teligarjan (0.25ha), baittyagarjan (0.25ha) dhakijam(0.25ha) and telsur (0.25ha) at Kaptai, Hyanko, Ichamati, Dulahazara and Salna SOCs.	1.25 ha seedling seed orchard were established at Dulahazara(0.25ha), Hayanko (0.25ha), Ichamioti (0.25ha), Kaptai (0.25ha-teak), and Salna (0.25ha) SOCs.

f) Establishment of 1.25ha (teak 1.0 ha, dhakijam0.13ha and teligarjan 0.12ha) clonal seed orchard at Kaptai, Hyanko, Ichamati, Salna and Dulahazara SOCs.	1.25ha clonal seed orchard of teak were established at Kaptai, Ichamoti, Dulahazara Hayanko and Salna SOCs.
g) Maintenance of existing 37.25 ha CSO and SSO at Ichamati, Salna, Hyanko, Kaptai and Dulahazara SOCs.	Existing 37.25 ha CSO and SSO were maintained by weeding at Ichamati, Salna, Hyanko, Kaptai and Dulahazara SOCs.
h) Maintenance by gap filling in previously raised 12ha (SSO 2.5 ha and CSO 9.5 ha) orchard at Dulahazara, Ichamati, Kaptai, Hyanko and Salna SOCs.	Previously raised 12 ha SSO and CSO were maintained by gap filling at Ichamati, Kaptai, Dulahazara ,Salna and Hayanko SOCs.
i) Data collection at Ichamati, Salna, Hyanko, Kaptai and DulahazaraSOCs.	Data on survival % and height growth of teak clonal seed orchard and seedling seed orchard of mixed species at Dulahazara, Hayankoo, Ichamoti and Salna SOCs were recorded. Average height ranges by 0.5 – 0.67m and survival 70% - 95% for clonal seed orchard. On the other hand height ranges by 0.75 – 1.5m and survival 78% - 86% for seedling seed orchard of mixed species which are shown in Table 2&3.

Table-1. List of centrewise collected seeds of different species

Sr.no	Name of species	Scientific name	Ukh	Dul	Kap	Ich	Hya	Sal	Bar	HQ	Total
01	Acacia hybrid	*Acacia aurculiformis x Acacia mangium*	1	2	1	1	2	2	1	-	10
02	Agar	*Aquilaria malaccensis*	-	1	-	-	-	-	1	-	2
03	Akashmoni	*Acacia auriculiformis*	2	-	-	-	2	4	2	-	10
04	Bohera	*Terminalia bellirica*	-	-	1	2	2	-	3	-	8
05	Boilum	*Anisoptera scaphula*	5	-	-	-	-	-	-	-	5
06	Boittyagarjan	*Dipterocarpus costatus*	-	15	-	-	-	-	-	-	15
07	Champa	*Michelia champaca*	-	-	-	2	-	-	-	-	2
08	Chapalish	*Artocarpus chama*	1	-	1	-	-	-	-	-	2
09	Chickrassi	*Chukrasia velutina*	-	-	-	1	1	-	-	-	2
10	Civit	*Swintonia floribunda*	-	-	-	-	-	-	-	5	5
11	Dhali-garjan	*Dipterocarpus alatus*	15	10	-	-	-	-	-	-	25
12	Dhakijam	*Syzygium grandis*	-	30	-	-	-	-	-	-	30
13	Haritaki	*Terminalia chebula*	2	2	2	-	1	-	3		10
14	Kadam	*Anthocephalu s chinensis*	-	-	-	0.5	0.25	-	0.25		1
15	Lohakat	*Xylia kerrii*	-	-	0.5	-	-	-		0.5	1
16	Mangium	*Acacia mangium*	1	-	-	-	-	2	1	-	4
17	Mahogany	*Swietenia macrophylla*	-	2	2	2	2	2	-	-	10
18	Neem	*Azadirachta indica*	-	-	1	1	1			-	3
19	Raintree	*Samanea saman*	1	-	1	1	1	1	-	-	5
20	Silkoroi	*Albizia procera*	-	1	1	-	-	-	-	-	2
21	Teli-garjan	*Dipterocarpus terbinatus*	-	20	-	-	-	-	-	10	30
22	Toon	*Toona ciliata*	-	-	-	0.5	0.5	-	-		1
23	Uriam	*Mangifera sylvatica*	1	-	-	-	-	-	-	1	2
	Total		29	83	10.5	11	12.75	11	11.25	16.5	185

Note: Bar = Barshijura, Dul = Dulahazara, Ukh = Ukhia, Hya= Hyanko, Ich = Ichamati, Kap = Kaptai and Sal = Salna. HQ = Head Quarter

Table- 2. Growth performance of teak clonal seed orchards (2015 – 16) at different SOCs

Name of centers	Average Height(m)	Average Survival %
Dulahazara	0.65	95%
Hayanko	0.67	70%
Salna	0.58	86%
Ichamoti	0.64	95%

Table- 3. Growth performance of seedling seed orchard of mixed species (2015 – 16) at different centers

Name of centers	Average Height(m)	Average Survival %
Dulahazara	0.75	83
Hayanko	1.42	86
Salna	1.50	78
Ichamoti	1.21	82

1.9 **Achievement (s), if any :** At Hyanko, Dulahazara, Ichamati, Salna and Kaptai SOCs, 33.25 ha clonal seed orchard of teak,gamar and mahogany and 26.25 ha seedling seed orchard of garjan, dholigarjan, dhakijam, chapalish, eucalyptus (Eucalyptus camaldulensis, E. tereticornis, E. europhylla), akashmoni and gamar were established and seeds are being collected from teak and gamar seed orchard at Kaptai.

1.10 **Financial statement**   :
1.10.1 Total cost   **:** Tk.   40,00,000.00
1.10.2 Cost of the year   **:** Tk.   6.80,280.00
1.10.3 Expenditure of the year   **:** Tk.   6.80,280.00
1.10.4 Source of fund   **:** GOB.
1.11 **Beneficiaries:** FD, NGOs, other tree planting agencies and private land owners.

2. **Study**   :   On-going
2.1 **Programme Area**   :   Production of quality planting materials
2.2 **Title of the Study**   :   Popularizing quality planting materials (3rd Phase)
2.3 **Justification :** At present awareness on quality planting materials (QPM) is at minimum level amongst the tree planters and nursery owners. It is also true that availability of QPM is also insufficient. Thus, production of QPM using seeds from seed orchards and other improved sources will make access to QPM to the tree planters. Therefore, the study has been undertaken to create awareness about the QPM through the distribution of quality seeds and seedlings as planting materials.
2.4 **Objective(s)**   :
2.4.1 To develop awareness about the importance and benefits of using quality seeds and seedlings.
2.4.2 To increase the quality and quantity of tree production in plantation and homesteads.
2.5 **Expected output :**
   a. Farmers and planters will aware about quality forest tree seeds and planting materials.
   b. Productivity/yield of the plantation will increase.
2.6 **Study Period**   :
2.6.1 Starting year   : 2013-2014 (3rd Phase)
2.6.2 Completion year   : 2015-2016
2.7 **Personnel**   :
2.7.1 Project Leader: **:** Md. Arifur Rahaman, SRO.
2.7.2 Associates   **:** Dr. Hasina Mariam, DO.; Md. Mezan-Ul-Hoque, RO.; A.K.M Azad, RO. ; S.M. Kamal Uddin, RO.

2.8   **Progress**

2.8.1 Previous years, if any: Distributed 13,000 quality seedlings of 13 species.

2.8.2 This year   :

Activities of the study	Progress
a) Raising of 10,000 seedlings of mahogany, hybrid acacia, akashmoni, kadam, telsur, champa, chickrassi, haritaki, amloki, bohera, neem, raintree etc. considering the demands of earlier years at HQ nursery.	10,000 no. seedlings of ten different forest tree species were raised at HQ nursery. Data on seed germination period, germination percentage survival percentage and growth performance of seedlings are shown in Table 1.
b) Production of 3,000 rooted cuttings of hybrid acacia(2500) and agar(500) at HQ nursery for the distribution to different stakeholders.	3,000 no. rooted cuttings of hybrid acacia were produced at HQ nursery and distributed to DNMS and different tree planters.
c) Distribution of seedlings among the farmers, planters and other users.	Collected revenue Tk. 27,777.00 through the distribution of seedlings and seeds among the farmers, planters and other users.
d) Data collection on survival % of raised seedlings at nursery stage.	Survival percentage of 10 different forest tree species were 90% - 95% at nursery stage (Table 1)

Table- 1. Percentage of seed germination and survivability of seedlings of different forest tree species raised at HQ nursery.

Sl. no.	Species	Scientific name	No of seedling (raised)	Survivality (%)
1	Acacia hybrid	*Acacia aurculiformis x Acacia mangium*	1000	95
2	Bohera	*Terminalia bellirica*	1000	95
3	Chickrasi	*Chukrasia velutina*	1000	90
4	Civit	*Swintonia floribunda*	250	95
5	Horitaki	*Terminalia chebula*	200	95
6	Gutguittya	*Protium serratum*	225	95
7	kadam	*Anthocephalus chinensis*	125	80
8	Mehogani	*Swietenia macrophylla*	2600	90
9	Raintree	*Samanea saman*	1000	95
10	Segun	*Tectona grandis*	2700	95
	Total =		10,000	

2.9   **Achievement (s), if any :** Awareness has developed about use of quality seed and seedlings. Quality seeds and seedlings have been used by farmers and increased Forest and homestead plantation .

2.10   **Financial statement**   :
2.10.1 Total cost   : Tk.   1,20,000.00
2.10.2 Cost of the year   : Tk.   42,000.00
2.10.3 Expenditure of the year : Tk.   42,000.00
2.10.4 Source of fund   : GOB.
2.11   **Beneficiaries:** FD, NGOs and other tree planting agencies.

3.   **Study**   : On-going
3.1 **Programme Area**   : Production of quality planting materials
3.2 **Title of the Study** : Testing of seeds before distribution and standardization of storage behaviour
3.3 **Justification :** Forest productivity and quality of plantation greatly depend on genetic quality as well as physiological quality of seeds. Physiological quality of collected seeds determines the germination capacity, vigor and health of the planting materials produced. Therefore, it is necessary to carry out different tests including viability and germination of the collected seeds before they are distributed. Therefore, the study has been undertaken to carry out research on seed germination and seed storage behaviour of important tree species.
3.4 **Objective(s)**   :
3.4.1 To develop a unified system of seed collection, storage, export, import, testing and distribution of forest tree seeds.
3.4.2 To ensure the supply of quality seeds to the planters.
3.4.3 To strengthen the BFRI seed testing laboratory.
3.5 **Expected output :** Seed with better physiological and physical quality will ensure better productivity of the plantation.
3.6 **Study Period**   :
3.6.1 Starting year   : 2012-2013(5th Phase)
3.6.2 Completion year   : 2016-2017
3.7 **Personnel**   :
3.7.1 Project Leader: : Md. Mezan-Ul-Haque, RO.
3.7.2 Associates   : Dr. Hasina Mariam, DO; Md. Arifur Rahaman, SRO; A.K.M Azad, RO.; S.M Kamal Uddin, RO
3.8 **Progress**
3.8.1 Previous years, if any: Storage behaviour of civit and agar and routine testing of the collected seeds were done prior to distribution of seeds.
3.8.2 This year   :

Activities of the study	Progress
a) Data collection on storage behavior of boilam (*Anisoptera scaphula)* seeds.	Observed seed storage behaviour of boilam (*Anisoptera scaphula)* treated in six media, viz.-T_0: control, T_1: sand, T_2: chalk-powder, T_3: normal- refrigerator, T_4: saw-dust and T_5: ash. Seed germination showed better (53.33%) in the storage condition of sand and viability of seeds up to 30 days storage since seed collection (Table 1).
b) . Germination and viability tests of the collected seeds before distribution.	Germination and viability of collected seeds were tested before distribution. Data on germination period and viability were observed. Among them ranges of germination period varied from species to species (6-30days) and viability (40%-90%) were observed. (Table 2).

Table-1. Effects of storage conditions on germination of boilam (*Anisoptera scaphula)*seeds

Treatments	Germination (%) after storage (days)											
	0	3	6	9	12	15	18	21	24	27	30	33
T_0- control	84	80	73.33	66.67	66.67	46.67	46.67	46.67	40	26.67	26.67	-
T_1- sand	84	80	80	80	73.33	73.33	60	60	53.53	53.33	53.33	26.67
T_2 – chalk powder	84	73.33	73.33	60	60	60.0	46.67	46.67	20	20	6.67	-
T_3 – refrigerator	84	53.33	33.33	20	-	-	-	-	-	-	-	-
T_4 – sawdust	84	60	60	60	46.67	40	40	26.63	13.33	13.33	6.67	-
T_5 – ash	84	60	60	60	40	40	40	33.33	13.33	13.33	6.67	-

Table- 2. List of seeds tested before distribution

Sr. no	Species name	Scientific name	Germination period(days)	Viability (%)
01	Acacia hybrid	*Acacia aurculiformis x Acacia mangium*	7-20	70-80
02	Agar	*Aquilaria agallocha*	6-15	60-85
03	Akashmoni	*Acacia auriculiformis*	7-15	70-80
04	Bohera	*Terminalia bellirica*	10-20	55-65
05	Boilum	*Anisoptera scaphula*	7-12	75-85
06	Boittyagarjan	*Dipterocarpus costatus*	7-15	50-60
07	Champa	*Michelia champaca*	18-35	40-50
08	Chapalish	*Artocarpus chama*	10-15	70-80
09	Chickrassi	*Chukrasia velutina*	7-10	50-60
10	Civit	*Swintonia floribunda*	7-10	70-80
11	Dhali-garjan	*Dipterocarpus alatus*	7-10	70-80
12	Dhakijam	*Syzygium grandis*	7-10	70-80
13	Haritaki	*Terminalia chebula*	12-18	40-45
14	Kadam	*Anthocephalus chinensis*	20-25	40-60
15	Lohakat	*Xylia kerrii*	7-10	70-80
16	Mangium	*Acacia mangium*	7-10	65-75
17	Mahogany	*Swietenia macrophylla*	7-10	60-70
18	Neem	*Azadirachta indica*	7-10	70-80
19	Raintree	*Samanea saman*	8-12	80-90
20	Silkoroi	*Albizia procera*	10-30	60-80
21	Teli-garjan	*Dipterocarpus terbinatus*	5-10	70-80
22	Toon	*Toona ciliata*	7-10	50-60
23	Uriam	*Mangifera sylvatica*	15-20	65-75

3.9   **Achievement (s), if any :** Unified systems of seed distribution for akasmoni were developed. Seed storage and testing facilities were developed.

3.10   **Financial statement**   **:**

3.10.1 Total cost   **:** Tk.   1,80,000.00

3.10.2 Cost of the year   **:** Tk.   40,000.00

3.10.3 Expenditure of the year   **:** Tk.   40,000.00

3.10.4 Source of fund   **:** GOB.

3.11   **Beneficiaries:** FD, NGOs, tree planting agencies and private land owners.

4.   **Study**   : On-going

4.1   **Programme Area**   : Breeding and tree improvement

4.2   **Title of the Study**   : Centralization of high yielding clones of rubber (*Hevea brasiliensis*) and establishment of orchard

4.3   **Justification :** Rubber has already emerged as a cash crop in Bangladesh. To become self-sufficient in this important commodity, large scale plantations are to be raised. Its success will greatly depend on adequate research, especially research on the breeding namely-the development of clones suitable for the environment conditions of Bangladesh. That's why; priority has to be given for establishing rubber orchard through centralization of high yielding clones of rubber for breeding research in rubber.

4.4   **Objective(s)**   :

4.4.1 To increase the productivity of latex by selecting better yielding rubber plant/ clone.

4.4.2 Centralization of high yielding clones in hedge orchard.

4.5   **Expected output :** Latex production of rubber plant will be increased.

4.6   **Study Period**   **:**

4.6.1 Starting year   **:** 2013-2014(2nd Phase)

4.6.2 Completion year   **:** 2017-2018

3.7   **Personnel**   **:**

4.7.1 Project Leader: **:** Md. Kamaluddin, RO.

4.7.2 Associates   **:** Dr. Hasina Mariam, DO; Md. ArifurRahaman, SRO; Md.Mezan-Ul-Haque,RO; A.K.M Azad, RO.

4.8   **Progress**

4.8.1 Previous years, if any: One hundred twenty trees were selected at Datmara Rubber estate, 20000 root stocks were raised to produce ramets by using selected clones. Raised 2.5 ha clonal trial plots at Datmara rubber estate from 32 selected trees.

4.8.2 This year   **:**

Activities of the study	Progress
a) Seed collection and raising of 3000 at Hayanko SOC seedlings.	a. Rubber seeds were collected and raised 3000 no. seedlings at Hayanko.
b) Preparation of 1500 rubber ramets at Hayanko SOC	b. Prepared 1500 nos. of rubber ramets at Hyanko SOC
c) Maintenance of previously raised 5.75 ha rubber plantation (3 times) at Dantmara Rubber Estate, Hyanko.	Maintained 5.75 ha previously raised rubber plantation by weeding and fertilizing at Dantmara Rubber Estate, Hyankoo SOC.
d) Data collection.	Growth data of 2014- 15 and 2015 -16 plantation year were collected. Data showed that average height and gbh were 3.6 -5.5m and 27.9-42.96cm (Table-1)

Table1. Growth performance of rubber plantation at Hayankoo seed orchard centere .

Plantion year	Plantion area(ha.)	Average GBH(cm)	Average Height(m)	Average Survival %
2014- 15	2.5	38.26	5.32	96%
2015 - 16	1.2	27.90	3.6	95%

4.9   **Achievement (s), if any :** A clonal trial of 32 clones were established by Hayanko SOC at Dantmara rubber estate, Fatickchari, Chittagong.

4.10   **Financial statement**   **:**

4.10.1 Total cost   **:** Tk. 21,00,000.00

4.10.2 Cost of the year   **:** Tk. 4,37,720.00

4.10.3 Expenditure of the year   **:** Tk. 4,37,720.00

4.10.4 Source of fund   **:** GOB.

4.11   **Beneficiaries:** BFIDC and private entrepreneurs.

5.   **Study**   : New

5.1   **Programme Area**   : Production of quality planting materials

5.2   **Title of the Study**   : Assessment of seed production capacity of dhakijam, gamar and jarul species

5.3   **Justification :** Quality seed is a prerequisite for the success and optimum production of a plantation. Growth and yield of a plantation significantly be improved through using the physical, physiological and genetically improved fruits and seeds. Since the plantation forests are increasing recently, the gap between demand and supply of quality seeds is very important for manmade forests in the country. Foresters and private planters are interested for quality planting materials but unfortunately the source and production of quality seeds in Bangladesh is not adequate to meet the

demand. Whereas, importing quality seeds from abroad are very expensive and troublesome. So, in response to demand for quality seeds, Seed Orchard Division of Bangladesh Forest Research Institute (BFRI) have select some plus trees (PT) and also established seedling seed orchard (SSO), clonal seed orchard (CSO) and seed production areas (SPAs) of commonly planted forest tree species. In addition, public and private organizations raising plantations throughout the country shall be able to select the seed trees from their plantations. However, it is essential to assess the seed production age, time and capability of individual trees of selected forest tree species.

Therefore, the study has been undertaken to carry out research on reproductive age, fruit/seed production capacity and germination percentage of dhakijam, gamar and jarul forest tree species .

5.4 **Objective(s)** :

5.4.1 To determine the capacity of seed production of an individual tree.

5.4.2 To find out the peak period of seed collection of a species.

5.5 **Expected output :** Information about the seed production capacity of an individual tree of selected (three)forest tree species will be available which will be helpful for seedling raising and sucessful tree plantation.

5.6 **Study Period** :

5.6.1 Starting year : 2016-2017

5.6.2 Completion year : 2018-2019

5.7 **Personnel** :

5.7.1 Project Leader: : Md. Mezan-Ul-Haque, RO.

5.7.2 Associates : Dr. Hasina Mariam,DO; Md. Arifur Rahaman, SRO; A.K.M Azad, RO; S M Kamal Uddin, RO

5.8 **Progress**

5.8.1 Previous years, if any: New

5.8.2 This year :

Activities of the study	Progress
a) Selection of seed trees .	64 seed trees of dhakijam (Hayanko -32,Dulahazra -32), 40 seed trees of gamar (Ichamoti) and 60 seed trees of jarul (Ichamoti - 30, Salna - 30) were selected .
b) Seed collection.	Seeds were collected from selected dhakijam and gamar seed trees on the basis of girth (G) and crown dia (C) and weighed of collected seeds. ➢ The average weight of dhakijam seeds were found 20.16 kg and 19.38kg per tree at Hayanko and Dulahazra (Table-1) . ➢ The average weight of gamar seeds were found 9.93 kg per tree at Ichamoti (Table 2) .
c) Germination test of collected seeds.	Germination test of dhakijam and gamar seeds are going on.

**Table- 1. Seed production capacity of dhakijam (*Syzygium grandis)*

Location	G_1(gbh < 125cm)		G_2(gbh >125cm)		Mean weight
	C_1 (crown dia <8.5m)	C_2 (crown dia>8.5m)	C_1 (crown dia <8.5m)	C_2 (crown dia >8.5m)	
Hayanko	11.5	13.5	19.6	36.0	20.16
Dulahazra	16.69	17.67	19.94	23.19	19.36

Table- 2. Seed production capacity of gamar (*Gmelina arborea*)

ocation	G$_1$(gbh < 45cm)		G$_2$(gbh >45cm)		Mean weight
	C$_1$ (crown dia <5.5m)	C$_2$ (crown dia>8.5m)	C$_1$ (crown dia <5.5m)	C$_2$ (crown dia >8.5m)	
Ichamoti	4.8	7.5	10.8	16.6	9.93

5.9   **Achievement (s), if any :** A total of 1.07 ha bamboo and rattan plantation have been raised inside older keora forests.

5.10   **Financial statement**   :
5.10.1 Total cost   : Tk.   1100,000.00
5.10.2 Cost of the year   : Tk.   3,00,000.00
5.10.3 Expenditure of the year : Tk.   3,00,000.00
5.10.4 Source of fund   : GOB.
5.11   **Beneficiaries**   : FD, NGOs, tree planting agencies and private land owners.
         .

SILVICULTURE GENETICS DIVISION

1.   **Study**   : On-going
1.1   **Programme Area**   : **:** Bamboo and Non-Timber Economic Crops
1.2   **Title of the Study** : Mass propagation of bamboos (*Dendrocalamus giganteus, D. longispathus, Bambusa balcooa, B. vulgaris, B. bambos, B. cacharensis, B. multiplex, B. tulda, B. jaintica,* and *D. brandisii*) through branch cuttings and seedlings proliferation (3rd Phase)
1.3   **Justification :** NA
1.4   **Objective(s)**   :
1.4.1 To make available bamboo propagules for wide distribution and dissemination with developed technology.
1.4.2 To develop linkage with different stakeholders.
1.5   **Expected output :** Increased bamboo cultivation and production.
1.6   **Study Period**   :
1.6.1 Starting year   : 2014-2015
1.6.2 Completion year   : 2019-2020
1.7   **Personnel**   :
1.7.1 Project Leader: : Dr. Md. Mahbubur Rahman, DO
1.7.2 Associates   **:** Nusrat Sultana, SRO; Dr. Waheeda Parvin, Curator; Saiful Alam Md. Tareq, FI.
1.8   **Progress**
1.8.1 Previous years, if any: Raised forty four thousand (44,000) propagules of ten demanding bamboo species (*Dendrocalamus giganteus, D. longispathus, Bambusa balcooa, B. vulgaris, B. bambos, B. cacharensis, B. multiplex, B. tulda, B. jaintiana,* and *D. brandisii*) and distributed to the different stakeholder.

1.8.2 This year   :

Activities of the study	Progress
a) Collection of planting materials of selected species.	Surveyed different parts of Bangladesh Sylhet, Mymensingh, Chittagong Hill Tracts and Jessore for bamboo branch / seed collection of selected species.
b) Production of 10,000 bamboo propagules	Produced 10,000 propagules of ten bamboo species. Five thousand bamboo propagules were raised from branch cuttings and five thousand through seedling proliferation. Four thousand and four hundred eighty

	two (4,482) bamboo propagules were distributed among the stakeholders from July 2016 to April 2017 (Fig. 1, Table 1).
c) Data collection on survival rate of cuttings.	Survival range of cuttings varies from 40 – 90% based on species.
d) Preparation of report.	Hormonal treatment (IBA & NAA) influenced the rooting percentage of branch cutting.
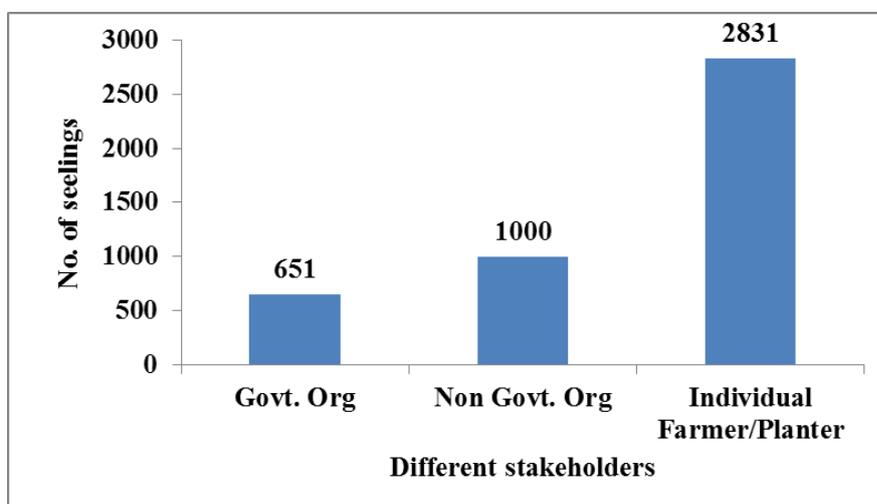
Figure 1. Bamboo seedlings distribution trends among different stakeholders.

Table1. **Seedlings are available of bamboo species at nursery**

Sl. No.	Local name	Scientific name
1	Borak	*Bambusa balcooa*
2	Tetua	*Bambusa jaintiana*
3	Farua	*Bambusa polymorpha*
4	Bajja	*Bambusa vulgaris*
5	Sorna	*Bambusa vulgaris var striata*
6	Ghoti	*Bambusa ventricosa*
7	Brandisi	*Dendrocalamus brandisii*
8	Bhudum	*Dendrocalamus giganteus*
9	Ora	*Dendrocalamus longispathus*
10	China	*Dendrocalamus latiflorus*
11	Rangoon	*Thyrsostachys oliveri*
12	Hedge	*Bambusa sp.*

1.9   **Achievement (s), if any :** People's awareness increased for bamboo cultivation through planting branch cuttings propagules.

1.10   **Financial statement   :**
1.10.1 Total cost   **:** Tk.   10,00,000.00
1.10.2 Cost of the year   **:** Tk.   2.00,000.00
1.10.3 Expenditure of the year   **:** Tk.   2.00,000.00
1.10.4 Source of fund   **:** GOB.
1.11   **Beneficiaries:** BFRI, FD, NGO's, Universities

2. **Study** : On-going

2.1 **Programme Area** : Bio-diversity and Conservation

2.2 **Title of the Study** : Conservation of threatened plant species through domestication.

2.3 **Justification : NA**

2.4 **Objective(s)** :

2.4.1 To conserve and centralize the gene resource of threatened forest plant species.

2.4.2 To domesticate the threatened species for conservation.

2.4.3 To raise demonstration and resource plots for conservation purpose.

2.5 **Expected output :** Establishment of conservation plots of different threatened species as genetic resources for future research.

2.6 **Study Period** :

2.6.1 Starting year : 2014-2015

2.6.2 Completion year : 2019-2020

2.7 **Personnel** :

2.7.1 Project Leader: : Dr. Md. Mahbubur Rahman, DO

2.7.2 Associates : Nusrat Sultana, SRO; Dr. Waheeda Parvin, Curator; Saiful Alam Md. Tareq, FI.

2.8 **Progress**

2.8.1 Previous years, if any (2010-2016): Raised twenty eight thousand (28,000) seedlings of 22 threatened forest tree species for the establishment of conservation plots.

