# ANNUAL RESEARCH PROGRESS: 2015 – 2016


Government of the people's Republic of Bangladesh

**Bangladesh Forest Research Institute**

Chittagong

# Contents of the Research Progress : 2015 – 16

## FOREST MANAGEMENT WING

# Research Progress 2015-16
# 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 is 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** :

a. 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
b. Awareness among the local people about values of local biodiversity and their conservation will be strengthened for future conservation.
c. Motivation of community people for restoration for their perennial water source and better livelihoods.
d. BFRI herbarium will be enriched with voucher specimens of the VCF.

**1.6 Study period** :

1.6.1 Starting year : 2013- 14

1.6.2 Completion year : 2016-17

**1.7 Personnel(s)** :

1.7.1 Study 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 year: Two discussions meeting were conducted with the karbary 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, Arorosa 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. Group discussion with local people and Kabaries. | a. Two 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. Preparation of site map and laying out sample plots. | b. Total 21 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. Collection of botanical samples and processing of the samples. | c. Sixty eight botanical samples were collected from the sample plots. Collected samples processed and persevered in the BFRI herbarium. Collected samples were classified into trees, shrubs, herbs and climbers species. |
| d. Identification of species and data analysis. | A total of 46 species under 26 genera of 18 families have been identified comparing with the authentic samples of the BFRI herbarium. Among them 22 trees, 10 shrubs, 5 herbs and 9 climbers species. Mounting, leveling and family wise arranged of 17 identified samples for preserved in the BFRI herbarium. The quantitative data for the floristic composition have collected. |
| e. Motivate the local peoples towards enrichment plantation for restoration. | Local people were become aware about the importance of biodiversity conservation in their area. They express their consent for enrichment planting with rare indigenous species in the VCF. |
| f. Motivate the local people for conservation of indigenous tree seedlings and enrichment planting with supplied indigenous species. | Total 6000 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. |
| g. Data processing and report writing | Preparation of draft of scientific report is under process. |

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

**1.10 Financial statement** :

1.10.1 Total cost : Tk. 5,00, 000/-

1.10.2 Cost of the year : Tk. 1,65,990/-

1.10.3 Expenditure of the year : Tk. 1,65,990/-

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** : 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** :

a. 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.

b. 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- 14

2.6.2 **Completion year** : 2016-17

**2.7 Personnel(s)** :

2.7.1 Study leader : Mohammed Mohiuddin, D.O

2.7.2 Associates : Asim Kumar Paul, R.O., Syedul Alam RA-1

**2.8 Progress** :

2.8.1 **Previous year:** 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 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. Group discussion meeting with herbal healers. | a. Five 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. Collection of ethno-botanical samples processing and identification of the collected samples. | b. Most of the plants collected from natural vegetation and few of them from collected from home gardens. Total 86 ethno-medicinal plants were collected from the Kutubchari, Badalchari, Budchari, Duluchari, Khamar para and Kaptai Kolabunia para in Rangamati district and 98 ethno-medicinal plants species were collected from the Ganj para, Alutila, Shilatuk para, Dharmaghar, Guimara and Amtoli in Khagrachari hill district forests area. Among the collected species were 31 trees, 55 shrubs, 98 herbs species. Total 112 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 information on parts uses disease name, medicine preparation and habitat of plant growing. | 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 22 plant species are used to bone fracture, followed by 19 species for paralysis, 17 tumor/boils, 17 for heart disease, 15 species for female disease, 15 species for high blood pressure, 15 species for kidney/urinary problem, 12 species for jaundice, 11 for fever, and 10 species for blood purifier, 09 for asthma, 07 species for stomach pain, 06 species for head ache, 05 species for dysentery and 04 for diabetes. 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 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. |

**2.9 Achievement(s), if any** :
**2.10 Financial statement** :
2.10.1 Total cost : Tk. 4,00, 000/-
2.10.2 Cost of the year : Tk. 1,58,000/-
2.10.3 Expenditure of the year : Tk. 1,58,000/-
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(s)** :
3.7.1 Study leader : Mohammed Mohiuddin, D.O.

3.7.2 Associates : Asim Kumar Paul, R.O.; Syedul Alam, RA-1.

**3.8 Progress** :

3.8.1 Previous year: : New Study

3.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a. Transect walk and quadrate prepared for data collection. | a. Total 10 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 110 plant species of the existing plants in the WS. Among the listed species were 50 trees, 30 shrubs, 20 herbs and 10 climber species. |
| c. Botanical specimens voucher collection and note in their morphological character. | c. Total 86 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 73 species have been identified comparing with the authentic samples of the BFRI herbarium. Mounting, leveling and family wise arranged of 22 identified samples for preserved 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

3.10.2 Cost of the year : Tk. 2,5,990

3.10.3 Expenditure of the year : Tk. 2,5,990

3.10.4 Source of fund : GOB

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

## Forest Economics Division

**1 Study** : On-going

1.1 Programme Area : Forest Inventory and Economics.

**1.2 Title of the Study** : **Impact of the Coastal afforestation of Bangladesh in respect of financial and socioeconomic conditions of local people**

**1.3 Justification :** The people of coastal area are very poor and depend on agriculture as seasonal laborer. Poverty is a major problem and is acute due to natural disaster frequently, especially in coastal area of the country. The government has given priority to develop the coastal areas where most of the poor people live. So, the afforestation programmed was 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 transformed the condition of socioeconomic and environmental development of the country. Now, it is proper time to assess the source of income and change of the livelihood of local people due to afforestation and its' economic viability in the coastal zone which is contributing to the national economy.

**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 afforestation areas.

1.4.2 To assess income generation of local people.

1.4.3 To make financial analysis of afforestation in Coastal zone.

1.4.4 To estimate the sequestrated carbon in the selected years of plantations of Coastal Afforestation.

**1.5 Expected output**: Generation of income, production system, input- out-put ratio of local people and the economic profitability will be assessed in Coastal zone.

**1.6 Study period** :

1.6.1 Starting year : 2012- 13

1.6.2 Completion year : 2015-16

**1.7 Personnel(s)** :

1.7.1 Study leader : M.A Taher Hossain; RO

1.7.2 Associates : Hasina Mariam; DO, Rukshana Akther, FI; Md. Melon; FI & Forzana Yasmin; RA-1

**1.8 Progress** :

1.8.1 Previous year: Collected information on the strip plantations raised during 1995-96 to 2000-01 under the Coastal Afforetation Division (CAD) of Noakhali & Bhola and Social Forest Division (SFD) of Bagerhat & Barisal were analyzed. The total plantations of targeted period of four Divisions were 1922 & 818 and 2742 & 900 seedling km respectively. Therefore, Stratified Random Sampling technique was been followed to assess the forest resources of the targeted strip plantations. The total tree stocking (nos.) & carbon sequestration (tons) determined were about 980 and 170 thousand in Noakhali, 256 and 42 thousand in Bhola, 870 & 146 thousand in Bagerhat and 383 & 68 thousand in Barisal. Its' sequestrated carbon were equivalent to 594, 153, 535 and 249 thousand tons of absorbing Green House Gas ($CO_2$) for purifying air of the atmosphere. The average financial Net Present Value of Benefit (NPVB), Internal Rate of Return (IRR) and B-C ratio of the same targeted plantations years were 513 ("000"Tk/ha), 30% and 4.21 in Noakhali, 215 ("000"Tk/ha), 23% & 2.79 in Bhola, 217 ('000"Tk/ha), 25% and 3.33 in Bagerhat and 388 ("000"Tk/ha), 28% & 3.32.in Barisal. So, the generated income on targeted strip plantations for local beneficiaries were been estimated in current price about Tk. 840 million in Noakhali (2013) 202 million in Bhola (2015), 656 million in Bagerhat (2014) and Tk. 464 million in Barisal (2015).

1.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a. Conduct pilot survey and selection of participants with the help DFO office of Patuakhali and Chittagong | a. Conducted pilot survey were to determine the required number of plots as sample size in order to assess forest resource of the strip plantation established during 1995-96 to 2000-01 under the Coastal Afforestation Division (CAD) of Patuakhali and Chittagong. Arranged group discussions were with the local participants of 3 locations from each Division that would directly or indirectly having benefited form strip plantation. Among the participant of strip plantation from each location, 25 beneficiaries were been selected randomly for interview regarding their production and income from their participated strip plantations. |
| b. Data collection and analysis. | b. The required number of samples size for the study areas of Patuakhali and Chittagong were determined as 200 (size 100 sq. meter) and 180 plots at 8% and 7.2 % margin of error respectively through pilot survey. These sample plots were been allocated stratum (year-basis) wise proportionately for required data collection. The collected information were GBH/DBH of trees and number of tree species per plot, price of species wise tree round log in different sizes & fuel wood and cost of nursery and plantation management etc. The Stratified Random Sampling was been followed to assess the number tree stocking, tree biomass and forest carbon storing of the strip plantation raised during 1995-96 to 2000-01 under the CAD of Patuakhali and Chittagong.. Statistical and economic estimated results of targeted strip plantations are in table 1, 2, 3, 4, 5, 6 & 7. |

**Tab. 1 Establishment of strip plantations (seedling km) from 1995-96 to 2000-01 under the C-A Divisions of Patuakhali and Chittagong**

| Plantation Year | Seedling km | |
|---|---|---|
| | Patuakhli (Pkli) | Chittagong (Ctg.) |
| 1995-96 | 124 | 47 |
| 1996-97 | 229 | 60 |
| 1997-98 | 218 | 147 |
| 1998-99 | 183 | 81 |
| 1999-00 | 207 | 132 |
| 2000-01 | 273 | 97 |
| **Total** | 1234 | 564 |

**Tab. 2 Girth at Breast Height (GBH) basis tree species (no./ha) and Tree covered (%) of the strip plantations raised from 1995-96 to 2000-01 under two Coastal Forest Divisions**

| Patuakhali | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SPP name | GBH Class | | | | | | | Total | Tree covered (%) |
| | >45 | 45-59 | 60-89 | 90-119 | 120-149 | 150-179 | 180-209 | | |
| Akashmoni | 12 | 58 | 154 | 76 | 8 | 1 | | 308 | 43% |
| Sisoo | 14 | 33 | 61 | 21 | 3 | | | 130 | 18% |
| Raintree | 2 | 6 | 16 | 23 | 10 | 8 | 1 | 64 | 9% |
| Mehogani | 5 | 9 | 23 | 12 | 2 | 1 | | 51 | 7% |
| Babla | 10 | 16 | 17 | 1 | | | | 43 | 6% |
| Rajkoroi | 2 | 5 | 12 | 12 | 4 | 3 | | 37 | 5% |
| Arjun | 3 | 2 | 12 | 4 | 2 | | | 23 | 3% |
| Epil-epil | 4 | 3 | 6 | 4 | | | | 16 | 2% |
| Khoa babla | | 3 | 7 | 4 | 1 | | | 15 | 2% |
| Others | 9 | 9 | 9 | 5 | 1 | | | 32 | 4% |

| Chittagong | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SPP name | GBH Class | | | | | | Total | Tree covered (%) |
| | >45 | 45-59 | 60-89 | 90-119 | 120-149 | 150-179 | | |
| Akashmoni | 36 | 35 | 54 | 36 | 10 | 1 | 171 | 40% |
| Rain tree | 7 | 8 | 19 | 18 | 4 | 1 | 57 | 13% |
| Mehogoni | 1 | 8 | 21 | 6 | | | 36 | 8% |
| Babla | 12 | 12 | 8 | 2 | | | 33 | 8% |
| Koroi | 1 | 7 | 12 | 9 | 1 | | 29 | 7% |
| Jau | 6 | 8 | 7 | 3 | | | 24 | 6% |
| Neem | 4 | 7 | 6 | 1 | 1 | | 19 | 5% |
| Epil-epil | 2 | 3 | 2 | 2 | 1 | | 11 | 3% |
| Eucalyptus | 4 | 5 | 2 | | | | 11 | 3% |
| Others | 11 | 7 | 15 | 3 | 1 | 1 | 38 | 9% |

**Note:** Number of same tree species 10 and below per hectare were included in the column of others.

**Tab.3 Tree resources estimation in various categories of the targeted strip plantations of two Coastal Forest Divisions**

| Plantation Year | Tree stocking (no./ha) | | Tree Bio-mass (ton/ha) | | Interim products(ton/ha) | | | | End product/ha | | | | Intangible product (ton/ha/year) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Agri. crops | | Fodder & fuelwood | | Commercial wood (m3) | | Fodder & fuelwood (ton) | | O-C Sequestration | | GHG ($CO_2$) absorption | |
| | **Pkli** | **Ctg** | **Pkli** | **Ctg** | **Pkli** | **Ctg** | **Pkli** | **Ctg** | **Pkli** | **Ctg** | **Pkli** | **Ctg** | **Pkli** | **Ctg** | **Pkli** | **Ctg** |
| 1995-96 | 835 | 433 | 456 | 266 | 0.8 | 0.3 | 5.8 | 0.9 | 333 | 94 | 156 | 86 | 14 | 9 | 50 | 32 |
| 1996-97 | 757 | 447 | 464 | 255 | 0.5 | 0.2 | 3.0 | 0.6 | 314 | 85 | 144 | 77 | 15 | 9 | 54 | 32 |
| 1997-98 | 686 | 457 | 335 | 210 | 0.9 | 0.4 | 6.5 | 1.3 | 247 | 86 | 121 | 81 | 12 | 8 | 43 | 30 |
| 1998-99 | 613 | 462 | 308 | 123 | 0.9 | 0.4 | 6.1 | 1.2 | 199 | 88 | 97 | 57 | 12 | 6 | 43 | 21 |
| 1999-00 | 691 | 429 | 271 | 142 | 1.0 | 0.4 | 6.9 | 1.4 | 175 | 42 | 97 | 50 | 11 | 7 | 41 | 25 |
| 2000-01 | 757 | 358 | 229 | 86 | 1.1 | 0.5 | 7.6 | 1.5 | 138 | 27 | 89 | 36 | 10 | 5 | 38 | 20 |

**Note:** Patuakhali- Pkli & Chittagong-Ctg

**Tab. 4 Estimated tangible and intangible forest resources of the strip plantations raised during 1995-96 to 2000-01 under the Coastal Divisions of Patuakhali and Chittagong**

| **Parameters** | **Total estimation (95% of C.I)** | |
|---|---|---|
| | **Patuakhli (Pkli)** | **Chittagong (Ctg.)** |
| Study areas (ha) | 494 | 225 |
| Number of tree Stocking ("000") | 355 (±15) | 97(±8) |
| Tree Biomass ("000" ton) | 164 (±11) | 38(±5) |
| O-C Flux ("000" ton) | 82 (±5) | 19(±3) |
| O-C Sequestration ('000" ton) | 98 (±5) | 26(±3) |
| $CO_2$ Assimilation ('000" ton) | 359 (±20) | 97(±10) |

**Tab. 5 Result of financial and economic indicators of the targeted strip plantations in two Forest Coastal Divisions**

| **Plantation Year** | **PVC ("000" Tk/ha)** | | **Financial indicators** | | | | **Economic indicators** | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **NPVB ("000"Tk/ha** | | **IRR** | | **NPVB ('000" Tk/ha)** | | **IRR** | |
| | **Pkli** | **Ctg** | **Pkli** | **Ctg** | **Pkli** | **Ctg** | **Pkli** | **Ctg** | **Pkli** | **Ctg** |
| 1995-96 | 149 | 84 | 398 | 88 | 26% | 16.53% | 489 | 146 | 39% | 23% |
| 1996-97 | 163 | 86 | 403 | 89 | 26% | 16.84% | 501 | 149 | 36% | 24% |
| 1997-98 | 147 | 97 | 321 | 96 | 25% | 16.97% | 401 | 151 | 33% | 22% |
| 1998-99 | 149 | 103 | 293 | 79 | 24% | 15.93% | 372 | 119 | 32% | 20% |
| 1999-00 | 129 | 76 | 275 | 50 | 28% | 15.75% | 351 | 97 | 39% | 23% |
| 2000-01 | 127 | 90 | 227 | -2 | 26% | 9.76% | 298 | 34 | 35% | 15% |

**Tab. 6 Land Expectation Value (LEV) and Equal Annual Income (EAI) per hectare in respect of NPV and LEV for the strip plantations in two Forest Coastal Divisions**

| Age of Plantation (year) | LEV ("000" Tk) | | EAI $_{LEV}$ ("000" Tk) | | EAI $_{NPV}$ ("000" Tk) | |
|---|---|---|---|---|---|---|
| | Pkli | Ctg | Pkli | Ctg | Pkli | Ctg |
| 19 | 77.78 | 17.21 | 9.30 | 2.06 | 47.57 | 10.52 |
| 18 | 88.28 | 19.60 | 10.76 | 2.39 | 49.08 | 10.90 |
| 17 | 79.20 | 23.67 | 9.87 | 2.95 | 40.03 | 11.97 |
| 16 | 81.41 | 21.95 | 10.41 | 2.81 | 37.41 | 10.09 |
| 15 | 86.61 | 15.77 | 11.39 | 2.07 | 36.18 | 6.59 |
| 14 | 81.20 | -0.68 | 11.02 | -0.09 | 30.83 | -0.26 |

**Tab. 7 Financial achievement of the strip plantations raised from 1995-96 to 2000-01 in two Forest Coastal Divisions**

| Plantation Year | Plantation area (ha) | | Present Value in Million Tk. | | | | Beneficiaries sharing (Tk. in million) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Investment | | Net profit | | Interim crop value & 55% Net Profit (PV) | | Generated income | |
| | Pkli | Ctg | Pkli | Ctg | Pkli | Ctg | Pkli | Ctg | Pkli | Ctg |
| 1995-96 | 50 | 19 | 7.39 | 1.57 | 19.74 | 1.65 | 12.21 | 1.80 | 82.14 | 12.09 |
| 1996-97 | 92 | 24 | 14.92 | 2.06 | 36.87 | 2.15 | 41.54 | 4.20 | 254.07 | 25.69 |
| 1997-98 | 87 | 59 | 12.86 | 5.69 | 28.00 | 5.63 | 18.57 | 5.15 | 98.97 | 28.62 |
| 1998-99 | 73 | 32 | 10.90 | 3.35 | 21.42 | 2.56 | 14.70 | 2.69 | 74.31 | 13.59 |
| 1999-00 | 83 | 53 | 10.69 | 4.02 | 22.78 | 2.64 | 15.07 | 3.04 | 65.82 | 13.96 |
| 2000-01 | 109 | 39 | 13.87 | 3.50 | 24.80 | -0.07 | 17.95 | 1.65 | 74.97 | 6.89 |
| | **Total** | | | | | | | | 650.27 | 100.85 |

- Generated income of beneficiaries were 55 percent shared from sales proceeds of final tree harvest in addition to 100 percent of all other benefits from interim crops that were agricultural crops, thinning and pruning materials at 5$^{th}$ and 8$^{th}$ year period of the respective strip plantations .

**Remarks:** Standing incomes are 650 and 101 million taka for the local poor participants from the targeted year of plantations of two Coastal Forest Divisions. Moreover, 98 and 26 thousand metric ton of Organic carbon are sequestered and that are equivalent to 359 and 97 thousand metric ton of $CO_2$ gas mitigation in reducing compromise of climate change by the strip plantations established from 1995-96 to 2000-01 under the Coastal Forest Divisions of Patuakhali and Chittagong respectively**.**

**1.9 Achievement(s), if any** : Generated additional income of local poor participants, sequestrated organic carbon (O-C) and its' equivalent of green house gas ($CO_2$) mitigation in reducing compromise of climate change are estimated from the strip plantation raised during 1995-96 to 2000-01 under the Patuakhali and Chittagong and other Coastal Forest Divisions of Bangladesh.