2.8.2 This year :

Activities of the study	Progress
a) Collection of seeds and seedlings of seven threatened forest tree species	Seeds of eight threatened tree species such as titpai (*Millettia plguensis*), nima (*Knema bengalensis*), asok (*Saraca asoca*), karanja (*Pongamia pinnata)*, batna (*Castanopsis indica*), udal, (*Sterculia villosa*), civit (*Swintonia floribunda*), and raktan (*Lophopetalum fimbriatum)* were collected and seedling raised in nursery (Table 2).
b) Raising of five thousands seedlings of selected species and maintenance of seedlings in the nursery.	Raised 5,000 seedlings of collected species in polybag.
c) Maintaining two acre plantation of 22 threatened species in IFESCU campus.	Maintained and data collected. Average plant height and diameter were recorded (Fig. 2).
d) Raising two acre new plantation.	Two acre new plantation of eighteen threatened species were raised at Radar unit of Bangladesh Air Force, Cox's Bazar.
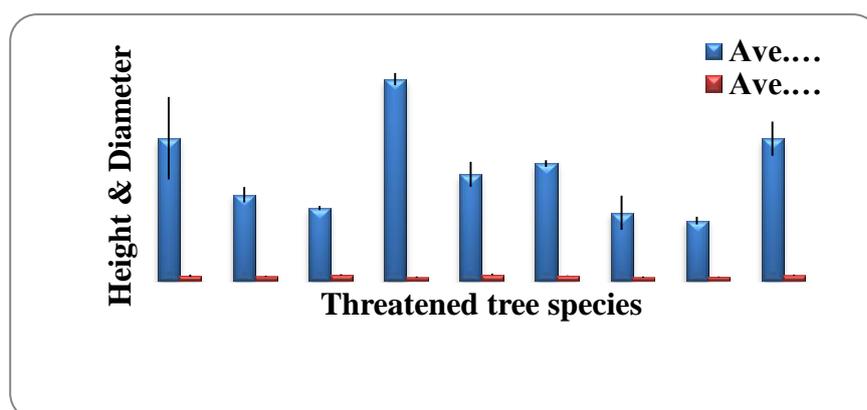
Figure- 2. Growth performance of different plant species at CU campus

Table- 2. List of threatened plant species are available in nursery.

Sl . No.	Local name	Scientific name
01	Asok	*Saraca asoca*
02	Dharmara	*Stereospermum personatum*
03	Horitoki	*Terminalia chebula*
04	Buddhu narkili	*Pterygota alata*
05	Voikodom	*Hymenodictyon orixense*
06	Chalmugra	*Hydnocarpus kurzii*
07	Titpai	*Millettia peguensis*
08	Patagota	*Firmiana colorata*
09	Tamal	*Diospoyros montana*
10	Boxbadam	*Sterculia foetida*
11	Karanja	*Pongamia Pinnata*
12	Kuchila	*Strychnos nux-vomica*
13	Udal	*Sterculia villosa*
14	Gutguttya	*Protium serratum*
15	Batna	*Castanopsis indica*
16	Nima	*Knema bengalensis*
17	Civit	*Swintonia floribunda*
18	Raktan	*Lophopetalum fimbriatum*

2.9   **Achievement (s), if any :** Raised 4 acre of conservation plots of 22 threatened forest tree species at IFESCU campus of Chittagong University and Radar unit of Bangladesh Air Force, Cox's Bazar.

2.10   **Financial statement   :**

2.10.1 Total cost   : Tk.   6,50,000.00
2.10.2 Cost of the year   : Tk.   64,470.00
2.10.3 Expenditure of the year   : Tk.   64,470.00
2.10.4 Source of fund   : GOB.

2.11   **Beneficiaries:** BFRI, FD, NGO's, Universities

3.   **Study**   : On-going
3.1   **Programme Area**   : Breeding and Tree Improvement
3.2   **Title of the Study**   : Development of tissue culture techniques for different bamboo species viz., farua (*Bambusa polymorpha*), bhudum (*Dendrocalamus giganteus*), china bamboo (*D. latiflorus),* wappi (*Thyrsostachys sp.)* and pencha (*D. hamiltonii*) (2nd Phase)

3.3   **Justification : NA**
3.4   **Objective(s)   :**
3.4.1   To develop micro-propagation techniques for the bamboo species.
3.4.2   To produce a homogenous plant population.
3.4.3   To conserve i*n vitro* plants.
3.5   **Expected output :** Production of large number of quality planting stocks through tissue culture technique.
3.6   **Study Period   :**
3.6.1   Starting year   : 2014-2015
3.6.2   Completion year   : 2019-2020

3.7 **Personnel** :
3.7.1 Project Leader: : Dr. Waheeda Parvin, Curator
3.7.2 Associates : Dr. Md. Mahbubur Rahman, DO; Nusrat Sultana, SRO; Saiful Alam Md. Tareq, FI.
3.8 **Progress**
3.8.1 Previous years, if any (2010-2016) : Culture establishment and multiple shoot production of farua (*Bambusa polymorpa*), bhudum (*Dendrocalamus giganteus*), dolu *(Schizostachyum dullooa)*, membra *(D. membranaceus,)*, ora *(D . longispathus)*, (*D. latiflorus*), wappi (*Thyrsostachys sp.*) and pencha (*D. hamiltonii*) bamboos were done successfully. Rooted plantlets produced of *D. giganteus, D. brandisii*, and *B. balcooa* and hardened in soil.
3.8.2 This year :

Activities of the study	Progress
a) Explants collection	Explants (nodal bud) of farua (*Bambusa polymorpa),* bhudum (*Dendrocalamus giganteus),* wappi *(Thyrsostachys sp.)* china (*D. latiflorus),* and pancha (*D. hamiltoni)* bamboo were collected from Khagrachari, Sylhet, Teknaf and BFRI bambusetum.
b) Culture establishment and multiple shoot production	The optimization of multiple shoot production was carried out of five bamboo species in MS media (solid & liquid) supplemented with different concentrations of BAP (6-benzyl amino purine) alone and KIN (6-furfuryl amino purine). Among the different concentrations of BAP, 3 mg/L in MS solid and liquid medium produced maximum shoots after 28days of culture. BAP performed better in both medium than KIN to produce multiple shoots. Different sucrose level in culture medium and interval of sub-culture influenced the multiple shoot production (Fig. 3,4,5, & 6).
c) Root induction and maintenance of the plantlets	Different experiments were carried out for optimization of root induction from induced multiple shoots. Different concentrations of IBA (Indole-3 Butyric Acid) were supplemented with half strength MS medium (Fig. 7)
d) Transfer of the plantlets into soil for hardening	Rooted plantlets of *D. giganteus,* and *D. brandisii* were transferred into soil for hardening.
e) One thousand tissue culture bamboo seedlings will be produced	Produced tissue culture plantlets of *D giganteus* and *D. brandisii*.
f) Raising 1.0 acre new bamboo demonstration plot with tissue culture plant lets	A demonstration plot with tissue culture plantlets was raised at Radar unit of Bangladesh Air Force, Cox's Bazar.
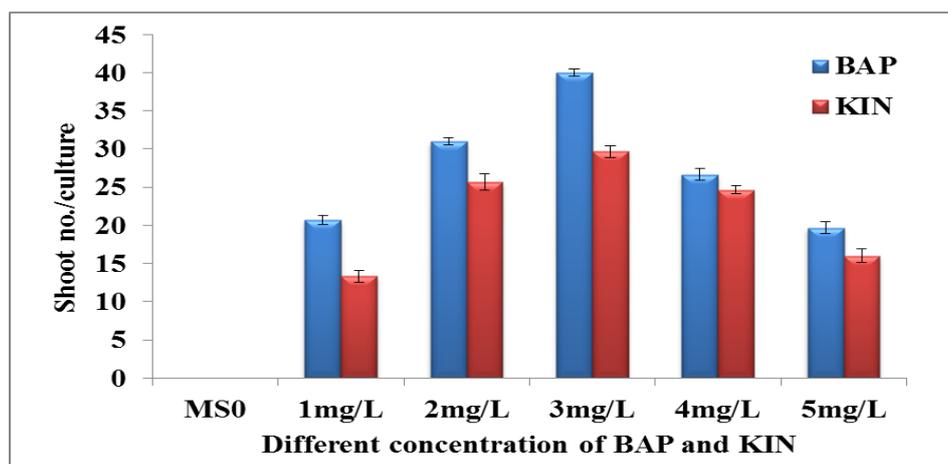
Figure- 3. Effect of MS Medium supplemented with different concentrations of BAP and KIN on multiple shoot formation
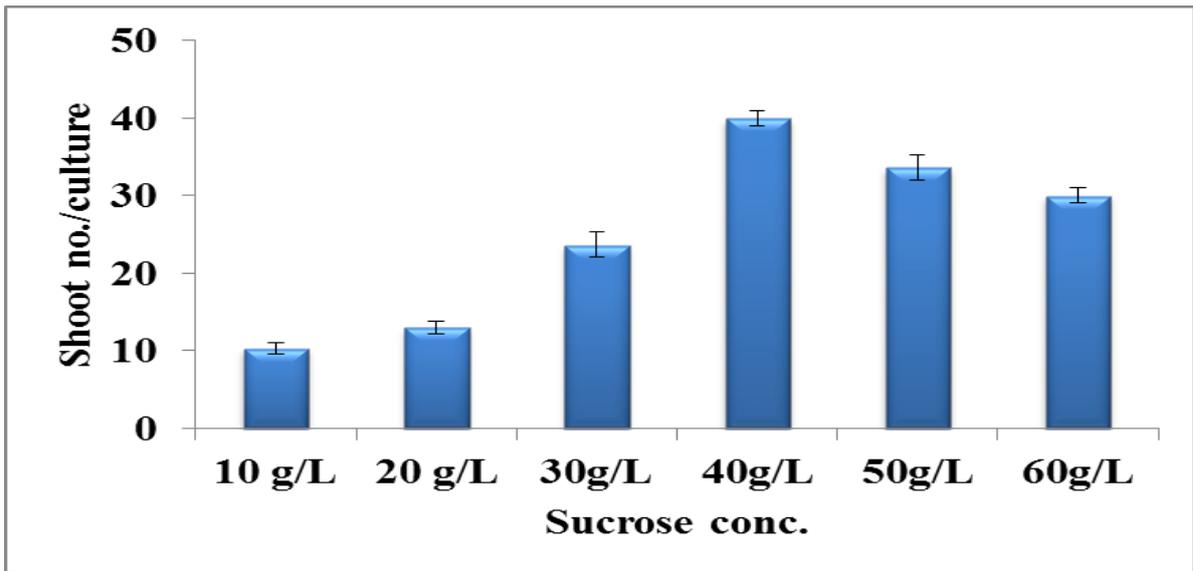
Figure- 4. Effect of different strength of sucrose on multiple shoot formation.
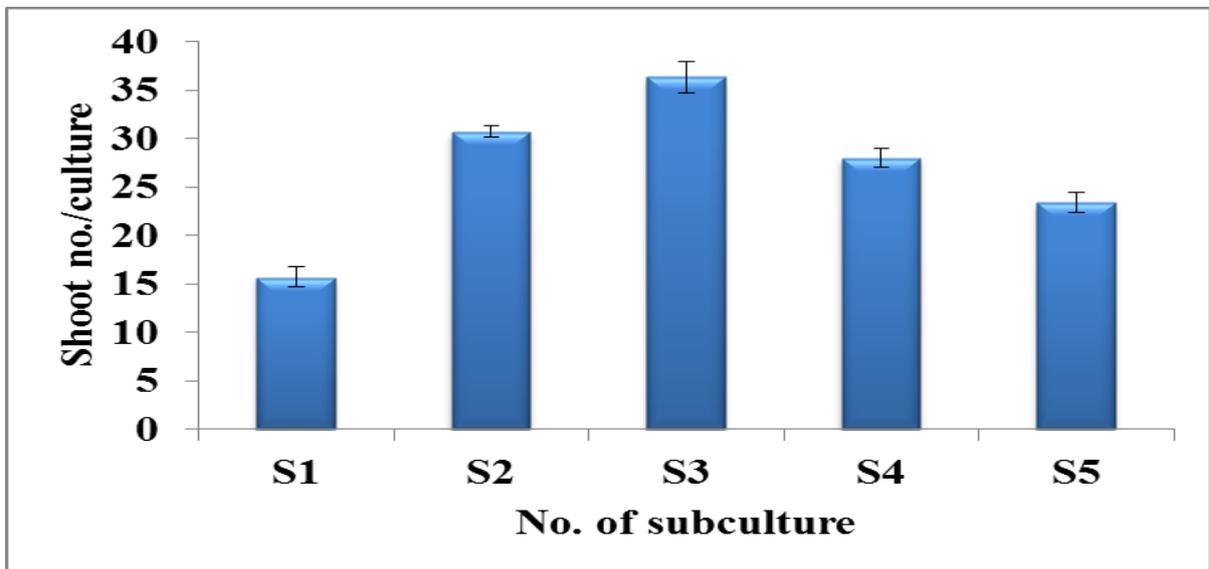

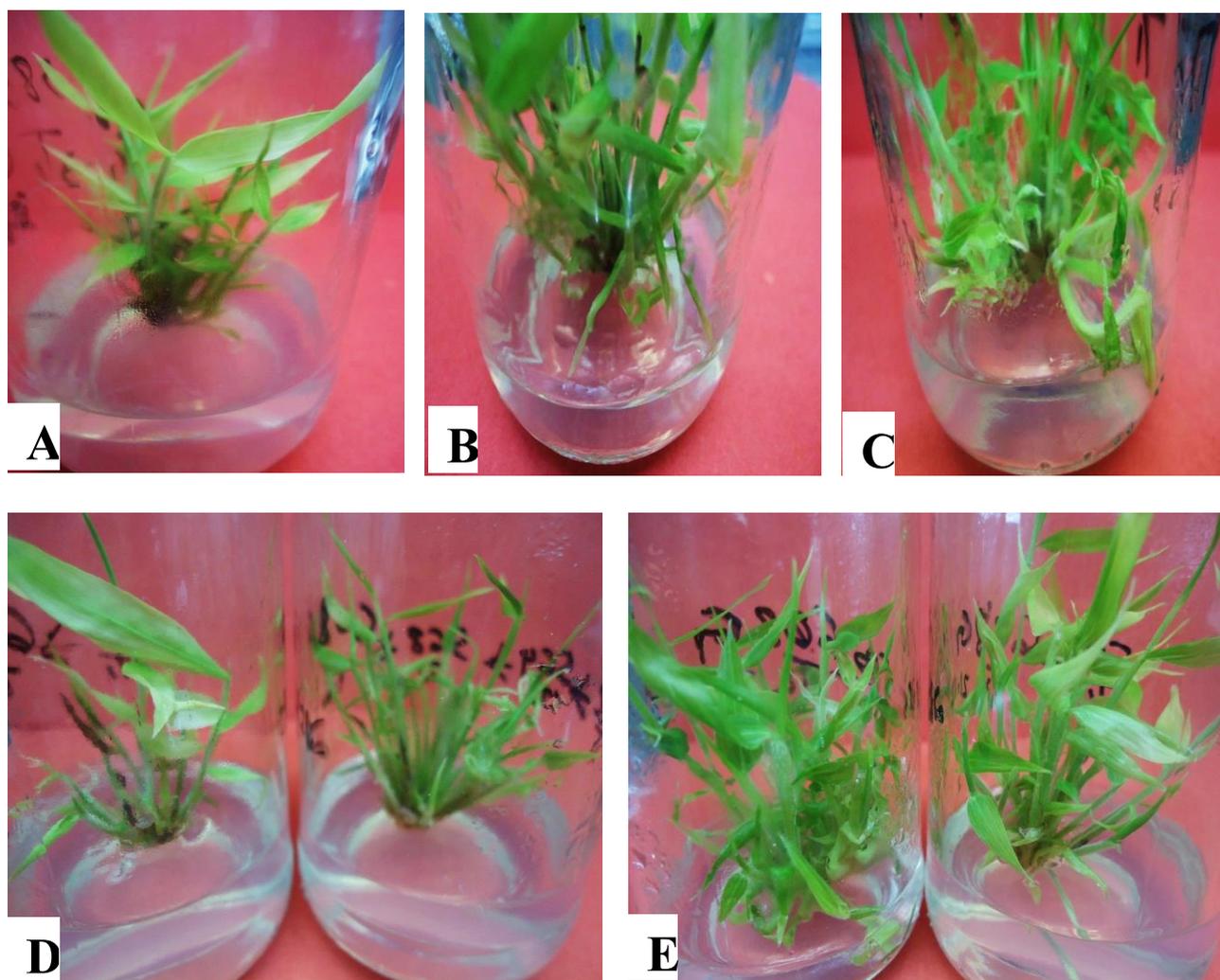Figure- 5. Effect of subcultures on multiple shoot formation

Figure 6. Optimization of multiple shoot production of Bhudum bamboo (A - E)
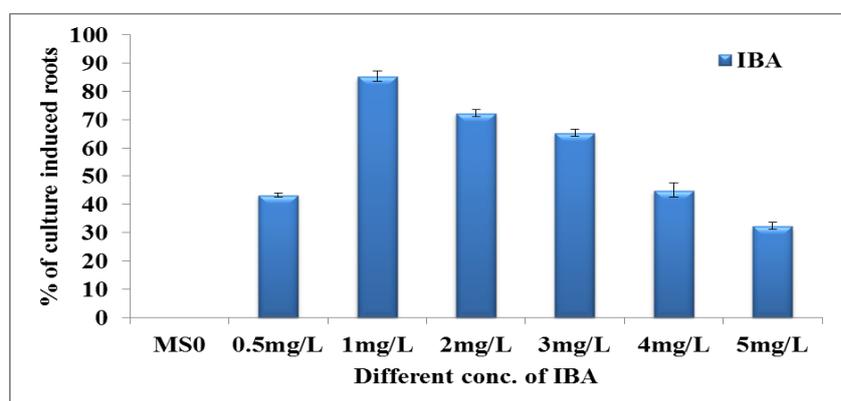

Figure 7. Effect of different concentrations of IBA on root formation.

3.9 **Achievement (s), if any :** Tissue culture protocols of bhudum bamboo was developed.
3.10 Financial statement :
3.10.1 Total cost : Tk. 15,80,000.00
3.10.2 Cost of the year : Tk. 95,280.00
3.10.3 Expenditure of the year : Tk. 95,280.00
3.10.4 Source of fund : GOB.
3.11 **Beneficiaries:** BFRI, FD, NGO's, Universities.

4.   **Study**   : On-going

4.1   **Programme Area**   : Breeding and tree improvement

4.2   **Title of the Study** : Development of tissue culture techniques for 1) Timber trees: boilam (*Anisoptera scaphula*), tamal (*Diospyros montana*), and agar (*Aquilaria malaccensis*) 2) Medicinal plant: Diabetic plant (*Gynura procumbens*) and 3) Fruit tree: lotkon (*Baccaurea sapida*)

4.3   **Justification : NA**

4.4   **Objective(s)   :**

4.4.1 To develop micro-propagation techniques for the species.

4.4.2 To produce a homogenous plant population.

4.4.3 To conserve i*n vitro* plants.

4.5   **Expected output :** Production of large number of quality planting stocks through tissue culture technique.

4.6   **Study Period**   :

4.6.1 Starting year   : 2014-2015

4.6.2 Completion year   : 2019-2020

3.7   **Personnel**   :

4.7.1 Project Leader: : Nusrat Sultana, SRO

4.7.2 Associates   : Dr. Md. Mahbubur Rahman, DO; Dr. Waheeda Parvin, Curator; Saiful Alam Md. Tareq, FI.

4.8   **Progress**

4.8.1 Previous years, if any (2012-16) : Direct and indirect regeneration of amloki was achieved from cotyledon derived callus and shoot tip culture.

4.8.2 This year   :

Activities of the study	Progress
a) Explants collection	Explants of selected species collected from Srimongal, Sylhet, Ukhia and different areas of Chittagong.
b) Establishment of culture and production of multiple shoots	Culture established and shoot produced of agar, tamal, boilam and diabetic plant. Optimization of shoot production of diabetic plant was done in MS medium supplemented with different concentrations of BAP. Maximum shoot produced in 1.0 mg/mL BAP supplemented in MS medium after 28 days of culture (Table 3, Fig.8).
c) Root induction and maintenance of the plant lets.	Excised shoots of diabetic plant were inserted in root inducing media.
d) Transfer of the plantlets into soil for hardening.	Rooted plantlets of diabetic plant were transferred to soil and hardened.
e) One thousand tissue culture seedlings will be produced	Produced tissue culture plantlets of diabetic plant.

Table 3. Effect of different concentrations of BAP supplemented with MS medium on shoot multiplication of diabetic plant.

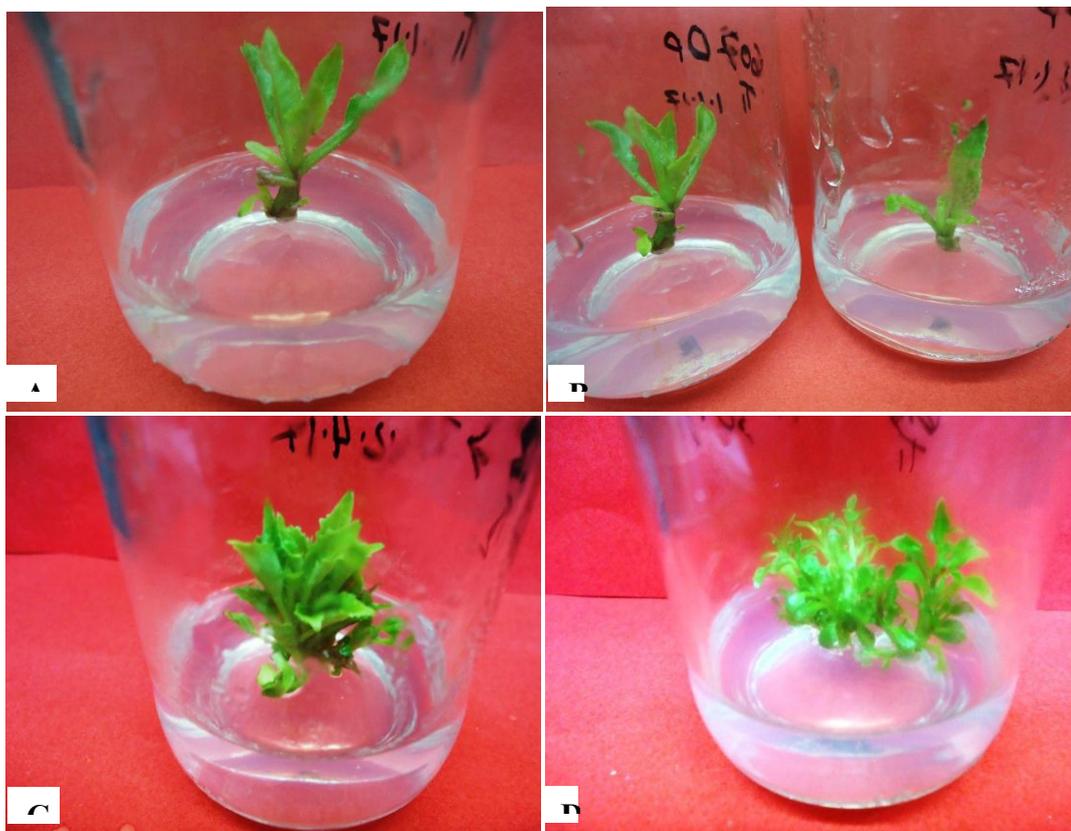| Hormone in shoot inducing medium mg/L	% of culture produced shoot after 15 days	Maximum shoot no. / culture after 15 days	Maximum shoot no. / culture after 28 days
MS + 0.5 mg/L BAP	40	6	10
MS + 1.0 mg/L BAP	60	12	15
MS + 2.0 mg/L BAP	70	10	10
MS + 3.0 mg/L BAP	50	9	10

Figure- 8: Optimization of shoot production of Diabetic plant in MS medium.

4.9 **Achievement (s), if any :** Tissue culture protocol of amloki was developed.
4.10 Financial statement :
4.10.1 Total cost : Tk. 6,00,000.00
4.10.2 Cost of the year : Tk. 89,790.00
4.10.3 Expenditure of the year : Tk. 89,790.00
4.10.4 Source of fund : GOB.
4.11 **Beneficiaries:** BFRI, FD, NGO's, Universities

5. **Study** : New
5.1 **Programme Area** : Breeding and Tree Improvement
5.2 **Title of the Study** : Development of improved protocols for *in vitro* plant regeneration of selected rubber (*Hevea brasiliensis*). clones.
5.3 **Justification : NA**
5.4 **Objective(s)** :
5.4.1 To establish embryogenic callus culture and plant regeneration protocol via somatic embryogenesis from potential explants of *H. brasiliensis*.

5.4.2 To evaluate the *in vitro* micro-propagation capacity of somatic embryo derived plants.

5.4.3 To produce a homogenous plant population of selected rubber clone.

5.5 **Expected output :** Production of large number of quality planting stocks through tissue culture technique of selected rubber clones.

5.6 **Study Period** :
5.6.1 Starting year : 2016-2017
5.6.2 Completion year : 2019-2020

5.7 **Personnel** :
5.7.1 Project Leader: : Dr. Md. Mahbubur Rahman, DO
5.7.2 Associates : Nusrat Sultana, SRO; Dr. Waheeda Parvin, Curator; Saiful Alam Md. Tareq, FI.
5.8 **Progress**
5.8.1 Previous years, if any: New
5.8.2 This year :

Activities of the study	Progress
a) Selection of high yield latex producing mother trees.	Selected rubber trees at Srimongal and Madhupur rubber garden of BFIDC.
b) Explant collection and culture establishment	Explant collected from Satgao rubber garden of Srimongal.
c) Primary callus induction from different explants	Induced primary callus from cotyledon explants in MS medium supplemented with different concentrations of 2,4 D. Callus initiated in 0.5 mg/mL 2.4 D after 28 days of culture (Fig. 9).
d) Establishment of embryogenic callus culture and plant regeneration	Callus tissues have been maintaining for proliferation and optimization of its growth.
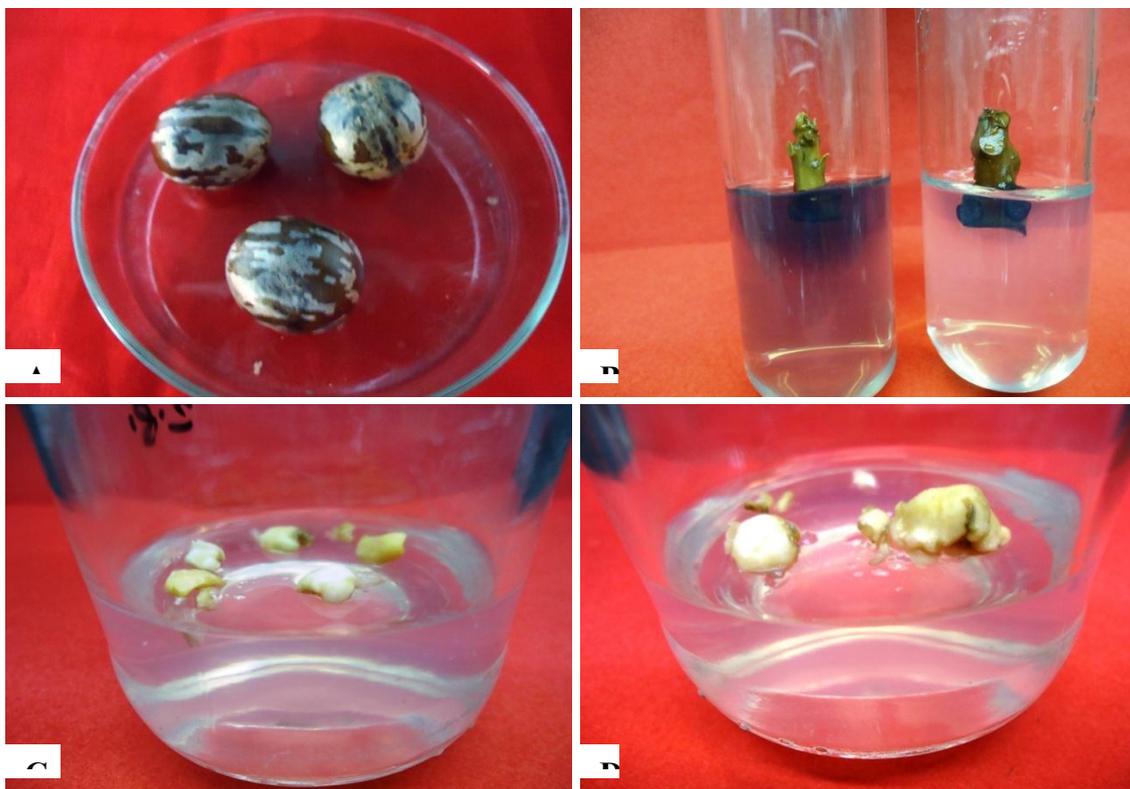
Figure- 9. Culture establishment for direct and indirect regeneration (A-D)

5.9 **Achievement (s), if any :** A total of 1.07 ha bamboo and rattan plantation have been raised inside older keora forests.
5.10 **Financial statement** :
5.10.1 Total cost : Tk. 15,00,000.00
5.10.2 Cost of the year : Tk. 3,75,000.00
5.10.3 Expenditure of the year : Tk. 3,75,000.00
5.10.4 Source of fund : GOB.
5.11 **Beneficiaries: :** BFRI, FD, NGO's, Universities

SILVICULTURE RESEARCH DIVISION

1.   **Study**   : On-going
1.1   **Programme Area**   : Breeding and Tree Improvement
1.2   **Title of the Study** : Growth performance of different forest tree species in research plots
1.3   **Justification :** Since 1985 experimental plantations (elimination trial, species / provenances trial, spacing trial, growth trial, pilot plantations, etc.) with different local and exotic species have been raised at four Silviculture Research Stations. These experimental plantations require cultural operations and Silviculture treatments at different stages of tree growth. With a view to maintain sound and healthy tree in the older experimental plots and to collect data the experiment as been undertaken.
1.4   **Objective(s)**   :
1.4.1 To assess the growth performance of different tree species in four agro-ecological regions of the country.
1.4.2 To determine the silvics of different forest tree species.
1.4.3 To develop quality seed sources.
1.5   **Expected output :** Site suitable species and provenances for plantation development will be selected for different site quality index in different agro-ecological regions of Bangladesh. Silvicultural techniques (spacing, weeding, fertilization, pruning, thinning and coppicing) for plantation management will be developed for maximizing yield of the plantation.
1.6   **Study Period**   :
1.6.1 Starting year   : 2015-2016 (4th Phase)
1.6.2 Completion year   : 2019-2020
1.7   **Personnel**   :
1.7.1 Project Leader: : Nasrat Begum, DFO,
1.7.2 Associates   : Abdullah- Al- Masud Mazumder, RO and M. R. Islam, FI.
1.8   **Progress**
1.8.1 Previous years, if any: Up to Dec. **2016,** around 15**0** ha experimental plantations (oil palm, agar, sal, muli bamboo, ex-situ conservation plots, species elimination trials; provenance trials, coppicing trials, spacing trials, mixed planting trials, under planting trials, planting technique, arboretum of 46 species, etc.) were raised at four Silviculture Research Stations. Those plantations were maintained by weeding, cleaning, climber cutting, pruning, etc. Biomass of three eucalyptus species viz. *Eucalyptus camaldulensis*, *E. tereticornis* and *E. brassiana* (3rd rotation) was assessed at Charkai SR Station. Phenological data of 240 indigenous and exotic tree species were compiled.
1.8.2 This year   :

Activities of the study	Progress
a) Maintenance of 58.0 ha experimental plantations (ex-situ conservation plots, species elimination and site suitability trial, provenance trial, mixed species trial plantations, bamboo plantations, etc.) raised up to 2014 at Keochia, Lawachara, Charaljani and Charkai SR stations.	Maintained 58.0ha previously raised experimental plantations (Oil palm, Agar and Sal plantations, etc.) by weeding at Keochia, Lawachara, Charaljani and Charkai SR stations.
b) Collection of data on survival, height, diameter at breast height, total biomass, coppicing ability etc.	Collected survival and height growth data of older plantations Table 1,2,& 3.

1.9   **Achievement (s), if any** : Determined phenological characteristics of 240 indigenous and exotic species, selected site specific species/ provenance for large scale plantation (15 fast-growing species, 21 medium rotation species, 17 long rotation species, 4 provenance of *A. auriculiformis*, 6 provenance of *Acacia mangium*, 3 provenance of *Pinus caribaea*, 3

provenance of *P. oocarpa*, 4 provenance of *Glericidia sepium*, 3, 2, 2, 2 provenance of *Eucalyptus camaldulensis, E. brassiana, E. tereticornis, E. urophylla* respectively), established plantations of 70 indigenous and exotic tree species. Assessed biomass of three eucalyptus species viz. *Eucalyptus camaldulensis, E. tereticornis* and *E. brassiana* (3rd rotation) at Charkai SR Station.

Table- 1. Survival and height growth performance of sal (*Shorea robusta*) planted with different planting materials Charkai SRS.

Year of planting	Treatment	Survival (%)	Height growth (cm)	Collar dia (mm)
June 2014	Seed	93	157.37	3.64
	Seedling	90	216.67	4.2
	Stump	91	163.06	-
June 2015	Seed	91	152.72	2.5
	Seedling	92	155.44	3..27
	Stump	91	70.55	-

Table-4. Survival and height growth of agar (*Aquilaria malaccensis*) with different spacing at Keochia, Charkai and Charaljani Research Stations at age of 6 month.

Planting year	Locations	Spacing (m)	Survival (%)	Height (m)	Collar dia (cm)
June,2011 6 years	Keochia Plain foot hill	1.5m x1.5m	57	4.37	6.04
		2.0m x 2.0m	60	4.53	6.90
		2.5m x2.5m	63	4.5	6.93
		3.0m x3.0m	65	5.14	7.57
June,2013 3years	Hill slope with hard soil	1.5m x 1.5m	46	1.68	2.24
		2.0m x 2.0m	41	1.75	2.23
		2.5m x2.5m	32	1.44	1.82
		3.0m x 3.0m	39	1.65	2.08
June,2014 3years	Keochia Plain foot hill	1.5m x 1.5m	55	1.57	2.03
		2.0m x 2.0m	63	1.62	2.28
		2.5m x2.5m	57	1.48	1.95
		3.0m x 3.0m	42	1.48	2.00
June,2014	Charaljani	1.5m x 1.5m	11	2.99	6.09
		2.0m x 2.0m	18	2.56	5.27
		2.5m x 2.5m	16	2.52	6.75
		3.0m x3.0m	9	2.75	7.68
June,2014		1.5m x 1.5m	64	2.40	7.33
		2.0m x 2.0m	63	2.59	7.46
		2.5m x2.5m	63	2.39	7.46
		3.0m x 3.0m	67	2.42	7.41
June,2014l	Charkai Plain Land	1.5m x1.5m	91	1.46	3.78
		2.0m x2.0m	91	1.51	4.09
		2.5mx2.5m	92	1.48	3.8
		3.0m x3.0m	89	1.49	3.98
June, 2015		1.5m x1.5m	92	1.09	2.94
		2.0m x2.0m	94	1.10	2.92
		2.5mx2.5m	68	1.07	3.17
		3.0m x3.0m	92	1.10	2.83

1.10	**Financial statement**	:		
1.10.1	Total cost	:	Tk.	20,00,000.00
1.10.2	Cost of the year	:	Tk.	2.02,000.00
1.10.3	Expenditure of the year	:	Tk.	2.02,000.00
1.10.4	Source of fund	:	GOB.	

1.11 **Beneficiaries:** FD, Wood based industries, NGOs, Farmers, Educational Institutions and other tree planting agencies.

2. **Study** : On-going

2.1 **Programme Area** : Production of quality planting materials.

2.2 **Title of the Study** : Large scale production of quality seedlings of important forest tree species

2.3 **Justification :** In Bangladesh every year different government organizations, NGOs, private planters, etc. are raising plantation with different forest tree species. Most of the plantations are usually established by nursery raised seedlings. Quality seedling is the prime factor for the establishment of successful plantation ensuring good economic return. However, the nursery owners do not pay much attention in production of quality seedlings and the planters are also not so much aware about the quality seedlings. As a result the planters do not get expected production from their plantations. Therefore, the study has been undertaken for the production and supply of quality seedling to planters as well as awareness development about quality planting materials.

2.4 **Objective(s)** :

2.4.1 To determine age, height and root-shoot ratio of seedlings for dispatch from nursery to plantation.

2.4.2 To provide quality seedlings to planters for successful plantation establishment.

2.4.3 To develop linkages with planters for awareness development about quality seedling.

2.5 **Expected output :**

a. Awareness development about quality seeds and seedlings.

b. Increased yield of timber and fuel wood.

2.6 **Study Period** :

2.6.1 Starting year : 2015-2016 (2nd Phase)

2.6.2 Completion year : 2019-2020

2.7 **Personnel** :

2.7.1 Project Leader: : Nasrat Begum, DFO,

2.7.2 Associates : Abdullah-Al-Masud Mazumder, RO and M Rabiul Islam, FI.

2.8 **Progress**

2.8.1 Previous years, if any: Raised and distributed more than 11, 25,000 quality seedlings of different indigenous and exotic forest tree species, viz. acacia hybrid *(Acacia auriculiformis* X *A. mangium),* banderhola *(Duabanga grandiflora)*, civit *(Swintonia floribunda)*, teli-garjan *(Dipterocarpus turbinatus)*, gamar (*Gmelina arborea*), sal (*Shorea robusta*), segun *(Tectona grandis)*, lohakat *(Xylia xylocarpa)*, chickrassi *(Chukrassia velutina)*, eucalyptus *(Eucalyptus camaldulensis)*, raintree *(Samanea saman)*, mahogany *(Swietenia mahogoni)*, sonalu *(Cassia fistula)*, kala-koroi *(Albizia lebbeck)*, raj-koroi *(A. richardiana)*, sil-koroi *(A. procera)*, chakua-koroi *(A.chinensis),* motor-koroi *(A. lucida),* arjun *(Terminalia arjuna)*, pitraj *(Aphanamixis polystachya),* bohera *(Terminalia bellirica)*, haritaki *(Terminalia chebula)*, menda *(Litsea monopetala)*, haldu *(Haldina cordifolia),* kat badam *(Terminalia catappa)*, palas *(Butea monosperma)*, khayer *(Acacia catechu),* tamal *(Diospyros montana)*, krishnachura *(Delonix regia)*, kalo-jam *(Syzygium cumini),* kanchan *(Bauhinia racemosa)*, jarul *(Lagerstroemia speciosa)*, parul *(Stereospermum suaveolens)*, dhakijam *(Syzygium grande),* chapalish *(Artocarpus chama),* telsur *(Hopea odorata),* champa (*Michelia champaca),* cryptocarya

(Cryptocarpa amygdalina), baobab (*Andansonia digitata)*, kerung (*Pongamia pinnata)*, boilam (*Anisoptera scaphula*), toon (*Toona ciliata*), chalmugra (*Gynocordia odorata*), goda/awal (*Vitex peduncularis*), raktan (*Lophopetalum fimbriatum*), udal (*Firmiana colorata*), sidha-jarul (*Lagerstroemia parviflora*), hargaza (*Dillenia pentagina*), dholi-garjan (*Dipterocarpus alatus*), kanaidinga (*Oroxylum indicum*), agar (*Aquilaria malaccensis*), gandhi-gazari (*Miliusa velutina*), pakhiara (*Thespesia populnea*), mailam (*Bouea oppositifolia*), pine (*Pinus caribaea*), dharmara (*Stereospermum personatum*), punnyal (*Calophyllum inophyllum*), arshal (*Vitex glabrata*), bot (*Ficus bengalensis*), box badam/ jangli badam (*Sterculia foetida*), etc.

2.8.2 This year :

Activities of the study	Progress
a) Collection/purchase of seeds of popular /threatened forest tree species from seed orchards, plantations and natural forests and raising of 25,000 seedlings at HQs and four research stations.	Collected seeds from selected mother trees. Raised 25,000 seedlings of Mahua ((*Madhuca longifolia)*, Champa (*Michelia champaca),* Agar (*Aquilaria malaccensis*), lambu (*Khaya anthotheca*), Rata (*Dysoxylum grande*), Neem (*Azadirachta indica*) Raktan (*Lophopetalum fimbriatum*), Gutgutia (*Portium serratum*), Nalita (*Trema orientalis*) Jog dumur (*Ficus racemosa*) Kadam (*Neolamrckia kadamba*) haritaki (*Terminalia chebula*), Chapalish (*Artocarpus chama),* hybrid acacia (*Acacia auriculiformis* X *A. mangium),* Tamal (*Diospyros montana)* Jalpai (*Elaeocarpus varunua*) Kat badam (*Terminalia catappa*), arjun (*Terminalia arjuna*), Telsur (*Hopea odorata),* lohakat *(Xylia kerrii*), Boilam (*Anisoptera scaphula*), Teli-garjan (*Dipterocarpus turbinatus*) Palas *(Butea monosperma)*, mahogany *(Swietenia mahogoni)*, Dharmara (*Stereospermum personatum*), Toon (*Toona ciliata*), banderhola *(Duabanga grandiflora)*, jarul (*Lagerstroemia speciosa*), Burma simul (Cieba pentendra), Haldu *(Haldina cordifolia),*Civit (*Swintonia floribunda*), Vella/Bhui kadam (*Hymenodectylon excelsum*), Dud kuruch (*W. arborea*) etc. different forest tree species and raising seedlings at HQs nursery.
b) Maintenance of seedlings in the nursery through weeding, watering, sorting, rearrangement, etc.	Maintained existing seedlings in the nursery through watering, weeding, sorting, rearrangement, etc.
c) Seedling raising technique of Tentul dharmara, goda, boilam and gutgutia.	Developed seedling raising technique of Tentul and Dharmara.
d) Collection of data on germination, height and collar diameter, root-shoot ratio of different species.	Collected data on seedlings survival%, germination, height, and collar diameter of different species are shown in Table 1, & 2.

Table 1. Seed germination, survival and growth of seedlings of 32 forest tree species at different age.

Sl. No	Scientific name	Germination period		Ger. %	Sur. (%)	Av. ht. (cm)	Collar dia (mm)	Age (month)
		Start	comp					
1	Mahua ((*M. longifolia)*	20	18	21	89	34.8	5.84	11
2	Champa (*M. champa*)	7		65	90	56.5	7.26	12
3	Agar (*A. malaccensis*)	18	45	33	87	47	8.61	10
4	Pitraj *(A. polystachya),*	20	60	84	84	12.6	2.44	2.0
5	Tamal *Diospyros montana*	84	50	20	20	10.87	2.86	3.25

6	Neem (*A. indica*)	7	10	66	80	30.7	4.91	11
7	Raktan (*L. fimbriatum*)	15	45	78	88	32.4	4.88	10
8	Bokain(*M. azadhirack*)	20	53	63	100	10.2	1.92	2.0
9	Chickrassi (*C. velutina*)	10	38	72	100	15.0	1.74	2.15
10	Bakul (*Mimosops elengi*)	31	30	93	100	6.0	1.5	1.0
11	Arjun *(Terminalia arjuna)*,	5	33	80	100	11.75	2.39	1.10
12	Bhui kadam/ Bhutum	21	24	65	100	5.2	3.12	1.0
13	Haldu (*H. cordifolia*)	19		230/g	100	5.0	2.9	4.0
14	Dharmara (*S. personatum*	6	30	64	100	10.01	1.83	1.0
15	Kanchan (*B. racemosa*	5	15	94	100	15.4	2.30	
16	Minjiri (Cassia siamea)	5	37	61	100	8.4	2.19	2.5
17	Chapalish (*A.s chama)*,	7		65	95	54.8	5.57	8.0
18	Kannary (Coronaria gardenia)	31	24	59	100	3.4	1.50	2.20
19	Lohakat (*Xylia xylocarpa*)	8	15	67	100	12.1	2.39	2.0
20	Jog dumur (*F. racemosa*)			208/g		18.93	3.30	5
21	Teli-garjan (*D. turbinatus*)	5	20	60	100	13.2	3.0	2.0
22	Boilam (*A. scaphula*)	10	18	44	100	19.2	5.54	12
23	Gutgutia (*P.serratum*)	27	49	2	100	-	-	-
24	Haritaki (*T chebula)*,	60	15	39	93	60.0	4.0	4.15
25	Hybrid acacia *(A. auriculiformis* X *A. mangium),*	5	15	85	100	49.2	4.11	4.0
26	Rata *(Dysoxylum grande)*,	25	45	73	100	-	-	-
27	Palas *(Butea monosperma)*	8	26	30	100	16	3.41	1.10
28	Banderhola (*D. grandiflora*)	15	20	550/g	100	42.1	6.14	10
29	Dud kuruch (*W. arborea*)	36	13	98	100	12.	2.39	1.0
30	box badam (*S. foetida*)	13	24	93	100	11.4	5.03	1.0
31	Tentul (*T. indica*)	10	20	100	100	25.5	2.65	2.5
32	Civit (*S. floribunda),*	5	10	91	100	18.82	2.92	3.0

Figure : Seedlings raised in the H/Q nuersery

Box badam   **Telsur**   **Bakul**   **Lambu**

Champa

Bohera

Lohakath

Dharmara

Dharmara

Sonalu

kadam

Arjun

Civit

Parul

Chickrassi

Dud kuruch

Jog dumur

Tentul

Kanchan

Jhau

Kannaray

Sidha jarul

Palas

Vuthum

Tamal   **Haldu**   **Agar**   **Gutgutia**

Mohua   **Jigni**
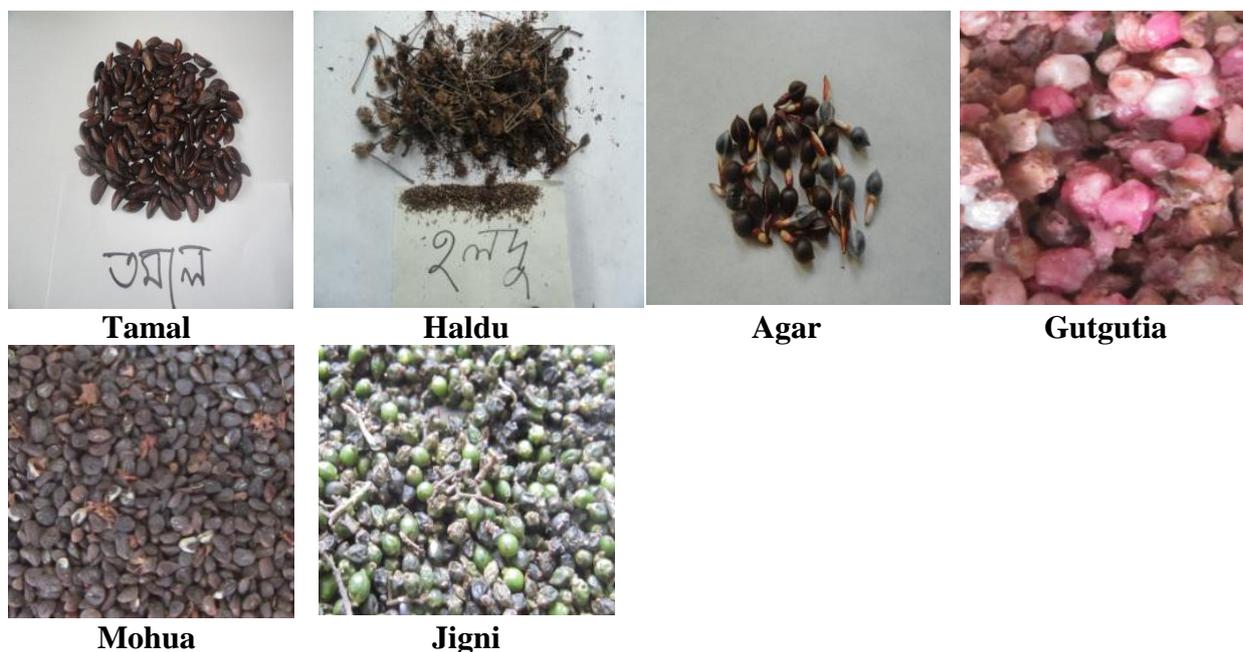
Figure: Seeds of different important species raised in H/Q nursery

Table 2. Germination Trial of Tentul (*Tamarindus indica*) by Grading Method

Treatments	Ger. period		Ger. %	Sur. %	Ht. (cm)	Cd. (mm)
	start	Comp				
T_1 (contol/mix, seeds without soaking)	10	30	92	100	23.2	2.83
T_2 (large seeds without soaking)	10	30	100	100	25.2	2.65
T_3(small seeds without soaking)	10	30	94	100	24.5	2.64
T_4 mix / large + small seeds with seed cover soaking for 24 hours)	10	30	95	100	20.4	2.37
T_5 (mix / large + small seeds soaking for 24 hours)	10	30	92	100	23.2	2.87
T_6(large seeds soaking for 24 hours)	10	30	98	100	23.3	2.81
T_7 (small seeds soaking for 24 hours)	10	30	94	100	22.0	2.60

Figure 1. Fruits of Tentul   Figure 2. Seeds of Tentul   Figure 4. Seedlings of Tentul

2.9   **Achievement (s), if any :** Developed appropriate nursery technique for 30 indigenous and exotic forest tree species.

2.10   **Financial statement**   **:**
2.10.1 Total cost   **:** Tk.   10,00,000.00
2.10.2 Cost of the year   **:** Tk.   81,000.00
2.10.3 Expenditure of the year   **:** Tk.   81,000.00
2.10.4 Source of fund   **:** GOB.
2.11   **Beneficiaries:** FD, NGOs, Farmers, Educational institutions and other tree planting gencies.

3.   **Study**   : Ongoing

3.1   **Programme Area**   : Biodiversity and Conservation.

3.2   **Title of the Study**   : Conservation of indigenous/native forest tree species in different dendro-ecological regions of Bangladesh

3.3   **Justification :** once Bangladesh was famous for its floral biodiversity. About 5700 species of angiosperms and more than 800 forest tree species were available in Bangladesh. But in course of time the number of species has been decreasing alarmingly due to over population, urbanization, over extraction/unrolled cutting of forest resources, plantation of exotic species through clearing of indigenous/natural species, etc. In the meantime some forest tree species have already been extinct and many are in the verge of extinction. Scientists are suspecting 106 numbers of plant species are endangered. However the number may be much more than that. Now a day's conservation of biodiversity is an important issue all over the world. As a national institute on forestry research, BFRI has a responsibility and should take necessary steps to conserve all the native/indigenous forest tree species of Bangladesh. Therefore, the study has been undertaken to protect the indigenous species from extinction though conservation.

3.4   **Objective(s)**   :

3.4.1 To conserve germplasm of indigenous forest tree species in different ecological regions of Bangladesh.

3.4.2 To observe their suitability in particular sites.

3.5   **Expected output :** 120-150 indigenous forest tree species will be conserved over an area of 50.0 hectare at four Silviculture Research Stations.

3.6   **Study Period**   :

3.6.1 Starting year   **:** 2013-2014

3.6.2 Completion year   **:** 2017-2018

3.7   **Personnel**   :

3.7.1 Project Leader: : Nasrat Begum, DFO.

3.7.2 Associates   : Abdullah-Al-Masud Mazumder, RO. and Md. Rabiul Islam, FI.

3.8   **Progress**

3.8.1 Previous years, if any: Raised 35 ha plantations with 106 indigenous forest tree species at Charkai, Charaljani, lawachara and Keochia SR Station.

3.8.2 This year   :

Action plan as per annual research programme	Progress
a. Collection of seeds and raising 30,000 seedlings of different indigenous forest tree species at Charkai, Lawachara and Keochia research stations.	Collected seeds and raised 30,000 seedlings of different indigenous forest tree species at Charkai, Lawachara and Keochia research stations.
b. Maintenance of seedlings in the nursery through weeding, watering, sorting, rearrangement etc.	Maintained seedlings in the nursery through weeding, watering, sorting, rearrangement etc.
c. Raising of 10.0 hectares plantations at Charkai, Lawachara and Keochia research stations.	Raised 10.0 hectares plantations at Charkai, Lawachara and Keochia research stations. Details of Plantation are shown in Table – 1.
d. Data analysis and reporting.	Collected data on survival%, height, and collar diameter of seedlings of last year (14 – 15 & 15-16) plantation are shown in Table- 2,3, 4, & 5.

Table-1. Area of plantations and name of species planted at three SRS in 2016-2017

Locations	Area of plantations	No. of Species	Name of species (Total 42 species)
Keochia, Chittagong	4.0 ha	20	Telsur. Civit, Chikrassi, Bandarhola, Toon, Dhakijam, Kalo jam, Sal, Golapjam, Putijam, Gutgutia, Pitraj, Minjiri, Bohera, Chatian, Kat badam, Punnayal, Champa, lohakath, Dharmara etc.
Lawachara, Moulavi bazar	1.0 ha.	11	Dayphol, Kalo menda, Civit, Chikrassi, Dharmara, jarul, Cao, Batna/ Khami, Mehogani, Raintree, Kanaidinga.
Charkai, Dinajpur	5 ha.	21	Ban amra, Kalojam, Kanjal bhadi, Chickrassi Horitaki, Vela, Kalokaroi, Bakul, Rain tree, Sonalu, Arjun, Vutum, Bohera, Khoier, Neem, Kanaidinga, Minjiri, Jarul, Motor Koroi, Puti jam, Teli,garjan. etc.

Table- 2 Mean survival and growth of seedlings of 45 forest tree species at Keochia Research Station,(plantation 2014 – 2015).

Sl. No.	Species name	2015		
		Sur. %	Ht. (m)	Dia (cm)
1	Sal (*Shorea robusta*)	48	0.55-1.55	1.06 – 2.13
2	Putijam (*Syzygium fruticosum*)	43	0.80 – 1.68	0.92 – 1.96
3	Dhakijam (*S. grande*)	43	0.93 – 1.96	1.06 – 2.21
4	Golapjam (*Syzygium jambos*)	43	0.83 – 1.67	0.87- 1.9
5	Dharmara(*S. personatum*)	40	0.56 – 1.33	0.57 - 1.71
6	Kalojam (*Syzygium cumini*)	36	0.70 – 1.47	0.62 - 1.85
7	Putrongib (*Putranjiva roxbourghii*	11	0.60 – 0.73	0.61 – 0.73
8	Telsur (*Hopea odorata*)	38	0.88 – 1.02	1.00 -1.5
9	Toon (*Toona ciliata*)	7	0.95 -1.40	1.5- 1.65
10	Simul (*Bombax ceiba*)	31	0.55 – 1.23	0.62- 1.40
11	Kumbi (*Careya arborea*)	33	0.50 - 0.62	0.60 – 0.71
12	Bakul (*Mimosops elengi*)	35	0.92 – 1.25	1.17 – 1.45
13	Lohakath (*Xylia xylocarpa*),	33	0.87 – 1.18	1.09 – 1.46
14	Garjan (*Dipterocarpus turbinatus*)	36	0.98 – 1.15	1.18 – 1.22
15	Sonalu (*Cassia fistula*)	30	0.98 – 1.05	0.93 - 1.22
16	Chikrassi (*Chukrassia velutina*)	36	1.13 - 1.25	1.01 – 1.31
17	Kathal (*Artocarpus heterophyllus*)	25	1.44	1.75
18	Kalo karai(*Albizia lebbeck*)	31	0.58 – 1.23	0.60 – 0.95
19	Pitraj (*Aphanamixis polystachya*)	26	0.71 – 0.83	096– 1.00
20	Sil koroi (*A. procera*),	28	0.74-1.21	0.62 -1.16
21	Amloki (*Phyllanthus emblica*)	21	0.88 – 1.14	1.06 – 1.27
22	Raintree(*Samanea saman*)	23	0.89 - 099	1.10 – 1.17
23	Tentul (*Terminalia indica*)	24	0.62 – 0.95	0.58 – 0.85
24	Chatian (*Alstonia scholaris*)	29	1.56 – 2.12	1.87 – 2.02
25	Am (*Mangifera indica*)	26	1.00 – 1.04	1.09 – 1.24
26	Hijal (*Barringtonia acutangula*)	24	0.49 – 0.65	0.62 – 0.83
27	Agar (*Aquilaria malaccensis*)	36	1.08 – 1.23	1.02 – 1.23
28	Bon kao(*Garcinia cowa*)	19	0.58 – 0.92	0.73 – 1.13
29	Boilam (*Anisoptera scaphula*)	22	1.10 – 1.16	1.33 – 1.42
30	Chapalish (*Artocarpus chama*)	19	0.64 – 1.19	0.94 – 1.19

31	Civit (*Swintonia floribunda*)Keron	22	1..16 – 1.29	1.28 – 1.55
32	Minjiri (*Senna siamea*)	50	1.29 – 2.30	1.57 - 3.37
33	Sada kanchan (*Bauhinia racemosa*)	25	0.85 - 2.10	0.95 – 2.10
34	Haritaki (*Terminalia chebula*)	29	0.96 – 1.07	1.18 – 1.26
35	Mahua (*Madhuca longifolia*)	22	.053 -1.05	0.67 – 1.22
36	Mahogani (*Swietenia mahogoni*)	24	.089 – 2.1	0.97 – 2.29
37	Radachura (*Caesalpinia pulcherrima*)	27	0.76 -1.69	.095 -1.88
38	Champa (*Michelia champaca*),	17	.078 -1.66	0.88 -1.70
39	Chalta (*Dillenia indica*)	20	0.5. -0.85	0.65 -1.00
40	kerong (*Pongamia pinnata*)	29	0.70 -1.20	0.75 -1.30
41	Kajubada(*A. occidentale*)	25	0.55 – 1.00	0.70 -1.25
42	Udal (*Firmiana colorata*)	D	-	-
43	Box badam (*Sterculia foetida*)	D	-	-
44	Bon amra (*Spondias pinnata*)	4	0.80 – 1.20	0.95
45	Deshi neem (*Azadirachta indica*)/	25	0.85 -1.10	0.95 -1.25

Table- 3. Mean survival and growth of seedlings of 20 forest tree species at Keochia Research Station (plantation-2015-16).