**1.10 Financial statement** :

1.10.1 Total cost : Tk. 6,50,000
1.10.2 Cost of the year : Tk. 1,57,400
1.10.3 Expenditure of the year : Tk. 1,57,400
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- 16
1.6.2 Completion year : 2019-20
**1.7 Personnel(s)** :
1.7.1 Study leader : Md. Abul Hasnat Shah Jalal, SRO.
1.7.2 Associates : Mohammad Shahid Ullah, DO; Mofizul Islam Khan, FI
**1.8 Progress** :
1.8.1 Previous year, 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 recorded 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 Tree | DBH (cm) | Height (m) | Mean Annual Increment | |
|---|---|---|---|---|---|---|---|
| | | | | | | DBH (cm) | Height (m) |
| 1(A) | 2008 | 08 | 28 | 10.1 | 9.8 | 1.3 | 1.2 |
| 2(A) | 2008 | 08 | 13 | 13.7 | 10.3 | 1.7 | 1.3 |
| 3(A) | 2008 | 08 | 27 | 10.3 | 9.1 | 1.3 | 1.1 |
| 4 | 2006 | 10 | 14 | 16.7 | 17.4 | 1.7 | 1.7 |
| 5 | 2006 | 10 | 14 | 13.9 | 15.9 | 1.4 | 1.6 |
| 6 | 2006 | 10 | 23 | 12.9 | 16.1 | 1.3 | 1.6 |
| 7 | 2005 | 11 | 37 | 11.5 | 13.7 | 1.0 | 1.2 |
| 8 | 2005 | 11 | 24 | 14.2 | 14.7 | 1.3 | 1.3 |
| 9 | 2005 | 11 | 23 | 15.0 | 14.4 | 1.4 | 1.3 |
| 10(A) | 2011 | 05 | 65 | 6.8 | 8.5 | 1.4 | 1.7 |
| 11(A) | 2011 | 05 | 39 | 8.4 | 9.3 | 1.7 | 1.9 |
| 12(A) | 2011 | 05 | 46 | 6.7 | 7.2 | 1.3 | 1.4 |
| 13 | 2007 | 09 | 23 | 16.0 | 14.1 | 1.8 | 1.6 |
| 14 | 2007 | 09 | 22 | 13.9 | 13.5 | 1.5 | 1.5 |
| 15 | 2007 | 09 | 14 | 14.2 | 13.0 | 1.6 | 1.4 |

**Table 2. Growth increment of akashmoni trees at Hiako and Andharmanik under Chittagong Forest Division.**

| Plot Number | Year of Plantation | Age (year) | Number of Tree | DBH (cm) | Height (m) | Mean Annual Increment | |
|---|---|---|---|---|---|---|---|
| | | | | | | DBH (cm) | Height (m) |
| 1 | 2007 | 09 | 72 | 8.0 | 8.2 | 0.9 | 0.9 |
| 2 | 2007 | 09 | 40 | 8.7 | 7.0 | 1.0 | 0.8 |
| 3 | 2006 | 10 | 12 | 18.5 | 15.6 | 1.9 | 1.6 |
| 4 | 2006 | 10 | 15 | 17.0 | 13.9 | 1.7 | 1.4 |
| 5 | 2006 | 10 | 16 | 17.6 | 13.8 | 1.8 | 1.4 |
| 6 | 2005 | 11 | 13 | 18.0 | 13.8 | 1.6 | 1.3 |
| 7 | 2005 | 11 | 19 | 19.2 | 15.2 | 1.7 | 1.4 |
| 8 | 2004 | 12 | 23 | 14.6 | 11.5 | 1.2 | 1.0 |
| 9 | 2004 | 12 | 17 | 15.8 | 13.4 | 1.3 | 1.1 |
| 10 | 2004 | 12 | 17 | 14.9 | 11.4 | 1.2 | 1.0 |
| 11 | 2003 | 13 | 15 | 19.9 | 13.4 | 1.5 | 1.0 |
| 12 | 2003 | 13 | 17 | 18.4 | 13.4 | 1.4 | 1.0 |

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

| Plot Number | Year of Plantation | Age (year) | Number of Tree | Average DBH (cm) | Average Height (m) | Mean Annual Increment | |
|---|---|---|---|---|---|---|---|
| | | | | | | DBH (cm) | Height (m) |
| 1 | 2000 | 16.5 | 40 | 14.8 | 13.8 | 0.9 | 0.8 |
| 2 | 1998 | 18.5 | 31 | 17.0 | 14.3 | 0.9 | 0.8 |
| 3 | 2000 | 16.5 | 31 | 18.1 | 14.8 | 1.1 | 0.9 |
| 4 | 2004 | 12.5 | 34 | 18.3 | 14.5 | 1.5 | 1.2 |
| 6 | 1991 | 25.5 | 59 | 12.5 | 12.1 | 0.5 | 0.5 |
| 7 | 2008 | 8.5 | 51 | 13.3 | 10.7 | 1.6 | 1.3 |
| 8 | 2002 | 14.5 | 24 | 22.0 | 15.5 | 1.5 | 1.1 |
| 9 | 1996 | 20.5 | 27 | 28.4 | 16.5 | 1.4 | 0.8 |
| 10 | 2000 | 16.5 | 25 | 20.8 | 16.2 | 1.3 | 1.0 |
| 11 | 2000 | 16.5 | 34 | 14.7 | 11.8 | 0.9 | 0.7 |
| 12 | 1997 | 19.5 | 15 | 21.4 | 14.7 | 1.1 | 0.8 |
| 13 | 1997 | 19.5 | 34 | 15.5 | 14.8 | 0.8 | 0.8 |
| 14 | 1994 | 22.5 | 06 | 27.8 | 14.8 | 1.2 | 0.7 |
| 15 | 1998 | 18.5 | 26 | 15.7 | 12.0 | 0.8 | 0.6 |
| 16 | 1994 | 22.5 | 23 | 23.4 | 14.3 | 1.0 | 0.6 |
| 17 | 1994 | 22.5 | 21 | 23.3 | 15.7 | 1.0 | 0.7 |
| 18 | 2008 | 8.5 | 32 | 12.5 | 7.8 | 1.5 | 0.9 |
| 19 | 2008 | 8.5 | 26 | 10.8 | 6.6 | 1.3 | 0.8 |
| 20 | 1995 | 21.5 | 30 | 19.6 | 14.1 | 0.9 | 0.7 |
| 21 | 1995 | 21.5 | 38 | 20.3 | 14.8 | 0.9 | 0.7 |
| 22 | 2005 | 11.5 | 20 | 17.3 | 13.9 | 1.5 | 1.2 |
| 23 | 2007 | 9.5 | 39 | 15.2 | 9.9 | 1.6 | 1.0 |
| 24 | 2007 | 9.5 | 36 | 12.4 | 11.1 | 1.3 | 1.2 |
| 25 | 2007 | 9.5 | 40 | 11.7 | 9.2 | 1.2 | 1.0 |
| 26 | 1994 | 22.5 | 14 | 12.4 | 9.8 | 0.6 | 0.4 |
| 27 | 1994 | 22.5 | 08 | 11.3 | 9.2 | 0.5 | 0.4 |
| 28 | 2007 | 9.5 | 25 | 14.2 | 9.5 | 1.5 | 1.0 |
| 29 | 2007 | 9.5 | 31 | 13.9 | 9.7 | 1.5 | 1.0 |
| 30 | 1993 | 21.5 | 19 | 19.0 | 17.7 | 0.9 | 0.8 |
| 31 | 1995 | 21.5 | 28 | 18.8 | 16.8 | 0.9 | 0.8 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 32 | 2002 | 14.5 | 35 | 13.9 | 11.3 | 1.0 | 0.8 |
| 33 | 2008 | 8.5 | 28 | 13.4 | 9.3 | 1.6 | 1.1 |
| 34 | 1990 | 26.5 | 17 | 17.2 | 13.3 | 0.6 | 0.5 |
| 35 | 1995 | 21.5 | 31 | 15.9 | 12.9 | 0.7 | 0.6 |
| 36 | 1995 | 21.5 | 44 | 13.3 | 12.3 | 0.6 | 0.6 |
| 37 | 2005 | 11.5 | 45 | 10.5 | 9.3 | 0.9 | 0.8 |
| 38 | 2002 | 14.5 | 48 | 14.5 | 13.8 | 1.0 | 1.0 |
| 39 | 2001 | 15.5 | 44 | 14.0 | 10.6 | 0.9 | 0.7 |
| 40 | 1997 | 19.5 | 21 | 19.1 | 15.0 | 1.0 | 0.8 |
| 41 | 1995 | 21.5 | 27 | 18.8 | 13.4 | 0.9 | 0.6 |
| 42 | 1995 | 21.5 | 42 | 15.0 | 11.7 | 0.7 | 0.5 |
| 43 | 1995 | 21.5 | 23 | 15.4 | 14.7 | 0.7 | 0.7 |
| 44 | 2001 | 15.5 | 30 | 15.9 | 14.2 | 1.0 | 0.9 |

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

**1.10 Financial statement** :

1.10.1 Total cost : Tk. 5,00,000

1.10.2 Cost of the year : Tk. 49,995

1.10.3 Expenditure of the year : Tk. 49,995

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** : **New**

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 :** Bangladesh has 710 km long coastal belt. Bangladesh Forest Department (BFD) initiated coastal plantations with two mangrove species namely keora and baen in 1960's. However, it gains momentum in 1975 with the assistance of World Bank. Till today BFD successfully raised more than 2,00,000 ha. coastal plantations. Bangladesh Forest Research Institute (BFRI) provides technical back up in the coastal plantations. From 1990 Plantation Trial Unit Division of BFRI, Barisal introduced under planting trial in existing keora plantation with commercially important mangrove species for creating second rotation crops and sustainability of costal mangrove plantations. At present there are about 25 successful under plantation trial plots in different island of Patuakhali and Bhola districts. The volume tables, growth and yield of these mangrove species are not known. This information is required for proper management and future planning of coastal mangrove plantations.

**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** :

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

b. Site indices curves for the species grown as under planting will be available.

c. Physical rotation of these species will be determined.

**2.6 Study period** :

2.6.1 Starting year : 2015- 16

2.6.2 Completion year : 2019-20

**2.7 Personnel(s)** :

2.7.1 Study leader : Md.Abul Hasnat Shah Jalal, SRO.

2.7.2 Associates : Mohammad. Shahid Ullah, DO; Mofizul Islam Khan, FI.

**2.8 Progress** :

2.8.1 **Previous year, if any** **:** New study.
2.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a. Establishment of 25 nos. permanent sample plots (PSPs) in under planting trial plots of Patuakhali and Bhola districts coastal plantation.<br>b. Measurement of DBH and height of theplanted mangrove species.<br>c. Mapping of the plots.<br>d. Summarization of collected data. | a. Established 20 nos. permanent sample plots (PSPs) in under planting trial plots of Bhola district and 33 nos. permanent sample plots in Patuakhali district coastal plantation.<br>b. DBH and height of all under planted mangrove trees in the plot were measured.<br>c. All the plots were mapped with GPS reading.<br>d. 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 Tree | Age (year) | Average DBH (cm) | Average Height (m) | Mean Annual Increment | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | DBH (cm) | Height (m) |
| 1 | 1994 | Passur | 34 | 21.5 | 7.0 | 6.0 | 0.3 | 0.3 |
| 2 | 1994 | Passur | 46 | 21.5 | 7.1 | 6.7 | 0.3 | 0.3 |
| 3 | 1994 | Passur | 30 | 21.5 | 7.4 | 6.8 | 0.3 | 0.3 |
| 4 | 1994 | Gewa | 42 | 21.5 | 10.8 | 11.2 | 0.5 | 0.5 |
| 5 | 1994 | Gewa | 55 | 21.5 | 8.8 | 9.4 | 0.4 | 0.4 |
| 6 | 1994 | Gewa | 48 | 21.5 | 7.6 | 8.5 | 0.4 | 0.4 |
| 7 | 1994 | Sundri | 28 | 21.5 | 4.5 | 5.8 | 0.2 | 0.3 |
| 8 | 1994 | Sundri | 38 | 21.5 | 3.8 | 3.6 | 0.2 | 0.2 |
| 9 | 1994 | Sundri | 56 | 21.5 | 4.0 | 5.4 | 0.2 | 0.3 |
| 10 | 1993 | Gewa | 50 | 22.5 | 10.3 | 10.0 | 0.5 | 0.4 |
| 11 | 2000 | Sundri | 55 | 22.5 | 3.8 | 4.7 | 0.2 | 0.2 |
| 12 | 1997 | Passur | 38 | 22.5 | 4.9 | 4.0 | 0.2 | 0.2 |
| 13 | 1997 | Gewa | 65 | 22.5 | 8.0 | 9.2 | 0.4 | 0.4 |
| 14 | 1993 | Sundri | 67 | 22.5 | 2.8 | 4.0 | 0.1 | 0.2 |
| 15 | 1993 | Passur | 29 | 22.5 | 6.2 | 5.8 | 0.3 | 0.3 |
| 16 | 1994 | Passur | 16 | 25.5 | 4.8 | 4.5 | 0.2 | 0.2 |
| 17 | 1994 | Gewa | 42 | 25.5 | 6.9 | 8.2 | 0.3 | 0.3 |
| 18 | 2008 | Gewa | 30 | 25.5 | 7.5 | 8.7 | 0.3 | 0.3 |
| 19 | 2008 | Gewa | 33 | 25.5 | 7.4 | 8.8 | 0.3 | 0.3 |
| 20 | 1995 | Passur | 11 | 25.5 | 6.5 | 6.7 | 0.3 | 0.3 |
| 21 | 1995 | Passur | 11 | 25.5 | 6.9 | 7.4 | 0.3 | 0.3 |
| 22 | 2005 | Sundri | 28 | 25.5 | 4.5 | 6.1 | 0.2 | 0.2 |
| 23 | 2007 | Sundri | 33 | 25.5 | 4.3 | 5.1 | 0.2 | 0.2 |
| 24 | 2007 | Gewa | 31 | 24.5 | 8.8 | 7.1 | 0.4 | 0.3 |
| 25 | 2007 | Gewa | 72 | 24.5 | 7.0 | 8.0 | 0.3 | 0.3 |
| 26 | 1994 | Gewa | 77 | 24.5 | 8.6 | 8.9 | 0.3 | 0.4 |
| 27 | 1994 | Passur | 27 | 24.5 | 10.4 | 10.0 | 0.4 | 0.4 |
| 28 | 2007 | Sundri | 18 | 24.5 | 5.4 | 5.1 | 0.2 | 0.2 |
| 29 | 2007 | Sundri | 13 | 24.5 | 6.6 | 7.4 | 0.3 | 0.3 |
| 30 | 1993 | Gewa | 44 | 19.5 | 7.5 | 7.5 | 0.4 | 0.4 |
| 31 | 1995 | Gewa | 29 | 19.5 | 6.6 | 7.2 | 0.3 | 0.4 |
| 32 | 2002 | Sundri | 19 | 19.5 | 6.9 | 6.8 | 0.4 | 0.3 |
| 33 | 2008 | Sundri | 16 | 19.5 | 5.0 | 4.6 | 0.3 | 0.2 |

**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 Tree | Age (year) | Average DBH (cm) | Average Height (m) | Mean Annual Increment | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | DBH (cm) | Height (m) |
| 1 | 1990 | Sundri | 28 | 26.5 | 5.8 | 6.5 | 0.2 | 0.2 |
| 2 | 1990 | Gewa | 40 | 26.5 | 11.7 | 11.4 | 0.4 | 0.4 |
| 3 | 1993 | Gewa | 46 | 23.5 | 10.4 | 8.5 | 0.4 | 0.4 |
| 4 | 1993 | Sundri | 28 | 23.5 | 4.0 | 3.9 | 0.2 | 0.2 |
| 5 | 1997 | Gewa | 30 | 18.5 | 10.6 | 9.4 | 0.6 | 0.5 |
| 6 | 1997 | Sundri | 23 | 18.5 | 2.7 | 3.1 | 0.1 | 0.2 |
| 7 | 1991 | Gewa | 69 | 24.5 | 7.3 | 9.0 | 0.3 | 0.4 |
| 8 | 1991 | Sundri | 23 | 24.5 | 4.6 | 6.1 | 0.2 | 0.3 |
| 9 | 1994 | Gewa | 26 | 21.5 | 5.9 | 6.6 | 0.3 | 0.3 |
| 10 | 1994 | Gewa | 26 | 21.5 | 5.4 | 6.5 | 0.3 | 0.3 |
| 11 | 1994 | Sundri | 39 | 21.5 | 1.7 | 2.7 | 0.1 | 0.1 |
| 12 | 1990 | Sundri | 17 | 25.5 | 8.1 | 6.8 | 0.3 | 0.3 |
| 13 | 1990 | Gewa | 52 | 25.5 | 12.3 | 11.3 | 0.5 | 0.4 |
| 14 | 1991 | Gewa | 57 | 24.5 | 8.8 | 9.3 | 0.4 | 0.4 |
| 15 | 1991 | Sundri | 12 | 24.5 | 3.9 | 5.3 | 0.2 | 0.2 |
| 16 | 1993 | Sundri | 19 | 25.5 | 4.0 | 3.6 | 0.2 | 0.1 |
| 17 | 1993 | Gewa | 43 | 25.5 | 8.8 | 7.5 | 0.3 | 0.3 |
| 18 | 1993 | Sundri | 28 | 25.5 | 3.1 | 3.6 | 0.1 | 0.1 |
| 19 | 1997 | Sundri | 15 | 18.5 | 3.2 | 2.7 | 0.2 | 0.1 |
| 20 | 1997 | Gewa | 45 | 18.5 | 9.3 | 7.3 | 0.5 | 0.4 |

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

**2.10 Financial statement** :

2.10.1 Total cost : Tk. 4,30, 000

2.10.2 Cost of the year : Tk. 80,000

2.10.3 Expenditure of the year : Tk. 80,000

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.

## 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 :** Form 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 farmers 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 Expected output** : 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(s)** :

1.7.1 Study leader : Md. Rafiqul Islam, DO.

1.7.2 Associates : Dr, M. A. Rahman, S.R.O.; M. Junayed, R.O.; Md. Zillur Rahman, RA-1; Kazi Ashad-uz-zaman; Shameema Nasreen, FI.

**1.8 Progress** :

1.8.1 Previous years, if any :

i) A survey was conducted during September 2014 to June 2015 to observe disease prevalence of different medicinal plants in Natore, Gaibandha, Bogra, and Tangail, regions. Through the survey, 4 diseases of different medicinal plants with their incidence and severity were recorded. The highest leaf blight (55%) and root rot (45%) of Ashwagandha was recorded at Palashbari sadar upazila of Gaibandha. The highest root rot of Basok (43%) and Tulsi (40%) was recorded at Dighalkandi, Bogra Sadar upazila. The higher leaf spot (27%) of Aloe vera and stem rot of Kalomeagh (33%) was recorded at Kholabari Natore and Palshbari Gaibandha, respectively.

ii) Leaf defoliator of Basok was identified from (60.0%) in Sunamgonj is recorded. In FPD nursery tulsi was infested by scale insect 50.0%, 90.0% and 80.0%, respectively.

iii) The causal organism of root rot of Tulsi, Kalomeagh and Basok caused by *Fusarium* sp. was isolated and identified.

iv) Leaf spot & root rot of Ashwagandha caused by *Alternaria* sp and *Fusarium* sp. were isolated and identified. Five *Trichoderma* strains viz. *T. virens* IMI-392430, *T. pseudokoningii* IMI-392431, *T. harzianum* IMI-392432, *T. harzianum* IMI-392433 and *T. harzianum* IMI-392434 were evaluated to control the root rot disease of Ashwagandha in *in vitro* condition and *T. harzianum* IMI-392432 showed the best performance.

v) Field evaluation of *Trichoderma* strains to control the root rot disease of Ashwagandha is going on.

vi) Neem oil was applied (4ml/L) to control the scale insect, aphid and mite of Basok (*Adhatoda vasica*), Ashwagandha (*Withania somnifera*), Tulsi (*Ocimum sanctum*), and Shotomoly (*Asparagus racemosus)* under field condition. The result showed that Neem oil controlled the pest (95%) effectively.

1.8.2 This year :

| Action plan as per annual research programme | Progress |
|---|---|
| a. Collection of samples | i) Disease samples of *Aloe indica*, *Ocimum sanctum*, *Adhatoda vasica*, *Andrograpis peniculata* for microfungal isolation were collected during field visit from Tangail, Bogra, Gaibandha, Joypurhat and Naogaon 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 | i) Sap sucking insect (*Aphis nerii*) of Akanda is identified from FPD nursery.<br>ii) The causal organism of root rot of Tulsi caused by *Fusarium* sp., Leaf spot and root rot of Ashwagandha caused by *Alternaria* sp 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 | i) Five *Trichoderma* strains were evaluated to control the root rot disease of Ashwagandha in *in vitro condition* and the ***T. harzianum*** **IMI-392432 showed the best performance.** |

| | |
|---|---|
| | ii) 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. | i) Basok (*Adhatoda vasica*), Ashwagandha (*Withania somnifera*), Tulsi (*Ocimum sanctum*), Kalomeagh (*Andrographis paniculata*), Sarpogandha *(Rauwolfia serpentina)*, Ghritokanchon (*Aloe indica*) and Sotomoly (*Asparagus racemosus)* have been 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 the root rot disease of ashwagandha in *in vitro* condition where *T. harzianum* IMI-392432 showed the best performance. Urea (26%), Neem oil (66%), Sulphur (87%), Turmeric powder (92%), Omite (98%) was applied to control red mite of ashwagandha. 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

1.10.2 Cost of the year : Tk. 4,00,000

1.10.3 Expenditure of the year : Tk. 4,00,000

1.10.4 Source of fund : GOB

**1.11** **Beneficiaries** : FD, NGOs and general public.

**2** **Study** : On going

2.1 Programme Area : Forest Pests and Diseases

**2.2** **Title of the Study** : Pests and diseases of bamboos in Bangladesh and its management

**2.3** **Justification :** Bamboo is one of the most important multipurpose and fast growing plant resources in Bangladesh. It is assessed that more than 30 bamboo species have been growing in the country. Bamboo is the most fascinating plants and is used in everyday lives in so many ways. It is used in making agricultural implements, construction of houses, different type of fishing gears, domestic utensils, mats, storage basket, hats, homestead garden fencing, garden stakes, as containers for food and drink, and for making all sorts of house-hold goods. Bamboo shoot is a very popular and delicious food and bamboo leaves are also used as fodder. To meet up the ever increasing demand of bamboo and bamboo products, a large scale plantation programme has been taken in our country both in the government and non-government sectors. Forest department has set up huge bamboo plantation in the country. Recently a number of insect and pathogenic problem have been reported from different agencies. In many cases, insect pests and diseases are causing considerable damage. So, pests and diseases are of great concern to manage bamboo plantation. Due to the pest and diseases infestation the production of bamboo will be seriously hampered and there will be very low yield. So, it is an urgent task to take a study on this problem in order to save the resources from pest and disease infestation. There is no comprehensive work on pests and diseases of bamboo except bamboo blight. So, this study has taken for intensive study of pest and diseases of bamboos and their management in order to increase productivity, and also to conserve the valuable resource.

**2.4** **Objective(s)** :

2.4.1 To survey and assess the present status of pest and disease infestation in bamboos from different areas of the country.

2.4.2 To collect and identify major pests and pathogens of bamboos.

2.4.3 To study nature and extent of damage by pest and pathogens.

2.4.4 To study the biology and ecology of the causal agent(s).

2.4.5 To develop suitable management techniques for controlling pest and disease.

**2.5** **Expected output** : Increased production of bamboo will be ensured.

**2.6** **Study period** :

2.6.1 Starting year : 2013-2014

2.6.2 Completion year : 2015-2016

**2.7** **Personnel(s)** :

2.7.1 Study leader : Md. Rafiqul Islam, DO

2.7.2 Associates : Dr, M. A. Rahman, S.R.O.; M. Junayed, R.O.; Md. Zillur Rahman ,RA-1; Kazi Ashad-uz-zaman, FI; Shameema Nasreen, FI

**2.8** **Progress** :

2.8.1 **Previous years, if any :** A Lepidopteran moth (leaf roller) was identified from seedlings raised from bamboo branch cutting at nursery of Silviculture Genetics Division of BFRI and Lama, Bandarban. Scale insect, aphid were recorded from different areas of Jessore, Satkhira, Khulna and Bagerhat.