Sl. No.	Species name	2016		
		Sur. %	Ht. (m)	Dia (cm)
1	Telsur (*Hopea odorata*)	89	0.56 -0.94	0.55 -0.94
2	Garjan (*Dipterocarpus turbinatus*)	72	0.44 – 0.80	0. 51 – 0.92
3	Bokain (*Melia azederach*)	70	0.36 – 0.71	0.34 – 0.57
4	Sal (*Shorea robusta*)	75	0.39 – 0.66	0.44– 0.64
5	Chatian (*Alstonia scholaris*)	89	0.66 – 3.88	0.83 – 0.92
6	Chapalish (*Artocarpus chama*)	84	0.68 – 1.44	0.74 – 1.08
7	Kalojam (*Syzygium cumini*)	86	0.38 – 0.56	0.46 – 0.64
8	Kumbi (C*areya arborea*))	88		
9	Agar (*Aquilaria malaccensis*)	91	0.61 – 1.01	0.42 – 0.81
10	Kannayri (Gardenia coronaria)	90	0.63 – 0.79	0.78 – 1.25
11	Borta (*Artocarpus lacucha*)	80	0.49 – 0.84	0.50 – 0.59
12	Lohakath (*Xylia xylocarpa*)	81	0.46 – 0.77	0.49 – 0.87
13	Tentul (*Terminalia indica*)	86	0.45 – 0.56	0.45 – 0.51
14	Chikrassi (*Chukrassia velutina*)	92	0.69 – 1.27	0.48 – 0.80
15	Box badam (*Sterculia foetida*)	72	0.41 – 0.56	0.50 – 0.65
16	Civit (*Swintonia floribunda*)	84	1.10 – 1.57	0.96 – 1.29
17	Dhakijam (*Syzygium grande*)	77	0.68 – 0.84	0.67 – 83
18	Bohera (*Termanalia bellerica*)	92	0.86 – 1.06	0.59 – 0.85
19	Minjiri (*Senna siamea*)	76	0.45 – 0.91	0.47 – 0.98
20	Sonalu (*Cassia fistula*)	79	0.28 – 0.52	0.40 -50

Table-4. Mean survival and growth of seedlings of 49 forest tree species at Lawachara Research Station, (plantation-2014-15).

Sl. No.	Species name	Survival	Height range (cm)	Dia range (mm)
1	Painnya jam (*Syzigium formosum*)	88	72 – 132 -	6 - 10
2	Mini jarul (*Lagerstoemia indica*)	90	63 -108	7- 10
3	Bon kao(*Garcinia cowa*)	88	74 -117	5 - 8
4	Kanak (*Schima wallichii*)	88	73 - 149	7 - 11
5	Dhakijam (*S. grande*)	88	73 - 116	5 - 8

6	Arjun (*Terminalia arjuna*)	85	79 - 109	6 - 8
7	Lal Awal (*Vitex pinnata*)	68	74 - 129	8 -11
8	Lohakath (*Xylia xylocarpa*)	87	58 - 90	5 - 9
9	Sil Koroi (*Albizzia procera*)	84	95 - 148	6 - 8
10	Amloki (*Phyllanthus emblica*)	88	74 - 127	7 - 9
11	Putijam (*Syzygium fruticosum*)	81	53 - 66	4 -7
12	Minjiri (*Senna siamea*)	69	79 - 121	7 - 9
13	Dakrum (*Fernandoa adenophylla*)	62	49 - 66	8 - 9
14	Agar (*Aquilaria malaccensis*)	88	49 - 86	4 - 7
15	Mahogani (*Swietenia mahogoni*)	64	50 - 86	7 - 9
16	Goda jam (*Syzygium nervosum*)	72	48 - 66	7 - 9
17	Chapalish (*Artocarpus chama*)	92	66 - 100	7 - 9
18	Bokain (*Melia azederach*)	64	64 - 100	7 -9
19	Borta (*Artocarpus lacucha*)	84	49 - 100	8 - 11
20	Bon simul (*Bombax insigne*)	82	54 - 127	7 -9
21	Gamar (*Gmelina arborea*)	89	59 - 89	7 - 8
22	Raintree (*Albizia saman*)	89	156 - 200	15 - 17
23	Lukluki (*Flacourtia jangomas*)	84	28 - 50	15 -17
24	Pannaya dumur (*Ficus nervosa*)	94	54 -92	7 - 10
25	Golapjam (*Syzygium jambos*)	84	75 - 117	7 - 10
26	Khoir (*Acacia catechu*)	80	28 - 50	3 - 6
27	Kalojam (*S. cumini*)	89	60 - 116	7-10
28	Kata jarul (*Lagerstoemia speciosa*)	84	64 - 92	8 - 10
29	Mandar (*Erythrina variegate*)	84	126 - 162	8 - 12
30	Boilam(*Anisoptera scaphula*)	84	64 - 91	6 - 9
31	Garjan (*Depterocarpus sp.*)	86	64 - 92	7 - 10
32	Chatiyan (*Alstonia scholaris*)	86	65 - 102	7 - 10
33	Horina (*Vitex peduncularis*)	82	54 - 71	6 - 8
34	Segun (*Tectona grandis*)	84	54 - 70	7 - 10
35	Dharmara (*S. personatum*)	85	49 - 70	7 - 10
36	Pyeara	84	65 - 102	7 - 10
37	Kanaidingha (*Oroxylum indicum*)	84	64 - 102	5 - 7
38	Amra (*Spondias pinnata*)	66	53 - 70	8 - 10
39	Kanchan (*Bauhinia racemosa*)	83	74 - 132	5 - 10
40	Raktan (*Lophopetalum fimbriatum*)	90	69 - 96	8 - 5
41	Motor koroi (*A. lucida*)	86	132 - 85	9 - 6
43	Moskon(*Pterospermum acerifolium*)	82	43 - 65	8 - 6
44	Kannari (*Gardenia coronaria*)	72	48 - 70	7 - 9
45	Bohera (Termanalia bellerica)	88	71 - 44	4 - 6
46	Badhi (*Lanea coromandilica*)	68	100 - 132	9 - 10
47	Civit (*Swintonia floribunda*)	92	125 173	8 - 9
48	Jambura (*Citrus maxima*)	87	43 - 66	6 - 9
49	Goda jam	72	48 - 66	9 - 7

Table 3. Mean survival and growth of seedlings of 45 forest tree species at Lawachara Research Station, (plantation-2015-16).

Sl. No.	Species name	2016		
		Survival %	Height (cm)	Dia (mm)
1	Chapalish (*Artocarpus chama)*	84	40 - 70	5 - 9
2	Boilam(*Anisoptera scaphula*	84	60 - 90	6 - 8
3	Dakrum(*Fernandoa adenophylla*	88	40 - 100	7- 8
4	Pitraj (*Aphanamixis polystachya)*	79	57 - 95	5 - 8
5	Garjan (*Depterocarpus sp.)*	86	40–80	5 - 7
6	Chickrassi (*Chuckrassia velutina)*	92	40 - 70	5 - 8
7	Sil Koroi (*Albizzia procera)*	82	50 - 100	5 - 7
8	Sal (*Shorea robusta)*	86	60 - 100	5 - 7
9	Mini jarul (*Lagerstoemia indica)*	90	40 - 90	5 -7
10	Dayfal (*Garcinia xanthochymus)*	81	30 - 60	4 - 5
11	Lohakath (*Xylia xylocarpa)*	90	40 - 60	4 - 5
12	Udal (*Firmiana colorata)*	90	35 - 80	5 - 8
13	Chatiyan (*Alstonia scholaris)*	80	40 - 80	5 - 6
14	Pitali (*Mallotas nidiflorus)*	84	45 - 80	7 - 5
15	Bon simul (*Bombax pentendra*	86	45 - 100	4 - 9
16	Amloki (*Phyllanthus emblica)*	80	44 - 96	4 - 7
17	Raktan (*Lophopetalum fimbriatum*	80	40 - 70	4 - 6
18	Kanaidingha(*Oroxylum indicum)*	70	35 - 67	3 - 7
19	Segun (*Tectona grandis)*	73	40 - 60	4 - 6
20	Bon kao(*Garcinia cowa)*	80	50 - 80	5 - 7
21	Agar (*Aquilaria malaccensis)*	82	43 - 73	4 - 6
22	Arjun (*Terminalia arjuna)*	73	45 - 100	5 - 8
23	Jambura (*Citrus maxima)*	86	50 - 85	5 - 7
24	Batna/Khami	86	40 - 60	4 - 6
25	Tentul (*Terminalia indica)*	89	45 - 80	4 - 6
26	Civit (*Swintonia floribunda)*	82	65 - 90	4 - 8
27	Horina (*Vitex peduncularis)*	75	40 - 83	4 - 7
28	Neem (*A. indica)*	84	50 - 84	4 - 6
29	Dharmara (*S. personatum)*	84	40 - 60	4 – 6
30	Jalpai (*Elaeocarpus verunua*)	84	39 - 96	4 - 8
31	Urium (*Bouea oppositifolia)*	90	40 - 90	4 - 6
32	Royna (*Aphanamixis polystechia)*	90	44 - 70	4 - 6
33	Sidha Jarul (*Lagarstreomia parviflora*)	89	60 - 100	5 - 8
34	Gamar (*Gmelina arborea)*	88	40 -70	4 - 5
35	Golapjam (*Syzygium jambos)*	88	40 - 85	
36	Kalaoza (Ehetia serrata)	90	45 - 80	5 - 7
37	Kadam (*Neolamarkia kadamba)*	86	40 - 130	4 - 8
38	Bokain (*Melia azederach)*	68	80- 120	7 - 9
39	Bon jam (*Syzygium fruticosum)*	88	60 - 120	7 - 9
40	Sheora (*Streblus asper)*	76	55 - 71	6 - 5
41	Menda (*litsea glutinosa)*	76	35 - 65	4 - 5
43	Goiya (*Pisidium guajava)*	76	90 - 130	7 -9
44	Krishnachura (*Delonix regia)*	64	55 - 85	6 - 7
45	Painna jam (*Syzugium formosum)*	64	45 - 70	5 -7

Table-5. Mean survival and growth of seedlings of forest tree species at Charkai Research Station (plantation-2014-2015).

Sl. No.	Species name	2015		
		Sur. %	Ht (cm)	Collar Dia (cm)
1	Rong (*Morinda angustifolia*)	83	55,5 – 135.35	3.63 – 8.88
2	Dhaki jam (*Syzygium grande*)	81	38.3 – 112.35	2.22 – 6.63
3	Rakto chandan (*Pterocarpus indicus*)	79	37.2 – 98.2	3.1 – 6.15
4	Sil koroi (*A. procera*),	79	75.75 – 121.1	6.33 – 9.23
5	Kalo koroi (*Aibizzia. lebbeck*)	75	65.66 – 117.2	6.32 – 9.11
6	Bhutum (*Hymenodictylon orixensis*)	83	40.2 – 109.5	4.9 – 8.8
7	Kumvi (*Careya arborea*)	74	52.33–111.11	3.65 – 8.67
8	Kanjol badhi (*Bischofia javanica*)	81	72.33–123.22	5.22 – 9.12
9	Khudijam (*Syzygium cymosum*)	81	75.33 - 102.33	4.44 – 8.33
10	Bela (*Semecarpus subpenduriformis*	75	70.3 – 127.2	5.12 – 9.00
11	Gamar (*Gmelina arborea*)	78	62.23–106.22	3.1 – 8.1
12	Ata (*Annona squamosa*)	70	52.2 – 111.3	2.5 – 6.17
13	Jiga (*Lannea coromandelica*))	80	35.22 – 96.33	3.3 – 7.12
14	Titgila (*Entada rheedii*)	78	32.2 – 73.3	3.5 – 6.7
15	Agar (*Aquilaria malaccensis*)	76	71.1 – 112.2	6.2 – 9.3
16	Deshi jam (*Syzygium fruitycosum*	80	40.2 – 116.3	2.7 – 5.1
17	Kadam (*Neolamarckia cadamba*)	85	55.2 – 113.9	5.1 – 7.5
18	Tentul (*Terminalia indica*)	84	57.1 – 107.3	3.2 – 6.15
19	Amloki (*Phyllanthus emblica*	78	41.1 – 97.2	3.1 – 7.9
20	Arjun (*Terminalia arjuna*	71	42.2 – 95.5	4.1 – 6.9
21	Bakul (*Mimosops elengi*)	83	43.3 – 92.2	3.2 – 7.5
22	Ban Amra (*Spondias pinnata*	80	45.2 – 99.9	3.3 – 7.3
23	Deshi gab (*Diospyros malabarica*))	79	42.7 – 88.3	3.7 – 8.1
24	Motor koroi (*Albizzia lucida*)	79	55.3 – 99.3	3.8 – 7.5
25	Kalo jam (*Syzygium cumini*)	81	47.33 – 78.35	5.7 – 7.8
26	Sissoo (*Dalbergia sissoo*)	78	75.5 – 115.5	6.7 – 9.3
27	Chatian (*Alstonia scholaris*)	81	43.3 – 83.3	3.9 – 5.6
28	Udal (*Firmiana colorata*)	75	47.5 – 112.3	4.1 – 8.3
29	Sida jarul (*Lagerstroemia parviflora*)	78	70.2 – 135.3	6.1 – 10.2
30	Bohera (*Terminalia bellirica*)	88	70.3 – 110.3	5.9 – 8.2
31	Haldu (*Haldina cordifolia*)	75	66.7 – 95.2	4.8 – 7.8
32	Pitraj (*Aphanamixis polystachya*)	80	75. 13 – 85.3	4.2 – 6.8
33	Tamal (*Diospyros Montana*)	85	67.73 – 99.8	5.1 – 7.7
34	Palash (*Butea monosperma*)	89	55 .35 – 11.3	5.8 – 9.8
35	Hijal (*Barringtonia acutangula*)	70	65.23 – 100.7	4.9 – 7.5
36	Bokain (*Melia azederach*)	75	80.35 – 127.3	5.33 – 9.0
37	Box badam (*Sterculia foetida*)	83	80.9 – 147.2	4.9 – 8.8
38	Pitali (*Mallotas nidiflorus*	78	55.5 – 95.7	3.4 – 6.3
39	Jhau (C. *equisetifolia*)	73	65.7 – 110.3	3.9 – 6.3
40	Simul (*Ceiba pentendra*)	84	70.3 – 127.3	4.1 – 8.3
41	Kannayri (*Gardenia coronaria*)	81	95.2 – 130.3	5.3 – 8.9
42	Neem (*Azadirachta indica*)	82	70.23 – 110.3	4.5 – 7.5
43	Kanaidinga (*Oroxylum indicum*)	88	65.5 – 117.7	5.1 – 7.7
44	Chikrassi (*Chukrassia velutina*)	84	73.3 – 137.2	4.4 – 7.8

Table 5. Mean survival and growth of seedlings of forest tree species at Charkai Research Station (plantation-2015-2016).

Sl. No.	Species name	2016		
		Sur %	Sur %	Sur %
1	Deshi gab (Diospyros malabarica)	89	35.32 - 67.75	1.15 – 2.18
2	Kanaidinga (Oroxylum indicum)	81	25.5 – 55.23	2.0 – 2.9
3	Bohera (Terminalia bellirica)	84	21.2 – 71.3	2.29 – 4.88
4	Debdaru (polyalthya longifolia)	78	45.23 – 80.33	3.12 – 6.8
5	Agar (Aquilaria malaccensis)	92	75.23 – 120.33	3,35 – 6.9
6	Tamal (Diospyros Montana)	87	23.23 – 55.5	2.21 – 5.1
7	Khaiya babla(Pithcellobium dulce)	78	55.23 – 87.3	3.15 – 5.77
8	Jolpai (Elaeocarpus vernua)	92	47.75 – 92.3	3.9 – 5.88
9	Chesra koroi (Albizia chinensis)	83	60.23 – 115.3	4.33 – 8.99
10	Khejur (Phoenix sylvatica)	96	22.3 – 43.3	7.5 – 10.35
11	Sonalu	93	23.3 – 55.3	2.1 – 5.55
12	Kalo koroi (Aibizzia. lebbeck)	84	75.5 – 130.23	4.95 – 6.35
13	Kanjol badhi (Bischofia javanica)	81	66.33 – 137.3	3.33 – 7.53
14	Bel (Aleo marmalos)	78	20.0 – 43.3	2.1- 3.88
15	Gandhi gajari (Miliusa velutina)	77	35.2 – 70.35	2.25 – 5.23
16	Neem (Azadirachta indica)	82	30.33 – 43.35	2.12 – 3.33
17	Bela (Semecarpus subpenduriformis)	91	25.25 – 50.33	1.9 – 3.75
18	Rain tree (Samanea saman)	92	77.23 – 140.33	4.95 – 8.75
19	Lohakath (Xylia xylocarpa)	81	35.15 – 67.23	3.0 – 5.17
20	Tentul (Tarmarindus indica)	80	55.2 – 90.23	3.37 – 5.67
21	Kumvi (Careya arborea)	83	37.2 – 57.8	2.1 – 5.78
22	Vutum (Hymenodictylon orixensis)	81	33.3 – 68.8	2.9 – 5.77
23	Motor koroi (Albizzia lucida	88	35.23 – 78.3	3.23 – 6.7
24	Kalo jam (Syzygium cumini)	81	30.33 – 55.23	1.17 – 3.23
25	Pitraj (Aphanamixis polystachya)	89	37.3 – 90.23	2.22 – 3.95
26	Ban Amra (Spondias pinnata	78	63.3 – 121.3	3.1 – 5.95
27	Ban Amra (Spondias pinnata	83	55.3 – 80.23	3.35 – 6.75
28	Sida jarul (Lagerstroemia parviflora)	81	27.35 – 67.35	4.1 -6.88
29	Bakul (Mimosops elengi)	76	47.35 – 78.35	3.3 – 6.1
30	Babla (Acacia nilotica)	89	47.35 – 78.35	3.15 – 5.95
31	Pitali (Mallotas nidiflorus)	77	66.15 – 88.7	3.35 – 6.67
32	Jhau (C. equisetifolia)	80	30.0 – 55.35	2.2 – 3.95
33	Arjun (Terminalia arjuna	92	70.15 – 95.5	3.8 – 7.55
34	Titgila (Entada rheedii)	87	35.3 – 68.30	2.9 – 3.88

3.9 **Achievement (s), if any :** Established 35 hectares plantations of 106 indigenous species

3.10 **Financial statement** :
3.10.1 Total cost : Tk. 30,00,000.00
3.10.2 Cost of the year : Tk. 6,49,000.00
3.10.3 Expenditure of the year : Tk. 6,49,000.00
3.10.4 Source of fund : GOB.
3.11 **Beneficiaries:** FD, NGOs, Farmers, Educational institutions and other tree planting agenci

4.   **Study**   : Ongoing

4.1   **Programme Area**   : Plantation technique and forest management

4.2   **Title of the Study**   : Suitability of *Khaya anthotheca* (lambu) plantation in Bangladesh

4.3   **Justification :** *Khaya anthotheca* is popularly known as lambu, a fast growing exotic tree species having multipurpose uses. For the last few years, the tree has been widely planting by the private planters all over Bangladesh, especially in the northern and south-western region of the country due to its initial rapid height growth. Before going to a large scale plantation with an exotic species, it is necessary to know the site suitability, survival, growth, disease infestation, environmental effect, etc. of that species in the new habitat. However, there is no such information for introduction of lambu in Bangladesh. So, the study has been undertaken with the following objectives.

4.4   **Objective(s)**   :

4.4.1 To develop/standardize nursery technique of lambu.

4.4.2 To determine suitable plantation technique and site suitability of lambu.

4.5   **Expected output :** Feasibility of large scale plantation of lambu in Bangladesh.

4.6   **Study Period**   :
4.6.1 Starting year   : 2013-2014
4.6.2 Completion year   : 2017-2018

3.7   **Personnel**   :
4.7.1 Project Leader: : Nasrat Begum, DFO.
4.7.2 Associates   : Abdullah-Al-Masud Mazumder, RO. and Md. Rabiul Islam, FI.

4.8   **Progress**
4.8.1 Raised 6.0 ha trial plantation at four (Charkai, Charaljani, Lawachara and Keochia) Silviculture Research Stations.

4.8.2 **This year**   :

Action plan as per annual research programme	Progress
a. Collection/purchase of seeds and raising 6000 seedlings	a. Collected seeds and raised 6000 seedlings.
b. Maintenance of 6 ha last year experimental plantation.	b. Maintained 6 ha last year experimental plantations for three times.
c. Raising trial plantation over an area of 2.0 ha (0.5 ha in each station) at Charkai, Charaljani, lawachara and Keochia SR Station.	c. Raised 2.0 ha trial plantation (0.5 ha in each station) at Charkai, Charaljani, lawachara and Keochia SR Station
d. Data collection and analysis	d. Collected data on survival and height growth (Table-1, 2 & 3)

Table-1. Survival and height growth of lambu (*Khaya anthothica*) three year (2013 - 2014) plantations at four SRS.

Location	Spacing (m)	2014		
		Sur. (%)	Height (m)	Collar Dia (cm)
Keochia	2.0 × 2.0	28	0.54	0.63
Hill slope	2.25 × 2.25	26	0.55	0.81
	2.50 × 2.50	28	0.58	0.82
Charaljani	2.00 × 2.00	83	1.71	2.81
Plain land	2.25 × 2.25	83	1.73	3.07
	2.50 × 2.50	80	1.61	2.52

	2.0 × 2.0	58	1.64	2.70
Lawachara Flat hill	2.25 × 2.25	60	1.8	2.70
	2.5 × 2.5	63	1.68	2.65
Charkai Plain land	2.00 × 2.00	91	1.28	4.31
	2.25 × 2.25	93	1.39	4.31
	2.50 × 2.50	92	1.26	4.02

Table-2. Av. Survival and height growth of lambu (*Khaya anthothica*) two years (2014 - 2015) plantations at four SRS.

Location	Spacing (m)	2015		
		Sur. (%)	Height (m)	Collar Dia (cm)
Keochia Hill slope	2.0 × 2.0	68	0.71	0.93
	2.25 × 2.25	67	0.62	0.83
	2.50 × 2.50	73	0.66	0.90
Charaljani Plain land	2.00 × 2.00	85	61.0	10.82
	2.25 × 2.25	83	63.64	10.91
	2.50 × 2.50	85	61.56	11.13
Lawachara **High slope**	2.0 × 2.0	d	d	d
	2.25 × 2.25	d	d	d
	2.5 × 2.5	d	d	d
Charkai Plain land	1.50 × 1.50	90	95.88	3.15
	2.00 × 2.00	90	106.32	3.2
	2.5 × 2.5	90	106.94	3.23
	2.30 × 2.30	89	104.09	3.13

Table-3. Average survival and height growth of lambu (*Khaya anthothica*) one year (2015 - 2016) plantations at four SRS.

Location	Spacing (m)	2016		
		Sur. (%)	Ht. (cm)	Cd (mm)
Keochia Hill slope	2.0 × 2.0	68	63.0	9.5
	2.25 × 2.25	64	59.0	8.6
	2.50 × 2.50	67	63.0	9.2
Charaljani Plain land	1.5 × 1.5	95	53.72	10.3
	2.0 × 2.0	93	53.81	9.99
	2.50 × 2.50	93	53.82	9.88
Lawachara Flat hill	2.0 × 2.0	77	0.51	3.04
	2.25 × 2.25	81	0.53	3.1
	2.5 × 2.5	83	0.53	3.02
Charkai Plain land	1.50 × 1.50	89	56.59	2.28
	2.00 × 2.00	92	55.7	2.31
	2.25 × 2.25	93	58.19	2.34
	2.50 × 2.50	94	69.75	2.38

Plantation 2014-15 at Lawachara

Plantation 2014-15 at keochia

Plantation 2015-16 at keochia

4.9   **Achievement (s), if any :** Preliminary data revealed that Lambu plantation is not suitable at hill slope.

4.10   Financial statement   **:**

4.10.1   Total cost   **:** Tk.   6,50,000.00

4.10.2   Cost of the year   **:** Tk.   1,24,000.00

4.10.3   Expenditure of the year   **:** Tk.   1,24,000.00

4.10.4   Source of fund   **:** GOB.

4.11   **Beneficiaries:** FD, NGOs, Farmers, Educational institutions and other tree planting agencies.

5.   **Study**   : New

5.1   **Programme Area**   : Plantation technique and forest management

5.2   **Title of the Study**   : Restoration of degraded sal forest through mix planting with sal (*Shorea robusta*) and other site suitable species

5.3   **Justification :** Once sal forest was one of the well-recognized natural forests of Bangladesh with a rich biological diversity. Wood of sal tree has a great demand for various uses. In addition to the valuable sal tree, the forest also contained some other valuable tree species like, *Albizia procera, Artocarpus chama, Gmelia arborea, Phylenthus embelica, Butea frondosa, Cassia fistula, Adina codifolia, Lagerstroemea parviflora* etc.as associates of sal. Wood of these species is used for construction, furniture, bullock-cart wheels, axles and planking. The forest is also a major source of firewood. From the last few decades, vegetation of sal forest has been degrading day by day which is now becomes very much alarming. Due to drastic degradation of forest vegetation, valuable rare wildlife of the forest has also been losing. To restore the sal forest, it is very much imperative to enrich the forest through plantation with seeds/seedlings of sal and other site suitable species. So the study has been undertaken to develop a mixed plantation model of sal tree along with suitable species.

5.4 **Objective(s)   :**

5.4.1 To develop suitable mixed plantation model for the enrichment of degraded sal forest.

5.4.2 To monitor the changes of biodiversity of sal forest overtime after establishing the plantation.

5.5 **Expected output :** Techniques for restoration of degraded sal forest will be developed.

5.6 **Study Period   :**
5.6.1 Starting year   **:** 2015-2016
5.6.2 Completion year   **:** 2019-2020
5.7 **Personnel   :**
5.7.1 Project Leader: **:** Abdullah-Al-Masud Mazumder, RO
5.7.2 Associates   **:** Nasrat Begum, DFO.and M. R. Islam, FI.
5.8 **Progress**
5.8.1 Previous years, if any: Raised 1.5 ha live fencing/boundary of experimental plantation with jali bet and babla at Charkai research station plantation at

5.8.2 This year   **:**

Activities for the year	Progress
a. Collection of seeds and raising 3000 seedlings of sal, kalo koroi, amloki and Chapalish at Charkai research station	a. Collection of seeds and raised 3000 seedlings of sal, kalo koroi, amloki and chapalish at Charkai research station.
b. Collection of seed and raising 1500 seedlings of jali bet and 1500 babla for live-fence around the boundary of forest land plantation at Charkai and Charaljani research station.	b. Collected seed and raised 1500 seedlings of jali bet and 1500 seedlings of babla for live-fence around the boundary of experimental plantation at Charkai and Charaljani research station.
c Maintenance of seedlings in the nursery through weeding, watering, sorting, rearrangement, etc.	c. Maintained seedlings in the nursery through weeding, watering, sorting, rearrangement, etc.
d. Maintenance of last years' live fencing experimental plantation at Charkai research station.plantation	d. Maintained last years' 0.5 ha live fencing/ boundary of experimental plantation at Charkai research station.
e. Collection of data on survival, height and collar dia. of the seedlings	e. Collected data on survival (91%, 89%) and height (24.40m & 30.24cm) of babla and Jalibet.
f. Planting 3000 seedlings of jail bet and babla along with the margin/boundary of forest land at Charkai and Charaljani research stations.	f. Planted 3000 seedlings of jail bet and babla along with the margin/boundary of forest land at Charaljani and Charkai research stations.
g. Raising 1.0 ha plantation of sal, sada koroi, neem and gargon at Charkai and Charaljani research station.	g. Raised 1.0 ha mix plantation of sal, sada koroi, neem and garjon at Charkai and Charaljani research station.

5.9 **Achievement (s), if any** :   NA

5.10 **Financial statement   :**
5.10.1 Total cost   **:** Tk.   5,00,000.00
5.10.2 Cost of the year   **:** Tk.   81,000.00
5.10.3 Expenditure of the year **:** Tk.   81,000.00
5.10.4 Source of fund   **:** GOB.

5.11 **Beneficiaries:** FD, Educational institutions and Forestry related agencies.

6.   **Study**   : On going
6.1   **Programme Area**   : Biodiversity and Conservation
6.2   **Title of the Study** : Effect of betel leaf cultivation by the Khasia community on the vegetation and soil of Lawachara Forest
6.3   **Justification :** Lawachara National Park is a part of the reserve forest which was declared as a National Park in 1996 having a total area of 1250 ha. Originally, the forest was supported by natural vegetation cover of mixed tropical evergreen type. There are altogether 14 villages of the Khasia community, of which two are located within the park and the rest lie on the boundary of park and/or just at the outskirt of the park and all have stake with the forest. Forest Department allotted 1.2 ha land to each registered villagers for betel leaf cultivation. However, they are using much more area than they are allotted. The allocation was made in exchange of participation in plantation management activities and enforcement patrols. The Khasia community uses the trees as the support of betel leaf plants. Presently betel leaf cultivation practice involves the cleaning of forest floor, mulching at the base of the betel leaf plants, and lopping of lower branches and top portion of the trees. In this process the cultivators completely clean the undergrowth vegetation of the forest and thus affect the soil health as well as the whole forest ecosystem. So it is important to know in what extent impact of betel leaf cultivation on the forest ecosystem.

6.4   **Objective(s)**   :
6.4.1 To find out the lopping intensity of support trees in relation to betel leaf production.

6.4.2 To determine the soil loss from the forest floor.

6.5   **Expected output :**

a. Appropriate lopping technique of support trees for betel leaf cultivation will be developed.

b. Growth performance of support trees will be assessed.

6.6   **Study Period**   :
6.6.1 Starting year   **:** 2015-2016
6.6.2 Completion year   **:** 2019-2020
6.7   **Personnel**   :
6.7.1 Project Leader: **:** Abdullah-Al-Masud Mazumdar, RO
6.7.2 Associates   **:** Nasrat Begum, DFO. Md. Rabiul Islam, FI.
6.8   **Progress**
6.8.1 Previous years, if any: New study
6.8.2 This year   **:**

Activities for the year	Progress
a. Maintenance of plot (weeding, mulching, irrigation, pruning etc.).	a. Maintained plots through weeding, mulching, irrigation, pruning etc.
b. Site selection and field layout.	b Site selected and field layout completed.
c. Establishment of demonstration plots.	c. Established demonstration plots.
d. Data collection	d. collected.

Table- 1: Soil erosion in different treatment plots.

Treatments	Mean soil erosion (in inch)
T_0 (control)	0.99
T_1 (50% looping + surface clear)	1.11
T_2 (50% looping + surface unclear)	0.92
T_3 (25% looping + surface clear)	1.02
T_4 (25% looping + surface unclear)	0.83

Table- 2 : Betel leaf production in different treatments

Treatments	Avr. Betel leaf production (kanta/plot/month)
T_0 (control)	18.66
T_1 (50% looping + surface clear)	38.67
T_2 (50% looping + surface unclear)	27
T_3 (25% looping + surface clear)	35.34
T_4 (25% looping + surface unclear)	24.67

6.9 **Achievement (s), if any** : New study.
6.10 **Financial statement** :
6.10.1 Total cost : Tk. 6,00,000.00
6.10.2 Cost of the year : Tk. 60,000.00
6.10.3 Expenditure of the year : Tk. 60,000.00
6.10.4 Source of fund : GOB.
6.11 **Beneficiaries:** FD, NGOs, the Khasia people and other communities, Educational institutions and other tree planting agencies.

7. **Study** : New
7.1 **Programme Area** : Plantation Techniques and Forest Management
7.2 **Title of the Study** : Development of plantation technique of Jigni (*Trema orientalis*) for pulpwood production
7.3 **Justification :** Trema orientalis (L) Blume, pioneer and multipurpose plant species showing better growth performance than *Acacia mangium* and *Eucalyptus camadonesis* (Jahan & Mun, 2005)**.** It grows naturally throughout country, especially central and north zone of the country. Owing to its dense root system in the surface soil, it grows rapidly in stone and drought land. It is a nitrogen-fixing tree and an economically valuable species for local communities due to its use as fuel wood. It's used in paper production, manufacturing of poles and for medicinal purposes including the treatment of respiratory, inflammatory, and helminthic diseases. Although *T. orientalis* is a good candidate for reforestation, pulp and paper industries, low percentage germination and nonsynchronous germination prevents this species from being efficiently used for large-scale production of seedlings. Thus, investigating the enhancement of seed germination and seedling production of *T. orientalis* is an important step for using this species in pulp and paper industries and in sustainable ecological restoration of degraded wastelands. The present study was aimed at evaluating the seed germination response of *T. orientalis* to different treatments and proper plantation method.
7.4 **Objective(s)** :
7.4.1 To standardize nursery technique of *T. orientalis*
7.4.2 To standardize suitable plantation technique of *T. orientalis*

7.5 **Expected output** : Large scale plantation in Bangladesh. Provide raw materials for pulp and paper industries, poles and fuel woods.

7.6 **Study Period** :
7.6.1 Starting year : 2016-2017
7.6.2 Completion year : 2020-2021
7.7 **Personnel** :
7.7.1 Project Leader: : Abdullah-Al-Masud Mazumdar, RO
7.7.2 Associates : Nasrat Begum, DFO. Md. Rabiul Islam, FI.
7.8 **Progress**
7.8.1 Previous years, if any: NA

7.8.2 This year   :

Activities for the year	Progress
a. Literature review.	a. Literature reviewed.
b. Raising 6000 seedling at H/Q nursery and four Silviculture Research Station.	b. Raised 6000 seedling at f at H/Q nursery and four Silviculture Research Station. Station
c. Maintenance of seedlings in the nursery through weeding, watering, sorting, rearrangement, etc.	c Maintained seedlings in the nursery through weeding, watering, sorting, rearrangement, etc.
d. Collection of data on germination, survival and height growth of the seedlings	d. Collected data on germination, survival and height growth of the seedlings. Table – 1.
e. Raising 1.25 ha plantations at Keochia, Charaljani, and Charkai SR Station.	e. Raised 1.25 ha plantation at Charkai, Charaljani, and Keochia SR Station
f. Report writing	f. Processing.

Table-1: Germination period, Germination%, survival% and height growth of Jigni (*Trema orintalis*) seedlings.

Treatments	Germination period (days)		Ger %	Age (Two month)			
	start	Compl.		Sur. %	Ht (cm)	Cd (mm)	Leaf no.
T$_1$ (Control)	23	64	25	100	9.2	3.28	9
T$_2$ (Soaked in normal water for 10 days).	23	50	32	100	6.0	2,45	7
T$_3$ (Soaked in normal water for 15 days)	23	66	27	100	7.79	2.63	7
T$_4$ (Soaked in boil water for 30 second)	23	60	18	100	5.52	2.07	6

7.9   **Achievement (s), if any** :   New study.
7.10   **Financial statement**   :
7.10.1 Total cost   : Tk.   6,00,000.00
7.10.2 Cost of the year   : Tk.   2,50,000.00
7.10.3 Expenditure of the year : Tk.   2,50,000.00
7.10.4 Source of fund   : GOB.
7.11   **Beneficiaries:** FD and Paper industries .

Figure 2. Jigni seedlings raised in the Nursery

Figure 3. Six month aged Jigni seedlings in the nursery

SOIL SCIENCE DIVISION

1.   **Study**   : Ongoing
1.1   **Programme Area**   : Plantation technique and forest management
1.2   **Title of the Study**   : Effect of integrated soil fertility management in rubber planataion at Dantmara Rubber Estate,Fatikchari, Chittagong.
1.3   **Justification:** Integrated soil fertility management (ISFM) in rubber plantation can be very productive both from latex yield and economic viewpoint. Development of ISFM in the rubber plantation is a holistic approach that includes two way options of chemical and biological fertilizers management throughout the life cycle of the plant. Integration of nitrogen shrubs/cover crops will be the important components of the ISFM system which will be combined with other components from plantation establishment to harvesting of rubber wood. Very few investigations have so far been done on the potential use of intercropping by introducing different nitrogen fixing shrubs/cover crops like gliricidia, indigofera, calopogonium, stylosenthes, arhar, lemon, zinger, turmeric, pineapple, cassava, banana, medicinal plants, etc. for improving soil fertility in rubber plantation. Encouraging results on the growth and yield of rubber plantation was obtained from banana, cassava, zinger and cultivation of other crops in some rubber growing countries. Improved soil and water conservation practices through intercropping of leguminous cover crops, organic manuring, mulching, etc. in the rubber plantation may contribute to increase soil organic carbon by about 30-50% (Yogaratnam, 2007). Rubber plantation can reduce air pollution and help to maintain ecological balance. While the world is facing the affects of climate change, rubber trees can protect us from its bad effect. Properly managed plantations are self-suitable ecosystems and could maintain a fair degree of biodiversity. In view of developing suitable models of ISFM in combination with appropriate selection of intercrops for increasing latex yield and income in the rubber plantation the present research work has been initiated.
1.4   **Objectives**   :
1.4.1 To utilize litter fall of rubber trees as organic compost
1.4.2 To assess the effect of compost on growth and latex production in new and mature rubber plantation
1.4.3 To evalute the role of different nitrogen fixing crops in new rubber plantation
1.5   **Expected output:** Incresing soil fertility and latex production of rubber plantation
1.6   **Study period**   :
1.6.1 Starting year   : 2010-11
1.6.2 completion year   : 2016-17
1.7   **Personnels**   :
1.7.1 Study leader   : Md. Motiar Rahman, Senior Research Officer
1.7.2 Associates   : Syeeda Rayhana Merry, Divisional Officer
1.8   **Progress**   :
1.8.1 Previous years (2015-16): Data on growth and latex production were collected and recorded.
1.8.2 This year   :

Activities of the study	Progress
a. Prepared heap will be maintained for composting of litter falls	a. Prepared heaps were maintained for five times. After composting the heaps were filled up with soil.
b. Compost samples from heap will be collected for storage and application	b. Compost samples were stored and applied in the mature and immature rubber plantation at the rate of 4.0 and 2.0 kg per tree respectively.
c. Data collection on latex yield for 36 (12x3) times from selected mature rubber plantation	c. Data on latex yield were collected from July, 2016 to June, 2017 from selected mature rubber plantation. Data on height and GBH was also collected from immature and cover crop rubber plantation respectively (Fig. 1-5).

d. Land will be prepared for cover crops in the experimental plot	d. Field managemnet were done through weeding and land preparation was completed as per schedule for cover crops
e. Field management by two times weeding and pruning of 2.0 hactare established plantation and repiring fence	e. Weeding and pruning was done and existing fence were repaired.
f. Seed collection of pueraria, thai lazzabati and arhar	f. Seed of pueraria, thai lazzabati and arhor was collected and applied in the experimental plot.
g. Cover crops (pueraria-*Pueraria phaseoloides* and thai lazzabati-*Mimosa invisa*) will be broadcast and shruby crop (arhar-*Cajanus cajan*) seed sown as intercrop in established 1.0 hactare rubber plantation	g. Cover crops (pueraria-*Pueraria phaseoloides* and thai lazzabati-*Mimosa invisa*) were broadcast and shruby crop (arhar-*Cajanus cajan*) seed sown as intercrop in new established rubber plantation.
h. Data analysis and report writing	h. Data were analyzed and compiled

1.9   **Achievement**   : Established 1.5 acre experimental rubber plantation at Dantmara Rubber Estate, Fatikchari, Chittagong.

1.10   **Financial Statement**   :
1.10.1 Total cost   : Tk. 5,00,000.00
1.10.2 Cost of the year   : Tk. 1,61,420.00
1.10.3 Expenditure of the year   : Tk. 1,61,420.00
1.10.4 Source of fund   : GOB

1.11   **Beneficiaries**   : BFIDC and private rubber planters
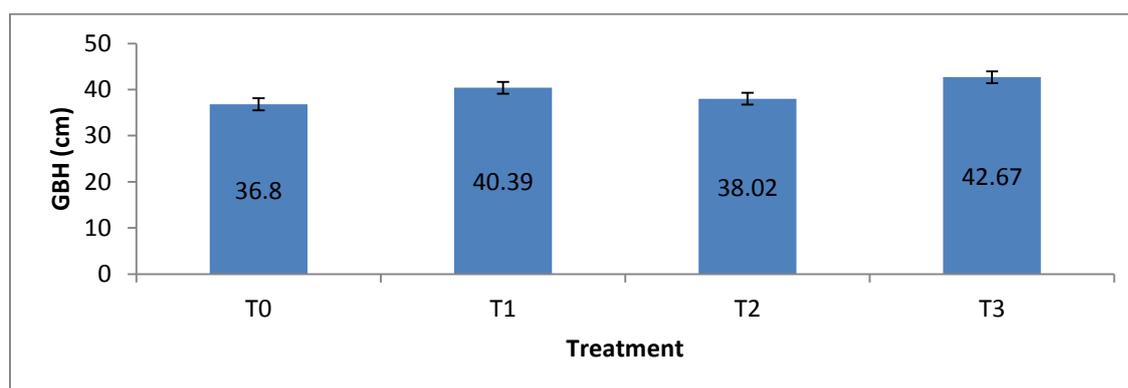
Fig. 1: Average girth at breast height (GBH) of rubber plantation in different cover and inter Crops (expt. 1)

T_0: Rubber plantation (control)
T_1: Pueraria as a cover crop in rubber plantation
T_2: Arhar as a inter crop in rubber plantation
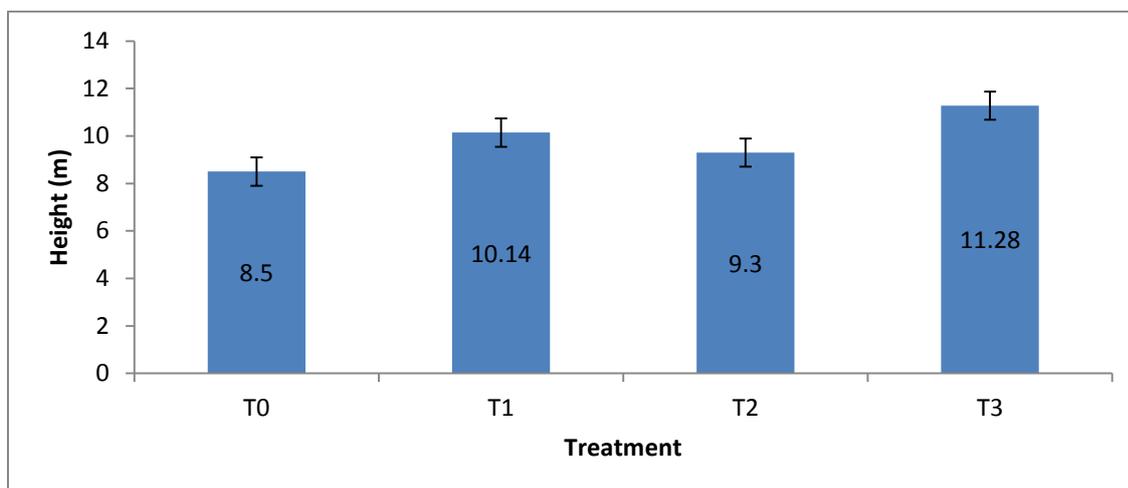T_3: Thai lazzabati as a cover crop in rubber plantation

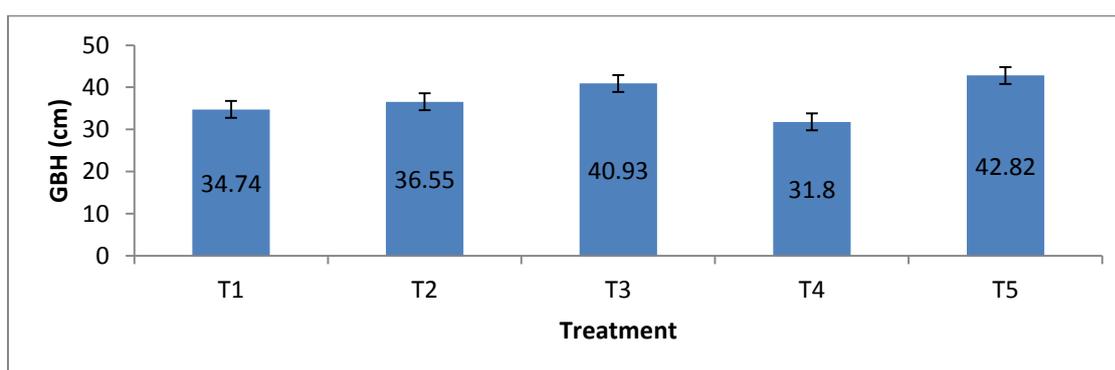**Fig. 2:** Average height (m) of rubber plantation in different cover and inter crops (expt. 1)

Fig. 3: Average girth at breast height (GBH) of rubber plantation in different treatments(expt. 2)

T_1: Rubber leaf litter compost (2 kg/tree)
T_2: Rubber leaf litter + comdung compost (2 kg/tree)
T_3: Rubber leaf litter + PKS fertilizer compost (2 kg/tree)
T_4: Rubber leaf litter + rubber effluent compost (2 kg/tree)
T_5: NPK fertilizer (50 g urea + 30 g TSP + 20 g MP/tree)
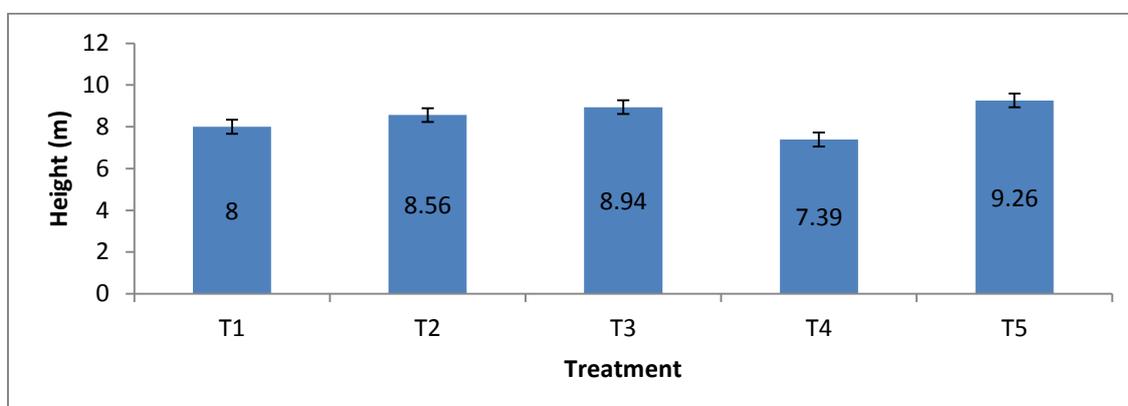
Fig. 4: Average height (m) of rubber plantation in different treatments (expt. 2)
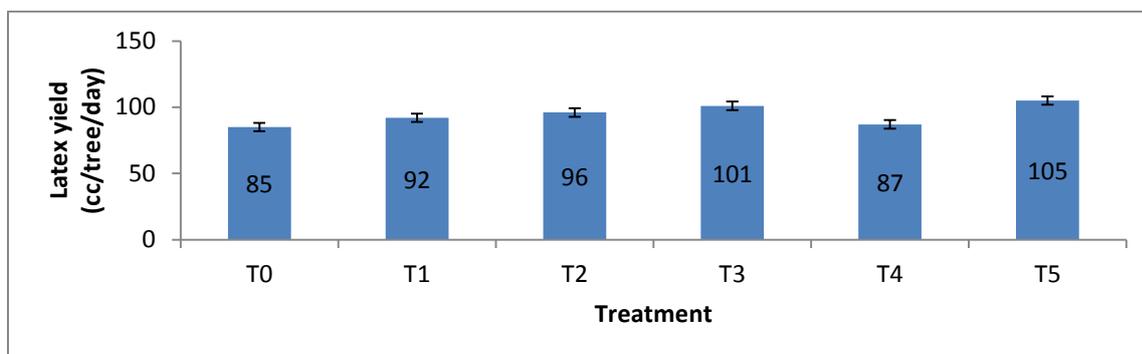
Fig. 5: Average latex yield (cc/tree/day) of rubber plantation in different treatments (expt. 3)

T_0: Control

T_1: Rubber leaf litter compost (4 kg/tree)

T_2: Rubber leaf litter + comdung compost (4 kg/tree)

T_3: Rubber leaf litter + PKS fertilizer compost (4 kg/tree)

T_4: Rubber leaf litter + rubber effluent compost (4 kg/tree)

T_5: NPK fertilizer (150 g urea + 100 g TSP + 100 g MP/tree)

2. **Study** : On-going

2.1 **Programme Area** : Soil conservation and watershed management

2.2 **Title of the Study** : Assessment of carbon storage trends in the soil-plant system in different forest areas

2.3 **Justification :** The forest plays a critical role in global carbon cycle and offer significant potential to capture and hold carbon, thus forming an important climate change mitigation option. Although, deforestation contributes to about 1.6 Gt C per year, thus provides a large mitigation opportunity to stabilize greenhouse gases (GHG) concentration (2 to 4 Gt C annually) in the atmosphere (Scholes and Noble, 2001) along with significant benefits. As tree grow and their biomass increases, they absorb carbon from the atmosphere and store it the plant tissues (Mathews et. al., 2000) resulting in growth of different parts. Active absorption of CO_2 from the atmosphere in photosynthetic process and its subsequent storage in the biomass of growing trees or plants is the carbon storage (Baes et. al., 1977). In terms of atmospheric carbon reduction, trees in urban areas offer the double benefit of direct carbon storage and stability of natural ecosystem with increased recycling of nutrient along with maintenance of climatic conditions by the biogeochemical processes.

Soil carbon level is expected to decrease due to increased net primary production. The quality of soil organic matter may also shift where more inert components of the carbon pool prevail. An increased risk of soil erosion and nutrient loss due to reduced vegetation cover in combination with episodic rainfall and greater wind intensities is expected. A shift in land suitability for farming due to greater significance of soil texture on plant / soil-water dynamics and plant available water is likely. Transient salinity may be increased. Soil biology and microbial population are expected to change under conditions of elevated carbon dioxide and changed moisture and temperatures regimes (Nuttall, 2007).

Assessment of aboveground carbon content in different forests is essential to evaluate soil carbon status to prepare useful database and its change over time. This will contribute to improved forest management as well as appropriate land use in the changing environment. In view of this the present research work was undertaken.

2.4 **Objectives** :

2.4.1 To determine carbon storage of different forest tree species and adjacent soil

2.4.2 To assess the correlation between soil and plant system on carbon storage trends

2.5 **Expected output:** Prepared data bank on carbon storage trends from different forest tree species and soil

2.6	**Study period**	:
2.6.1	Starting year	: 2010-11
2.6.2	completion year	: 2016-17
2.7	**Personnels**	:
2.7.1	Study leader	: Md. Motiar Rahman, Senior Research Officer
2.7.2	Associates	: Syeeda Rayhana Meery, Divisional Officer
2.8	**Progress**	:

2.8.1 Previous years (2015-16)   : Organic carbon content of 25 (twenty five) species (12 mangrove and 13 hill & plain land forest species) and soil samples from adjacent selected tree species were analyzed and recorded.

2.8.2   This year   :

Activities of the study	Progress
a. Root, stem, branch, twig and leaf samples from one forest species will be collected at different forest areas for determination of carbon content	a. Root, stem, branch, twig and leaf samples of lambu (*Khaya anthotheca*) forest tree species from different locations of Jessore (Benapole, Jhikorgacha and Sharsha Upazila) district were collected and analyzed for carbon content (Table 1).
b. Soil profile will be excavated and soil samples will be collected from adjacent selected trees	b. Soil profiles were excavated and composite soil samples under 0-15 and 15-30 soil depth at each selected tree species were collected and analyzed (Table 2).
c. Soil and plant samples will be analyzed	c. Soil and plant samples were analyzed and completed.
d. Data analysis and report writing	d. Data were analyzed and compiled.

2.9   **Achievement:** Carbon content of twenty six forest tree species were assessed for preparartion of data bank.

2.10	**Financial Statement**	:
2.10.1	Total cost	: Tk. 6,00,000.00
2.10.2	Cost of the year	: Tk. 1,38,580.00
2.10.3	Expenditure of the year	: Tk. 1,38,580.00
2.10.4	Source of fund	: GOB
2.11	**Beneficiaries**	: FD, NGO and academicians

Table-1: Average carbon content (%) of lambu (*Khaya anthotheca*) tree species from different locations of Jessore district

Location	Age group (Years)	Carbon content (%)					
		Leaf	Twigs	Branch	Stem	Root	Mean
Gantipara, Sharsha	1-5	49.75	53.13	-	54.76	54.36	53.00
Gantipara, Sharsha	6-10	51.48	53.34	53.71	53.17	54.38	53.22
Durgapur, Benapole	11-15	50.62	53.55	54.53	55.13	55.55	53.86
Bagachra, Sharsha	16-20	51.53	52.90	52.98	55.77	54.66	53.57
Godkhali, Jhikorgacha	21-25	52.76	53.88	55.82	56.50	54.62	54.72
Mean		**51.23**	**53.36**	**54.26**	**55.07**	**54.71**	**53.67**

Table-2: Soil organic carbon content (%) at adjacent selected tree species different locations of Jessore district

Location	Age group (Years)	Bulk density (g/cm3)		Organic carbon (%)		Total carbon (t/ha.)	
		0-15	15-30	0-15	15-30	0-15	15-30
Gantipara, Sharsha	1-5	1.45	1.34	0.45	0.22	9.78	4.42
Gantipara, Sharsha	6-10	1.45	1.34	0.45	0.30	9.78	6.03
Durgapur, Benapole	11-15	1.44	1.43	0.52	0.30	11.23	6.43
Bagachra, Sharsha	16-20	1.37	1.35	0.52	0.45	10.69	9.11
Godkhali, Jhikorgacha	21-25	1.61	1.58	0.56	0.23	13.52	5.45

3.   **Study**   : New

3.1 **Programme Area**   : Soil conservation and watershed management

3.2 **Title of the Study** : Effect of acacia and eucalyptus tree species on soil properties in three Agro Ecological Zones (AEZs) of Bangladesh

3.3 **Justification :** Fast growing tree plantations, mainly *Eucalyptus* spp., *Pinus* spp. and *Acacia* spp. are widespread in tropical countries. This has been a controversial topic, some arguing that these species exhaust soil water and nutrient resources, and prevent understorey vegetation growth, thus resulting in decreased biodiversity and in further soil erosion and loss of fertility. Several regional meetings have debated these issues, and an abundant literature has emerged from the 1991, 1995 and 1997 meetings of the International Union of Forestry Research Organizations (IUFRO). The IUFRO work focused on assessing the environmental impact of exotic tree plantations compared to other ecosystems, native or planted. Four main issues were considered.

The first issue, concerning biodiversity, was addressed during the World Bank Biodiversity Rehabilitation Project, which examined the hypothesis that tree plantation can catalyze biodiversity rehabilitation on degraded tropical lands. Mainly conducted on sites with degraded soils and vegetation, these studies found fast growing tree plantations (eucalyptus and other species) helped regeneration of undergrowth plants from surrounding forests, thus increasing biodiversity and fertility.

The second issue, dealt with nutrient requirement and nutrient cycling. It was shown that nutrient requirements of eucalypt and pine stands were of the same order to magnitude and were generally higher than those of native ecosystems. However nutrients outputs resulting from harvest varied greatly according to species and harvest practices for the previous stand. Nutrients needed for stand growth were provided primarily through nutrient cycling by litter fall and internal fluxes. These processes allowed a satisfactory tree growth on nutrient-poor soils.

The third issue dealt with changes in the physico-chemical properties of the soils. Comparisons were made between mono-specific eucalypt stands with mono-specific stands of other tree species, mixed stands eucalypts and nitrogen fixing trees or the previous vegetation. The general trend in these studies was a decrease of soil Ca and N under eucalypt or pine monoculture. However, the introduction of N fixing species improved N balance and tree growth.

The fourth issue concerned the water needs of exotic plantations, especially in the eucalypt plantations. It was shown that water use efficiency depended on water availability and on genetic origin of the planted trees. Hydrological studies carried out in several countries showed a decrease in stream flows when tree plantations were grown in the watersheds, and this decrease was greater with eucalypt than with pine, although

pines exhibit a lower water use efficiency. Such results could guide the choice of the species to be grown. Considering the issues, the present study has undertaken to fulfill the following objectives.

3.4   **Objectives**   :

3.4.1 To observe the change of soil properties occurred due to the acacia and eucalyptus tree plantations

3.4.2 To find out the relationship between the tree growth of acacia and eucalyptus tree species and soil properties

3.5   **Expected output**   : Impact of acacia and eucalyptus tree species on soil properties

3.6   **Study period**   :

3.6.1 Starting year   : 2016-17

3.6.2 Completion year   : 2018-19

3.7   **Personnels**   :

3.7.1 Study leader   : Md. Motiar Rahman, Senior Research Officer

3.7.2 Associates   : Syeeda Rayhana Merry, Divisional Officer

3.8   **Progress**   :

3.8.1 Previous years (if any)   : Not applicable

3.8.2 This year   :

Activities of the study	Progress
a. Site selection	Four sites namely Dantmara, Fatikchari & Ranirhat, Rangunia (AEZ-29), Dokhola, Madhupur, Tangail (AEZ-28) and Kotbari, Comilla (AEZ-19) were selected for soil samples and data collection.
b. Excavation of soil profile for identification of different soil horizon in each site from different plantations	Eighty four soil profiles (21 from each site) were excavated for identification of different soil horizon from different plantations.
c. Collection of soil core samples from each horizon in each site for determination of bulk density, moisture content and soil texture	One thousand eight (1008) numbers core soil samples were collected for determination of bulk density, moisture content and soil texture.
d. Collection of composite soil samples from each horizon for determination of soil macro (total N and available P, K, S, Ca & Mg) and micro (available Fe, Zn, Cu, B, Mn) nutrient elements	Three hundred thirty six (336) numbers composite soil samples were collceted fot determination of soil macro and micro nutrient elements.
e. Collection of tree growth parameter including age, height and girth at breast height (GBH)/ diameter at breast height (DBH) from each site in different plantations	Data on tree growth parameters like GBH and age were collected from each selected plantations and each site.
f. Soil sample processing and analysis	Soil sample processing is going on. After processing the samples will be send to Soil Science Division of BARI, Gazipur for analysis of soil macro and micro nutrient elements.
g. Data analysis and report writing	Data analysis is going on.

3.9   **Achievement**   : Not applicable

3.10 **Financial Statement**   :

3.10.1 Total cost   : Tk. 15,00,000.00

3.10.2 Cost of the year   : Tk. 6,38,200.00

3.10.3 Expenditure of the year : Tk. 6,38,200.00

3.10.4 Source of fund   : GOB

3.11 **Beneficiaries**   : FD, researchers and academicians

Wildlife Section

1.   **Study**   : On-going (Extension)
1.1   **Programme Area** : Biodiversity and conservation
1.2   **Title of the Study** : Mammalian species diversity in Hazarikhil wildlife sanctuary of Bangladesh

1.3   **Justification :** Bangladesh is a transitional zone for the flora and fauna of the subcontinent and that of Southeast Asia (Stanford 1991). The distributional ranges of many wildlife species typical to each of these two biotic sub-regions overlap in Bangladesh, making the country's wildlife very diverse. Bangladesh is the home of 36 species of amphibians, 154 species of reptiles, 690 species of birds and 121 species of mammals (Feeroz et al. 2012). Most of these species are restricted to the forest areas especially the protected areas (Feeroz, 2013). A total of 37 protected forest areas have been established in Bangladesh of which 20 are National Park and 17 are Wildlife Sanctuary (Feeroz, 2013).