2.8.2 This year :

| Action plan as per annual research programme | Progress |
|---|---|
| a. Survey and determination of present status in Bangladesh. | A survey was conducted in Kustia, Maherpur, Nilphamari, Sylhet and Chittagonjg Hill Tracts of Bangladesh. The highest insect infestation and disease prevalence was found in Sylhet areas. The lowest insects and disease prevalence was recorded in Kustia and Maherpur regions. |
| b. Sample collection | Samples are collected from different areas (Kustia, Maherpur, Nilphamari, Sylhet and Chittagonjg Hill Tracts of Bangladesh. |
| c. Isolation and identification of major pests and pathogens. | i) Bamboo calm rot disease caused by *Fusarium* sp. was isolated and identified.<br>ii) Leaf roller (*Pyrausta bambusivora, Pyrausta coclesalis*), scale insect and borer insect of bamboo were identified.<br>iii) Bamboo borer(*Omaphisa fuscidentalis* Hampson).(*Chlorophorus annularis* Fabricius.).<br>iv) Bamboo sapsucker(*Oregma bambusae* Buckton.).<br>v) Bamboo blight disease caused by *Sarocladium oryzae* identified. |
| d. Morphological and cultural studies of major pests and pathogens. | Cultural and morphological studies in *Fusarium* sp. under laboratory condition is going on |
| e) Management of pests and pathogens through plant extracts bio-control agents, pesticides and fungicides in *in vitro* and *in vivo* condition. | i) Leaf roller was controlled (95%) by Malathion 57EC.<br>ii) Scale insect was controlled (98%) by Ripcord 20EC(1ml/L). |

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

**2.10 Financial statement** :

2.10.1 Total cost : Tk. 12,00,000
2.10.2 Cost of the year : Tk. 2,50,000
2.10.3 Expenditure of the year : Tk. 2,50,000
2.10.4 Source of fund : GOB

**2.11 Beneficiaries** : FD, NGO's, Farmers, Educational institutions and planting agencies.

**3 Study** : New

3.1 Programme Area : Forest Pests and Diseases

**3.2 Title of the Study** : Major pests and diseases of *Hevea* Rubber and their management

**3.3 Justification :** 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 (FDC) and private planters in the country. Forest department has also taken large scale plantations programme for the last 3-4 decads. 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 sweetable pest and diseases management technique in order to increase productivity of rubber.

**3.4 Objective(s)** :

3.4.1 To survey the incidence and asses the present status of pest and disease infestation in rubber nurseries and plantation from different areas of Bangladesh.

3.4.2 To study nature and extent of damage by insect-pest and pathogens.

3.4.3 Isolation and identification of major pest and pathogens and proving pathogenicity.

3.4.4 Morphological and cultural studies of major pathogens.

3.4.5 To study the biology and ecology of the causal agent(s).

3.4.6 To develop suitable management techniques for controlling pest and disease.

**3.5 Expected output** : Plant protection operations will be ensured for healthy growth and economic production of *Hevea.*

**3.6 Study period** :

3.6.1 **Starting year** : 2015-2016

3.6.2 **Completion year** : 2019-2020

**3.7 Personnel(s)** :

3.7.1 Study leader : M. R. Islam, D.O.

3.7.2 Associates : Dr, M. A. Rahman, S.R.O.; M. Junayed, R.O.; M. Z. Rahman, R.A. (Gr-1); K.A. Zaman F.I.; S. Nasreen F.I.

**3.8 Progress** :

3.8.1 Previous year: :

3.8.2 This year :

| Action plan as per annual research programme | Progress |
|---|---|
| a. To survey for the incidence and assess the present status of pest and disease | i) A survey was conducted in Sylhet, Moulovibazar, 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. |
| b. Nature and extent of damage by insect-pest and pathogens. | i) 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. |
| c) Isolation and identification of major pest and pathogens | i) *Corynespora* leaf fall disease caused by *Corynespora cassiicola* is identified.<br>ii) Bird's Eye Spot disease caused by *Drechslera heveae* is identified.<br>iii) 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. | Ruber plants have been cultivated and maintained at FPD nursery for to observe natural pest/disease infestation /infection. |

**3.9 Achievement(s), if any** :
**3.10 Financial statement** :
3.10.1 Total cost : Tk. 10,00,000
3.10.2 Cost of the year : Tk. 4,00,000
3.10.3 Expenditure of the year : Tk. 4,00,000
3.10.4 Source of fund : GOB
**3.11 Beneficiaries** : FD, NGOs and general public.

## 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 : 2011- 12
1.6.2 Completion year : 2015-16

**1.7 Personnel(s)** :
1.7.1 Study leader : Dr. M. M. Rahman, DO
1.7.2 Associates : Dr. A. S. M. Helal Siddiqui, SRO

**1.8 Progress** :
1.8.1 Previous year, 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 recoded from the PSPs since inception of the study. Average seedlings recruitment in the year 2013 was found 33,311/ha/year. Among them, *Heritiera fomes* constituted 29.69%, *Excoecaria agallocha* 25.18%, *Ceriops decandra* 22.82%, *Bruguiera sexangula* 8.27%, *Avicennia officinalis* 6.54%, *Aegiceras corniculatum* 0.97%, *Xylocarpus mekongensis* 2.57%, *Amoora cuculata* 2.74%, *Cynometra ramiflora* 0.63%, *Phoenix paludosa* 0.10% and *Rhizophora mucronata* 0.17%.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.

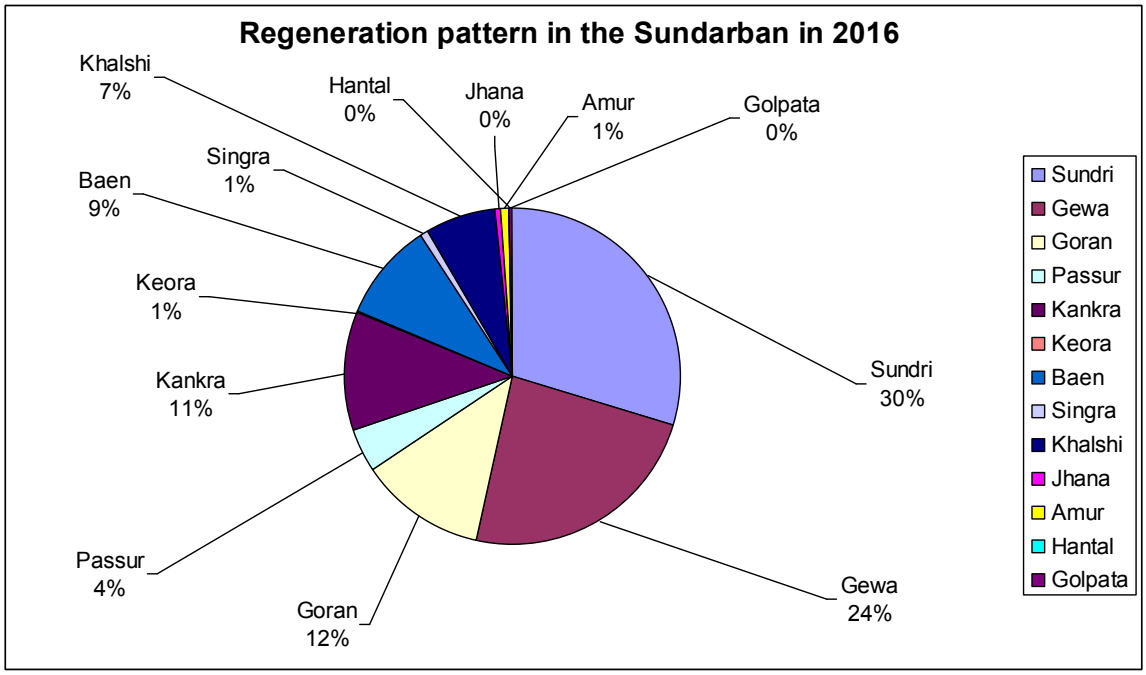
1.8.2 This year :

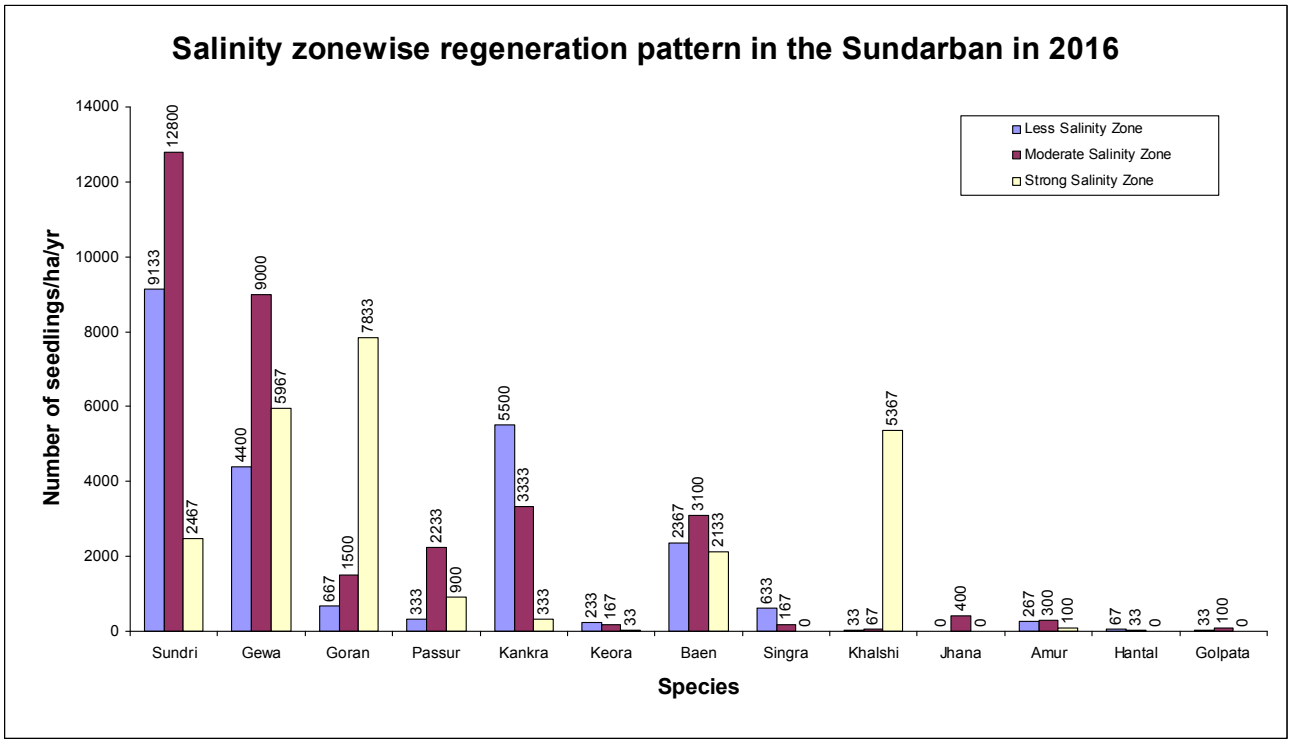
| Activities of the study | Progress |
|---|---|
| a) Maintenance (Demarcation of plots, replacement of damaged | a) Thirty PSPs in different salinity zones (10 PSPs in each saline zone) of the Sundarban were maintained (Table-1). |

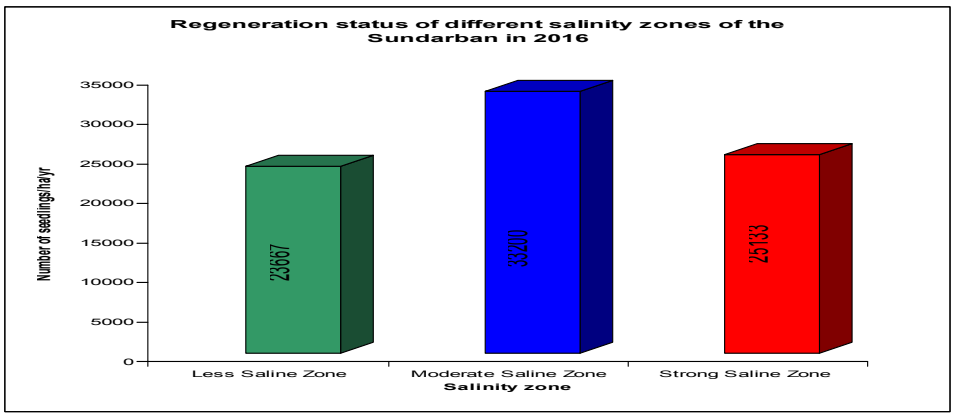
| | |
|---|---|
| signboards, number-plates, jungle cutting etc.) of 30 PSPs in different salinity zones throughout the Sundarban. | |
| b) Collection of data on regeneration, salinity and siltation data from the PSPs. | b) Data on regeneration, salinity and siltation data from the PSPs were collected |
| c) Compilation and analysis of data. | c) Data on regeneration of major mangrove species were recorded from 30 PSPs. 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 mekongensis 4* %, *Amoora cuculata* 1% and rest other species 2% 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 2016 shown in Fig. C. |

**Table 1. Salinity basis 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 |
| Moderate Saline Zone | 11. | Charaputia | 2 | 15 |
| | 12. | Baniakhali | 7 | 35 |
| | 13. | Kashiabad | 8 | 36 |
| | 14. | Alkidives (East) | 15 | 17 |
| | 15. | Alkidives (West) | 16 | 17 |
| | 16. | Bosboja (East) | 22 | 37 |
| | 17. | Bosboja (West) | 23 | 37 |
| | 18. | Kalabogi | 24 | 32 |
| | 19. | Katka | 27 | 7 |
| | 20. | Bhadra | 29 | 29 |
| Strong Saline Zone | 21. | Gewakhali (W) | 11 | 38 |
| | 22. | Sonamukhi khal | 12 | 41 |
| | 23. | Ball River | 17 | 41 |
| | 24. | Kadamtala | 18 | 46 |
| | 25. | Chunkuri (East) | 19 | 47 |
| | 26. | Chunkuri (West) | 20 | 47 |
| | 27. | Kateshor | 21 | 46 |
| | 28. | Koikhali | 30 | 47 |
| | 29. | Burigoalini | 9 | 46 |
| | 30. | Gewakhali (E) | 10 | 20 |


Regeneration pattern in the Sundarban in 2016
Khalshi 7%
Hantal 0%
Jhana 0%
Amur 1%
Golpata 0%
Singra 1%
Baen 9%
Keora 1%
Kankra 11%
Sundri 30%
Passur 4%
Goran 12%
Gewa 24%
Sundri
Gewa
Goran
Passur
Kankra
Keora
Baen
Singra
Khalshi
Jhana
Amur
Hantal
Golpata


Salinity zonewise regeneration pattern in the Sundarban in 2016
Number of seedlings/ha/yr
Species
Less Salinity Zone
Moderate Salinity Zone
Strong Salinity Zone
Sundri 9133 12800 2467
Gewa 4400 9000 5967
Goran 667 1500 7833
Passur 333 2233 900
Kankra 5500 3333 333
Keora 233 167 33
Baen 2367 3100 2133
Singra 633 167 0
Khalshi 33 67 5367
Jhana 0 400 0
Amur 267 300 100
Hantal 67 33 0
Golpata 33 100 0


Regeneration status of different salinity zones of the Sundarban in 2016
Number of seedlings/ha/yr
23667
33200
25133
Less Saline Zone
Moderate Saline Zone
Strong Saline Zone
Salinity zone

**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. 10,00,000

1.10.2 Cost of the year : Tk. 1,50,000

1.10.3 Expenditure of the year : Tk. 1,50,000

1.10.4 Source of fund : GOB

**1.11 Beneficiaries** : FD.

**2 Study** : On-going

2.1 Programme Area : Biodiversity and Conservation.

**2.2 Title of the Study** : Centralization and conservation of mangrove vegetation in three salinity zones of the Sundarban

**2.3 Justification :** Establishment and maintenance of mangrove arboretum is very much essential for conservation of genetic resources and to study taxonomy, ecology, silviculture, genetic diversity etc. of all mangrove species available in the Sundarban.

**2.4 Objective(s)** :

2.4.1 To conserve mangrove species in their natural habitat.

2.4.2 To centralize threatened mangrove species.

2.4.3 To observe the flora-fauna interaction over time.

2.4.4 To demonstrate flora and fauna in natural habitat in the Sundarban.

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

**2.6 Study period** :

2.6.1 Starting year : 2011- 12

2.6.2 Completion year : 2015-16

**2.7 Personnel(s)** :

2.7.1 Study leader : Dr.M. M. Rahman, DO

2.7.2 Associates : Dr. A. S. M. Helal Siddiqui, SRO

**2.8 Progress** :

2.8.1 **Previous year**, **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.

2.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a. Raising of 10,000 seedlings of three mangrove species namely lal kankra, jhana, passur, dhundul and khalshi for raising experimental plantation. | a. A total of 10,000 seedlings of three mangrove species namely lal kankra, jhana, passur, dhundul and khalshi for raising experimental plantation were raised. |
| b. Maintenance of previously raised experimental plantations of kirpa (1.8 ha), passur (1.2 ha), jhana (0.9 ha), khalshi (2.3 ha), amur (1.8 ha) bakul kankra(1.8 ha), amdhekur (0.9ha), dhundul (1.8 ha) and marichabaen (0.9 ha). | b. Previously raised experimental plantations of kirpa (1.8 ha), passur (1.2 ha), jhana (0.6 ha), khalshi (2 ha), amur (1.8 ha) bakul kankra(1.8 ha), amdhekur (0.9ha), dhundul (1.8 ha) and marichabaen (0.9 ha) were maintained. |
| c. Collection of survival and growth data from the experimental plantations twice a year. | c. Survival and growth data from the experimental plantations were collected twice a year. |
| d. Compilation and analysis of data. | d. Growth performances of different mangrove species planted at different locations in different years of the Sundarbans are shown in Table-1, 2, 3, 4, 5, 6 and 7. |

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

| Name of Location | Year of plantation | Mean Height (m) | Mean Dbh (cm) | Mean Survival (%) |
|---|---|---|---|---|
| Munshigonj | 2004 | 4.26 | 3.45 | 86 |
| | 2006 | 3.40 | 2.95 | 70 |
| Dhangmari | 2004 | 5.54 | 4.65 | 87 |
| | 2006 | 3.82 | 5.83 | 97 |

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

| Name of Location | Name of species | | | | | | |
|---|---|---|---|---|---|---|---|
| | Passur | | Khalshi | | Jhana | | |
| | Mean Height (m) | Mean Survival (%) | Mean Height (m) | Mean Survival (%) | Mean Height (m) | Mean Dbh (cm) | Mean Survival (%) |
| Dhangmari | 2.15 | 88 | 3.89 | 98 | 6.52 | 5.64 | 67 |
| Bogi | | | 3.46 | 67 | | | |

**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 Survival (%) |
| Dhangmari | 6.61 | 49 | | | 1.43 | 85 | | |
| Munshiganj | | | | | 1.02 | 43 | 4.90 | 56 |
| Bogi | | | 1.19 | 39 | 1.49 | 65 | | |

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

| Name of Location | Name of species | | | | | |
|---|---|---|---|---|---|---|
| | Moricha Baen | | Lal kakra | | Amdhekur | |
| | Av. ht. (m) | Av. Surv. % | Av. ht. (m) | Av. Surv. % | Av. ht. (m) | Av. Surv. % |
| Dhangmari | 1.76 | 16 | 0.96 | 60 | 1.55 | 60 |
| Munshigonj | - | - | 0.99 | 47 | 1.40 | 50 |

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

| Name of Location | Name of species | | | | | |
|---|---|---|---|---|---|---|
| | Kankra | | Dhundul | | Bhatkathi | |
| | Av. ht. (m) | Av. Surv. % | Av. ht. (m) | Av. Surv. % | Av. ht. (m) | Av. Surv. % |
| Dhangmari | 1.48 | 77 | 2.32 | 65 | **2.14** | 76 |
| Munshigonj | | | 2.90 | 40 | 1.25 | 55 |
| Bogi | 1.36 | 30 | 1.56 | 38 | 1.05 | 72 |

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

| Name of Location | Name of species | | | | | |
|---|---|---|---|---|---|---|
| | Lal Kankra | | Dhundul | | Singra | |
| | Av. ht. (m) | Av. Surv. % | Av. ht. (m) | Av. Surv. % | Av. ht. (m) | Av. Surv. % |
| Dhangmari | 0.99 | 88 | 1.54 | 91 | 0.58 | 82 |
| Bogi | | | 1.25 | 44 | 0.74 | 69 |

**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 | 0.63 | 100 | 1.13 | 100 | 1.17 | 100 | | |
| Munshiganj | 0.37 | 100 | 1.26 | 100 | 0.94 | 100 | | |
| Bogi | | | 0.76 | 89 | 0.98 | 28 | 0.72 | 100 |

**2.9 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.

**2.10 Financial statement** :

2.10.1 Total cost : Tk. 14,00,000

2.10.2 Cost of the year : Tk. 3,50,000

2.10.3 Expenditure of the year : Tk. 3,50,000

2.10.4 Source of fund : GOB

**2.11 Beneficiaries** : FD, Universities, NGOs, Researchers, Visitors, Students.

**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** :

3.6.1 Starting year : 2011-2012

3.6.2 Completion year : 2015-2016

**3.7 Personnel(s)** :

3.7.1 Study leader : Dr. A. S. M. Helal Siddiqui, SRO

3.7.2 Associates : Dr. M. M. Rahman, DO

**3.8 Progress :**

3.8.1 Previous year, 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 :

| Action plan as per annual research programme | 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 and 5. |

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

| Research Station | Year of plantation | Spacing | Mean Height (m) | Mean DBH (cm) | Mean Survival (%) |
|---|---|---|---|---|---|
| Dhangmari | 1996 | 1.5mx 1.5m | 13.05 | 18.36 | 55 |
| | | 1.75m x 1.75m | 13.30 | 18.62 | 67 |
| | | 2.0m x 2.0m | 11.81 | 17.35 | 78 |
| Bogi | 1993 | 1.5mx 1.5m | 13.78 | 15.76 | 60 |
| | | 1.75m x 1.75m | 13.46 | 14.38 | 72 |
| | | 2.0m x 2.0m | 13.05 | 15.27 | 82 |

**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 Height (m) | Mean DBH (cm) | Mean Survival (%) |
|---|---|---|---|---|---|
| Burigoalini | 95 | Sundri | 2.82 | 3.5 | 18 |
| | 95 | Gewa | 4.17 | 5.00 | 63 |
| | 95 | Kirpa | 5.48 | 6.48 | 34 |
| | 99 | Kankra | 2.73 | 5.40 | 20 |
| | 99 | Khalshi | 4.72 | 5.59 | 72 |