However, the wildlife diversity of Bangladesh is under tremendous pressure due to different anthropogenic effects. Twelve species of wild animals have become extinct from the wild over the last century of which 9 are mammals (Feeroz, et al. 2012). Most of the extant species of Bangladesh are facing different categories of threats. Mammals especially primates, civets and squirrels play a vital role for the expansion of natural forest through seed dispersion (Chapman, 1995). Hazarikhil is one of the Wildlife Sanctuaries of Bangladesh. Recently Bangladesh Forest Research Institute took a step to estimate avian species diversity of Hazarikhil WS and recorded 118 avian species. There is very few or no information on mammalian diversity of Hazarikhil WS. Thus the study is planned to estimate the mammalian diversity in this wildlife sanctuary. However, the proposed research has been designed to achieve the following aims and objectives.

1.4   **Objective(s)**   :
1.4.1 To find out mammalian species diversity of Hazarikhil WS.
1.4.2 To estimate the population density of these mammalian species.
1.4.3 To identify major threats to the mammalian species in this WS.
1.4.4 Wildlife specimen collection & Preservation.

1.5   **Expected output :** Informations will help to Develop a management plan for sustainable conservation for mammalian species.

1.6   **Study Period**   :
1.6.1 Starting year   : 2015-2016
1.6.2 Completion year   : 2017-2018
1.7   **Personnel**   :
1.7.1 Project Leader: : Md.Anisur Rahman, SRO
1.7.2 Associates   : S. M Rabiul Alam, SRO; M. K. Islam, RA -1; S.M. Mainuddin, FI
1.8   **Progress**
1.8.1 Previous years, if any: Periodical surveys following sample line transect method and camera trapping 18 species of mammals were recorded.
1.8.2 This year   :

Activities of the study	Progress
a) Field visit for establishing trails.	Field visits were done Eight times in Hazarikhl WS areas. During survey GPS was utilized to determine transects position and coverage areas in the National Park region. A total of seven (07) transects were established.
b) Baseline survey for Mammalian species.	Periodical survey were made in the Hazarikhil Wildlife Sanctuary following sample line transect method. Binocular and camera were used for observation and pictures collection of mammals. Camera trap were used for nocturnal mammalian species during survey 33 species of mammals were recorded.
c) Report writing and printing.	Report writing is going on. Three display boards have been printed.

1.9   **Achievement (s), if any : N/A**
1.10   **Financial statement**   :
1.10.1 Total cost   **:** Tk.   8, 00, 000.00
1.10.2 Cost of the year   **:** Tk.   3,40,220.00
1.10.3 Expenditure of the year   **:** Tk.   1,40,220.00
1.10.4 Source of fund   **:** GOB.
1.11   **Beneficiaries:** Researchers, students and teachers of different educational institutions and Forest Department / NGOs

2.   **Study**   : On-going

2.1   **Programme Area**   : Biodiversity and conservation

2.2   **Title of the Study** : Survey of Nocturnal Mammals in Bangabandhu Sheikh Mujib Safari Park, Cox's Bazar using Camera Trap.

2.3   **Justification : N/A**

2.4   **Objective(s)**   :
2.4.1 To evaluate the status of nocturnal mammals.
2.4.2 To find out the active area for targeted species.
2.4.3 Wildlife specimen collection & Preservation.
2.5   **Expected output :** Formulation of conservation measures to conserve nocturnal mammals of Dulahazra Safari Park.

2.6   **Study Period**   :
2.6.1 Starting year   **:** 2016-2017
2.6.2 Completion year   **:** 2017-2018

2.7   **Personnel**   :
2.7.1 Project Leader: **:** S.M. Rabiul Alam, SRO
2.7.2 Associates   **:** M.A. Rahman, SRO; M. K. Islam, RA -1; S.M. Mainuddin, FI
2.8   **Progress**
2.8.1 Previous years, if any: N/A
2.8.2 This year   **:**

Activities of the study	Progress
a) Installation of camera trap.	6 camera traps were installed in each fieldtrip in 12 locations.
b) Status survey for nocturnal mammals.	Periodical survey were made. Camera trap were used for nocturnal mammalian species during survey 04 species of mammals were recorded.
c) Data analysis & report preparation.	Data analysis & report writing will be done.

2.9   **Achievement (s), if any : N/A**
2.10   **Financial statement**   :
2.10.1 Total cost   **:** Tk.   3,90,000.00
2.10.2 Cost of the year   **:** Tk.   -
2.10.3 Expenditure of the year   **:** Tk.   1,71,630.00
2.10.4 Source of fund   **:** GOB.

2.11   **Beneficiaries:** Researchers, students and teachers of different educational institutions and Forest Department / NGOs

3.   **Study**   : On-going
3.1   **Programme Area**   : Biodiversity and conservation
3.2   **Title of the Study**   : Population Status and Conservation of Nocturnal Mammals and
                                     Birds in BFRI Campus
3.3   **Justification :** N/A
3.4   **Objective(s)**   :
3.4.1 Determine the population status of birds and nocturnal mammals.
3.4.2 Take conservation measures to conserve targeted species.
3.4.3 Wildlife specimen collection & Preservation.
3.5   **Expected output :** Ensure suitable habitat for targeted species.

3.6   **Study Period**   :
3.6.1 Starting year   : 2016-2017
3.6.2 Completion year   : 2019-2020
3.7   **Personnel**   :
3.7.1 Project Leader: : S.M. Rabiul Alam, SRO
3.7.2 Associates   : M.A. Rahman, RO; M. K. Islam, RA -1; S.M. Mainuddin, FI
3.8   **Progress**
3.8.1 Previous years, if any: N/A
3.8.2 This year   :

Activities of the study	Progress
a) Installation of camera trap and status survey for nocturnal mammals.	6 camera traps were installed in 14 locations. Camera trap were used for nocturnal mammalian species during survey 04 species of mammals were recorded.
b) Establishment of Sampling Transects for bird survey.	3 Sampling Transects were established for bird survey.
c) Regular bird survey for density estimation.	Regular bird survey (06) in each month for density estimation.
d) Habitat improvement of birds and nocturnal mammals.	50 Artificial nests were created for birds breeding facility.
e) Data analysis & report preparation.	Data analysis & report writing will be done.

3.9   **Achievement (s), if any** : N/A
3.10   **Financial statement**   :
3.10.1 Total cost   : Tk.   7,00,000.00
3.10.2 Cost of the year   : Tk.   -
3.10.3 Expenditure of the year   : Tk.   2,31,225.00
3.10.4 Source of fund   : GOB.
3.11   **Beneficiaries:** Researchers, students and teachers of different educational institutions and
                          Forest Department / NGOs

FOREST PRODUCTS WING

Forest Chemistry Division

1.	**Study**	:	On-going
1.1	**Programme Area**	:	Post Harvest Utilization-Chemical Processing.
1.2	**Title of the Study**	:	Artificial Inoculation of Agar wood (*Aquilaria malaccensis* Lam.) by Chemical Inducing Agent(s).

1.3 **Justification : NA**

1.4 **Objective(s)** :

1.4.1 To explore an efficient and suitable chemical inducing agent(s) for the artificial inoculation of agar tree.

1.4.2 To develop and optimize the inoculation technique for the best formation of agar resins.

1.4.3 To investigate the origin or process of agar resin deposition.

1.5 **Expected output** : Explore an artificial chemical inducement technique for the best formation of agar resin within short period and effect of age and location factor for better agar resin formation.

1.6	**Study Period**	:	
1.6.1	Starting year	:	2014-2015
1.6.2	Completion year	:	2018-2019
1.7	**Personnel**	:	
1.7.1	Project Leader:	:	M. Jakir Hossain, SRO
1.7.2	Associates	:	S. Akhter, Director, BFRI; Syeeda Rayhana Merry, DO; M. S. Rahman, RO; S. C. Nath, RA (Gr.-1); M. Saidur Rahman, SO (BCSIR Laboratories, Chittagong)

1.8 **Progress**

1.8.1 Previous years, if any: Around 10 types of individual or blended chemical inducing agents or synthesized nanoparticles hydrosols were applied into 10 agar trees at different areas of Bangladesh namely: Korerhat agar wood Garden, Mirsarai, Chittagong, Fashiyakhali agar wood Garden, Cox's Bazar; Holudia agarwood Garden, Bandarban, Minister agar wood Garden at Banshkhali, Chittagong and BCSIR Laboratories Chittagong Campus, agar wood trees with the help of scientists of Bangladesh Council of Scientific and Industrial Research Laboratories, Chittagong. All of the inoculated trees were visited several times after inoculation. From the investigation it was observed that most of the inocula were effective for agar resin generation and within three to six months, after inoculation the white wood became black around the zone of application and mostly in the longitudinal direction as shown in Fig.1. But, after 18 months the initially formed black wood became rotten which make the tree hollow and weak. Interestingly, a new layer of agar with improved quality was formed around the hollow part.
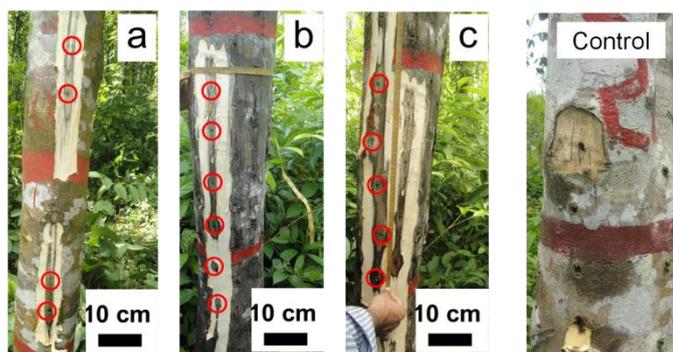

Fig.1. The black discoloration indicates the deposition of agar resins after application of chemical inducing-agents after six months. (a) and (b) Holudia agar wood Garden, Bandarban district. (c) Fashiyakhali agar wood Garden, Cox's Bazar.

Fig.2. Initially formed agar or resin was destroyed and a new layer of agar with improved quality were formed around the hollow part.

1.8.2 This year   :

Activities of the study	Progress
a. Preparation of nanoparticles for inducement.	Around 30 types of individual or blended chemical inducing agents or synthesized nanoparticles hydrosols were prepared.
b. In vitro application of suitable chemical inducing agent(s) as well as nanoparticles.	As prepared inocula were in 20 plants at six agarwood gardens
c. Quantification and analysis of formed agar wood resin.	The formed agar was quantified by physical and eye estimation method.

According to the work plan of 2016-17, total 30 (thirty) artificial agarwood inoculation experiments were carried out in 20 (twenty) plants at 6 (six) agarwood gardens. Among the experiments, water soluble different chemical inocula and iron oxide hydrosol inocula of different concentrations were applied as shown in the following table. The experimented trees were observed time to time. Of the experiments, agar formation was detected in ten experiments. Interestingly, better quality agar was formed due to the effect of iron oxide hydrosols with full success as shown in the below picture.

Table: Table shows the inoculation experiments at 2016-17 fiscal year.

SN	Garden	Chemical	Concentration (mM)	Quantity (mL)	Remarks
1.	**Holudia, Bandarban**	IONP Hydrsol stabilized with citric acid	0.25	500	Formed
2.			0.50	500	Formed
3.			1.00	500	Formed
4.	**Fashiyakhali, Cox's Bazar**	Ferrous sulfate	Saturated	1	Formed
5.		Ferric sulfate	Saturated	1	Formed
6.		Mixture of ferrous sulfate and ferric sulfate	Saturated	1	Formed
7.	**Korerhat, Chittagong**	Ferric chloride	0.25	1000	Rotten
8.			0.50	1000	Rotten
9.			1.00	1000	Rotten
10.	**Banskhali, Chittagong**	Mixture of ferrous sulfate and ferric chloride	0.25	1000	Not observed
11.			0.50	1000	Not observed
12.			1.00	1000	Not observed

13.		IONP Hydrsol stabilized with citric acid	0.50	500	Formed
14.			1.00	500	Formed
15.		Sodium sulfate	Saturated	1	Formed
16.		Sodium chloride	0.50	500	No change
17.			1.00	500	No change
18.		Ferrous chloride	0.25	500	Rotten
19.			0.50	500	Rotten
20.	**BCSIR Laboratories, Chittagong**		1.00	500	Rotten
21.		Ferric chloride	0.25	500	Rotten
22.			0.50	500	Rotten
23.			1.00	500	Rotten
24.		Mixture of ferric chloride and sodium chloride	0.25	500	Rotten
25.			0.50	500	Rotten
26.			1.00	500	Rotten
27.		Mixture of ferrous chloride and sodium chloride	0.25	500	No change
28.			0.50	500	No change
29.			1.00	500	No change
30.	**Baghaichhari, Rangamati**	Chisel Burning Method	Create holes by burning of standing trees		Started forming

Fig. 3. Application of Fe3O4 hydrosol to agarwood tree.

1.9   **Achievement (s), if any :** Application of IONPs inocula accelerates agar resin formation.

1.10   **Financial statement**   :
1.10.1   Total cost   : Tk.   10, 00, 000.00
1.10.2   Cost of the year   : Tk.   2,30,200.00
1.10.3   Expenditure of the year   : Tk.   2,30,200.00
1.10.4   Source of fund   : GOB.

1.11   **Beneficiaries:** FD, Agar producers and traders, community people.

2.   **Study**   : On-going
2.1 **Programme Area**   : Post Harvest Utilization-Chemical Processing.
2.2 **Title of the Study** : Phytochemical analysis and antioxidant potential of five
                                indigenous medicinal plants.
2.3 **Justification : N/A**
2.4 **Objective(s)**   :
2.4.1 To estimate the phytochemicals qualitatively in medicinal plants.
2.4.2 To determine the antioxidant potential for assessment their efficacy.
2.5 **Expected output** : Effort to explore new medicinal species with the help of taxonomist
     that/those have higher antioxidant properties. Also search for better antioxidant properties
     rich but less explored medicinal plants in Bangladesh.
2.6 **Study Period**   :
2.6.1 Starting year   : 2014-2015
2.6.2 Completion year   : 2016-2017
2.7 **Personnel**   :
2.7.1 Project Leader: : M. Jakir Hossain, SRO
2.7.2 Associates   : Syeeda Rayhana Merry, SRO; M. S. Rahman, RO; S. C. *Nath*, RA (Gr.-1)
2.8 **Progress**
2.8.1 Previous years, if any: Five less explored medicinal plants viz. (a) Ashoke *(Sara caasoca),*
       (b) Khonachhal (*Oroxylum indicum),* (c) Dudhiya *(Euphorbia hirta),* (d) Mutha/VadalGhas
       (*Kyllinga nemoralic)*, (e) Shetodrone (*Leucas indica / aspara)* samples were collected and
       dried in shade and also preserved for extraction and antioxidant value determination related
       works. Of them, three sample (a, b & c) were analyzed. Literature review and methodology
       preparation for rest of two sample analysis have done.

2.8.2 This year   :

Activities of the study	Progress
a) Explore and collection of five medicinal plants on priority basis	Five less explored medicinal plants viz. (a) Ashoke *(Saraca asoca),* (b)Khonachhal (*Oroxylum indicum),* (c) Dudhiya *(Euphorbia hirta),* (d) Mutha/Vadal Ghas (*Kyllinga nemoralic)*, (e) Shetodrone (*Leucas indica/aspara)* samples were collected
b) Solvent extraction of plant materials for phytochemical analysis	Two reference species (Basak & Shuti) and two samples (Ashoke & Khonachhal) were analyzed. Literature review and methodology preparation for rest of three samples analysis have done.
c) Screening of phytochemicals by qualitative and quantitative methods	Phytochemical screening of two samples was carried out.
d) Qualitative and quantitative determination of antioxidant activity through standard test method	Preparation of methodologies for carrying out experiments has been completed.

Five less explored medicinal plants viz. (a) Ashok *(Saraca asoca),* (b) Khonachhal (*Oroxylum indicum),* (c) Dudhiya *(Euphorbia hirta),* (d) Mutha/Vadal Ghas (*Kyllinga nemoralic)*, (e) Shetodrone (*Leucas indica/aspara)* samples were collected. After pulverizing the dried samples by with wileymill, chemical analysis was carried out. Following reported protocols, phytochemical analysis and antioxidant potential were determined. It was observed that most of the experimented plants contain alkaloids, glycosides, flavonoids, tannins, terpenes, phenolic compounds and some of them contain carbohydrates, amino acids and quinines. Antioxidant potential determination of the samples were carried out by 2,2-diphenyl-1-picrylhydrazyl

(DPPH) radical scavenging method, where ascorbic acid used as standard and antioxidant efficacy was calculated according to the following equation-

$$AA\% = 100 - \left[\frac{(Abs_{sample} - Abs_{blank})x100}{Abs_{control}}\right]$$

Maximum antioxidant activity was observed for Khonachhal (80±2%), whereas minimum activity was observed for Vadal Ghas (68±3%). All samples contain moderate quantity of poly-phenols, those are responsible for their antioxidant activity.

Table :Phytochemical Screening Results (Last Year) :

No.	Phytochemicals	Khona sal	Ashok	Shuti	Basak
1	Alkaloids	P	P	P	P
2	Glycosides	A	P	P	P
3	Flavonoids	P	A	P	P
4	Tannins	P	P	P	P
5	Phlobatannins	A	A	A	P
6	Terpenes	P	P	P	P
7	Tri-terpenes	A	A	P	A
8	Phenolics	P	P	P	P
9	Steroids	P	A	P	A
10	Phytosteroids	P	A	P	A
11	Carbohydrates	P	A	P	P
12	Proteins	P	A	P	P
13	Amino acids	A	A	P	A
14	Quinones	A	P	A	A

2.9 **Achievement (s), if any : N/A**
2.10 **Financial statement   :**
2.10.1 Total cost   **:** Tk.   5,00,000.00
2.10.2 Cost of the year   **:** Tk.   2,69,800.00
2.10.3 Expenditure of the year **:** Tk.   2,69,800.00
2.10.4 Source of fund   **:** GOB.
2.11 **Beneficiaries:** Pharmaceuticals and Ayurvedic Industries, Medicinal plants producers and traders.

3. **Study**   : New
3.1 **Programme Area** : Post Harvest Utilization-Chemical Processing.
3.2 **Title of the Study** : Popularization of agar deposition and oil extraction techniques of agar plant.
3.3 **Justification :** Agarwood, a non-timber forest product used as fragrance, medicine, incense, aromatherapy and religious ceremonies from the ancient time. The healthy agarwood is a white, soft, even-grained, and not scented when freshly cut. Under certain external factors or pathological conditions, the heart wood becomes saturated with resin, and eventually becomes hard to very hard. The process of agar-resin deposition is not fully understood yet, but the existence of an exposed, open wound seemed to be of more important for the formation of resin which is accelerated by the presence of iron or iron oxides. It was also observed that period and way of nailing, nail size and their pretreatment could affect the yield and quality of agar formation.

The natural production of agar requires long time. The traditional iron nailing technique is still popular in Bangladesh and is commercially profitable according to different reports. Even though agarwood plantation is rapidly increasing, however most of the new planters hardly know either its inoculation or extraction process. Forest Chemistry Division of BFRI modified the existing agar oil extraction technique. Following this technique the extraction yield was increased by ~50% as well as the distillation time was decreased from 30 days to 10 days.

The present study is undertaken to inform and train up the new planters across Bangladesh on: (a) Inoculation of agarwood plants by iron nailing method following a better technique, (b) Harvesting and oil extraction process from resin-rich wood, and (c) Gradation of agarwood and agar-oil according to their resin deposition/quality by physical testing.

3.4 **Objective(s)** :
3.4.1 To disseminate artificial agarwood inoculation techniques for better resin deposition.
3.4.2 To promote efficient extraction process of agar oil from wood.
3.5 **Expected output :** New agarwood planters will be informed about artificial inoculation as well efficient oil extraction technique. Export of agar products will be increased.
3.6 **Study Period** :
3.6.1 Starting year : 2016-2017
3.6.2 Completion year : 2018-2019
3.7 **Personnel** :
3.7.1 Project Leader: : M. S. Rahman, (RO)
3.7.2 Associates : M. Jakir Hossain, (SRO); M. Zillur Rahman.(RA Gr-1);
S. C. Nath (RA Gr.-1)

3.8 **Progress**
3.8.1 Previous years, if any: Not Applicable
3.8.2 This year :

Activities of the study	Progress
a. Site selection; total three sites.	Three sites viz. Kapkai, Rangamati; Hiyanko, Fatichhari, Chittagong and Lama, Bandarban were selected.
b. Preparation of training materials	Training materials such as bulletin, poster, leaflet, power point presentation, etc. were prepared.
c. Arrangement of trainings / workshops collaborating with all stakeholders: Forest Department, cultivators, local NGOs and local administrations.	Three trainings / workshop programmes on agar production, extraction and utilization were conducted at Kapkai, Rangamati; Hiyanko, Fatichhari, Chittagong and Lama, Bandarban. In all, over 90 new agar planter /agar producers and traders were trained.

Agarwood is a dark resinous heartwood that is extremely rare. Although Bangladesh and part of India were the primary source of agar in ancient time, however over exploitation make this genera extinct in the natural forest globally. Due to various initiatives from government and private sector, there are large numbers of plantations in different areas of Bangladesh, especially in hilly regions. Unfortunately, most of the cultivators have no idea of its artificial inoculation, extraction, quality assessment and marketing process. Interestingly, they never seen agar or its derivatives except in newspaper, books, mobile or television. They only know that it is a profitable forest species. Moreover, there is no exact data of the agarwood plantations in Bangladesh. This study was undertaken considering these points.

We arranged three day-long workshops at three newly planted locations- (a) Kaptai, Rangamati; (b) Heyanko, Fatikchhari, Chittagong; and (c) Lama, Bandarban. All workshops had two sessions- (a) Lecture session: Consists of three lectures with multimedia presentation on agarwood prospect, plantation, management, artificial inoculation, harvesting, oil extraction and

marketing; and (b) Open discussion session: Plantation problem, paste management, inoculation technology were mostly discussed. In each workshop, more than 30 planters, local government representatives, representatives from Forest Department and Bangladesh Forest Industries Development Corporation were participated.

3.9   **Achievement (s), if any : N/A**
3.10   **Financial statement**   **:**
3.10.1 Total cost   **:** Tk.   8,00,000.00
3.10.2 Cost of the year   **:** Tk.   2,00,00.00
3.10.3 Expenditure of the year   **:** Tk.   2,00,00.00
3.10.4 Source of fund   **:** GOB.
3.11   **Beneficiaries:** Forest Department, New agar producers and traders.

Fig.1. Day-long workshop at Kaptai, Rangamati.

Fig.2. Day-long workshop at Heyanko, Fatikchhari, Chittagong.

Fig.3. Day-long workshop at Lama, Bandarban.

Pulp and Paper Division

1.	**Study**	:	On-going
1.1	**Programme Area**	:	Post Harvest Utilization – Chemical Processing
1.2	**Title of the Study**	:	Production of nano composite from fibers of *Acacia hybrid* and simul (*Bombax ceiba*) tree species of Bangladesh.

1.3 **Justification :** Cellulose is the most abundant natural polymer and has been receiving great attention as nano materials. Nano cellulose is materials composed of nano sized cellulose fibrils with width less than 20 nm. Products from nanocellulose are highly durable, renewable, biodegradable and environmental friendly. Nano cellulose enhances the fiber-fiber bond strength and makes paper materials more strong. It has also application as a barrier in grease proof type of papers, commodity type of paper, construction, automotive, furniture, electronics, pharmacy, pigment and cosmetics.

Like other countries, people of Bangladesh are using extensively the polythene related packing materials for their daily needs. These are non-degradable causing pollution to the soil and block drainage system. At present, all over the world the development of environment friendly material to maintain green environment is one of the great challenges for the researcher. It is expected that biodegradable plastic material made from nano particle could save environment and also have positive contribution towards national economy. With this aim this study has been undertaken. During planned period nano cellulose will be produced from two first growing tree species namely *Acacia hybrid* and simul (*Bombax ceiba*). These nano materials would be used for the development of packaging material.

1.4 **Objective(s)** :

1.4.1 To develop modern technique for extraction of nanocellulose from wood pulp.

1.4.2 To produce environment friendly packaging materials.

1.4.3 To produce ethanol from hemicelluloses of wood.

1.5 **Expected output :** Better utilization of pulping raw materials as environment friendly value added product.

1.6	**Study Period**	:	
1.6.1	Starting year	:	2013-2014
1.6.2	Completion year	:	2017-2018
1.7	**Personnel**	:	
1.7.1	Project Leader:	:	Md. Misbahuddin, FI.
1.7.2	Associates	:	Daisy Biswas, DO; Md. Didarul Alam Chowdhury, Lecturer, Department of Applied & Environment Chemistry, University of Chittagong; Mohammed Jakir Hossain, SRO; Nazma Khatun, RO and Urboshi Roy, FI.

1.8   **Progress**
1.8.1 Previous years, if any: The freshly cut *Acacia* hybrid and Simul tree was collected from Banshkhali, Chittagong with bark on. The chips were then air dried. Then the chips of *Acacia* hybrid were treated in water and Na_2CO_3. The chemical constituents of untreated and treated chips were determined.

Kraft pulps of *Acacia* hybrid and Simul tree were prepared with the untreated chips at 25% sulphidity by maintaining 2000 H-Factor. The alkali doses were varied from 14 to 18% at 2% increments. Soda pulps were prepared with and without anthraquinone. The black liquor of pulps were analysed for residual alkali. Kappa number of the pulps was determined

1.8.2 This year   :

Activities of the study	Progress
a) Determination of chemical constituent of simul ((**Bombax ceiba**).	Dust of simul wood was prepared. Dry matter content was determined and then cold and hot water solubility was evaluated.
b) Preparation of chemical pulp from simul chips by varying alkali dose and time	Kraft pulps from 10 kg chips of acacia hybrid and 8 kg chips of simul wood were prepared at 25% sulphidity level by maintaining 2000 H-Factor. The black liquor of pulps were analysed for residual alkali.
c) Determination of kappa number and yield	Kappa number of simul pulps was determined.
d) Preparation and characterization of nanocellulose from pulp/wood	Simul and Acacia hybrid pulps were beated at 5000 and 10000 rev. to produce nano cellulose. Chlorine dioxide (ClO_2) were prepared and strength were determined for bleaching.

1.9   **Achievement (s), if any : Nil.**
1.10   **Financial statement**   :
1.10.1 Total cost   **:** Tk.   7,50 000.00
1.10.2 Cost of the year   **:** Tk.   1,50,000.00
1.10.3 Expenditure of the year   **:** Tk.   1,50,000.00
1.10.4 Source of fund   **:** GOB.
1.11   **Beneficiaries:** Pulp, Paper and Pharmaceutical Industry.

2.   **Study**   : New
2.1   **Programme Area**   : Post Harvest Utilization – Chemical Processing
2.2   **Title of the Study**   : Suitability of *Acacia* hybrid and rubber tree (*Hevea brasiliensis*) for making hardboard
2.3   **Justification :** *Acacia mangium* and *Acacia auriculiformis* was introduced in Bangladesh as shade tree in tree gardens. The cross pollination of these species results *Acacia* hybrid. It is a fast growing medium sized leguminous tree. The species is more productive than either of the parent species. At present thousands of hectares of *Acacia* hybrid and rubber tree (*Hevea brasiliensis*) have been planted by Forest Department and also local people. In Bangladesh it has very limited use. Bangladesh Forest Research Institute has been conducting research to determine its end uses. To this end, hardboard making study is undertaken for knowing the suitability of the species.
2.4   **Objective(s)**   :
2.4.1 To investigate the suitability of *Acacia* hybrid and rubber tree (*Hevea brasiliensis*) for making hardboard
2.5   **Expected output** : Better utilization of raw materials for making hardboard, as environment friendly value added product.

2.6   **Study Period**   :
2.6.1 Starting year   : 2014-2015
2.6.2 Completion year   : 2017-2018

2.7   **Personnel**   :
2.7.1 Project Leader: : Nazma Khatun, RO.
2.7.2 Associates   : Md. Misbahuddin, FI; Urboshi Roy, FI. and Daisy Biswas, DO

2.8   **Progress**
2.8.1 Previous years, if any: The freshly cut *Acacia* hybrid logs were debarked and chipped. These were screened to remove oversized and pin chips. In addition, the knots, barks and decayed wood chips were removed The accepted chips were about 20 mm in length, 10 mm in width and 3 mm in thickness. The chips were cooked in steam for 30, 60 and 90 minutes in laboratory model stainless steel rotary digesters. The pressure at the time of experiment was 100 and 150 psi. Some of the chips were treated with NaOH, Na_2SO_3 and mixture of NaOH and Na_2SO_3 and then cooked. The steamed cooked chips were then defiberised in a single rotating disk attrition mill at different plate clearances. Three pulps of different freenesses were made from each cook. Then S-1-S hardboards were made. The sample of size 12.7 cm x 5.08 cm were prepared from the hardboards. These were conditioned and tested to determine water absorption, thickness swelling and modulus of rupture. Treated chips prior mechanical refining produce stronger hardboards than steamed cooked chips.

2.8.2 This year   :

Activities of the study	Progress
a) Treating of rubber chips with steam and chemicals	The chips of rubber stem were cooked in steam for 30, 60 and 90 minutes in laboratory model stainless steel rotary digesters. The pressure was 100 psi. Some of the chips were treated in chemicals likely NaOH, Na_2SO_3 and mixture of NaOH and Na_2SO_3.
b) Making hardboard from treated rubber chips at different freeness level.	The steamed cooked and chemically treated chips were then defiberised in a single rotating disk attrition mill at different plate clearances. Three pulps of different freenesses were made from each cook. Then S-1-S hardboards were made in hot press. The sample of size 12.7 cm x 5.08 cm were prepared. These were conditioned and tested to determine water absorption, thickness swelling and modulus of rupture (Table- 1).
c) Reporting.	

2.9   **Achievement (s), if any :** Treated chips of rubber stem prior mechanical refining produce stronger hardboards than steamed cooked chips. However, the boards are less water resistant

2.10 **Financial statement**   :
2.10.1 Total cost   : Tk.   3,00,000.00
2.10.2 Cost of the year   : Tk.   1,00,000.00
2.10.3 Expenditure of the year : Tk.   1,00,000.00
2.10.4 Source of fund   : GOB.

2.11 **Beneficiaries:** Hardboard Industry and local people .

Table:1 Strength and water resistant properties of hardboard made from steamed and treated chips of rubber stem

Treatment No.	Cooking condition		Freeness in Seconds	Modulus of Rupture (MOR) kg/cm²	Water absorption (%)	
	Digester pressure (kg/cm²)	Steaming time (minute)			Change in weight	Change in thickness
1	7.03	30	18	29	85	67
			20	37	59	30
			23	46	73	46
2		60	19	46	62	26
			20	71	48	27
			27	86	53	67
3		90	34	135	47	28
			37	143	51	34
			40	152	54	24
4	1% NaOH		49	124	62	38
			53	143	55	34
			63	153	74	48
5	2% NaOH		30	135	79	51
			34	141	77	51
			48	166	52	28
6	3% NaOH		29	133	86	50
			37	135	53	31
			56	145	61	34
7	NaOH and Na_2SO_3 (3% in mixture)		26	62	92	57
			30	67	84	51
			31	68	80	50
8	3% Na_2SO_3		57	159	46	21
			59	162	55	30
			60	165	59	36

3.   **Study**   : New

3.1 **Programme Area** : Post Harvest Utilization – Chemical Processing

3.2 **Title of the Study** : Influence of age on chemical pulping of gamar (*Gmelina arborea*) and akashmoni (*Acacia auriculiformis*)

3.3 **Justification** : Pulp and paper industry of Bangladesh uses both wood and non wood material for producing pulp. The per capita consumption of paper is increasing day by day with the increase of human population. But forest resources are decreasing at an alarming rate resulting acute crisis in raw material supply to the industry. To fulfill the need, both government and non-government organizations have been working in different aspects to increase the forest productivity. One of the approaches is the utilization of short rotation species for pulp production.

Pine is regarded as good raw material for pulping all over the world. Its rotation cycle is seven years (Rydholm, 1965). Gamar and akashmoni (*Auriculiformis*) wood is widely used in mixture with various wood and bamboo for pulp production in Karnaphulli Paper Mills. The rotation period of most of the wood species are more than 12 years. In comparison with pine, the rotation period of the species is too high. Previously, a study on the influence of age of gamar was conducted (Hossain *et al.* 1977). Scientist recommended 16 years of harvesting cycle for gamar wood as pulping raw material. There were certain limitations in

that study. To improve supply situation of the pulping raw material in the mill the cutting cycle of the species need to be reduced through process modification or changing cooking variables. With this aim in view, pulp making characteristics of gamar (*Gmelina arborea*) and akashmoni (*Auriculiformis*) of five age groups would be studied. The inter-relationship of age of wood species with pulp yield and quality would help to determine the optimum cutting cycle of the species.

3.4 **Objective(s)** :
3.4.1 To determine the optimum harvesting time of the species with respect to yield and quality pulp

3.5 **Expected output :** Rational utilization of species would be ensured

3.6 **Study Period** :
3.6.1 Starting year : 2015-2016
3.6.2 Completion year : 2018-2019
3.7 **Personnel** :
3.7.1 Project Leader: : Daisy Biswas, DO.
3.7.2 Associates : Md. Misbahuddin, FI; Urboshi Roy, FI. and Nazma Khatun, RO
3.8 **Progress**
3.8.1 Previous years, if any: Gamar logs of 4, 6, 8, 10 and 12 age groups were collected.
3.8.2 This year :

Activities of the study	Progress
a) Processing of chips and determination of chemical constituents	Gamar logs of five age groups were converted into chips of 2.54 cm. in length separately. Dust was prepared and preserved for determination of cold water solubility, hot water solubility, 1% caustic soda solubility, alcohol-benzene solubility, holocellulose and alphacellulose content.
b) Preparation of kraft and soda pulp by varying alkali dose, sulphidity and pulping time	Pulps were made from 4, 6, 8, 10 and 12 years gamar chips in kraft process maintaining 25% sulphidity by varying alkali doses (16, 18, & 20%).
c) Determination of kappa number and yield	Yield and Kappa numbers were determined from prepared pulps. It is found that 20% active alkali is needed to prepare bleachable grade pulp (Table-1).
d) Reporting.	

3.9 **Achievement (s), if any : Nil**
3.10 **Financial statement** :
3.10.1 Total cost : Tk. 5,00,000.00
3.10.2 Cost of the year : Tk. 1,00,00.00
3.10.3 Expenditure of the year : Tk. 1,00,00.00
3.10.4 Source of fund : GOB.
3.11 **Beneficiaries:** Pulp and Paper Industry and local people.

Table 1: Pulping studies of gamar of various age groups

Age (years)	Active alkali (%)	Pulp yield (%)	Rejects (%)	Kappa number
4 (With bark)	16	48.1	6.2	44.4
	18	49.2	3.3	30.5
	20	48.3	3.2	28.7
6	16	52.1	4.3	34.3
	18	52.7	3.5	29.5
	20	52.4	2.6	28.0

8	16	53.1	1.3	27.7
	18	52.4	0.5	27.3
	20	52.3	0.5	26.3
10	16	52.2	3.2	35.2
	18	51.6	0.9	26.5
	20	51.0	0.9	25.1
12	16	53.1	1.3	27.3
	18	51.5	1.1	26.5
	20	50.7	0.3	25.8

Seasoning and Timber Physics Division

1. **Study** : New
1.1 **Programme Area** : Post harvesting utilization- Physical processing.
1.2 **Title of the Study** : Effect of heat treatment on physical and mechanical properties of ghora neem (*Melia azedarach*), jam (*Syzygium cumini*), rain tree (*Samanea saman*), jarul (*Lagerstroemia speciosa*) and akashmoni (*Acacia auriculiformis*) wood

1.3 **Justification :** Wood is the fifth most important product of the world trade (Christophe and Gregoire 2001). Due to its poor dimension stability and low durability under variable atmosphere circumstance, researches on stabilization treatment are carried out to limit the moisture absorption by destroying or combining the hydroxyl groups of the wood (XlE et al. 2002). When wood is heated, its chemical and physical properties undergo permanent changes and its structure is reformed. Heat treatment is one of the processes used to modify the properties of wood. It serves to improve the natural quality properties of the wood, such as dimensional stability and resistance to bio-corrosion. It reduces certain mechanical properties, but the dimensional stability and the biological durability of wood increases through heat treatment. Also, heat treatment results in favorable changes in the physical properties of the wood, such as reduced shrinkage and swelling, low equilibrium moisture content, enhanced weather resistance, a decorative dark color, and better decay resistance Physical and mechanical properties of about 94 forests and homestead timber species were determined. But till now no information is available on heat treatment of wood. Basic information on physical and mechanical properties is needed prior to using wood species for making furniture and other construction uses. Much research has been done on the effect of heat treatment on the physical and mechanical properties of wood. The aim of this study is to examine the effect of heat treatment on physical and mechanical properties of five important forest trees.

1.4 **Objective(s)** :
1.4.1 To investigate the effect of heat treatment on physical and mechanical properties of wood
1.4.2 To asses the suitability of wood for making furniture and construction materials
1.5 **Expected output :** Quality improvement of wood with heat treatment for appropriate use.
1.6 **Study Period** :
1.6.1 Starting year : 2016-2017
1.6.2 Completion year : 2018-2019
1.7 **Personnel** :
1.7.1 Project Leader: : M. Rowson Ali, SRO
1.7.2 Associates : Dr. Daisy Biswas, DO and U. K. Rokeya, RO
1.8 **Progress**
1.8.1 Previous years, if any: NA

Activities of the study	Progress
a) Six standing trees of ghora neem (*Melia azedarach*) will be selected and collection of 60 cft. round wood from Southern part of Bangladesh.	a. 60 cft. round wood of ghora neem were collected at Bandarban Hill District.
b) Preparation of 360 samples for testing physical and mechanical properties.	b. 360 samples were prepared for determination of physical and mechanical properties.
c) Determination of the physical and mechanical properties of ghora neem woods following ASTM (American Society for Testing Materials) standards.	c) Moisture content and specific gravity of ghora neem wood were determined.
d) Two solar kilns will be maintained through repairing and painting.	d. Existing solar kilns were maintained by repairing and painting.
e) Data analysis and report writing.	e. Data are being recorded.

Table-1: Properties of ghora neem wood

Species	Properties	
	Moisture Content (%)	Specific gravity
Ghora neem (*Melia azedarach*)	53	0.44

1.9   **Achievement (s), if any : NA**
1.10   **Financial statement**   :
1.10.1 Total cost   : Tk.   10,50 000.00
1.10.2 Cost of the year   : Tk.   3,09,950.00
1.10.3 Expenditure of the year   : Tk.   3,09,950.00
1.10.4 Source of fund   : GOB.
1.11   **Beneficiaries:** BFIDC, FD, Wood Industries, University students, BFRI and others.

2.   **Study**   : New
2.1   **Programme Area**   : Post harvesting utilization-physical processing
2.2   **Title of the Study**   : Studies on physical and mechanical properties of haldu (*Haldina cordifolia*) and Jhau (*casuarina equisetifolia*) wood.
2.3   **Justification :** Haldu (*Haldina cordifolia*) occurs in the moist deciduous forests of Chittagong, Cox's Bazar, Sylhet, Dhaka and Mymensingh. Jhau (*Casuarina equisetifolia*) is mostly planted as roadside avenue and shade tree throughout the country.There are many such old trees planted during the British period. Sometimes occur naturally in the sea sore of Cox's Bazar and Teknaf. Till now, physical and mechanical properties of about 96 forest and homestead timber species were determined. Basic information on physical and mechanical properties is needed prior to using wood species for making furniture and other construction uses.
2.4   **Objective(s)**   :
2.4.1 To assess the suitability of jhau wood for making furniture and construction materials.
2.5   **Expected output :** Determination of physical and mechanical properties of jhau wood for appropriate use.
2.6   **Study Period**   :
2.6.1 Starting year   : 2016-2017
2.6.2 Completion year   : 2017-2018
2.7   **Personnel**   :
2.7.1 Project Leader: : U. K. Rokeya, RO
2.7.2 Associates   : Dr.Daisy Biswas, DO and M. Rowson Ali, SRO

2.8 **Progress**

2.8.1 Previous years, if any: NA

2.8.2 This year   :

Activities of the study	Progress
a) Three standing trees of jhau (*Casuarina equisetifolia*) will be selected and collection of 30 cft round wood from Sea-beach of Chittagong.	a. Three trees of jhau (*Casuarina equisetifolia)*) were selected at Sea-beach of Chittagong and 30 cft. round wood were collected.
b) Preparation of 276 samples of this species for testing physical and mechanical properties in green condition.	b. 276 samples of these species were prepared for testing physical and mechanical properties in green condition.
c) Determination of the physical and mechanical properties of jhau (*Casuarina equisetifolia)* wood in green condition following ASTM (American Society for Testing Materials) standards.	c. Physical and mechanical properties of these species were determined in green condition.
d) Data analysis and report writing.	d. Data were recorded and shown in table-1.

Table-1: Data on physical and mechanical properties of jhau and teak in green condition

Serial no	Properties	Jhau	Teak
01.	Moisture content (%)	40	55
02.	Specific gravity	0.87	0.58
03.	Static bending (kg/cm²) Stress at proportional limit Modulus of rupture Modulus of elasticity (1000 kg/cm²)	 527 990 150	 514 867 120
04.	Compression parallel to grain (kg/cm²) Stress at proportional limit Maximum crushing strength	 312 410	 288 383
05.	Compression perpendicular to grain Stress at proportional limit (kg/cm²)	 149	 67
07.	Hardness (kg) Side End	 995 940	 495 507
08	Nail holding capacity (kg) Side End	 199 195	 138 95
09	Tension perpendicular to grain (kg/cm2) Radial Tangential	 60 63	 44 49
10	Shearing strength (kg/cm2) Radial Tangential	 165 172	 86 103
11	Cleavage load(kg/cm) in width Radial Tangential	 96 63	 68 77

2.9   **Achievement (s), if any : NA**
2.10   **Financial statement**   :
2.10.1 Total cost   : Tk.   3,10,000.00
2.10.2 Cost of the year   : Tk.   1,17,660.00
2.10.3 Expenditure of the year : Tk.   1,17,660.00
2.10.4 Source of fund   : GOB.
2.11   **Beneficiaries:** FD, BFIDC, Wood based Industries, Universities and BFRI.

Veneer and Composite Wood Products Division

1.   **Study**   : On going
1.1   **Programme Area**   : Post Harvest Utilization –Chemical Processing
1.2   **Title of the Study** : Development of doors and partition using bamboo composite products.
1.3   **Justification :** The forest of Bangladesh is declining day by day with the growth of population. The declining of timber demands import of wood which create negative effect on the national economy. Furthermore, declining of forest causes adverse effect on climate change. Bamboo is the appropriate substitute of wood which is versatile and highly renewable material. Bamboo is fast growing and can harvest within 3 years. It is comparatively cheap and has a tremendous growth potential in rural areas. Every household maintains small bamboo yard for various uses. Bamboo is used in housing, furniture making, packing, transport and various purposes. It is important raw material in the handicraft and small cottage industry sector. Bamboo in panel form is well suited to wood substitute and therefore development of cost effective technologies to produce bamboo composite products is an important area of research. Recently Bangladesh Forest Research Institute developed attractive bamboo tiles and bamboo composite furniture using thick wall bamboo. Bamboo composite products can be used for making doors and partition. Manufacture of doors and partition using bamboo composites instead of wood will decrease the pressure on wood and will create income generating opportunities for bamboo growers and producers.
1.4   **Objective(s)**   :
1.4.1   To assess the potential of bamboo composites for making doors and partition.
1.4.2   To assess economic feasibility of doors and partition made of bamboo composites.
1.4.3   To disseminate the information to the end-users.
1.5   **Expected output:** Manufacture of doors and partition using bamboo composites will help to decrease the pressure on valuable timber and will create income-generating opportunities for bamboo growers and employment at the unit and improve the livelihood of the rural people in Bangladesh.
1.6   **Study Period**   : 2014-2015, 2019-2020
1.6.1   Starting year   : 2017-2018(2nd phase)
1.6.2   Completion year   : 2019-2020
1.7   **Personnel**   :
1.7.1   Project Leader: : Dr. K. Akhter, DO
1.7.2   Associates   : M. M. Rahaman, RO, S. Hossain, RO, M.R.Islam, FI.
1.8   **Progress**
1.8.1   Previous years, if any: Borak (*Bambusabalcooa*) bamboos were collected from Borkolupozilla Rangamati,Chittagong. Strips were prepared, dried and treated with borax-boric acid solution. Using these strips bamboo panel boards were prepared in hot press. Bamboo particleboards were made by using bamboo chips and planner shaving. Bamboo mats were prepared using mitinga bamboo (*Bambusatulda*). Mats were used in face and

back side of particle board. Borax-boric acid (2%) was added with UF glue. One door was prepared using bamboo panel board and one partition was prepared bamboo mat overlaid particle boards. The bamboo composite products were kept in VCWP Division for service test. Borak (*Bambusa balcooa*) bamboos were collected from Anowara Banshkhali, Chittagong. Bamboo mats were prepared using Mitinga (Bambusa tulda). Strips were prepared and treated with borax-boric acid solution. Bamboo composite products such as bamboo panel board and bamboo mat over laying particle board were made using borak bamboo. Bamboo particleboards were made by using bamboo chips and planner shaving. Borax-boric acid (2%) was added with UF glue. One door and one partition were prepared using bamboo panel & bamboo mat overlaid particle boards. The composite furniture are kept in VCWP Division for service test.

1.8.2 This year   :

Activities of the study	Progress
a) Procurement of chemicals and other materials	Chemicals and other materials were procured.
b) Selection of design of doors and partition.	Bamboo composite products were selected for making doors and partition
c) Procurement of bamboo culms (*Bambusa vulgaris/Bambusa balcooa*)	Borak (*Bambusa balcooa*) bamboos were collected from Anowara Banshkhali, Chittagong.
d) Preparation and processing of bamboo mats, bamboo strips.	Strips were prepared and treated with borax-boric acid solution. Bamboo mats were prepared using Mitinga (*Bambusa tulda*) which were also treated with borax-boric acid solution.
e) Manufacturing of bamboo composites.	Bamboo composite products such as bamboo panel board and bamboo mat over laying particle board were made using borak (*Bambusa balcooa*) bamboo. Bamboo particleboard was made by using bamboo chips and planner shaving with levorotatory hot press. Borax-boric acid (2%) was added with UF glue.
f) Manufacturing of one door and one partition using bamboo composites	Bamboo panel board and bamboo mat overlaid particle boards were prepared for making one door and one partition. The composite furniture is kept in VCWP Division.
g) Visit to Bamboo product shop & industries	Bamboo furniture shop & industries in Camilla were visited. End-users were encouraged and advised to visit BFRI and seek for the technology in the related field.
h) Calculation of manufacturing cost.	Price of the raw materials and manufacturing cost were calculated.(Table-1)

Table: 1 Different bamboo furniture made from composite products

Furniture	Size	Bamboo species	Composite products	Material cost	Manufacturing cost
Bamboo door	7ft.×3ft	*Bambusa balcooa* and *Bambusa tulda*	Bamboo panel board and bamboo mat overlaid particle	7,000/-	3,000/-
Bamboo partition	5ft.×4ft	*Bambusa balcooa* and *Bambusa tulda*	Bamboo panel board and bamboo mat overlaid particle	1,500/-	1,000/-

1.9   **Achievement (s), if any : NA.**

1.10   **Financial statement**   **:**
1.10.1 Total cost   **:** Tk. 5,00,000.00
1.10.2 Cumulative cost   **:** Tk. 3,00,000.00
1.10.3 Cost of the year   **:** Tk. 1,00,000.00
1.10.4 Source of fund   **:** GOB
1.11   **Beneficiaries:** Door & windows industries, Bamboo/wood plywood and particleboard industries, farmers/bamboo growers, general people, village women, NGOs.

2.   **Study**   : On-going

2.1   **Programme Area**   : Post Harvest Utilization -Physical Processing

2.2   **Title of the Study**   : Suitability of manufacturing medium density fiberboard (MDF) from rubber *(Hevea brasiliensis)* wood and *hybrid acacia* wood.

2.3   **Justification :** The utilization of medium density fiberboard as a replacement of larger solid structure lumber is increasing day by day. As a result, medium density fiberboard (MDF) markets are growing rapidly for housing and household materials like doors, furniture and construction materials. Rubber wood and *hybrid acacia* wood are used for making furniture, doors and windows. The stem and branches of rubber and *hybrid acacia* trees are used as fuel wood or unused. This stem and branches can be used for making MDF. The aim of the study is to determine the suitability of manufacturing medium density fiberboard (MDF) from rubber wood *(Hevea braziliensis*) and *hybrid acacia* wood which will reduce pressure on wood and other composite products.

2.4   **Objective(s)**   :
2.4.1 To determine the suitability of medium density fiberboard made from rubber *(Hevea brasiliensis)* wood and hybrid *acacia* Wood.

2.5   **Expected output :** Maximum utilization of rubber *(Hevea brasiliensis)* wood and hybrid *acacia* wood for manufacturing medium density fiberboard (MDF).

2.6   **Study Period**   **:** 2014-2020
2.6.1 Starting year   **:** 2014-2015
2.6.2 Completion year   **:** 2019-2020
2.7   **Personnel**   **:**
2.7.1 Project Leader: **:** M. M. Rahaman, RO
2.7.2 Associates   **:** Dr. K. Akhter, DO, S. Hossain, RO, M. R. Islam F.I, M.M. Uddin F.I
2.8   **Progress**
2.8.1 Previous years, if any: Rubber woods were collected from Bangladesh Forest Industry Development Corporation (BFIDC), Kalurghat, Chittagong. These were crosscut to 1.25 m bolts. The diameter of log was 0.4020 m. These were submerged under water in the soaking tank to saturate with moisture and to avoid fungal and insect attacks. The bolts were peeled to 1.5 mm target thickness in a Coe-Veneer Lathe machine with knife angle at 91°15'. Recovery of veneer was calculated. Veneers were cutting with clipper machine and dried up to suitable moisture content (10-12%). Rubber Chips were prepared in hammer mill machine and screened using screener. Chips were dried up to suitable moisture content (8%) in batch oven. Chips were cooked at 120°C temperature and prepared to pulp using attrition mill. This pulp were dried in batch oven and stored in conditioned at 65±5% relative humidity and 20±2°C temperature This pulp were dried in batch oven and stored in conditioned at 65±5% relative humidity and 20±2°C temperature.

2.8.2 This year   :

Activities of the study	Progress
a) Procurement of chemicals and other materials	Chemicals and other materials were procured.
b) Manufacture of medium density fiber board (MDF).	Manufacture of medium density fiberboard (MDF) from rubber wood chips.
c) Conditioning of board in condition chamber.	Boards were condition in condition chamber.
d) Side cutting of medium density fiber board using carbide saw.	Sides were cutting in circular saw machine.
e) Preparation of MOR (modulus of rupture) samples of medium density fiber board.	Sample of MOR (modulus of rupture) were prepared in circular saw machine.
f) Preparation of IB (internal bond strength) samples of medium density fiber board.	Sample of IB (internal bond strength)were prepared in circular saw machine.
g) Preparation of TS (thickness swelling) samples of medium density fiber board.	Sample of TS (thickness swelling) were prepared in circular saw machine.
h) Preparation of WA (water absorption) samples of medium density fiber board.	Sample of WA (water absorption) were prepared in circular saw machine.
i) Conditioning of test sample in condition chamber.	Test samples were conditioned in conditioning chamber.
j) Determination of physical properties of fiber board	Physical properties of fiber board were determined.
k) Determination of mechanical properties of fiber board	Mechanical properties of fiber board were determined in test machine.
l) Visit particleboard industries.	Star particleboard industries in Dhaka were visited. End-users were encouraged and advised to visit BFRI and seek for the technology in related field.
m) Data analysis and reporting	Data were analyzed.

Table:1 Strength properties of MDF made from rubber wood (*Hevea brasiliensis*)

Standards compare	Thickness of fiberboard (mm)	Density of fiberboard (kg/m^3)	Static bending strength (N/mm^2)	Tensile Strength (N/mm^2)	Thickness Swelling (%)		Water Absorption (%)	
					2hr	24hr	2hr	24hr
	12.40	700	18.8	0.44	6.22	11.08	24.63	45.45
	12.35	725	19.0	0.44	7.30	11.73	39.81	48.68
	12.30	750	19.7	0.45	7.50	11.92	43.44	52.62
	12.25	775	20.0	0.46	9.09	12.76	53.34	53.95
	12.20	800	23.4	0.47	9.10	12.87	54.42	63.22
IS Specification 3087(Anon.1985)	6-40	500-900	11.20	0.80	10.00	-	25.00	50.00
German Standard Din 68761 (Verkor1975)	13-20	600-750	18.00	0.35	Max 6	-	-	-
BS Specification 5669 (Anon.1797)	6-19		14.00	0.34	12 (for 1hr soaking)	-	-	-

Table:2 Thickness swelling and water absorption MDF made from rubber wood (*Hevea brasiliensis*)

Standards compare	Thickness of fiberboard (mm)	Density of fiberboard (kg/m^3)	Static bending strength (N/mm^2)	Tensile Strength (N/mm^2)	Thickness Swelling (%)		Water Absorption (%)	
					2hr	24hr	2hr	24hr
	12.40	700	18.8	0.44	6.22	11.08	34.63	45.45
	12.35	725	19.0	0.44	7.30	11.73	39.81	48.68
	12.30	750	19.7	0.45	7.50	11.92	43.44	52.62
	12.25	775	20.0	0.46	9.09	12.76	53.34	53.95
	12.20	800	23.4	0.47	9.10	12.87	54.42	63.22
IS Specification 3087(Anon.1985)	6-40	500-900	11.20	0.80	10.00	-	25.00	50.00
German Standard Din 68761 (Verkor1975)	13-20	600-750	18.00	0.35	Max 6	-	-	-
BS Specification 5669 (Anon.1797)	6-19		14.00	0.34	12 (for 1hr soaking)	-	-	-

2.9   **Achievement (s), if any :**
2.10   **Financial statement**   **:**
2.10.1 Total cost   **:** Tk. 7,00,000.00
2.10.2 Cumulative cost   **:** Tk. 2,20,000.00
2.10.3 Cost of the year   **:** Tk.   95,000.00
2.10.4 Source of fund   **:** GOB
2.11   **Beneficiaries:** Wood merchants, plywood and particleboard industries/ BFIDC & NGOs

3.   **Study**   : On-going
3.1   **Programme Area**   : Training and technology transfer
3.2   **Title of the Study**   : Design Improvement of bamboo composite furniture and popularization of technology.
3.3   **Justification :** The forests of Bangladesh have been declining day by day with the growth of population. As a result, the gap between the demand and supply of wood is increasing. Furthermore, declining of forests cause adverse effect on climate change. Denuded land due to shifting cultivation, illicit felling, accelerated soil erosion and uncontrolled fire hazard can be deforested by environmentally, ecologically and economically viable fast growing species. Bamboo is appropriate fast growing species and can be used after 3 years. It is comparatively cheap and has a tremendous growth potential in rural areas. Some characteristics of bamboo such as rapid growth, lightness, flexibility, colour and attractive texture made it very useful to people. In rural area of Bangladesh, every household maintains small bamboo yard and get benefited by using and trading for various uses. Bamboo is used in housing, furniture making, packing, transport and various purposes. Limitation like short service life has been overcome by treatment technology developed by Bangladesh Forest Research Institute (BFRI). Composite technology made the bamboo in panel form which is well suited to wood substitute. BFRI developed attractive bamboo tiles and bamboo composite furniture using thick wall bamboo. Use of bamboo composites instead of wood will

decrease the pressure on wood and will create income generating opportunities for bamboo growers and producers. Bamboo panel products have demand in international market. Furthermore fast growing bamboo plantation will mitigate climate change risk. Extension of the bamboo composite technology will help people to develop entrepreneurship for bamboo composite products which will provide employment generation and foreign currency. These activities are undertaken to disseminate and popularize the Bamboo composite technology to the end-users.

3.4 **Objective(s)** :

3.4.1 To disseminate the information to the end-users

3.4.2 To motivate people through training, group discussions, personal contacts etc.

3.4.3 To provide technical support to the business initiators for development of entrepreneurship in bamboo composite products.

3.5 **Expected output** : Manufacture and use of bamboo composites will decrease the pressure on valuable timber. It will create income-generating opportunities for bamboo growers and employee at the unit. It will improve the livelihood of the rural people. Bamboo plantation will decrease climate change risk.