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

| Name of Location | Year of Plantation | Name of species | Mean Height (m) | Mean DBH (cm) | Mean Survival (%) |
|---|---|---|---|---|---|
| Andermanik | 1999 | Gewa | 3.67 | 5.80 | 59 |
| | | Goran | 1.69 | | 57 |
| Kadamtala | 2000 | Sundri | 1.22 | | 42 |
| | | Gewa | 3.89 | 5.25 | 80 |
| | | Amoor | 1.00 | | 22 |
| Khasitana | 1997 | Gewa | 3.75 | 5.56 | 68 |
| | | Goran | 2.20 | | 50 |
| | | Jhana | 8.41 | 9.69 | 21 |
| | 1999 | Sundri | 0.86 | | 28 |
| | 1998 | Gewa | 3.21 | | 47 |

**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 Height (m) | Mean Survival (%) |
|---|---|---|---|---|
| Munshigonj | 2010 | Kirpa | 2.33 | 60 |
| | 2011 | Sundri | 0.94 | 35 |
| | | Goran | 0.97 | 58 |
| | 2012 | Sundri | 0.45 | 25 |
| | | Kirpa | 0.70 | 30 |
| | 2013 | Jhana | 1.45 | 84 |
| | | Sundri | 0.62 | 84 |
| | | Goran | 0.38 | 83 |

**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 Height (m) | Mean Survival (%) |
|---|---|---|---|---|
| Nowsher Johala | 2010 | Sundri | 1.35 | 55 |
| | | Passur | 2.02 | 19 |
| | | Kankra | 2.37 | 68 |
| Hularchar | 2011 | Sundri | 1.33 | 89 |
| | | Passur | 1.44 | 28 |
| | | Kankra | 1.71 | 88 |
| | | Khalshi | 2.31 | 74 |
| | | Goran | 1.20 | 60 |
| | 2012 | Sundri | 1.20 | 66 |
| | | Passur | 1.77 | 60 |
| | | Kankra | 1.09 | 65 |
| | | Goran | 0.75 | 47 |
| | | Khalshi | 2.55 | 73 |
| | 2013 | Sundri | 0.82 | 85 |
| | | Passur | 0.91 | 91 |
| | | Kankra | 0.89 | 91 |
| | | Khalshi | 1.56 | 89 |
| | | Jhana | 1.10 | 87 |

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

| Year of Plantation | Name of species | Mean Height (m) | Mean Survival (%) |
|---|---|---|---|
| 2010 | Sundri | 3.55 | 80 |
| | Passur | 2.40 | 30 |
| | Singra | 0.68 | 56 |
| 2011 | Sundri | 2.55 | 96 |
| | Passur | 2.55 | 39 |
| | Khalshi | 1.57 | 79 |
| 2012 | Sundri | 1.48 | 94 |
| | Passur | 1.89 | 21 |
| | Kankra | 2.10 | 25 |
| | Khalshi | 1.42 | 77 |
| 2013 | Sundri | 0.83 | 43 |

**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. 9,00,000

3.10.2 Cost of the year : Tk. 2,50,000

3.10.3 Expenditure of the year : Tk. 2,50,000

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** : Development of a mangrove museum

**4.3 Justification :** 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.

**4.4 Objective(s)** :

4.4.1 To collect and preserve the representative specimens of flora and fauna from the Sundarban.

4.4.2 To demonstrate the specimens of flora and fauna to the students, teachers, researchers and visitors.

**4.5 Expected output** : Establishment of a mangrove museum housing representative flora and fauna of the Sundarban.

**4.6 Study period** :

4.6.1 Starting year : 2011- 12

4.6.2 Completion year : 2015-16

**4.7 Personnel(s)** :

4.7.1 Study 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: Museum room was renovated and furnished with iron racks, multipurpose almirah, display boards and xylarium. Fifteen herbarium specimens of mangrove species were prepared. Fleshy fruits and plant parts of major mangrove species' specimens and twenty five fish specimens were collected from the Sundarbans and preserved in the museum. Sixteen wood samples of mangrove tree species were prepared and preserved in the museum. One number of tiger hide and one piece of deer hide were reprocessed and stuffed as well as demonstrated in the Mangrove museum. Previously collected flora and faunal specimens from the Sundarban were maintained in the museum.

4.8.2 This year :

| Action plan as per annual research programme | Progress |
|---|---|
| a) Collection and preservation of fleshy fruits, plant parts and available faunal specimens from the Sundarbans. | a) Fleshy fruits and plant parts of major mangrove species' specimens and fifteen fish specimens have been collected from the Sundarbans and preserved in the museum. |
| b) Maintenance of previously collected flora and faunal specimens in the museum. | b) Previously collected flora and faunal specimens from the Sundarban in the museum were maintained. |
| c) Preparation of digital banner for display boards, still pictures, digital pictures and lamination of still pictures. | c) Five digital banners and 50 nos of still pictures of different sizes were printed and laminated. |

**4.9** **Achievement(s), if any** : A museum has been established at the Divisional Head Quarter of Mangrove Silviculture Division, Khulna in 2002 having 55 flora and 50 faunal specimens and sixteen wood samples of mangrove tree species. One number of tiger hide and one piece of deer hide were reprocessed and stuffed as well as demonstrated in the Mangrove museum.

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

4.10.1 Total cost : Tk. 10,00,000/-

4.10.2 Cost of the year : Tk. 1,30,000/-

4.10.3 Expenditure of the year : Tk. 1,30,000/-

4.10.4 Source of fund : GOB

**4.11** **Beneficiaries** : FD, NGOs, Teachers and Students.

**5** **Study** : On-going

5.1 Programme Area : Biodiversity and Conservation.

**5.2** **Title of the Study** : Development of nursery and plantation techniques of khalshi (*Aegiceras corniculatum*) in the coastal zone of Bangladesh

**5.3** **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.

**5.4** **Objective(s)** :

5.4.1 To develop nursery and plantation techniques of Khalshi.

5.4.2 To conserve and extension of the species.

**5.5** **Expected output**: Development of nursery and plantation techniques of Khalshi. Extension and conservation of the species, honey production, employment and income generation.

**5.6** **Study period** :

5.6.1 Starting year : 2012-13

5.6.2 Completion year : 2016-17

**5.7** **Personnel(s)** :

5.7.1 Study leader : Dr. M. M. Rahman, DO

5.7.2 Associates : Dr. A. S. M. Helal Siddiqui, SRO

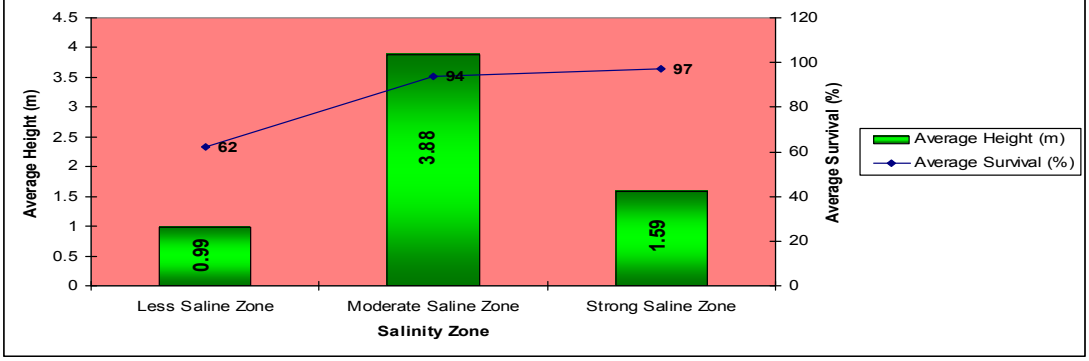
**5.8** **Progress** :

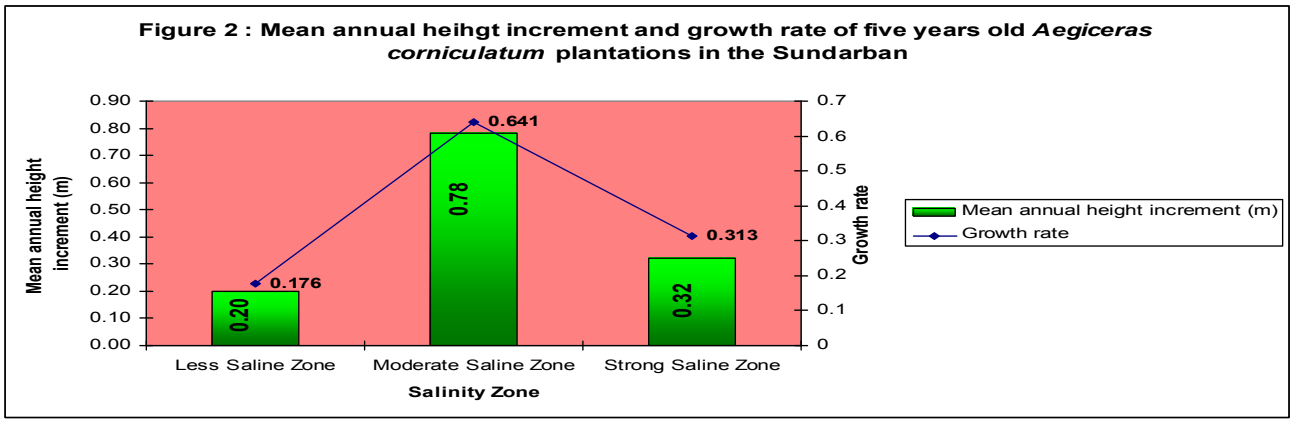
5.8.1 Previous year**,** if any : A total number of 25,000 propagules (seeds) of khalshi were collected from the Sundarban and 12,000 seedlings were raised for experimental plantations in three salinity zones of the Sundarban in different years. Data on soil pH, water salinity, light intensity, inundation and siltation in the selected sites were recorded. Germination of the seeds, survival and growth performance of the seedlings in the nursery were recorded.

5.8.2 This year :

| Action plan as per annual research programme | Progress |
|---|---|
| a) Raising plantation with the previously raised seedlings. | a) Experimental plantations were raised at three locations of the Sundarban. |
| b) Collection of propagules (seeds) from the Sundarban and nursery raising. | b) Propagules (seeds) of khalshi were collected from the Sundarban and 9,000 seedlings were raised for next year experimental plantation. |
| 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) Observation on germination of the seeds, survival and growth performance of the seedlings in the nursery. | d) Germination of the seeds, survival and growth performance of the seedlings in the nursery were recorded. |
| e) Maintenance of nursery and plantations. | e) Nurseries and plantations were properly maintained. |
| f) Data collection and analysis. | f) Data were collected and analyzed. Growth performance of khalshi at different locations in different years in three salinity zones of the Sundarbans shown in Figure – 1 & 2. It is observed that the best growths were recorded in moderate saline zone and significantly lower growths were recorded in strong saline zone of the Sundarban. The study has clearly identified and characterized a number of species-site relationships in the mangrove ecosystems of the Sundarban, findings that could be applied in future efforts towards the afforestation, conservation and management of the mangrove ecosystems in which local mangrove dwellers continue to extract resources on the basis of their needs and the capacity of the ecosystem to provide such resources on a sustainable basis. Mangrove afforestation with *A. corniculatum* can be an efficient and effective tool for disaster mitigation and enhanced livelihood as well as for the mitigation of climate change. |

**Figure 1 : Growth performance of *Aegiceras corniculatum* at five years old plantations in the Sundarban**






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

**5.10** **Financial statement** :

5.10.1 Total cost : Tk. 12,00,000/-

5.10.2 Cost of the year : Tk. 2,80,000/-

5.10.3 Expenditure of the year : Tk. 2,80,000/-

5.10.4 Source of fund : GOB

**5.11** **Beneficiaries** : FD, NGOs.

**6** **Study** : On-going

6.1 Programme Area : Breeding and Tree Improvement

**6.2** **Title of the Study** : Selection and development of the top dying tolerant sundri (*Heritiera fomes*) trees in the Sundarban

**6.3** **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.

**6.4** **Objective(s)** :

6.4.1 To develop a pure line of top dying tolerant sundri trees.

**6.5** **Expected output** : Selection and development of top dying resistant sundri trees in the Sundarban.

**6.6** **Study period** :

6.6.1 Starting year : 2011-2012

6.6.2 Completion year : 2015-16

**6.7** **Personnel(s)** :

6.7.1 Study leader : Dr. M. M. Rahman, DO

6.7.2 Associates : Dr. A. S. M. Helal Siddiqui, SRO

**6.8** **Progress** :

6.8.1 Previous year 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.

6.8.2 This year :

| Action plan as per annual research programme | Progress |
|---|---|
| a) Planting of previously raised seedlings of selected sundari trees at three locations of | a) Raised seedlings of selected sundari trees at three locations of the Sundarban were planted. |

| | |
|---|---|
| the Sundarban. | |
| b) Observation of flowering and fruiting behaviors in the selected trees. | b) Flowering and fruiting behaviors of the selected trees were observed and recorded. |
| 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 collected. |
| d) Collection of seeds from the selected trees. | d) Ten thousand seeds from the selected sundari trees were collected. |
| e) Raising seedlings at Munshigong, Bogi and Dhangmari Research Stations for next year plantations. | e) Six thousand seedlings were raised at Munshigong, Bogi and Dhangmari Research Stations for next year plantations. |
| f) Observation on germination of the seeds, survival and growth performance of the seedlings in the nursery. | f) Germination of the seeds, survival and growth performance of the seedlings in the nursery were recorded. |
| g) Data compilation | g) Growth performance of sundari at different locations in different years of the Sundarban is shown in Figure – 1 & 2. Selecting exceptionally sundari seedlings from nursery is a promising. Our final assessment as to efficiency of seedlings selection from selected trees of top-dying affected and non-affected areas awaits comparison of progeny from chosen selects with those from similarly chosen controls to see how much of the phenotypic gain is truly genetic. This investigation involved more selections and plantations than had been tried in the past. The next step in evaluating nursery selection is to compare progeny from selects with those of controls to see how much of the phenotypic gain is truly genetic. |

**Figure 1. Field evaluation of five year old offsprings of sundari trees selected from natural stress conditions of top dying**

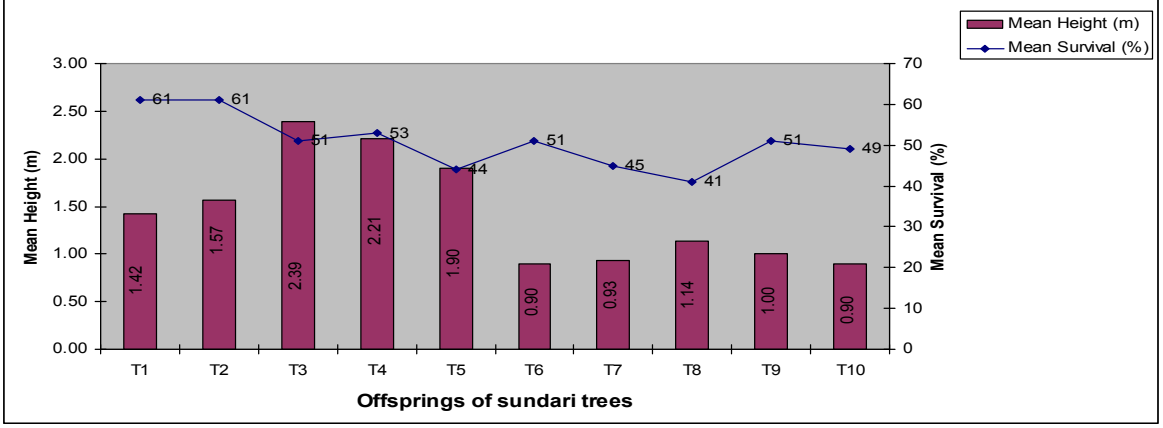
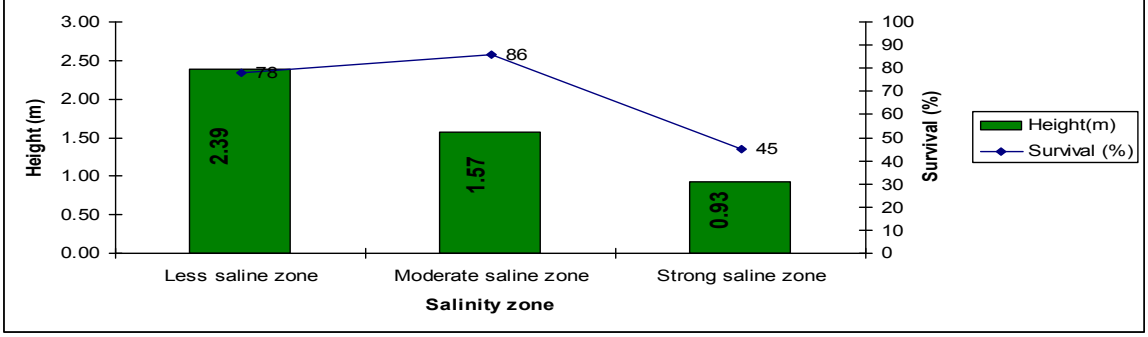



**Figure 2. Growth performance of 5 year old sundari plantations at different salinity zones of the Sundarban**



**6.9** **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.

**6.10** **Financial statement** :

6.10.1 Total cost : Tk. 12,50,000

6.10.2 Cost of the year : Tk. 2,40,000

6.10.3 Expenditure of the year : Tk. 2,40,000

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** **Expected output** : Appropriate plantation technique will be available for rising of different rattan species .Suitable management technique will be available. Rattan resources will be increase

**1.6** **Study period** :

1.6.1 Starting year : 2015-2016

1.6.2 Completion year : 2017-2018

**1.7** **Personnel(s)** :

1.7.1 Study leader : Md. Sah Alam, RO

1.7.2 Associates : Dr. Rafiqul Haider, DO; Anita Rany Shutrodhar, RO

**1.8** **Progress** :

1.8.1 Previous year, if any : NA

1.8.2 This year :

| Action plan as per annual research programme | Progress |
|---|---|
| Survey for selecting the study sites and the study will be conducted through systematic sampling | Three sites were selected in Maymensingh, Tangail and Rajshahi Division. In Maymensingh selects Valuka Range (Habibbari and Khadighar beat); Tangail, Modhupur Range (Dokhola and Rosulpur beat) and Rajshahi, Paikbanda Range (Damuirhat and Altadighi beat). |
| 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 (jali, kerak and golla) from Kaptai Sita Pahar, 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 9,000 seedlings to the interested farmers and different organizations including IUCN and earned revenue Tk. 36,000. |

| | |
|---|---|
| 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 Keochia Silviculture Research Station.<br>Total 100 people were participated in these awareness programmes and distributed 500 cane seedlings among the participants. |
| Data compilation and report writing. | |

Table1.1. Growth performance of Rattans

| Location | Species | Supporting tree | Age (Year) | Width per (cm) clump | Shoot no. per clump | Height (m) of main shoot | Diameter (cm) at breast height of main shoot |
|---|---|---|---|---|---|---|---|
| Kadigarh Beat, Mymensingh | Jali | Sal | 04 | 143.26 | 12.9 | 9.02 | 0.9 |
| | | | 08 | 179.22 | 16.7 | 14.63 | 1.35 |
| | | | 14 | 111.23 | 19.1 | 18.71 | 1.58 |
| | Kerak | | 04 | 98.76 | 11.9 | 9.97 | 3.08 |
| | | | 08 | 124.97 | 13.1 | 11.77 | 3.27 |
| | | | 14 | 131.06 | 13.7 | 12.71 | 3.96 |
| Hobirbari beat | Jali | Sal | 12 | 366.06 | 23.7 | 14.57 | 1.81 |
| | Kerak | | 12 | 124.05 | 13.8 | 13.13 | 2.08 |
| | Golla | | 12 | 478.54 | 28.2 | 16.73 | 3.43 |
| Rasulpur beat, Modhupur | Jali | Sal | 10 | 230.43 | 18 | 11.95 | 1.32 |
| | Kerak | | 10 | 128.32 | 12.7 | 13.87 | 3.51 |
| Dokhola Beat, Modhupur | Jali | Sal | 04 | 79.24 | 14 | 4.63 | 1.08 |
| | | | 15 | 176.17 | 22.3 | 16.89 | 1.93 |
| Maishor, Naogaon | Jali | Sal | 15 | 186.53 | 31.5 | 20.76 | 1.21 |
| | Kerak | | 10 | 47.85 | 8.2 | 3.14 | 2.03 |
| Alta Dighi, Naogaon | Jali | Sal& Akashmoni | 10 | 113.08 | 28 | 17.52 | 1.31 |
| | Kerak | | 10 | 103.33 | 10.5 | 13.08 | 2.39 |

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

**1.10 Financial statement** :

1.10.1 Total cost : Tk. 4,50,000

1.10.2 Cost of the year : Tk. 1,46,000

1.10.3 Expenditure of the year : Tk. 1,45,000

1.10.4 Source of fund : GOB

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

**2 Study** : On-going

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 Expected output** : 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(s)** :

2.7.1 Study leader : Anita Rany Shutrodhar, RO

2.7.2 Associates : Dr. Rafiqul Haider, DO; Md. Sah Alam, RO

**2.8 Progress** :

2.8.1 **Previous year**, **if any: New study**

2.8.2 This year :

| Action plan as per annual research programme | 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. | Germination percentage of the selected species recorded as gajpipul 75%, kurchi 98%, antamul 60%, chandan 60% and iswarmul 90%. Data provided in Table 2.1. |
| Maintenance of seedlings in the nursery | Seedlings were maintained in the nursery. |
| Establishment of 0.25 hectare experimental plantations with five selected medicinal plants in Hinguli Research Station. | Established 0.25 hectare experimental plantations with 11 medicinal plants in Hinguli Research Station. (ritha, kurchi, agar, arjun, neem, amloki, horitaki, bohera, bakul, mahua and box-badam ) and with 09 species at Chittagong University campus. |

| | |
|---|---|
| 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 2.1. |
| Report writing and printing | |

Table 2.1. Germination and other 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 normal water for 4 hrs | 40 | 8-16 | 7 | 33 |
| | Soaked in normal water for 6 hrs | 60 | 8-14 | 10 | 35 |
| | Soaked in normal water for 08 hrs | 55 | 10-16 | 9 | 32 |
| | Soaked in normal water for 10 hrs | 52 | 10-17 | 8 | 32 |
| | Soaked in normal water for 12 hrs | 35 | 10-18 | 8 | 31 |
| Gajpipul | Control | 75 | 35-42 | 10 | 40 |
| | Soaked in normal water for 6 hrs | 50 | 40-44 | 8 | 36 |
| | Soaked in normal 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 normal water for 6 hrs | 98 | 5-10 | 18 | 50 |
| | Soaked in normal water for 12 hrs | 76 | 6-12 | 12 | 42 |
| | Soaked in normal water for 18 hrs | 68 | 6-12 | 11 | 40 |
| | Soaked in normal water for 24 hrs | 66 | 8-15 | 14 | 40 |
| Chandan | Control | 25 | 52-80 | 5 | 16 |
| | Soaked in normal water for 12hrs | 40 | 48-80 | 6.5 | 14 |
| | Soaked in normal water for 24hrs | 45 | 45-75 | 7 | 18 |
| | Soaked in normal water for 36hrs | 60 | 32-68 | 8 | 21 |
| | Soaked in normal water for 48 hrs | 48 | 35-70 | 7 | 20 |
| Ishwarmul | Control | 80 | 75-90 | 18 | 42 |
| | Soaked in normal water for 3 hrs | 90 | 60-75 | 20 | 50 |
| | Soaked in normal water for 6 hrs | 82 | 70-82 | 16 | 38 |
| | Soaked in normal water for 12 hrs | 60 | 75-85 | 15 | 40 |

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

**2.10 Financial statement** :

2.10.1 Total cost : Tk. 3,50,000

2.10.2 Cost of the year : Tk. 1,41,000

2.10.3 Expenditure of the year : Tk. 1,40,500

2.10.4 Source of fund : GOB

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

**3 Study** : On-going

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.

3.4.5 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(s)** :

3.7.1 Study leader : **Md. Sah Alam, RO**

3.7.2 Associates : Dr. Rafiqul Haider, DO and Anita Rany Shutrodhar, RO

**3.8 Progress** :

3.8.1 Previous year, if any : Propagating material of 11medicinal plants namely (ashphal, alubokhara, daruchini, lotkan, nagmoni, kakrasingh, quasia, joaphal, shamlata, borakanda and keu) were collected from different locations of Bangladesh and conserved them at BFRI HQs nursery

3.8.2 This year :

| Action plan as per annual research programme | Progress |
|---|---|
| Collection of propagating materials for 15 (annual and perennial) medicinal plants from Bogra, Natore, Gaibandha, Rangamati, Bandarban and Khagrachari districts and Sylhet regions. | Propagating materials of 07 medicinal plants namely gunura (*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 of Bangladesh. |
| Permanent nursery bed preparation and development including earth filling at Hinguli Research Station. | Prepared permanent nursery bed at Hinguli Research Station. |
| Raising 4,000 seedlings of different medicinal plants for establishing conservation plots and left over seedling for distribution. | 4,000 seedlings of 32 species namely arjun, bahera, haritaki, tulsi, neem, jalpai, ashok, agar, amloki, satamuli, kalomegh, aswagundha, nayontara, pipul, brahmi, basak, bakful, bakul, mesta, turukchondal, talmul, polaopata, datura, oporajita, tamal, misridana, himsagar, kuch, kalkesuti, bhuikumra, salpani and |

| | |
|---|---|
| | dontimul 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 and Hinguli Research Station. | Re-established 97 annual and newly established medicinal plants namely gynura, damas, ashphal, raktagola, alubokhara, and quasia at BFRI Headquarter. |
| 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.<br>Survival and growth performance of some selected medicinal species at Hinguli Research Station are given in Figure 3.1 (A-F). |

Table.3.1. Survival and growth performance of some selected medicinal species at Hinguli Research Station.

| Year of plantation | Name of the species | Av. Initial height (cm) | June-2015 | | June-2016 | |
|---|---|---|---|---|---|---|
| | | | Av. Survival (%) | Av. Height (cm) | Av. Survival (%) | Av. Height (cm) |
| 2013 | Amlaki | 34 | 71 | 110 | 70 | 215.83 |
| | Arjun | 37 | 60 | 102 | 60 | 363 |
| | Horitoki | 43 | 66 | 115 | 60 | 301.62 |
| | Tamal | 40 | 55 | 67.9 | 50 | 143.40 |
| | Bel | 35 | 50 | 71.28 | 50 | 108.75 |
| | Ritha | 50 | 60 | 93.75 | 60 | 127.5 |
| 2014 | Amlaki | 38 | 70 | 63 | 80 | 171.6 |
| | Horitoki | 35 | 65 | 60 | 80 | 164 |
| | Bahera | 37 | 50 | 59 | 75 | 153.78 |
| | Arjun | 33 | 55 | 60 | 70 | 240 |
| | Jalpai | 36 | 70 | 52 | 90 | 214.37 |
| 2015 | Agar | 57 | - | - | 80 | 76.67 |
| | Ashok | 27 | - | - | 65 | 33.83 |
| | Kuchila | 44 | - | - | 60 | 54.20 |
| | Kurchi | 90 | - | - | 60 | 119.8 |
| | Neem | 35 | - | - | 70 | 44.8 |
| | Horitoki | 69 | - | - | 60 | 83.2 |

**3.9** **Achievement(s), if any**: Conserve 175 medicinal plants, out of which 95 perennial (Ashphol, Alubokhra, daruchini, lotkon, nagmoni, passion fruit, kakrashing, koashia, jayphol, akonadi, shymlota, borakanda, ghritoakanchan, pipul, sarpagandha, choijal, anantamul, salpani, panbilash, buikumra, polash, karpur, all-spices, jayanti, naglingom, ayapana, tespata, mehedi, khoir, chandan, kuchila, kurchi, dhup, ritha, uriam etc.) and 80 annual (keu, kolaboti, brammi, mohabingharaj, kalokeshi, alkushi, aswagandha, ekangi, misridana, turukchandal, ulatchandal, punarnava, tulshi, beladona, dhutura, shankhamul, muktajhuri, bhuiamla etc.) at MFP nursery and BFRI campus as a permanent source of propagating materials.

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

3.10.1 Total cost : Tk. 6,80,000

3.10.2 Cost of the year : Tk. 4,30,000

3.10.3 Expenditure of the year : Tk. 4,30,000

3.10.4 Source of fund : GOB

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

**4 Study** : On-going

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

**4.2 Title of the Study** : **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- 12

4.6.2 Completion year : 2016-2017

**4.7 Personnel(s)** :

4.7.1 Study leader : Dr. Rafiqul Haider, DO

4.7.2 Associates : Md. Sah Alam, RO and Anita Rany Shutrodhar, RO

**4.8 Progress** :

4.8.1 Previous years, if any: Phenology (flowering, fruiting, leaf shedding etc.), germination percentage, germination period of seeds were studied. 300 seedlings planted at BFRI campus, International Islamic University, Kumira, Chittagong, Chittagong University campus, Sitakunda Ecopark, Mirpur Botanical Garden, Dhaka and Jahangirnagar University, Savar, Dhaka.

4.8.2 This year :

| | |
|---|---|
| Collection of seeds from Moulvibazar district | 35 kg seeds were collected from Adampur, Moulvibazar. |
| Raising 300 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. |
| Field layout (with 2.5 X 2.5 m spacing), and planting seedlings in the field. | Experimental plantations of dhup were raised at three places namely Hinguli Forest Research Station; Keochia Silviculture Research Station and Chittagong University campus. 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 data in the nursery and from experimental plantations | Data provided in Table 4.1 and 4.2. |

Table. 4.1. Germination percentage of Dhup in the nursery

| Treatment | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fresh seeds | | Seeds dried under sunlight for 1 day | | Seeds dried under sunlight for 2 days | | Seeds dried under sunlight for 3 days | |
| Normal seed | Scarified seed | Normal seed | Scarified seed | Normal seed | Scarified seed | Normal seed | Scarified seed |
| 52 % | 40 % | 68 % | 51 % | 81 % | 51 % | 60 % | 45 % |

(100 seeds in each treatment)

Table. 4.2. Survival and growth (height) of dhup plantation at different areas in 2015

| Year of Plantation | Locations | Av.initial height of seedling (cm) | (One year) June 2016 | | |
|---|---|---|---|---|---|
| | | | Av. survival (%) | Av. height (m ) | Remarks |
| 2015 | BFRI Headquarter campus | 43 | 96 | 2.50 | |
| | Mirpur Botanical Garden, Dhaka | | 96 | 2.86 | |
| | Sitakunda Eco-park | | 60 | 1.26 | Deer browsing |
| | Chittagong University | | 40 | 2.0 | Landslide |
| | Islamic University, Kumira | | 65 | 2.0 | Lower slope with water logging |
| | Jahangirnagar University | | 70 | 2.2 | Cattle grazing |

**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

4.10.2 Cost of the year : Tk. 1,15,000

4.10.3 Expenditure of the year : Tk. 1,15,000

4.10.4 Source of fund : GOB

**4.11** **Beneficiaries** : FD, NGOs, private planters, Farmers, Educational Institutes, Herbal drug producers etc.

**5** **Study** : On-going

5.1 Programme Area : Biodiversity and Conservation.

**5.2** **Title of the Study** : 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 : 2012-13

5.6.2 Completion year : 2016-17

**5.7** **Personnel(s)** :

5.7.1 Study leader : Dr. Rafiqul Haider, DO

5.7.2 Associates : Md. Sah Alam, RO and Anita Rany Shutrodhar, RO

**5.8** **Progress** :

5.8.1 Previous year**,** if any : 50 formulations of ethnomedicinal plant uses were collected from the Khasia community of Moulvibazar district.

5.8.2 This year :

| Action plan as per annual research program | Progress |
|---|---|
| Two to 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 | Ten (10) plant specimens were collected for identification. |

| | |
|---|---|
| Collection of information on conservation strategy | Khasia people collected from forests. |
| Documentation of medicinal uses of plant species | Almost similar type of information collected like previous year. However, formulations were validated from that group discussion. |

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

**5.10 Financial statement** :

5.10.1 Total cost : Tk. 2,50,000

5.10.2 Cost of the year : Tk. 68,000

5.10.3 Expenditure of the year : Tk. 68,000

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** : On-going

1.1 Programme Area : Plantation technique and forest management

**1.2 Title of the Study** : Introduction of bamboo, rattan and golpata in the coastal homesteads of Bangladesh

**1.3 Justification :** The home gardens of Bangladesh are small and scattered. These are extremely productive and regarded as a more reliable place for tree farming being adjacent to living quarters. Over 76% of the population lives in rural areas and they are heavily dependent on homegardens for their livelihood. Their aggregating area constitutes only about 0.25 million ha, representing 10% of the country's forests. An estimated 88% of all wood supplies are drawn from the homegardens. Bamboo and rattan are intensely related to traditional life of Bangladeshi, especially to rural people and nature lovers, being used in various household articles. About 15-17 bamboo species are cultivated in the village groves. At present, village bamboos constitute 80% of the total national supply. But in the coastal areas bamboo and rattan population are very poor. On the other hand, golpata is a very valuable mangrove plant species in the natural Sundarbans. Golpata leaves are widely used for thatching roofs and walls of dwelling in south-western region of the country. This species can be cultivated in the low land adjacent to homesteads in the coastal belt for increasing its productivity. Therefore, this study is undertaken to introduce site-suitable bamboo and rattan species in the coastal homesteads as well as to develop golpata cultivation to the farmer's level.

**1.4 Objective(s)** :

1.4.1 To investigate the possibility for introduction of bamboo, rattan and golpata in coastal homesteads of Bangladesh.

1.4.2 To select site suitability of bamboo, rattan and golpata in the coastal areas.

1.4.3 To increase the productivity of bamboo, rattan and golpata in the coastal areas.

**1.5 Expected output** : Production of bamboo, rattan and golpata in the coastal areas will be increased.

**1.6 Study period** :

1.6.1 Starting year : 2009-10

1.6.2 Completion year : 2013-14 (original), 2015-16 (2nd phase)

**1.7 Personnel(s)** :

1.7.1 Study 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 year, if any : Three awareness meeting were organized with coastal rural people for cultivating bamboo, rattan and golpata in the coastal homesteads at Char Kukri-Mukri, Kolatoli and Head Quarter Research Stations. A total of 5000 seedlings of rattan and 5000 seedlings of bamboo were raised in the nursery at 5 research stations. Seedlings of bamboo (2358 nos.) and rattan (2012 nos.) were distributed to 372 and 347 coastal farmers respectively. Data on survival, growth and development were recorded and analyzed.

1.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a) Organizing two awareness meetings with rural people for cultivating bamboo, rattan and golpata in the coastal homesteads at Sitakundu and Head Quarter Research Stations. | Two awareness meeting were organized with rural people for cultivating bamboo, rattan and golpata in the coastal homesteads at Sitakundu and Head Quarter Research Stations. |
| b) Collection of seeds of rattan for raising 5000 seedlings. | Seeds of rattan (jali bet) were collected for raising 5000 seedlings. |
| c) Collection of bamboo (*Bambusa balcooa*) branches for raising 5000 seedlings from branch cutting. | Totals of 5000 branches of bamboo were collected for raising seedlings. |
| d) Raising 5000 seedlings of rattan and 5000 seedlings of bamboo at Rangabali, Char Kukri-Mukri, Char Osman, Sitakundu and Head Quarter Research Stations. | A total of 5000 seedlings of rattan, 5000 seedlings of bamboo were raised in the nursery at Rangabali, Char Kukri-Mukri, Char Osman, Sitakundu and Head Quarter Research Stations. |
| e) Supplying of seedlings to the selected coastal farmers at 5 research stations. | Seedlings of bamboo (1198 nos.) and rattan (1126 nos.) were distributed to 200 coastal farmers. |
| f) Maintenance and supervision of seedlings planted in previous years. | Plantations of bamboo, rattan and golpata raised during 2010-2015 have been maintained. |
| g) Collection and analysis of data. | Growth data have been recorded and analyzed. |
| h) Preparation of scientific reports/articles. | One scientific article has been published in the *Journal of the Asiatic Society of Bangladesh (Science)* in December, 2015. |

**Table 1.** Seedlings of bamboo and rattan distributed to the coastal farmers during 2010- 2016.

| Location | Bamboo | | Rattan | |
|---|---|---|---|---|
| | No. of homesteads | No. of seedlings | No. of homesteads | No. of seedlings |
| Rangabali, Patuakhali | 639 | 3918 | 583 | 6409 |
| Char Kukri-Mukri, Bhola | 678 | 3780 | 623 | 6734 |
| Sitakundu, Chittagong | 196 | 4200 | 146 | 5126 |
| Char Osman, Noakhali | 307 | 3025 | 299 | 3750 |
| Kolatoli, Cox's Bazar | 45 | 640 | 45 | 1313 |
| Head Quarter, Barisal | 57 | 277 | 32 | 250 |
| Total | 1,922 | 15,840 | 1,728 | 23,582 |

**Table 2.** Growth performance of *Bambusa vulgaris* planted in 2010 (4.0 years old) at different location of the coastal belt of Bangladesh.

| Location | Survival % | Height of dominant culm (m) | Maximum height (m) | Diameter of dominant culm(cm) | Maximum diameter (cm) | No. of new culms/ clump | Total no. of culms/ clump |
|---|---|---|---|---|---|---|---|
| Rangabali | 30a | 16.30d | 20.53 | 5.29b | 6.84 | 6.15b | 15.50b |
| Char Kukri | 47b | 13.41c | 17.94 | 4.16a | 5.73 | 7.60b | 21.20b |
| Char Osman | 51b | 5.61a | 10.11 | 4.27a | 6.39 | 2.26a | 5.92a |
| Kolatoli | 34a | 9.91b | 16.34 | 4.98b | 7.05 | 10.50c | 16.10b |
| Average | 40.50 | 11.31 | - | 4.67 | - | 6.63 | 14.68 |

Notes: Means with the different letters (like a,b…) in a column are significantly different at 5% level.

**Table 3.** Growth performance of *Bambusa vulgaris* planted in 2011 (3.0 years old) at different location of the coastal belt of Bangladesh.

| Location | Survival % | Height of dominant culm (m) | Maximum height (m) | Diameter of dominant culm(cm) | Maximum diameter (cm) | No. of new culms/ clump | Total no. of culms/ clump |
|---|---|---|---|---|---|---|---|
| Rangabali | 31a | 13.21d | 16.16 | 4.55c | 6.13 | 6.15b | 15.44b |
| Char Kukri | 30a | 10.15c | 14.62 | 3.70b | 5.13 | 6.16b | 14.00b |
| Char Osman | 41b | 3.74a | 7.66 | 4.16b | 5.91 | 1.92a | 5.07a |
| Sitakukdu | 35ab | 4.91b | 8.40 | 2.02a | 3.47 | 3.60ab | 11.50b |
| Average | 34.25 | 8.00 | - | 3.16 | - | 4.46 | 11.50 |

**1.9 Achievement(s), if any** : Totals of 1922 coastal homesteads were selected till 2016 for introducing bamboo and rattan. A total of 15,840 seedlings of bamboo, 23,582 seedlings of rattan were distributed to the coastal farmers. Two scientific papers have been published in the Journal of Bioscience and Agriculture Research, and Asiatic Society of Bangladesh (Science).

**1.10 Financial statement** :

1.10.1 Total cost : Tk. 15,00,000

1.10.2 Cost of the year : Tk. 2,50,000

1.10.3 Expenditure of the year : Tk. 2,50,000

1.10.4 Source of fund : GOB

**1.11 Beneficiaries** : Forest Department and adjacent coastal dwellers.

**2 Study** : On-going

2.1 Programme Area : Plantation technique and forest management

**2.2 Title of the Study** : Introduction of major bee foraging mangrove plant species in the coastal belt of Bangladesh

**2.3 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 Sundarban. 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 Sundarban 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.

**2.4 Objective(s)** :

2.4.1 To develop better silvicultural techniques for each bee foraging mangrove plant species.

2.4.2 To provide the sources of honey plants.

**2.5 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.

**2.6 Study period** :

2.6.1 Starting year : 2010-11

2.6.2 Completion year : 2014-15 (original), 2016-17 (2nd Phase)

**2.7 Personnel(s)** :

2.7.1 Study leader : S. A. Islam, DO

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

**2.8 Progress** :

2.8.1 **Previous year**, **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, Stakundu and Char Osman Research Stations. Four hectares mixed plantations of khalshi, gewa, goran, passur and choyla were raised at 4 Research Stations. Previously raised 10.4 ha experimental plantations were maintained. Data were collected and compiled.

2.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a) Collection of seeds of khalshi (*Aegiceras corniculatum*) gewa (*Excoecaria agallocha*), goran (*Ceriops decandra*), passur (*Xylocarpus mekongensis*), dhundul (*Xylocarpus granatum*), Choyla (*Sonneratia caseolaris*), hantal (*Phoenix paludosa*) and baen (*Avicennia officinalis*). | 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, Stakundu and Char Osman Research Stations. | A total of 14,000 seedlings of these bee foraging species were raised at 4 Research Stations. |
| c) Raising of 4.0 ha experimental mixed plantations at 4 research stations. | A total of 4.0 ha mixed plantations of bee foraging species have been raised at 4 Research Stations. |
| d) Maintenance of previously raised 18.0 ha experimental plantations. | Previously raised 18.0 ha experimental plantations have been maintained. |
| e) Preparation of a brick soling nursery platform (50' x 25') at Rangabali Forest Research Station. | Brick soling nursery platform (50' x 25') have been prepared at Rangabali Forest Research Station. |
| f) Collection and analysis of data. | Data have been collected and compiled. |

**Table 1.** Growth performance of five bee foraging mangrove species planted in 2015 at different sites of the coastal areas.

| Species | Sitakundu | | Char Osman | |
|---|---|---|---|---|
| | Survival % | Ht. (m) | Survival % | Ht. (m) |
| Baen | 90.00 | 0.71 | 53.63 | 0.73 |
| Passur | 75.00 | 1.56 | 52.50 | 1.08 |
| Goran | 60.00 | 0.25 | 32.00 | 0.35 |
| Gewa | 75.00 | 0.40 | - | - |
| Khalshi | 45.00 | 0.22 | 21.00 | 0.46 |

**Table 2.** Growth performance of four bee foraging mangrove species planted at Sitakundu Research station

| Species | Plantation in 2013 | | Plantation in 2014 | |
|---|---|---|---|---|
| | Survival % | Ht. (m) | Survival % | Ht. (m) |
| Passur | 66.00 | 2.36 | 62.00 | 1.82 |
| Goran | 20.00 | 0.36 | 20.00 | 0.36 |
| Kankra | 32.00 | 0.55 | 25.00 | 0.55 |
| Khalshi | 15.00 | 0.36 | 35.00 | 0.34 |

**2.9 Achievement(s), if any** : A total of 18.0 ha experimental mixed plantations of some bee foraging mangrove plant species have been raised at Rangabali, Char kukri-Mukri, Sitakundu and Char Osman Research Stations.

**2.10 Financial statement** :

2.10.1 Total cost : Tk. 10,00,000

2.10.2 Cost of the year : Tk. 4,00,000

2.10.3 Expenditure of the year : Tk. 4,00,000

2.10.4 Source of fund : GOB

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

**3 Study** : On-going

3.1 Programme Area : Conservation of Biodiversity.

**3.2 Title of the Study** : Ecological succession in the man-made coastal forests in relation to age and other related factors

**3.3 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 gradually forming newly accreted lands throughout coastal belt. 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 (*Avicenia 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 study in this direction has 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.

**3.4 Objective(s)** :

3.4.1 To observe the changes of vegetation and natural regeneration in the coastal man-made forests.

3.4.2 To determine the impact of related climatic factors, which are responsible for the ecological succession in the coastal forests.