3.6 **Study Period** : 2015-2020
3.6.1 Starting year : 2015-2016
3.6.2 Completion year : 2019-2020
3.7 **Personnel** :
3.7.1 Project Leader: : Dr. Khurshid Akhter, DO
3.7.2 Associates : M.M. Rahaman, RO; H. Saddam ; & M. R. Islam, F I.
3.8 **Progress**
3.8.1 Previous years, if any: Borak (*Bambusa balcooa*) bamboos were collected from Anowara Banshkhali,Chittagong. Bamboo mats were prepared using Mitinga (Bambusa tulda). Strips were prepared and treated with borax-boric acid solution. Bamboo composite products such as bamboo panel board and bamboo mat over laying particle board were made using borak bamboo. Bamboo particleboards were made by using bamboo chips and planner shaving. Borax-boric acid (2%) was added with UF glue. One bending chair, two new designed armed chair and one tea table were prepared using bamboo panel & bamboo mat overlaid particle boards. The composite furniture are kept in VCWP Division for service test. Star particleboard industries in Dhaka were visited. End-users were encouraged and advised to visit BFRI and seek for the technology in related field.Training programme were arranged in Khagrachori on 02-01-2016 and Nawgaon on 16-05-2016**.**

3.8.2 This year :

Activities of the study	Progress
a) Procurement of chemicals and other materials	Chemicals and other materials were procured**.**
b) Selection of design of furniture.	Design of two dining chair, two folding chair selected.
c) Procurement of bamboo culms (*Bambusa vulgaris/ Bambusabalcooa*).	Borak (*Bambusa balcooa*) bamboos were collected from Anowara Banshkhali, Chittagong.
d) Preparation and processing of bamboo mats, bamboo strips.	Strips were prepared and treated with borax-boric acid solution. Bamboo mats were prepared using Mitinga (*Bambusa tulda*) which were also treated with borax-boric acid solution.
e) Manufacturingof bamboo composites panel.	Bamboo composite products such as bamboo panel board and bamboo mat over laying particle board were made using borak (*Bambusa balcooa*) bamboo. Bamboo particleboard was made by using bamboo chips and planner shaving. Borax-boric acid (2%) was added with UF glue.

f) Manufacturing of bamboo furniture using bamboo composites	Bamboo panel and bamboo mat overlaid particle boards were prepared in making two new design dyining chair and two folding chair. This composites furniture are kept in VCWP Division.
g) Arrangement of motivational activities in plywood and particleboard industries	Star particle board industries in Dhaka were visited. End-users were encouraged and advised to visit BFRI and seek for the technology in the related field.
h) Arrangement of training programme.	Training programme were arranged in Sylhet on 27-11-2016, Rangamati on 25-12-2016, Dhaka on 28-01-2017, Kaptai on 24-02-2017, Dinajpur on 05-05-2017 , Cox's bazaar on 19-05-2017 and VCWPD on 20-06-2017.

Table: Different bamboo furniture made from composite products

Furniture	Bamboo species	Composite products	Material cost	Manufacturing cost
Dyining chair.	*Bambusa balcooa*	Bamboo panel board	25,00/-	1,000/-
Dyining chair.	*Bambusa balcooa* and *Bambusa tulda*	Bamboo panel board and bamboo mat overlaid particle	2,00/-	1,000/-
Folding chair	*Bambusa balcooa*	Bamboo panel board	2,000/-	1,000/-
Folding chair	*Bambusa balcooa* and *Bambusa tulda*	Bamboo panel board and bamboo mat overlaid particle	1,500/-	1,000/-

3.9   **Achievement (s), if any : NA.**
3.10   **Financial statement   :**
3.10.1 Total cost   : Tk. 7,50,000.00
3.10.2 Cumulative cost   : Tk. 2,20,000.00
3.10.3 Cost of the year   : Tk. 2,10,000.00
3.10.4 Source of fund   : GOB

3.11   **Beneficiaries:** Bamboo growers, Bamboo/wood plywood and particleboard Industries, bamboo growers, general people, village women, NGOs

4.   **Study**   : On-going
4.1   **Programme Area**   : Post harvesting utilization-physical processing.
4.2   **Title of the Study** : Suitability of uprooted tea plants *(Camellia sinensis)* for particleboard and pulp production.
4.3   **Justification :** The utilization of plywood and particleboard as a replacement of larger solid structure lumber is increasing day by day. As a result, the plywood and particleboard markets are growing rapidly for making housing and household materials like doors, windows and furniture etc. The consumption of paper, board and newsprint has been growing at a robust rate of 20% annually in the last five years. This will increase extremely in the near future. Tea plant is occurring planted hill area in Bangladesh. There are total 163

tea gardens are exists in Bangladesh and these are at different places. Since it is not possible to collect better tea leaf from an old plant, every year there are huge amounts of old plants need to be removed from the tea garden which is commonly used as fuel wood. The wastage plant of tea may be an alternative new source of raw material for Particleboard and pulp industries to increase its economic value and reduce pressure on other species. However there is no information on the use of these resources as raw material for making pulp and particleboard. It is expected that if found suitable this resources would supplement as particleboard and pulping raw material alone or blended with other ligno-cellosic material. Therefore the study is undertaken to find out the suitability of making particleboard and pulp using wastage tea plant. Therefore immediate action is necessary to find out new source of raw material for pulp and paper mill for attaining self-sufficiency in paper production.

4.4 **Objective(s)** :

4.4.1 To determine the suitability of tea plant for particleboard making.

4.4.2 To determine the optimum cooking variables for making chemical pulp with respect to yield and quality pulp.

4.4.3 To improve the strength of pulp and particleboard by blending with hardwood / bamboo.

4.5 **Expected output :** Maximum utilization of tea plant by making particleboard and pulp.

4.6 **Study Period** : 2016-17 to 2018-19

4.6.1 Starting year : 2016-2017

4.6.2 Completion year : 2018-2019

4.7 **Personnel** :

4.7.1 Project Leader: : S. Hossain,RO.

4.7.2 Associates : M. M. Rahaman, RO, M.R.Islam, F.I ; N.Khatun, RO; U.Roy, FI.; M. M.Uddin, FI.

4.8 **Progress**

4.8.1 Previous years, if any: NA

4.8.2 This year :

Activities of the study	Progress
a) Procurement of chemicals and other materials	Chemicals and other materials were procured**.**
b) Collection of wastage tea plant.	Wastage tea plants were collected from Neptune tea garden in Narayonhat in Rawjan, Chittagong.
c) Clipping of tea plant in clipper machine.	Plant were cut into the clipper machine.
d) Drying of clipping materials up to suitable moisture (10-12%) content.	Clipping materials were drying up to suitable moisture (10-12%) content.
e) Preparation of chips in hammer milling machine.	Chips were prepared in hammer milling machine.

4.9 **Achievement (s), if any :**

4.10 **Financial statement** :

4.10.1 Total cost : Tk. 5,00,000.00

4.10.2 Cost of the year : Tk. 1,75,000.00 (VCWP: 1,00,000.00+ P&P: 75,000.00)

4.10.3 Expenditure of the year : Tk. 1,75,000.00 (VCWP: 1,10,000.00+ P&P: 65,000.00)

4.10.4 Source of fund : GOB

4.11 **Beneficiaries:** Wood merchants, plywood and particleboard industries & NGOs

Wood Preservation Division

1.   **Study**   :   On going

1.1 **Programme Area**   :   Post Harvest Utilization –Chemical Processing

1.2 **Title of the Study** :   Treatability and natural durability of bhudum (*Dendrocalamusgiganteus*) bamboo species.

1.3 **Justification : NA**

1.4 **Objective(s)**   :

1.4.1 To develop treating schedule for preservative treatment.

1.4.2 To determine outdoor service life of bamboo species treated with CCB preservative.

1.4.3 To disseminate the information to the end-users.

1.5   **Expected output :** The study will be helpful for the bamboo   users, Betel leaf farms, general public and cottage industries as well as for related to bamboo products.

1.6 **Study Period**   :

1.6.1 Starting year   **:** 2013- 2014

1.6.2 Completion year   **:** 2017 – 2018

1.7 **Personnel**   :

1.7.1 Project Leader: **:** Mozammel Hoque Chowdhury, RO.

1.7.2 Associates   **:** Dr. Khurshid Akhter, DO.; Mohammad Anisur Rahman, SRO; Abdus Salam, RO.

1.8 **Progress**

1.8.1 **Previous years, if any: NA**

1.8.2 **This year**   :

Activities of the study	Progress
a) Procurement of CCB (Copper-Chrome-Boron) preservative, chemicals, treatment materials instrument, bhudum (*Dendrocalamus giganteus*) bamboo.	a) Preservative, Treatment materials, bamboo etc. were procured from different areas and market.
b) Processing of bamboo and preparation of samples for stepping method.	b) For preservative treatment three nos of bamboo samples were prepared as follows: 16.76 m× dia 0.15 m.; 15.85 m× dia 0.15 m.; 15.24 m× dia 0.14 m.
c) Treatment of samples with preservative by stepping method.	c) Three numbers of bamboo samples have been treated using for stepping method. (Table-01)
d) Installation of treated samples in stake yards at BFRI campus & Barisal PTU campus for service test.	d) Treated samples were ready for installation at BFRI campus, Chittagong and Plantation Trial Unit (PTU) in Barisal stake-yard.
e) Collection of data from previously installed bhudum (*Dendrocalamus giganteus*) bamboo, samples at BFRI & Barisal stake yard which were treated with preservative.	e) The observation is given below.
f) Analysis of data and determination of treatability group	f) Highly treatable (Group: A).
g) Reporting.	g) Reporting are in progress

1.9 **Achievement (s), if any :**
1.10 **Financial statement** **:**
1.10.1 Total cost **:** Tk. 6,00,000.00
1.10.2 Cost of the year **:** Tk. 1,20,000.00
1.10.3 Expenditure of the year **:** Tk.
1.10.4 Source of fund **:** GOB
1.11 **Beneficiaries:** Betel leaf farms, Bangladesh Forest Industries Development Corporation (BFIDC) and general public.

Table-01: Retention of preservatives through bhudum (*Dendrocalamus giganteus*) bamboo that treated by stepping method.

Charge No.	Size (m)	Volume (m^3)	Moisture content (%)	Stepping period (day)	Average Retention (kg/m^3)
1	16.76 × dia 0.15	0.050	81 - 69	10	22
2	15.85× dia 0.15	0.047	81 - 69	15	25
3	15.24× dia 0.14	0.037	81 - 69	20	29

Table-02: Observation report of stake-yard bhudum (*Dendrocalamus giganteus*) bamboo sample at BFRI campus

SL.NO	Date of installation	Date of inspection	Treatment method & Name of preservative	Observation Report
01	02-03-2014	20-12-2016 & 21-03-2017	Sap-displacement, 20% CCB solution	Treated samples are still in good condition.
02	10-03-2015	20-12-2016 & 21-03-2017	Soaking method, 10% CCB solution	Treated samples are still in good condition.
03	05-05-2016	20-12-2016 & 21-03-2017	Double-diffusion method. CB-C solution	Treated samples are still in good condition.

Table-03: Observation report of stake-yard bhudum (*Dendrocalamus giganteus*) bamboo sample at Barisal PTU campus

SL.NO	Date of installation	Date of inspection	Treatment method & Name of preservative	Observation Report
01	25-12-2015	28-01-2017	Sap-displacement, 20% CCB solution	Treated samples are still in good condition.
02	10-06-2016	28-01-2017	Soaking method, 10% CCB solution	Treated samples are still in good condition.
03	28-01-2017	28-01-2017	Double-diffusion method. CB-C solution	Treated samples are still in good condition.

2. **Study** : On-going
2.1 **Programme Area** : Post Harvest Utilization- Chemical Processing.
2.2 **Title of the Study** : Popularization of preservation treatment technology through raining and entrepreneurship development.
2.3 **Justification : NA**
2.4 **Objective(s)** **:**
2.4.1 To motivate people through training, group discussions, personal contacts etc.

2.4.2 To provide technical support to the business initiators for development of entrepreneurship i preservative treatment

2.5   **Expected output :** Use of preservative treatment technology by betel leaf & vegetable farmers, common people and development of local entrepreneurship

2.6   **Study Period**   :
2.6.1   Starting year   **:** 2014-2015
2.6.2   Completion year   **:** 2016 – 2017
2.7   **Personnel**   :
2.7.1   Project Leader: **:** Abdus Salam, RO
2.7.2   Associates   **:** Dr. Khurshid Akhter, DO.; Mohammad Anisur Rahman, SRO; Mozammel Hoque Chowdhury, RO.

2.8   **Progress**
2.8.1   Previous years, if any: NA
2.8.2   **This year**   :

Activities of the study	Progress
a) Procurement of raw materials, chemicals and other inputs.	a) Raw materials, chemicals and other inputs (Bamboo, Sun grass etc.) were procured from different areas and market.
b) Treatment of demonstration materials for repairing of Bamboo model house at BFRI Campus.	b) Bamboo, Sun grass were treated for repairing of Bamboo model house at BFRI Campus.
c) Arrangement of training and motivational activities in Rangamati, Comilla/Dhaka, Khulna/ Serajgang and Magora/Rajshahi	c) Training and motivational activities were arrangement in Rangamati, Dhaka, Taragonj and Ramu.
d) Monitoring of service life of previously established experiments in betel leaf & vegetable farms in Barisal and Gaibandha.	d) Monitoring and evaluation of service life of previously established experiments in betel leaf & vegetable farms in Barisa and Gaibandha.
e) Reporting.	e) Reporting are in progress

2.9   **Achievement (s), if any :**
2.10   **Financial statement**   :
2.10.1 Total cost   **:** Tk. 6,00,000.00
2.10.2 Cost of the year   **:** Tk. 1,30,000.00
2.10.3 Expenditure of the year **:** Tk.   -
2.10.4 Source of fund   **:** GOB
2.11   **Beneficiaries:** Betel leaf & vegetable farmers, NGOs and general public, particularly the users of wood, bamboo, sun grass and other materials.

3.   **Study**   : On-going
3.1   **Programme Area**   : Post Harvest Utilization- Chemical Processing.
3.2   **Title of the Study** : Durability assessment of baijja *(Bambusa vulgaris)* and borak (*Bambusa balcooa*) bamboos under different duration of water treatment.
3.3   **Justification : NA**
3.4   **Objective(s)**   :
3.4.1   To assess the durability of bamboo after immersion under water.
3.4.2   To determine indoor service life of bamboo products after water treatment.

3.5   **Expected output :**
    a) Development of environmental friendly treatment process.
    b) Increase the service life of wood, bamboo and other lignocellulosic material.
    c) Decrease the pressure on forest resources.

3.6   **Study Period**   :
3.6.1 **Starting year**   **:** 2014- 2015
3.6.2 **Completion year**   **:** 2016 – 2017
3.7   **Personnel**   **:**
3.7.1 **Project Leader:**   **:** Abdus Salam, Research Officer.
3.7.2 **Associates**   **:** Mohammad Anisur Rahman, Senior Research Officer; & Mozammel Hoque Chy, Research Officer.
3.8   **Progress**
3.8.1 **Previous years, if any: NA**
3.8.2 **This year**   :

Activities of the study	Progress
a) Product will be prepared and kept for service test.	a) Products were prepared and kept for service test at deferent place in BFRI campus.
b) Observation and Collection of data.	b) After observation data were collected each three months.
c) Analysis and report writing	c) -

3.9   **Achievement (s), if any :**
3.10   **Financial statement**   :
3.10.1 Total cost   **:** Tk. 6,00,000.00
3.10.2 Cost of the year   **:** Tk. 62,000.00
3.10.3 Expenditure of the year   **:** Tk. -
3.10.4 Source of fund   **:** GOB
3.11   **Beneficiaries:** Betel leaf farms, Bangladesh Forest Industries Development Corporation (BFIDC) and general public.

4.   **Study**   : On-going
4.1   **Programme Area**   : Post Harvest Utilization –Chemical Processing
4.2   **Title of the Study**   : Development of neem (*Azadirachta indica*) leaves and mehagani *(Sweitenia microphylla)* seeds as eco-friendly wood preservative.
4.3   **Justification :** Conventional wood preservatives like CCA and CCB are facing lot of criticism all over the world. Most of these preservatives although found to be very effective against wood destroying agencies, being of synthetic origin, are said to cause a serious threat to the environment and to health of wood treatment workers. For the past few years there has been a substantial global awareness to outcast the conventional proprietary wood preservatives by the one which is of natural origin. It is essential to address the problem in view of environment protection. Eco-friendly wood preservatives may be considered as one option. The present study is an exploration of neem leaves and mahogani seeds against wood decaying fungi and termites. *Azadirachta indica*, commonly known as neem is one of the most widely recognized and extensively studied plant species of Bangladesh. Every part of the tree has been thoroughly evaluated for its marked activity against insects, microbes, pests etc. and has gain world-wide recognition as potential therapeutic agent. Present study has been undertaken for further work on neem leaves and mahogani seeds to develop potential eco-friendly wood preservatives.

4.4   **Objective(s)**   :
4.4.1 To develop environmental friendly wood preservatives

4.4.2 To investigate the effect of wood preservatives on wood against the wood decayagents.

4.5 **Expected output :**
　　a) Development of environmental friendly wood preservatives
　　b) Increase the service life of wood, bamboo and other lignocellulose material.
　　c) Decrease the pressure on forest resources.

4.6 **Study Period** :
4.6.1 Starting year : 2014-2015
4.6.2 Completion year : 2016-2017
4.7 **Personnel** :
4.7.1 Project Leader: : Mohammad Anisur Rahman, SRO
4.7.2 Associates : Dr. KhurshidAkhter, DO; Abdus Salam, R O & M. H. Chowdhury, RO.

4.8 **Progress**
4.8.1 **Previous years, if any:** Mango wood (*Mangifera indica*) and baijja bamboo (*Bambusa vulgaris*) samples were treated using 5% solution of neem leaves and mahogani seeds. After treatment the samples were kept for observation to investigate the effectiveness of neem leaves and mahogani seeds as eco-friendly wood preservatives. After one year it was observed that the treated samples are in better condition than the control samples. By using eco-friendly wood preservatives in wood and bamboo samples were kept for monitor due to service life evaluation and data were collected in every three month.

4.8.2 This year :

Activities of the study	Progress
a) Collection and processing of neem leaves and mahogany seeds.	a) Mahogani seeds and neem leaves were collected and kept it for air dry.
b) Grinding the neem leaves and mahogani seeds.	b) Neem leaves and mahogani seeds were grinded into fine powder by Willey mill.
c) Collection and processing of wood & bamboo samples for treatment and measurement of moisture content.	c) Wood & bamboo samples were collected and prepared for treatment. The moisture content of the sample were measured in table-1.
d) Preparation of 10% and 15% solution of neem leaves and mahogani seeds in water and measure the pH.	d) 10% and 15% solution of neem leaves and mahogany seeds were prepared in water for treatment and the pH of the solution were recorded in table-1
e) Treatment of wood/bamboo Samples.	e) Wood and bamboo samples were treated applying soaking process for different time duration in table-2
f) Monitoring and collection of data from previous treated sample.	f) Monitoring of previous sample and data collection is going on.

Table 1: pH of the neem leaves & mahogani seed solution and moisture content of wood & bamboo sample.

Sl.No.	pH of the 10% Neem leaves sol^n	pH of the 10% Mahogani seeds sol^n	Moisture content of wood	Moisture content of bamboo
1	8.0	7.5	22%	20%
2	7.8	7.7	19%	23%
3	8.0	7.4	20%	21%

Table 2: Treatment of wood and bamboo samples by 10% neem leaves and mahogani seed soln.

Name of species	Thickness of wood/bamboo(cm)	Observation (No. of sample)		
		Duration (days)		
		5 days	7 days	10 days
Wood	1.5 cm	5	5	5
Bamboo	1 cm	5	5	5

4.9   **Achievement (s), if any :**
4.10   **Financial statement**   **:**
4.10.1   Total cost   **:** Tk. 3,60,750.00
4.10.2   Cost of the year   **:** Tk. 1,20,000.00
4.10.3   Expenditure of the year   **:** Tk. 1,20,000.00
4.10.4   Source of fund   **:** GOB
4.11   **Beneficiaries:** Environmental friendly preservative, Nontoxic for betel leaf farmers and general public.

Wood Working and Timber Engineering Division

1.   **Study**   : On going

1.1   **Programme Area**   : Post Harvest Utilization – Physical Processing

1.2   **Title of the Study**   : Survey and improvement of sawing technique of different wood species for maximum yield.

1.3   **Justification :** The importance of sawmilling sector cannot be ignored as the use of wood products is increasing and subsequently wood based industries are expanding rapidly in Bangladesh. The conversion of log into sawn-timber requires many steps arriving at sawmill. Problems that arise from conventional sawing practices include low yields and inferior quality timber which increases loses of timber resources. The aim of this study is therefore to use the application of different improved sawing techniques instead of conventional sawing method to produce maximum yields. The overall economic benefits will be gained through the yield maximization of timber in the sawing unit throughout the country.

1.4   **Objective(s)**   **:**
1.4.1   To determine the cause of timber loss during sawing.
1.4.2   To maximize the yields of timber by applying improved sawing techniques.

1.5   **Expected output :** Minimizing sawing wastage and making as large quality sawn yield.

1.6   **Study Period**   **:**
1.6.1   Starting year   **:** 2014-2015
1.6.2   Completion year   **:** 2017-2018
1.7   **Personnel**   **:**
1.7.1   Project Leader: **:** M. Ashaduzzaman Sarker, RO
1.7.2   Associates   **:** M. Ramiz Uddin, DO; N. A. Mridha, RO & T. K. Dey, RA-l
1.8   **Progress**
1.8.1   Previous years, if any: 50 cft. gamar (*Gmelina arborea*) wood was collected. Sawmills at two locations, namely-Rajshahi and Kaptai were visited. Data on present sawing status for different density wood species from sawmills at above locations was collected. Different sawing techniques for low density wood species were applied and data were collected.

1.8.2 This year :

Activities of the study	Progress
a) Collection of 50 cft. medium density wood, mahogany (*Swietenia macrophylla*).	Procurement was completed.
b) Visit to sawmill at three locations, namely-Khulna, Dhaka and Cox's Bazar.	53 sawmill at two locations, namely- Khulna and Dhaka were visited.
c) Collection of data on present sawing status for different wood species from sawmill at above locations.	Data on present sawing status for different density wood species from sawmills at Dhaka and Khulna was collected.
d) Application of different sawing techniques and collection of data on those techniques for medium high density group wood at sawmill.	Sawing technique was applied for medium density wood species. Sawing data (Log wise) of medium density wood mahogany (*Swietenia macrophylla*) has been shown in table 1. Number of logs: 10; Minimum wastage: 10.7%; Maximum wastage: 18.7%; Average wastage: 16%.
e) Data analysis.	Data analysis is in progress.

1.9 **Achievement (s), if any :** By using quality saw blade, species wise selection of saw blade and proper maintenance of saw blade can produce quality sawn products and also minimized sawing wastage.

1.10 **Financial statement :**
1.10.1 Total cost : Tk. 5,00,000.00
1.10.2 Cost of the year : Tk. 1,98,000.00
1.10.3 Expenditure of the year : Tk. 1,07,000.00
1.10.4 Source of fund : GOB

1.11 **Beneficiaries:** Sawmill owners, timber traders, timber users, BFIDC and FD.

Table 1: Sawing data of mahogany wood (*Swietenia macrophylla*).

Log No.	Quantity round log	Board/ Lumber			Wastage of sawing wood
		Size by size	Quantity (cft.)	Total (cft.)	
1	5.6	3″ × 10″× 7′(1)	1.46	4.67	16.6%
		3″ × 7″ × 7′ (1)	1.02		
		3″ × 3″ × 7′(5)	2.19		
2	4.6	3″ × 8″ × 7′(1)	1.16	4.02	12.6%
		2″ × 8″ × 7′(2)	1.6		
		2″ × 1″ × 7′(13)	1.26		
3	5.4	3″ × 7″ × 7′(1)	1.02	4.48	17%
		2″ × 7″ × 7′(2)	2.68		
		2″× 1″× 2.5′(8)	0.28		
		2″× 1″× 4′(10)	0.5		
4	3.75	3″× 9.5″× 7′(1)	1.38	3.3	12%
		2″× 7″× 7′(1)	0.68		
		3″× 1″× 5′(10)	1.04		
		3″× 1″× 2′(5)	0.2		

5	4.2	3″× 8″× 6′(1)	1	3.75	10.7%
		2″× 8″× 6′(1)	0.7		
		3″× 3″× 6′(1)	0.37		
		3″× 1″× 3′(6)	0.38		
		3″× 9″× 7′(1)	1.31		
6	7	1″× 12″× 7′(6)	3.5	5.8	17%
		1″× 11″× 7′(1)	0.53		
		1″× 10″× 7′(2)	0.97		
		1″× 6″× 5′(1)	0.20		
		1″× 5″× 4′(1)	0.13		
		1″× 4″× 3′(1)	0.08		
		1″× 8″× 7′(1)	0.39		
7	6.15	1″× 9″× 7′(4)	1.75	5.08	17.4%
		1″× 7″× 7′(2)	0.68		
		1″× 7″× 5′(1)	0.24		
		1″× 4″× 7′(1)	0.19		
		1″× 8″× 3′(1)	0.17		
		1″×9″× 7′(1)	0.43		
		1″× 8″× 7′(5)	1.94		
8	4.39	1″× 10″× 7′(4)	1.94	3.69	16%
		1″× 6″× 7′(3)	0.87		
		1″× 4″× 7′(1)	0.19		
		1″× 8″× 7′(1)	0.39		
		1″× 6″× 5′(1)	0.20		
		0.5″× 6″× 7′(3)	0.43		
		1″× 5″× 2′(1)	0.06		
9	5.11	1″× 10″× 7′(6)	2.92	4.16	18.5%
		1″× 6″× 2′(1)	0.08		
		1″× 8″× 7′(3)	1.16		
10	6.43	1″× 12″× 7′(6)	3.5	5.23	18.7%
		1″× 9″× 7′(1)	0.87		
		1″× 4″× 3′(1)	0.08		
		1″× 8″× 7′(1)	0.39		
		1″× 4″× 7′(1)	0.19		

2. **Study** : On-going

2.1 **Programme Area** : Post Harvest Utilization -Physical Processing

2.2 **Title of the Study** : Characterization of hybrid acacia wood for working and finishing properties.

2.3 **Justification :** Hybrid acacia, a high yielding variety from cross pollination of *Acacia auliculiformis and Acacia mangium* is an exotic species and it has been introduced in Bangladesh from Northern Australia, Papua New Guinea and Indonesia. This species is available in roadsides, homestead agro-forestry and rural marginal lands. It has become very popular to the farmer due to its straight bole and fast growing nature. A huge quantity of hybrid acacia wood is being produced in Bangladesh. Hybrid acacia timber need to studies working and finishing properties before its proper and specific uses. The present study has been taken to find out the working and finishing properties of Hybrid acacia wood.

2.4 **Objective(s)** :

2.4.1 To assess the suitability of hybrid acacia wood for furniture and other utilization purposes.

2.4.2 To decrease the pressure on traditional timber species.

2.5   **Expected output** : Better utilization of wood and conservation of forest resources.
2.6   Study Period   **:**
2.6.1   Starting year   **:** 2015-2016
2.6.2   Completion year   **:** 2016-2017
2.7   **Personnel**   **:**
2.7.1   Project Leader: **:** M. Ramiz Uddin, DO
2.7.2   Associates   **:** M. Zahirul Alam, RO; N. A. Mridha, RO; M. Ashaduzzaman
                              Sarker, RO & T. K. Dey, RA-l
2.8   **Progress**
2.8.1   Previous years, if any: 50 cft. hybrid acacia wood was procured. Sawing qualities were
        determined. Working properties, such as-planning, shaping, boring, mortising and turning
        by machine and hand tools were determined.
2.8.2   This year   **:**

Activities of the study	Progress
a) Seasoning of hybrid acacia wood to 15% moisture content.	Seasoning was completed.
b) Treatment of the hybrid acacia wood using 10% borax-boric acid solution.	Treatment was completed.
c) Manufacture of six chair, six computer table, one single seated sofa, one double seated sofa, two tea table, one centre table and one bed and put under service test.	Manufacture of six chair, six computer table, one single seated sofa, one double seated sofa, two tea table, one centre table and one bed was completed. Distribution of furniture for service test were shown in table-2
d) Cost comparison of the furniture.	Cost comparison with teak furniture was shown in table-1.

2.9   **Achievement (s), if any :** Hybrid acacia wood produces quality furniture. Low income
                              generation people can afford hybrid acacia furniture with
                              reasonable price.
2.10   **Financial statement :**
2.10.1 Total cost   **:** Tk. 3,50,000.00
2.10.2 Cumulative cost   **:** Tk. 1,80,000.00
2.10.3 Cost of the year   **:** Tk. 1,43,000.00
2.10.4 Source of fund   **:** GOB

2.11   **Beneficiaries:** Common people, timber traders, wood based industries, FD,   BFIDC and
                              NGOs.

Table-1: Cost comparison of hybrid acacia furniture (2017).

Sl. No.	Name of the Item	Production cost (BFRI)	Market price (Teak)
1.	Single seated sofa 30″ x 24″ x 24″	13,000.00	20,000.00
2.	Double seated sofa 48″ x 24 ″ x 24″	19,000.00	32,000.00
3.	Chair 18″ x 21″ x 36″	5,000.00	8,000.00
4.	Computer Table 24″ x 36″ x 30″	10,000.00	16,000.00
5.	Bed 7″ x 4″x 2.5″	33,000.00	60,000.00

Table-2: Distribution of furniture made by hybrid acacia wood.

Sl. No.	Name of the furniture	Location
1.	Computer Table (6 nos.)	S & TP
		VCWP
		SSD
		P & P
		WWD
		WWD
2.	Chair (6 nos.)	BFRI Rest House
3.	Double seated Sofa	BFRI Rest House (WWD)
4.	Single seated Sofa	BFRI Rest House (WWD)
5.	Bed	BFRI Rest House (WWD)
6.	Tea table /Centre table	BFRI Rest House (WWD)