3.4.3 To increase coastal forest resources of the country.

**3.5 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 forest.

**3.6 Study period** :

3.6.1 Starting year : 2012-13

3.6.2 Completion year : 2016-17

**3.7 Personnel(s)** :

3.7.1 Study leader : M. M. Alam, RO

3.7.2 Associates : S. A. Islam, DO;. M. A. Habib, FI; M. G. Rasul, FI; M.A.Q. Miah, FI

**3.8 Progress** :

3.8.1 Previous year, if any : Totals of 108 Temporary Sample Plots (TSP) were maintained 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.

3.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a) Remarking and maintenanc of previously established 108 TSP plots by replacing poles and painting trees. | Previously established 108 TSP plots were maintained by replacing poles and painting of trees. |
| b) Procurement of two pH meters and two digital slide calipers. | Two soil pH meter and two digital slide calipers have been procured. |
| c) Recording data on siltation, soil erosion, soil/water salinity, inundation frequency, and impact of human and animal interferences. | Data on siltation, soil erosion, soil/water salinity, inundation frequency and impact of human and animal interferences have been recorded. |
| d) Collection of growth data of the plantations and status of natural regenerations. | Data on the status of natural regeneration have been recorded. One scientific paper has been published in the *Journal of Bioscience and agriculture Research*. |

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

| Species | Rangabali Island | | | | | Char Kukri-Mukri Island | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Seedling | Sapling | Pole | Tree | Total | Seedling | Sapling | Pole | Tree | Total |
| *Excoecaria agallocha* | 36000 | 12340 | 1274 | 1111 | 50725 | 19614 | 6814 | 1170 | 711 | 28309 |
| *Avicennia officinalis* | 162 | 0 | 0 | 0 | 162 | 2059 | 518 | 0 | 0 | 2577 |
| *Heritiera fomes* | 429 | 385 | 414 | 459 | 1687 | 725 | 577 | 148 | 118 | 1568 |
| *Bruguiera sexangula* | 59 | 0 | 14 | 88 | 161 | 296 | 0 | 0 | 14 | 310 |
| *Xylocarpus mekongensis* | 14 | 0 | 0 | 0 | 14 | 103 | 266 | 59 | 0 | 428 |
| *Aegiceras corniculatum* | 0 | 0 | 0 | 0 | 00 | 11333 | 459 | 29 | 0 | 11821 |
| *Phoenix paludosa* | 414 | 0 | 0 | 0 | 414 | 666 | 474 | 0 | 44 | 1184 |
| *Cynometra ramiflora* | 0 | 0 | 0 | 0 | 00 | 88 | 0 | 0 | 0 | 88 |
| *Tamarix indica* | 0 | 0 | 0 | 0 | 00 | 844 | 133 | 0 | 44 | 1021 |
| Total: | 37078 | 12725 | 1702 | 1658 | 53163 | 35728 | 9241 | 1406 | 931 | 47306 |

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

| Species | Sitakhundu | | | | | Hatiya Island | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Seedling | Sapling | Pole | Tree | Total | Seedling | Sapling | Pole | Tree | Total |
| *Excoecaria agallocha* | 37111 | 13511 | 844 | 281 | 51747 | 8474 | 8266 | 903 | 177 | 17820 |
| *Avicennia officinalis* | 700 | 0 | 0 | 0 | 700 | 0 | 0 | 0 | 0 | 0 |
| *Xylocarpus mekongensis* | 0 | 14 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 |
| *Aegiceras corniculatum* | 1363 | 29 | 0 | 0 | 1392 | 0 | 0 | 0 | 0 | 0 |
| *Phoenix paludosa* | 59 | 163 | 0 | 0 | 222 | 0 | 0 | 0 | 0 | 0 |
| *Tamarix indica* | 518 | 237 | 89 | 44 | 888 | 0 | 0 | 0 | 0 | 0 |
| *Ceriops decandra* | 3777 | 3200 | 0 | 0 | 6977 | 0 | 0 | 0 | 0 | 0 |
| Total: | 43528 | 17154 | 933 | 325 | 61940 | 8474 | 8266 | 903 | 177 | 17820 |

**Table 3.** Environmental factors in the TSP plots of keora plantations at Hatyia island in 2016

| Year of keora plantation | Soil $P^H$ | Water salinity | Siltation (cm) | Inundation frequency (month) | No. of dead keora trees |
|---|---|---|---|---|---|
| 1998 | 6.40 | 10‰ | 4.86 | 8 | 7 |
| 1980 | 6.35 | 10‰ | 1.30 | 3 | 1 |
| 1974 | 6.20 | 10‰ | 1.25 | 2 | 1 |

**3.9** **Achievement(s), if any**: A total of 108 Temporary Sample Plots (TSP) have been established at different chars and offshore islands in Rangabali, Char kukri-Mukri, Char Osman and Sitakundu Research Stations. Tree density in the established keora plantations in the coastal belt ranged between 311-2178 trees per hectare area. Totals of 6, 9, 7 and 1 mangrove species have been regenerated inside keora forests at Rangabali, Char Kukri-Mukri, Sitakundu and Hatiya sites respectively. The most abundant regenerated species is gewa in all along the coastal belt.

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

3.10.1 Total cost : Tk. 20,00,000

3.10.2 Cost of the year : Tk. 2,00,000

3.10.3 Expenditure of the year : Tk. 2,00,000

3.10.4 Source of fund : GOB

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

**4 Study** : On-going

4.1 Programme Area : Plantation technique and forest management

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

**4.3 Justification :** The Forest Department started mangrove afforestation in the coastal belt of Bangladesh from 1966. About 1,90,000 ha of coastal plantations have been raised in Bangladesh till to date. Among them keora and baen occupying 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 report was 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.

**4.4 Objective(s)** :

**4**.4.1 To assess the growth performance and phenology of different mangrove and non-mangrove species at different char lands.

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

**4.5 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.

**4.6 Study period** :

4.6.1 Starting year : 2013- 14

4.6.2 Completion year : 2017-2018

**4.7 Personnel(s)** :

4.7.1 Study 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 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 weeding, cleaning, climber cutting, fence repairing etc. Growth and survival data of mangroves and non-mangrove species were recorded from the experimental plantations raised in different islands under Rangabali and Char Kukri-Mukri Research Stations.

4.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a) Conservation and maintenance of 35.0 ha older trials of mangrove (25.0 ha), non-mangrove (9.0 ha) and palm (1.0 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 35.0 ha older trials of mangrove (25.0 ha), non-mangrove (9.0 ha) and palm (1.0 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 Sitakunda 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 older trial plots of mangrove and non-mangrove species were maintained 2nd time in different islands of Rangabali and Char Kukri-Mukri Research Stations. |
| c) Selection of trees of keora. baen, gewa, sundri, passur, kakra for phenological observation. | A total of 120 trees (20 trees in each species) of keora. baen, gewa, sundri, passur, kakra have been selected for phenological observation. |
| d) Collection of data on flowering and fruiting of these | Flowering and fruiting data have been collected from the |

| | |
|---|---|
| mangrove species. | selected trees. |
| e) Collection of data on height, DBH, canopy diameter, bole height, etc. from the experimental plantations once a year. | Data on height, DBH, canopy diameter, bole height, etc. have been collected from the experimental plantations once a year |
| f) Compilation and analysis of data. | Data have been compiled and analyzed. |
| g) Preparation of scientific reports/ articles. | Two scientific papers have been published in the *Journal of Bioscience and Agriculture Research*, and *Journal of Science, Technology & Environment Informatics.* |

**Table 1.** Growth performance of *S. apetala* planted in 2007 (7 years old) at Char Kukri-Mukri and Rangabali islands.

| Seed source | Char Kukri-Mukri | | | | Rangabali | | | |
|---|---|---|---|---|---|---|---|---|
| | Survival % | Height (m) | DBH (cm) | Wood volume ($m^3$/ha/yr) | Survival % | Height (m) | DBH (cm) | Wood volume ($m^3$/ha/yr) |
| Best trees | 48c | 12.54c | 15.58c | 38.09c | 54c | 12.09c | 14.56c | 37.50c |
| Selected trees | 38b | 9.42b | 11.75b | 15.07b | 46b | 9.83b | 10.98b | 18.25b |
| Mass collection | 32a | 7.71a | 9.76a | 9.52a | 41a | 8.51a | 9.75a | 8.13a |

**Notes**: Figures followed by different letters (like a, b and c) in the same column differ significantly at 5% level.

**Table 2.** Growth performance of *S. apetala* planted in 2009 (5 years old) at Char Kukri-Mukri and Rangabali islands.

| Seed source | Char Kukri-Mukri | | | | Rangabali | | | |
|---|---|---|---|---|---|---|---|---|
| | Survival % | Height (m) | DBH (cm) | Wood volume ($m^3$/ha/yr) | Survival % | Height (m) | DBH (cm) | Wood volume ($m^3$/ha/yr) |
| Best trees | 53c | 11.88c | 14.55c | 51.52c | 51c | 11.57c | 13.44c | 42.49c |
| Selected trees | 45b | 9.00b | 11.15b | 21.87b | 46b | 9.83b | 10.43b | 19.14b |
| Mass collection | 33a | 7.69a | 9.44a | 11.45a | 40a | 8.58a | 9.15a | 13.89a |

**Table 3.** Growth performance of some mainland tree species (mixed plantations) at Bogachator, Sitakundu Research Station.

| Name of Species | Plantation in 2012 | | | Plantation in 2013 | | |
|---|---|---|---|---|---|---|
| | Survival % | Height (m) | DBH (cm) | Survival % | Height (m) | DBH (cm) |
| Jhao | 92.66 | 12.26 | 7.25 | 85.33 | 6.35 | 7.26 |
| Karanja | 82.33 | 4.26 | 4.62 | 72.33 | 4.20 | 3.70 |
| Babla | 92.00 | 5.77 | 7.10 | 83.66 | 4.68 | 5.23 |
| Payra | 90.33 | 9.88 | 8.41 | 75.33 | 3.85 | 4.18 |
| Rain tree | - | - | - | 81.00 | 3.44 | 5.17 |
| Akashmoni | 92.66 | 11.31 | 7.53 | - | - | - |

**4.9** **Achievement(s), if any** : Till to-date, a total of 35.0 ha experimental plantations of mangrove (25.0 ha), non-mangrove (9.0 ha) and palm (1.0 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 have been recorded for raintree, jhao, payra, babla, sada koroi and kala koroi. Two scientific papers have been published in Journal of Bioscience and Agriculture Research, and Journal of Science, Technology & Environment Informatics.

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

4.10.1 Total cost : Tk. 15,00,000

4.10.2 Cost of the year : Tk. 4,20,000

4.10.3 Expenditure of the year : Tk. 4,20,000

4.10.4 Source of fund : GOB

**4.11 Beneficiaries** : FD; Local Farmers and NGO.

**5 Study** : On-going

5.1 Programme Area : Plantation technique and forest management

**5.2 Title of the Study** : Selection of salt tolerant fruit and medicinal tree species in the coastal areas of Bangladesh

**5.3 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 ha 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.

**5.4 Objective(s)** :

5.4.1 To select suitable salt tolerant fruit and medicinal tree species in the coastal areas of Bangladesh.

5.4.2 To observe the growth performance of different fruit and medicinal tree species in different sites.

5.4.3 To assess the production of fruits in different fruit tree species.

**5.5 Expected output**: Site-suitable fruit and medicinal tree species will be selected in the coastal areas of Bangladesh.

**5.6 Study period** :

5.6.1 Starting year : 2013-14

5.6.2 Completion year : 2017-18

**5.7 Personnel(s)** :

5.7.1 Study 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 year**,** if any : A total of 150 farmers were selected for planting fruit tree species in their homesteads. Totals of 6745 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 medicinal tree species were raised at 4 Research Stations.

5.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a) Organizing two awareness meetings with rural people for cultivating fruit trees in the coastal homesteads at Rangabali and Char Osman Research Stations. | Two awareness meetings with rural people for cultivating fruit trees in the coastal homesteads were organized at Rangabali and Char Osman Research Stations. |
| b) Selection of 150 farmer's homesteads (25 from each research station) for planting fruit trees in their homegarden at Rangabali, Char Kukri- | A total of 200 homesteads were selected for planting fruit tree species at Rangabali, Char Kukri-Mukri, Char Osman, Sitakundu and Head Quarter Research |

| | |
|---|---|
| Mukri, Char Osman, Sitakundu, Head Quarter and Kolatoli (Cox's Bazar) Research Stations. | Stations. |
| c) Raising/purchasing of 9,000 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 150 homesteads. | A total of 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. |
| d) Raising of 18,000 seedlings of medicinal tree species such as neem, arjun, simul, bohera, gora neem, khoer, katbadam, kadam, sonalu, pitraj, satian and bot. | Totals of 18,000 seedlings of medicinal tree species such as neem, arjun, simul, bohera, gora neem, khoer, katbadam, kadam, sonalu, pitraj and satian were raised. |
| e) Raising of 4.0 ha experimental plantations of medicinal tree species at 4 Research Stations. | Four hectares experimental plantations of 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 trees (9,000 nos.) have been distributed and planted in 200 coastal homesteads at 5 Research Stations. |
| g) Maintenance of previously raised 4.0 ha plantation at 4 Research Stations. | A total of 4.0 ha experimental plantations have been maintained at 4 Research Stations. |
| h) Collection of survival and growth data from the experimental plots. | Data on seedling survival and growth have been recorded. |
| i) Compilation and analysis of data. | Data have been compiled and analyzed. |

**Table 1.** Growth performance of some woody medicinal tree species (2 years old) planted in 2014 at Sitakundu coastal belt.

| Sl. No. | Species | Survival % | Height (m) | Collar dia (cm) | Stem length (m) | Crown dia (m) |
|---|---|---|---|---|---|---|
| 1. | Neem | 69.53 | 1.67 | 2.53 | 1.23 | 0.53 |
| 2. | Arjun | 78.40 | 1.89 | 4.27 | 0.93 | 1.28 |
| 3. | Shimul | 54.00 | 1.93 | 4.22 | 1.44 | 0.84 |
| 4. | Bohera | 65.68 | 1.11 | 2.25 | 0.95 | 0.68 |
| 5. | Khoer | 45.06 | 3.05 | 4.97 | 1.49 | 2.33 |
| 6. | Katbadam | 88.58 | 1.82 | 3.12 | 1.50 | 0.78 |
| 7. | kadam | 63.52 | 2.63 | 5.93 | 2.20 | 1.48 |
| 8. | Sonalu | 49.07 | 1.20 | 1.76 | 0.72 | 0.54 |
| 9. | Pitraj | 36.66 | 1.06 | 2.44 | 0.75 | 0.61 |
| 10. | Bokain | 41.66 | 1.67 | 2.15 | 1.45 | 0.47 |

**Table 2.** Growth performance of some woody medicinal tree species (one year old) planted in 2015 at Sitakundu coastal belt.

| Sl. No. | Species | Survival % | Height (m) | Collar dia (cm) | Stem length (m) | Crown dia (m) |
|---|---|---|---|---|---|---|
| 1. | Neem | 36.21 | 0.63 | 0.69 | 0.50 | 0.3 |
| 2. | Arjun | 88.48 | 0.92 | 1.45 | 0.65 | 0.43 |
| 3. | Shimul | 78.39 | 0.99 | 1.73 | 0.93 | 0.31 |
| 4. | Bohera | 67.69 | 0.52 | 0.89 | 0.44 | 0.24 |
| 5. | Khoer | 15.43 | 0.94 | 0.67 | 0.56 | 0.34 |
| 6. | Katbadam | 74.28 | 0.70 | 1.00 | 0.64 | 0.28 |
| 7. | kadam | 60.29 | 0.92 | 2.08 | 0.85 | 0.45 |
| 8. | Sonalu | 51.23 | 0.64 | 0.85 | 0.44 | 0.34 |
| 9. | Pitraj | 78.60 | 0.78 | 1.07 | 0.68 | 0.35 |
| 10. | Bokain | 17.49 | 0.89 | 0.95 | 0.70 | 0.35 |

**Table 3.** Growth performance of some major fruit tree species planted in the coastal homesteads of Bangladesh in 2014.

| Sl. No. | Name of Species | Char Osman | | Rangabali | | Char Kukri-Mukri | |
|---|---|---|---|---|---|---|---|
| | | Survival % | Height (m) | Survival % | Height (m) | Survival % | Height (m) |
| 1. | Coconut | 97.00 | 1.55 | 56.25 | 2.28 | 73.00 | 1.98 |
| 2. | Mango | 84.00 | 1.55 | 63.54 | 2.00 | 77.00 | 1.39 |
| 3. | Jack fruit | 71.00 | 1.12 | 58.33 | 2.50 | 77.00 | 1.5 |
| 4. | Black berry | 91.00 | 1.15 | 65.62 | 1.44 | 85.00 | 0.94 |
| 5. | Guava | 84.00 | 1.42 | 70.83 | 2.34 | 67.00 | 1.66 |
| 6. | Tamarind | 55.00 | 1.00 | 77.03 | 1.06 | 89.00 | 0.78 |
| 7. | Ber | - | - | 45.83 | 2.62 | 67.10 | 2.14 |
| 8. | Pummelo | 65.00 | 0.84 | 56.25 | 1.46 | 61.00 | 0.85 |
| 9. | Hog plant | 60.00 | 2.23 | 50.00 | 2.75 | 57.00 | 1.79 |
| 10. | Litchi | 71.00 | 1.25 | 38.54 | 1.63 | 37.00 | 1.15 |
| 11. | Indian olive | 50.00 | 0.74 | 39.58 | 1.71 | 35.86 | 1.53 |
| 12. | Velvety apple | - | - | 89.58 | 0.91 | 99.00 | 0.66 |
| 13. | Aonla | 79.00 | 1.85 | 50.00 | 2.36 | 27.00 | 1.49 |
| 14. | Lemon | - | - | 55.00 | 1.22 | 57.95 | 0.99 |
| 15. | Carambola | - | - | 43.75 | 1.77 | - | - |
| 16. | Wood apple | 63.00 | 1.03 | 43.47 | 1.02 | 53.00 | 1.72 |

**Table 4.** Growth performance of some medicinal tree species in the central coastal belt planted in 2014.

| Sl. No. | Name of Species | Char Kukri-Mukri | | Rangabali | |
|---|---|---|---|---|---|
| | | Survival % | Height(m) | Survival % | Height(m) |
| 1. | Neem | 60.49 | 1.18 | 56.68 | 0.63 |
| 2. | Aurjun | 54.79 | 1.25 | 82.71 | 0.82 |
| 3. | Shimul | 51.05 | 1.53 | 56.38 | 0.92 |
| 4. | Bohera | 41.56 | 1.32 | 60.08 | 0.66 |
| 5. | Bokain | 53.37 | 1.31 | 54.73 | 0.73 |
| 6. | Khoier | 52.26 | 2.75 | 76.95 | 2.05 |
| 7. | Katbadam | 57.20 | 1.40 | 69.54 | 0.54 |
| 8. | Kadam | 58.44 | 1.14 | 66.25 | 1.19 |
| 9. | Sonalu | 50.61 | 1.51 | 52.26 | 0.79 |
| 10. | Horitoki | 42.73 | 1.07 | 46.91 | 0.56 |
| 11. | Pitraj | - | - | - | - |

**5.9** **Achievement(s), if any** : A total of 6,745 seedlings of different fruit tree species have been distributed among 150 farmer's homesteads. Totals of 8.0 ha plantations of different medicinal tree species have been raised at 4 Research Stations

**5.10** **Financial statement** :

5.10.1 Total cost : Tk. 20,00,000

5.10.2 Cost of the year : Tk. 4.30,000

5.10.3 Expenditure of the year : Tk. 4.30,000

5.10.4 Source of fund : GOB

**5.11** **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** : **Selection of plus trees of important agroforestry and forest tree species**

**1.3** **Justification :** Phenotypic variations exist among individual trees of a species both in qualitative and quantitative

characters. So, for quick genetic gain phenotypically superior trees or plus trees (PTs) will be selected from existing base population for providing the breeding population of the tree improvement programme. Seeds and scions collected from the selected trees ultimately will provide the genetic materials for establishing seed orchards for production of easily harvested quality seeds in large quantities. Moreover, selected plus trees will provide an interim seed source for production of quality planting materials (QPM). Average production value of a trait for any species could be improved using open pollinated seeds from plus trees to establish plantation from which, in turn, the best trees are selected and so on. Therefore, the study has been undertaken for the selection plus trees as interim source of superior quality seeds and breeding materials.

**1.4 Objective(s)** :

1.4.1 To establish sources of superior quality seeds from selected clones or progenies.

1.4.2 To obtain best possible gains from the breeding programmes by testing progenies/clones of the selected plus trees.

1.4.3 To popularize superior quality seeds produced in seed orchards.

**1.5 Expected output** : An interim source of superior quality seeds and breeding materials will be available for the planters.

**1.6 Study period** :

1.6.1 Starting year : 2012-2013 (5th Phase)

1.6.2 Completion year : 2015-2016

**1.7 Personnel(s)** :

1.7.1 Study leader : Hasina Mariam, DO

1.7.2 Associates : Sukla Rani Bashak, SRO; Md. Arifur Rahaman, RO; Md. Mezan-Ul-Haque, RO; A.K.M Azad, RO; Md. Kamaluddin, RO and Md.MukhlesurRahman, FI.

**1.8 Progress** :

1.8.1 Previous years, if any : A total of 2204 plus trees of 59 different forest tree species namely- acacia hybrid (*Acacia auriculiformis X A. mangium*), akashmoni (*Acacia auriculiformis*), agar (*Aquilaria agallocha*), amloki (*Phyllanthus emblica*), arjun (*Terminalia arjuna*), baittya-garjan (*Dipterocarpus costatus*), banspata (*Podocarpus nerifolius*), bazna (*Zanthoxylum rhetsa*), bel (*Aegle marmelos*), bohera (*Terminalia bellirica*), boilam (*Anisoptera scaphula*), civit (*Swintonia floribunda*), champa *(Michelia champaca),* chapalish *(Artocarpus chama),* chatian *(Alstonia scholaris),* chickrassi *( Chukrasia velutina),* dholi-garjan *(Dipterocarpusalatus),* dharmara *(Stereospermum personatum),* dhaki-jam *(Syzygium grandis),* eucalyptus *(Eucalyptus camaldulensis),* gamar *(Gmelina arborea),* ghora-nim/bokain ( *Melia sempervirens),* goda/awal *(Vitex peduncularis),* gutguttya *(Protium serratum),* jhau (*Casuarina sp.*), horitaki *(Terminalia chebula),* kadam *(Anthocephalus chinensis),* kainjal *(Bischofia javanica),* kalo-jam *(Syzygium cumini),* kala-koroi *(Albizia lebbeck),* kanak *(Schima wallichii),* kanthal *(Artocarpus heterophyllus),*jalpai *(Elaeocarpus floribundus),* jarul *(Lagerstroemia speciosa),* lohakat *(Xylia kerrii),* mahogany (*Swieteia mahagoni),* moluccana *(Paraserianthes falcataria),* mangium *(Acacia mangium),* minjiri *(Cassia siamea),* nageswar *(Mesua nagassarium),* neem *(Azadirachta indica),* pitali *(Trewia nudiflora),* pitraj *(Aphanamixis polystachya),* raintree *(Samanea saman),* raj-koroi /chambol *(Albizia richardiana),* raktan *(Lophopetalum fimbriatum),* rubber *(Hevea brasiliensis),* sal *(Shorea robusta),* shegun *(Tectona grandis),* shil-batna *(Castanopsis indica),* simul *(Bombax ceiba),* sidha-jarul *(Lagerstroemia parviflora),* sil-Koroi *(Albizia procera),* sissoo *(Dalbergia sissoo),* sonalu *(Cassia fistula),* teli-garjan *(Dipterocarpus turbinatus),* telsur ( *Hopea odorata),* toon *(Toona ciliata) and* uriam (*Mangifera sylvatica*)were selected and seeds are being collected.

9536 kg seeds of 33 different forest tree species acacia hybrid *(Acacia auriculiformis X A. mangium)*, agar (*Aquilaria agallocha*), akasmoni (*Acacia auriculiformis*), arjun (*Terminalia arjuna*), baittya-garjan (*Dipterocarpus costatus*), bohera (*Terminalia bellirica*), boilam (*Anisoptera scaphula*), *champa (Michelia champaca), chickrassi (Chukrasia velutina),* civit (*Swintonia floribunda*), *dhaki-jam (Syzygium grandis),* dharmara (*Stereospermum personatum*), dholi-garjan (*Dipterocar pusalatus*), gamar (*Gmelina arborea*), goda (*Vitexpedu ncularis*), gutguttya (*Protium serratum*), haritaki (*Terminalia chebula*), jatbatna (*Castanopsis lancifolia*), *jhau (Casuarina equisetifolia),* kadam (*Anthocephalus chinensis*), kanak (*Schimawallichi*), lohakat (*Xyliakerrii*), mahogany (Swieteia mahagoni), mangium *(Acacia mangium), raintree (Samaneasaman),* neem (*Azadirachta indica*), raktan (*Lophopetalum fimbriatum*), shegun (*Tectona grandis*), *sil-koroi (Albizia procera),* sidha-jarul (*Lagerstroemia parviflora*), *teli-garjan (Dipterocarpus turbinatus),toon (Toonaciliata)* anduriam (*Mangifera sylvatica*) distributed /sold to different tree planting agencies.

1.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a. Selection of 75 plus trees (PT) at Barshijura | 75 plus trees of 15 different forest tree species were selected at |

| | |
|---|---|
| (7), Dulahazara (13), Hyanko (12), Ichamati (12), Kaptai (11), Salna (9) Ukhia (9) Seed Orchard Centers and Head Quarter (2). | Barshijura (7), Dulahazara (13), Ukhia (9), Hyanko (12), Ichamati (12), Kaptai (11), Salna (9) Seed Orchard Centers and Head Quarter (2) (Table 1). |
| 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 2. |

**Table 1. List of centre wise selected plus trees .**

| Sr. no | Species Name | Scientific name | Name of Centres | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Bar | Dul | **Hya** | **Ich** | **Kap** | **Sal** | Ukh | **H Q** | Total |
| 01 | Acacia hybrid | *Acacia aurculiformis x Acacia mangium* | 1 | 1 | **1** | **1** | **1** | **1** | **1** | - | 07 |
| 02 | Agar | *Aquilaria agallocha* | | 1 | - | - | - | - | - | - | 01 |
| 03 | Akashmoni | *Acacia auriculiformis* | 1 | 1 | **1** | **1** | **1** | **1** | **1** | - | 07 |
| 04 | Batna | | - | 1 | - | - | - | - | - | **1** | 02 |
| 05 | Baittya- Garjan | *Dipterocarpus costatus* | - | 2 | - | - | - | - | - | - | 02 |
| 06 | Chickrassi | *Chukrasia velutina* | - | - | **1** | **1** | **1** | - | - | - | 03 |
| 07 | Dhaki-jam | *Syzygium grande* | - | 1 | **1** | - | **1** | - | **1** | - | 04 |
| 08 | DhaliGarjan | *Dipterocarpus alatus* | - | 1 | - | - | - | - | **2** | - | 03 |
| 09 | Gamar | *Gmelina arborea* | - | 2 | **2** | **2** | - | **2** | - | - | 08 |
| 10 | Lohakath | *Xylia kerrii* | 1 | - | - | - | **2** | **1** | - | - | 04 |
| 11 | Mahogany | *Swietenia macrophylla* | 2 | - | **2** | **2** | **2** | **2** | **2** | - | 12 |
| 12 | Shegun | *Tectona grandis* | - | 2 | **2** | **2** | **2** | **2** | - | - | 10 |
| 13 | Sil-koroi | *Albizia procera* | 1 | - | - | **1** | - | - | - | - | 02 |
| 14 | Teli-garjan | *Dipterocarpus turbinatus* | 1 | 1 | **1** | **1** | - | - | **1** | - | 05 |
| 15 | Uriam | *Mangifera sylvatica* | - | | **1** | **1** | **1** | | **1** | **1** | 05 |
| | **Total** | | **07** | **13** | **12** | **12** | **11** | **9** | **9** | **02** | **75** |

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

**Table 2. List of centrewise collected seeds of different species.**

| Sr. no | Name of species | | Ukh | Dul | Kap | Ich | Hya | Sal | Bar | HQ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | Acacia | *Acacia aurculiformis x Acacia mangium* | 1 | 2 | 1 | 1 | 2 | 2 | 1 | - | **10** |
| 02 | Agar | *Aquilaria agallocha* | - | 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 grande* | - | 30 | - | - | - | - | - | - | **30** |
| 13 | Haritaki | *Terminalia chebula* | 2 | 2 | 2 | - | 1 | - | 3 | | **10** |
| 14 | Kadam | *Anthocephalu schinensis* | - | - | - | 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

**1.9 Achievement(s), if any** : Two thousand one hundred twenty nine plus trees of more than forty species were selected and 9721 kg seeds were collected and distributed. Better quality seed sources were created having broader genetic base.

**1.10 Financial statement** :

1.10.1 Total cost : Tk. 3,00,900

1.10.2 Cost of the year : Tk. 25,900

1.10.3 Expenditure of the year : Tk. 25,900

1.10.4 Source of fund : GOB

**1.11 Beneficiaries** : Forest Department (FD), Non-Government Organizations(NGOs) and other tree planting agencies and Private Land Owners.

**2 Study** : On-going

2.1 Programme Area : Breeding and Tree improvement

**2.2 Title of the Study** : Establishment and management of seed orchard

**2.3 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 making 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.

**2.4 Objective(s)** :

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

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

2.4.3 To develop suitable techniques for mass production of clonal planting materials.
2.4.4 To screen best clones/progenies.
2.4.5 To supply quality seeds to related stakeholders.

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

**2.6 Study period** :

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

2.6.2 Completion year : 2018-2019

**2.7 Personnel(s)** :

2.7.1 Study leader : Hasina Mariam, DO.

2.7.2 Associates : Sukla Rani Bashak, SRO; NaniGopalBhowmick, SRO; Md. ArifurRahaman, RO and Md. Mezan-Ul-Haque, RO.

**2.8 Progress** :

2.8.1 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 rootstocks 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.

2.8.2 This year :

| Action plan as per annual research programme | 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. Raising and maintenance of 21,000 seedlings (polybag size-5″ X 7″) for the establishment of 5.0 ha seedling seed orchard (SSO) (viz. agar-3500, teligarjan-3500, baittyagarjan-3500, dholigarjan-3500, dhakijam-3500, and telsur-3500) and raising 5,000 root stock (polybag size-12″ X 9″) of teak for the establisment of 5.0 ha clonal seed orchard (CSO) at Kaptai, Hyanko, Ichamati, Dulahazara and Salna SOCs. | 21,000 no. seedlings (4200 seedlings in each centre, viz. agar-3500, teligarjan-3500, baittyagarjan-3500, dholigarjan-3500, dhakijam-3500, and telsur-3500) were raised at Dulahazara, Hyanko, Salna, Ichamati, and Kaptai SOCs and maintained the seedlings for the establishment of SSO for the next year. Raised 5,000 no. root stocks of teak at Kaptai, Hyanko, Ichamati, Dulahazara and Salna (1000 in each centre) SOCs. |
| c. Preparation of 2500 ramets of teak for the establishment of clonal seed orchard at Dulahazara, Hyanko, Ichamati, Kaptai, and Salna SOCs. | 2500 no. teak ramets were prepared at Dulahazara (500), Hyankoo (500), Ichamoti (500), Salna (500), & Kaptai (500) SOCs. |
| d. Establishment of 2.5 ha seedling seed orchard of dholigarjan (0.5 ha), teligarjan (0.5ha), baittyagarjan (0.5ha) dhakijam (0.5ha) and telsur (0.5ha) at Kaptai, Hyanko, Ichamati, Dulahazara, Barshijora and Salna SOCs. | 2.5 ha seedling seed orchard were established at Dulahazara(0.5ha), Hayanko (0.5ha), Ichamioti (0.5ha), Kaptai (0.5ha-teak), and Salna (0.5ha) SOCs. |
| e. Establishment of 9.5 ha clonal seed orchard of teak(1.9ha each centre) at Kaptai, Hyanko, Ichamati, Salna and Dulahazara SOCs. | 9.5ha clonal seed orchard of teak were established at Kaptai, Ichamoti, Dulahazara Hayanko and Salna SOCs. |
| f. Maintenance of existing 40.75 ha CSO and SSO at Ichamati, Salna, Hyanko, Kaptai and Dulahazara SOCs. | Existing 40.75 ha CSO and SSO were maintained at Ichamati, Salna, Hyanko, Kaptai and Dulahazara SOCs. |
| g. Maintenance of previously raised 6.5 ha (SSO 3.5 ha and CSO 3 ha) orchard at Dulahazara, Ichamati, Kaptai, Hyanko and SalnaSOCs by gap filling. | Previously raised 6.5 ha SSO and CSO were maintained by weeding and gap filling at Ichamati, Kaptai, Dulahazara , Salna and Hyanko SOCs. |

| | |
|---|---|
| h. Data collection at Ichamati, Salna, Hyanko, Kaptai and Dulahazara SOCs. | Data on survival % and height growth of teak clonal seed orchard at Dulahazara, Hyankoo, Ichamoti and Salna SOCs were recorded. Data varied on different plus trees at different centers, height range varied by 1.14-1.69m at Dulahazara, 1.23-1.57m at Hayankoo,1.33-164 at Salna, 1.13-1.66m at Ichamoti. Survival rate of plus trees were 83-92% at Dulahazara, 81-91% at Hayanko, 83-91% and 82-93% at Ichamoti respectively which is shown in Table 1. |

**Table 1. Growth performance of teak (*Tectona grandis*) clonal seed orchard at different SOCs established in 2014.**

| PT No | Average Height(m) | | | | Survival % | | | |
|---|---|---|---|---|---|---|---|---|
| | Dulahazara | Hayanko | Salna | Ichamoti | Dulahazara | Hayanko | Salna | Ichamoti |
| 001 | 1.50 | 1.37 | 1.42 | 1.46 | 90 | 91 | 88 | 87 |
| 002 | 1.26 | 1.44 | 1.33 | 1.43 | 88 | 85 | 90 | 82 |
| 003 | 1.44 | 1.49 | 1.50 | 1.46 | 89 | 85 | 90 | 87 |
| 004 | 1.69 | 1.57 | 1.64 | 1.66 | 92 | 92 | 87 | 93 |
| 005 | 1.50 | 1.56 | 1.51 | 1.49 | 91 | 90 | 85 | 89 |
| 006 | 1.25 | 1.34 | 1.46 | 1.43 | 92 | 86 | 90 | 86 |
| 007 | 1.47 | 1.33 | 1.39 | 1.20 | 90 | 90 | 91 | 93 |
| 008 | 1.51 | 1.47 | 1.35 | 1.44 | 88 | 81 | 84 | 82 |
| 009 | 1.42 | 1.30 | 1.39 | 1.45 | 87 | 87 | 90 | 90 |
| 010 | 1.18 | 1.23 | 1.44 | 1.56 | 86 | 88 | 83 | 86 |
| 011 | 1.33 | 1.40 | 1.36 | 1.28 | 90 | 84 | 88 | 89 |
| 012 | 1.66 | 1.44 | 1.61 | 1.13 | 83 | 90 | 89 | 90 |

**2.9** **Achievement(s), if any** : At Hyanko, Dulahazara, Ichamati, Salna and KaptaiSOCs, 32.0 ha clonal seed orchard of teak,gamar and mahogany and 25.0 ha seedling seed orchard of garjan, dholigarjan, dhakijam, chapalish, eucalyptus (*Eucalyptus camaldulensis, E. tereticornis, E. europhylla*), akashmoni and gamarwere established and seeds are being collected from teak and gamar seed orchard at Kaptai.

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

2.10.1 Total cost : Tk. 40,00,000

2.10.2 Cost of the year : Tk. 8,60,450

2.10.3 Expenditure of the year : Tk. 8,60,450

2.10.4 Source of fund : GOB

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

**3** **Study** : On-going

3.1 Programme Area : Breeding and Tree improvement

**3.2** **Title of the Study** : Superior stand /woodlot selection and conversion into seed production area (SPA)

**3.3** **Justification :** For obtaining an immediate and rapid gain to the operational forestry plantation programme, short-term breeding programme applying the genetic principles like selection of superior woodlots/plantations and removing of undesirable trees from the woodlots/plantations for conservation into Seed Production Area (SPA) could be undertaken for developing an interim seed source. Therefore, the study has been undertaken to develop an interim seed source.

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

3.4.1 To develop an interim source of seeds.

3.4.2 To ensure supply of better quality seeds.

**3.5** **Expected output** : An interim source of superior quality seeds will be developed.

**3.6** **Study period** :

3.6.1 Starting year : 2013-2014 (4th Phase)

3.6.2 Completion year : 2015-2016

**3.7 Personnel(s)** :

3.7.1 Study leader : Sukla Rani Bashak, SRO.

3.7.2 Associates : Hasina Mariam, DO; Nani Gopal Bhowmick, SRO; Md. Arifur Rahaman, RO; Md. Mezan-Ul-Haque, RO; A.K.M Azad, RO; Md. Kamal Uddin, RO and Md.MukhlesurRahman, FI.

**3.8 Progress** :

3.8.1 Previous year, if any : Two hectare SPA of akashmoni were established. About 262 kg seeds of akashmoni were collected from the established SPA and distributed to DNMS, FD, and private planters. Inferior stock was removed from one hectare earlier raised plantation of akashmoni at Kaptai and one hectare at Ichamati seed orchard centre. Seven thousand seedling of akasmoni were raised and 0.75ha SSO were established.

3.8.2 This year :

| Action plan | Progress |
|---|---|
| a. Making completion report on established SPA. | Completion report on established SPA has been prepared . |

**3.9 Achievement(s), if any** : Established 2.0 ha Seed production area (SPA) of *Acacia auriculiformis* (akashmoni) species.

**3.10 Financial statement** :

3.10.1 Total cost : Tk. 70,000

3.10.2 Cost of the year : Tk. 70,000

3.10.3 Expenditure of the year : Tk. 00

3.10.4 Source of fund : GOB

**3.11 Beneficiaries** : FD, NGOs and other tree planting agencies.

**4 Study** : On-going

4.1 Programme Area : Production of quality planting materials

**4.2 Title of the Study** : Popularizing quality planting materials through distribution

**4.3 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.

**4.4 Objective(s)** :

4.4.1 To develop awareness about the importance and benefits of using quality seeds and seedlings.

4.4.2 To increase the quality and quantity of tree production in plantation and homesteads.

**4.5 Expected output** :

a. Farmers and planters will aware about quality forest tree seeds and planting materials.
b. Productivity/yield of the plantation will increase.

**4.6 Study period** :

4.6.1 Starting year : 2013-2014 (4$^{th}$Phase)

4.6.2 Completion year : 2016-2017

**4.7 Personnel(s)** :

4.7.1 Study leader : Md. Arifur Rahaman, RO.

4.7.2 Associates : Hasina Mariam, DO; Sukla Rani Bashak, SRO; NaniGopalBhowmick,SRO; Md. Mezan-Ul-Haque, RO; A.K.M Azad, RO; Md. Kamal Uddin, ROand Md. MukhlesurRahman, FI.

**4.8 Progress** :

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

4.8.2 This year :

| Action plan | Progress |
|---|---|
| a.Raising of 10,000 seedlings of mahogany, hybrid acacia, akashmoni, kadam, telsur, champa, chickrassi, haritaki, amloki, bohera, neem, raintree etc. considering the | 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 |

| | |
|---|---|
| demands of earlier years at HQ nursery. | 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. | 2500 no. rooted cuttings of hybrid acacia were produced and 500 no. of agar 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. 22,500.00 through the distribution of seedlings and seeds among the farmers, planters and other users. |
| d. Data collection on germination period, germination % and survival % of raised seedlings at nursery stage. | Data on germination period, germination % and survival % of ten thousand seedlings of ten different forest tree species were collected at nursery stage. Among them ranges of germination period varied from species to species (5-30days), germination percentage (60%-90%) and survival percentage (90%-95%) were observed. |

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

| Sl. no. | Species | Scientific name | Germination period(days) | Germi-nation (%) | No of seedling (raised) | Survivabi-lity (%) |
|---|---|---|---|---|---|---|
| 1 | Arjun | *Terminaliaarjuna* | 10-15 | 60 | 1000 | 95 |
| 2 | Bohera | *Terminaliabellirica* | 10-20 | 60 | 1000 | 95 |
| 2 | Boilam | *Anisoptera scaphula* | 7-12 | 45-55 | 1000 | 80 |
| 4 | Baittyagarjan | *Dipterocarpus costatus* | 7-15 | 50-60 | 500 | 85 |
| 5 | Civit | *Swintonia floribunda* | 7-10 | 70-80 | 1000 | 95 |
| 6 | Dholigarjan | *Dipterocarpus alatus* | 7-10 | 70-80 | 500 | 95 |
| 7 | Horitaki | *Terminalia chebula* | 10-20 | 45 | 500 | 95 |
| 8 | Mehogani | *Swieteniamacrophylla* | 7-10 | 80 | 1500 | 90 |
| 9 | Raintree | *Samaneasaman* | 8-12 | 80 | 500 | 95 |
| 10 | Segun | *Tectonagrandis* | 10-30 | 75 | 1000 | 95 |
| 11 | Telsur | *Hopeaodorta* | 5-7 | 70-80 | 500 | 90 |
| 12 | Teligarjan | *Dipterocarpus turbinatus* | 5-7 | 70-90 | 1000 | 95 |
| | **Total** | | | | **10,000** | |

**4.9** **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.

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

4.10.1 Total cost : Tk. 1,20,000

4.10.2 Cost of the year : Tk. 39,000

4.10.3 Expenditure of the year : Tk. 39,000

4.10.4 Source of fund : GOB

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

**5** **Study** : On-going

5.1 Programme Area : Production of quality planting materials

**5.2** **Title of the Study** : Testing of seeds before distribution and standardization of storage behaviour

**5.3** **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

**5.4** **Objective(s)** :

5.4.1 To develop a unified system of seed collection, storage, export, import, testing and distribution of forest tree seeds.

5.4.2 To ensure the supply of quality seeds to the planters.

5.4.3 To strengthen the BFRI seed testing laboratory.

**5.5 Expected output**: Seed with better physiological and physical quality will ensure better productivity of the plantation.

**5.6 Study period** :

5.6.1 Starting year : 2012-2013(5th Phase)

5.6.2 Completion year : 2016-2017

**5.7 Personnel(s)** :

5.7.1 Study leader : Md. Mezan-Ul-Haque, RO.

5.7.2 Associates : Hasina Mariam, DO; Sukla Rani Bashak, SRO; Nani Gopal Bhowmick, SRO; Md. Arifur Rahaman, RO; A.K.M Azad, RO; Md. Kamal Uddin, RO and Md. Mukhlesur Rahman, FI.

**5.8 Progress** :

5.8.1 Previous year**,** if any : Storage behaviour of civit and agar and routine testing of the collected seeds were done prior to distribution of seeds.

5.8.2 This year :

| Action plan | Progress |
|---|---|
| a.Data collection on storage behavior of teligarjan, baittyagarjan and dhaligarjan seeds. | **a.** Data on storage behavior of teli-garjan, baittya-garjan and dhali-garjan seeds recorded and has been analysing. |
| b. Germination and viability tests of the collected seeds before distribution. | b. Germination and viability of collected seeds were tested before distribution (Table 1). |

## Table 1: List of seeds tested before distribution

| Sr. no | Species name | Scientific name | Germination period(days) | Viability (%) |
|---|---|---|---|---|
| 01 | Acacia | *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 | 45-55 |
| 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 grande* | 7-10 | 70-80 |
| 13 | Haritaki | *Terminalia chebula* | 12-18 | 35-45 |
| 14 | Kadam | *Anthocephalu schinensis* | 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* | 5-7 | 70-80 |
| 22 | Toon | *Toona ciliata* | 7-10 | 50-60 |
| 23 | Uriam | *Mangifera sylvatica* | 15-20 | 65-75 |

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

**5.10 Financial statement** :

5.10.1 Total cost : Tk. 1,80,000/-

5.10.2 Cost of the year : Tk. 95,000/-

5.10.3 Expenditure of the year : Tk. 45,000/-

5.10.4 Source of fund : GOB

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

**6 Study** : On-going

6.1 Programme Area : Breeding and Tree Improvement

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

**6.3 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.

**6.4 Objective(s)** :

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

6.4.2 Centralization of high yielding clones in hedge orchard.

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

**6.6 Study period** :

6.6.1 Starting year : 2014-2015(2nd Phase)

6.6.2 Completion year : 2018-2019

**6.7 Personnel(s)** :

6.7.1 Study leader : Md. Kamaluddin, RO.

6.7.2 Associates : Hasina Mariam, DO; Sukla Rani Bashak, SRO; NaniGopalBhowmick, SRO; Md. ArifurRahaman, RO; Md.Mezan-Ul-Haque,RO; A.K.M Azad, RO and Md. Mukhlesu rRahman, FI.

**6.8 Progress** :

6.8.1 Previous year 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.

6.8.2 This year :

| Action plan | Progress |
|---|---|
| a. Seed collection and raising of 3000 (Hayanko-1000, Dulahazara-1000 & Ichamoti-1000) seedlings. | a. Rubber seeds were collected and raised 3000 no. seedlings at Hayanko (1000), Dulahazara(1000) & Ichamoti(1000) SOCs . |
| b. Preparation of 1500 rubber ramets at Hayanko(1000) and Ukhya(500)SOC | b. Prepared 1500 nos. of rubber ramets at Hyanko SOC |
| c. Establishment of 1 ha rubber orchard at Hyanko SOC. | c. Established 1 ha rubber orchard at Hyanko SOC. |
| c. Maintenance of previously raised 4.75 ha rubber plantation (3 times) at Dantmara Rubber Estate, Hyanko. | c. Maintained 4.75 ha previously raised rubber plantation by weeding and fertilizing at Dantmara Rubber Estate, Hyankoo SOC. |
| a. Data collection. | Growth data collected from last year clonal plantation. Data showed that the survivability of different clones of rubber was 84%-92%. The average height and dbh was 2 -3.3m and 1.5-2.18cm. |

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

**6.10 Financial statement** :

6.10.1 Total cost : Tk. 21,00,000

6.10.2 Cost of the year : Tk. 4,29,650

6.10.3 Expenditure of the year : Tk. 4,29,650

6.10.4 Source of fund : GOB

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

# 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(s)** :
1.7.1 Study leader Dr. Sharmila Das, DO
1.7.2 Associates : Dr. Md. Mahbubur Rahman, SRO.; Nusrat Sultana, SRO; Saiful Alam Md. Tareq, FI.
**1.8 Progress** :
1.8.1 Previous years, if any (2010-2015) : Raised thirty four thousand propagules of ten demanding bamboo species (*Dendrocalamus giganteus, D. longispathus, Bambusa balcooa, B. vulgaris, B. bambos, B. cacharensis, B. multiplex, B. tulda, B. jaintica,* 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 12,000 bamboo propagules | Produced 12,000 propagules of ten bamboo species. Five thousand bamboo propagules were raised from branch cuttings and seven thousand through seedling proliferation. Two thousand and eight hundred twenty three (2,823) bamboo propagules were distributed among the stakeholders by July 2015. |
| c. Data collection on survival rate of cuttings. | Survival range of cuttings varies from 25 – 90% based on species. |
| d. Preparation of report. | Hormonal treatment (IBA & NAA) influenced the rooting percentage of branch cutting. |

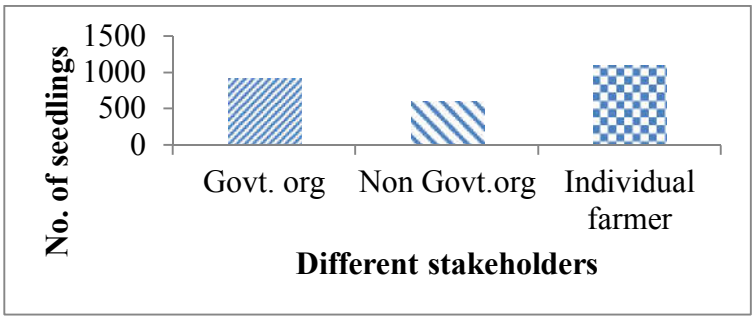



**Figure 1. Bamboo seedlings distribution trends among different stakeholders.**

**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. 12,50,000
1.10.2 Cost of the year : Tk. 2,31,150
1.10.3 Expenditure of the year : Tk. 2,31,150
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(s)** :
2.7.1 Study leader : Dr. Sharmila Das, DO
2.7.2 Associates : Dr. Md. Mahbubur Rahman, SRO; Nusrat Sultana, SRO; Saiful Alam Md. Tareq, FI

**2.8 Progress** :
2.8.1 Previous years, if any(2010-2015)**:** Raised twenty three thousand seedlings of twenty two 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 | a. Seeds of seven threatened tree species such as asok (*Saraca asoca)*, karanja (*Pongamia pinnata)* batna (*Castanopsis indica*), udal, (*Sterculia villosa*), pitali (*Trewia nudiflora*), gutguttya (*Protium serratum*), and raktan (*Lophopetalum fimbriatum)* were collected and sown in nursery bed. |
| b. Raising of five thousands seedlings of selected species and maintenance of seedlings in the nursery. | b. Raised 5,000 seedlings of collected species in polybag. |
| c. Maintaining two acre plantation of 22 threatened species in IFESCU campus. | c. Maintenance activities were done on time and data collected. Average field survival percentage of seedlings was found 60 %. |
| d. Raising two acre new plantation. | d. Two acre new plantation of eighteen threaten species were raised at Radar unit of Bangladesh Air Force, Cox's Bazar. |

**Table 1. 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* |

**2.9** **Achievement(s), if any** : Raised 5.5 acre of conservation plots of twenty two threatened forest tree species at Foy's Lake, Chittagong, 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. 6,00,000

2.10.2 Cost of the year : Tk. 90,850

2.10.3 Expenditure of the year : Tk. 90,850

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 (*Dendrocalamu giganteus*), china bamboo (*D. latiflorus)*, wappi (*Thyrsostachys sp.)* and pencha (*D. hamiltonii* )

**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(s)** :

3.7.1 Study leader : Dr. Md. Mahbubr Rahman, SRO
3.7.2 Associates : Nusrat Sultana, SRO**;** Saiful Alam Md. Tareq, FI

**3.8 Progress** :

3.8.1 Previous year, if any (2008-2015) : 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. brandisii*, and *B. balcooa* and hardened in soil.

3.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a. Explants collection | a. 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 | b. 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 combination with KIN (6-Furfuryl Amino Purine). Among the different concentrations of BAP, 2 mg/L in MS liquid medium produced maximum shoots after 28days of culture. In combination with KIN the maximum shoots were recorded in MS + 2 mg/L BAP + 1 mg/L KIN after 28 days of culture (Table 2). |
| c. Root induction and maintenance of the plantlets | c. 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. Results are presented in Table-3. |
| d. Transfer of the plantlets into soil for hardening | d. Rooted plantlets of *D. giganteus, D. brandisii* and *B. balcooa* were transferred into soil for hardening. |
| e. One thousand tissue culture bamboo seedlings will be produced | e. Produced tissue culture plantlets of *D giganteus, D. brandisii*, and *B. balcooa* . |
| f. Raising 1.0 acre new bamboo demonstration plot with tissue culture plant lets | f. A demonstration plot with tissue culture plantlets was raised at Radar unit of Bangladesh Air Force, Cox's Bazar. |

**Table 2. Effect of BAP with different concentrations of KIN in MS medium on shoot multiplication from sprouted nodal bud culture of five bamboo species**

| Growth regulators | Maximum shoot no / sp/ culture after 28 days | | | | |
|---|---|---|---|---|---|
| | Farua | Bhudum | China | Wappi | Pancha |
| MSO | - | - | - | - | - |
| BAP + KIN | | | | | |
| 1.0 + 0.5 | 6 | 9 | 6 | 7 | 8 |
| 1.0 + 1.0 | 15 | 25 | 10 | 10 | 9 |
| 1.0 + 1.5 | 12 | 20 | 9 | 9 | 7 |
| 1.0 + 2.0 | 10 | 18 | 7 | 7 | 5 |

**Table 3. Effect of different concentrations of IBA on MS medium for root induction from excised shoots of five bamboo species. (Data recorded after 15 days of culture).**

| Species | Media without growth regulator MSO | Media with growth regulator | | |
|---|---|---|---|---|
| | | MS+ IBA 0.5mg/L | MS+IBA 1.0mg/L | MS + IBA 2.0mg/L |
| | % of culture induced root. | % of culture induced root | % of culture induced root | % of culture induced root |
| Farua | - | 10 | 80 | 70 |
| Bhudum | - | 10 | 85 | 70 |
| China | - | - | - | - |
| Wappi | - | - | - | - |
| Pancha | - | - | - | - |

**3.9 Achievement(s), if any** : Tissue culture protocols of Farua and Bhudum bamboo were developed.

**3.10 Financial statement** :

3.10.1 Total cost : Tk. 21,50,000

3.10.2 Cost of the year : Tk. 3,58,000

3.10.3 Expenditure of the year : Tk. 3,58,000

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 *(Diospoyros montana),* 2) Medicinal plant: amloki *(Phyllanthus emblica)* 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

**4.7 Personnel(s)** :

4.7.1 Study leader : Dr. Md. Mahbubur Rahman, SRO

4.7.2 Associates : Nusrat Sultana, SRO**;** Saiful Alam Md. Tareq, FI

**4.8 Progress** :

4.8.1 Previous years, if any (2012-2015): Induced callus tissues of amloki from cotyledon explant and regenerated shoots. Culture established of tamal and produced shoots.

4.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a. Explants collection | a. Explants of selected species collected from Sreemangal (Moulavibazar), Sylhet, Ukhia and different areas of Chittagong. |
| b. Establishment of culture and production of multiple shoots | b. Indirect plant regeneration from cotyledon derived callus of amloki and direct regeneration through shoot tip culture were achieved. Conducted different experiments to optimize multiple shoot production in MS medium supplemented with cytokinin BAP and KIN. Maximum shoot produced in the medium having MS + 2.0 mg/L BAP + 4% Sugar +2.8 g/L gelrite after 28 days of culture. Results are shown in Table 4. Culture established of tamal, agar and fruit tree latkon. |
| c. Root induction and maintenance of the plant lets. | c. Induced roots on excised shoots of amloki for tissue culture plantlets and optimized root production (Table 5). |
| d. Transfer of the plantlets into soil for hardening. | d. Rooted plantlets of amloki were transferred to soil and hardened at green house. |
| e. One thousand tissue culture seedlings will be produced | e. Produced tissue culture plants of amloki. |

**Table 4. Effect of different concentrations of BAP supplemented with MS medium on shoot multiplication of amloki.**

| 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 | 10 | 20 |
| MS + 2.0 mg/L BAP | 70 | 12 | 25 |
| MS + 3.0 mg/L BAP | 50 | 10 | 15 |

**Table 5. Effect of different concentrations of IBA supplemented with MS medium on root production from excised shoot of amloki (*Phyllanthus emblica)*. (Data recorded after 15 and 28 days of culture).**

| Media composition | Morphogenic response | |
|---|---|---|
| | % of culture induced root after 15 days | % of culture induced root after 28 days |
| MSO (Control) | - | - |
| ½ MS + 0.5 mg/L IBA | 60 | 80 |
| ½ MS + 1.0 mg/L IBA | 50 | 60 |
| ½ MS + 1.5 mg/L IBA | 40 | 45 |
| ½ MS + 2.0 mg/L IBA | 30 | 30 |
| ½ MS + 3.0 mg/L IBA | 20 | 20 |

**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

4.10.2 Cost of the year : Tk. 1,20,000

4.10.3 Expenditure of the year : Tk. 1,20,000

4.10.4 Source of fund : GOB
**4.11 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 silvicultural 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 has 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(s)** :
1.7.1 Study leader : M Shahid Ullah, DFO
1.7.2 Associates : Nasrat Begum, SRO, Abdullah- Al- Masud Mazumder, RO and M. R. Islam, FI.
**1.8 Progress** :
1.8.1 Previous years, if any : Up to 2015, raised 158.0 ha experimental plantations (species elimination trials; provenance trials, coppicing trials, spacing trials, mixed planting trials, under planting trials, planting technique, arboretum of 36 species, Ex-situ conservation of different threatened spp , agar and oil palm cultivation etc.) at four Silviculture Research Stations. Maintained those plantations by weeding, cleaning, climber cutting, pruning, etc. Compiled phenological data of 240 indigenous and exotic tree species.
1.8.2 This year :

| Action plan as per annual research programme | Progress |
|---|---|
| a. Maintenance of 55.0 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 55.0 ha previously raised experimental plantations (Oil palm, Agar, ex-situ conservation plots, mixed species trial plantations, bamboo 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 on older plantations. |
| c. Data analysis and reporting. | Compiled data are shown in Table 1, 2, 3 and 4. |

**Table 1. Mean survival, height growth and leaf no of different sal (*Shorea robusta*) planting materials at Charkai Research Station- 2016**

| Year of planting | Treatment | Survival (%) | Height growth (cm) | Collar dia (mm) | Leaf Nos. |
|---|---|---|---|---|---|
| June 2014 | Seed | 100 | 105.62 | 4.33 | 31 |
| | Seedling | 94 | 132.77 | 4.47 | 32 |
| | Stump | 100 | 58.5 | - | 31 |
| June 2015 | Seed | 98 | 80.81 | 2.19 | 12 |
| | Seedling | 98 | 87.80 | 2.46 | 12 |
| | Stump | 98 | 62.50 | - | 11 |

**Table 2. Mean survival and growth performance of oil palm (*Elaeis guineensis)* in different spacing at Charaljani Research station -2016.**

| Planting year | Treatments (Spacing) | Sur. % | Av. Ht. (m) | Dia (cm) | Frond no. | Av. fruit bunch/Tree |
|---|---|---|---|---|---|---|
| June/11 | 5.0m x 5.0m | 79 | 5 | 8.93 | 50 | 19 |
| | 6.0m x 6.0m | 82 | 5.01 | 8.35 | 52 | 19 |
| | 7.0m x 7.0m | 79 | 5.02 | 10.01 | 49 | 19 |
| June/12 | 5.0m x 5.0m | 80 | 4.56 | 5.72 | 41 | 10 |
| | 6.0m x 6.0m | 84 | 4.06 | 5.56 | 44 | 11 |
| | 7.0m x 7.0m | 79 | 4.09 | 5.86 | 44 | 11 |
| June/13 | 5.0m x 5.0m | 68 | 1.3 | 0.84 | 14 | - |
| | 6.0m x 6.0m | 68 | 1.09 | 0.85 | 13 | - |
| | 7.0m x 7.0m | 72 | 1.04 | 0.84 | 13 | - |

**Table 3. Mean survival and growth performance of oil palm (*Elaeis guineensis)* in different spacing at Charkai Research station 2016.**

| Planting year | Treatments (Spacing) | Sur. % | Av. Ht. (m) | Dia(cm) | Frond no. |
|---|---|---|---|---|---|
| June/13 | 5.0 m x 5.0 m | 88 | 1.50 | 40 | 38 |
| | 6.0m x 6.0m | 96 | 1.60 | 42 | 40 |
| | 7.0m x 7.0m | 88 | 1.80 | 44 | 46 |
| June/14 | 5.0 m x 5.0 m | 88 | 1.00 | 14 | 22 |
| | 6.0m x 6.0m | 92 | 1.10 | 16 | 22 |
| | 7.0m x 7.0m | 84 | 1.20 | 16 | 24 |
| June/15 | 5.0 m x 5.0 m | 92 | 0.60 | 12 | 13 |
| | 6.0m x 6.0m | 84 | 0.64 | 12 | 13 |
| | 7.0m x 7.0m | 96 | 0.70 | 14 | 15 |

Remarks: Plantation raised in Keochia during 2011 2012 and 2013 were damaged severely by porcupine, wild boar, grazing and firing for three times.

**Table 4. Survival an`d height growth of agar (*Aquilaria malaccensis*) planted with different spacing at four SRS.**

| Locations | Planting year | Site condition | Spacing | Survival (%) | Height (m) |
|---|---|---|---|---|---|
| Keochia | June,2011 | Plain foot hill | 1.5m x 1.5m | 62 | 4.59 |
| | | | 2.0m x 2.0m | 65 | 4.44 |
| | | | 2.5m x 2.5m | 67 | 3.93 |
| | | | 3.0m x 3.0m | 72 | 4.92 |
| Charaljani | | Plain land | 1.5m x 1.5m | 16 | 2.28 |
| | | | 2.0m x 2.0m | 15 | 2.54 |
| | | | 2.5m x 2.5m | 13 | 2.76 |
| | | | 3.0m x 3.0m | 9 | 2.54 |
| Charaljani | June,2012 | Plain land | 1.5m x 1.5m | 56 | 2.52 |
| | | | 2.0m x 2.0m | 49 | 2.32 |
| | | | 2.5m x 2.5m | 56 | 2.46 |
| | | | 3.0m x 3.0m | 41 | 2.45 |
| Keochia | June,2013 | Moderate slope | 1.5m x 1.5m | 50 | 1.29 |
| | | | 2.0m x 2.0m | 45 | 1.28 |
| | | | 2.5m x 2.5m | 37 | 1.10 |
| | | | 3.0m x 3.0m | 44 | 1.39 |
| Charaljani | | Plain land | 1.5m x 1.5m | 72 | 2.12 |
| | | | 2.0m x 2.0m | 69 | 2.16 |
| | | | 2.5m x 2.5m | 67 | 2.08 |
| | | | 3.0m x 3.0m | 74 | 2.14 |
| Charkai | June,2014 | Plain land | 1.5m x 1.5m | 87 | 1.44 |
| | | | 2.0m x 2.0m | 91 | 1.45 |
| | | | 2.5m x 2.5m | 92 | 1.46 |
| | | | 3.0m x 3.0m | 90 | 1.44 |
| Keochia | | Gentle slope | 1.5m x 1.5m | 65 | 1.04 |
| | | | 2.0m x 2.0m | 78 | 0.96 |
| | | | 2.5m x 2.5m | 62 | 0.97 |
| | | | 3.0m x 3.0m | 46 | 1.03 |
| Charkai | June,2015 | Plain land | 1.5m x 1.5m | 91 | 1.05 |
| | | | 2.0m x 2.0m | 90 | 1.12 |
| | | | 2.5m x 2.5m | 93 | 1.17 |
| | | | 3.0m x 3.0m | 91 | 1.06 |

**1.9** **Achievement(s), if any** : Determined phenological characters 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.

**1.10** **Financial statement** :

1.10.1 Total cost : Tk. 20,00,000

1.10.2 Cost of the year : Tk. 3,50,000

1.10.3 Expenditure of the year : Tk. 3,50,000

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(s)** :

2.7.1 Study leader : Nasrat Begum, SRO.

2.7.2 Associates : M Shahid Ullah, DFO, 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, 30,000 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 kerrii*), 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 *(Adina 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 (*Magnolia 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 :

| Action plan as per annual research programme | Progress |
|---|---|
| a. Collection/purchase of seeds of popular /threatened forest tree species from seed orchards, plantations and natural forests and raising of 30,000 seedlings at HQs and four research stations. | Collected seeds from selected mother trees. Raised 30,000 seedlings of different forest tree species such as mahogany (*Swietenia mahagoni*), raintree (*Samanea saman*), segun (*Tectona grandis*), jarul (*Lagerstroemia speciosa*), arjun (*Terminalia arjuna*), amra (*Spondias pinnata*), sil-koroi *(A. procera*), horitoki *(Terminalia chebula*), kat-badam *(Terminalia catappa*), amloki (*Phyllanthus emblica*), chickrassi *(Chukrassia velutina*), toon (*Toona ciliata*), krishnachura *(Delonix regia*), Kat-badam (*Terminalia catappa* ) teli-garjan (*Dipterocarpus turbinatus*), hybrid |

| | |
|---|---|
| | acacia (*Acacia auriculiformis X A. mangium*), box badam (*Sterculia foetida*), sonalu *(Cassia fistula*), bohera *(Terminalia bellirica*), jalpai **(***Elaeocarpus vraunua***),** gamar (*Gmelina arborea*),bakul *(Mimosops elengi)*, lambu (*Khaya anthotheca)*, civit (*Swintnea floribunda*), dakhijam (*Syzizium grande*) sal (*Shorea robusta*), lohakath (*Xylia xylocarpa*) dholi gargon (*Dipterocarpus alatus)* boilam (*Anisotera glabra*), banderhola 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. Collection of data on seedlings growth, collar diameter, root-shoot ratio of different species. | Collected data on seedlings survival%, height, and collar diameter of different species are shown in Table 1, 2 & 3 |

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

| Sl. No | Scientific name | Germination period | | Germination % | Survival (%) | Av. ht. (cm) | Collar dia (mm) | Age (month) |
|---|---|---|---|---|---|---|---|---|
| | | Start (days) | Complete (days) | | | | | |
| 1 | **Raintree** (*Sammanea saman*) | 5 | 41 | 68 | 61.0 | 9.04 | 3.93 | 3.0 |
| 2 | **Mahogany** (*Swietenia mahagoni*) | 17 | 27 | 66 | 100 | 8.33 | 2.95 | 2.0 |
| 3 | **Bohera** *(Terminalia bellirica )* | 14 | 45 | 99 | 100 | 11.3 | 3.75 | 2.5 |
| 4 | **Teli-garjan** (*Dipterocarpus turbinatus*), | 5 | 27 | 60 | 100 | 6.66 | 2.82 | 1.0 |
| 5 | **Segun** (*Tectona grandis*) | 19 | 64 | 20 | 100 | 6.0 | 3.57 | 2.0 |
| 6 | **Arjun** (*Terminalia arjuna*) | 36 | 20 | 80 | 100 | 7.58 | 4.17 | 2.0 |
| 7 | **Sonalu** ( *Cassia fistula*) | 7 | 43 | 81 | 100 | 7.65 | 2.90 | 2.0 |
| 8 | **Chakua-koroi** *(A.chinensis),* | 6 | 48 | 96 | 100 | 9.33 | 3.84 | 2.4 |
| 9 | **Lohakath** (*Xylia xylocarpa*) | 6 | 11 | 54 | 100 | 4.03 | 2.05 | 1.4 |
| 10 | **Sal** (*Shorea robusta*) | 4 | 30 | 60 | 72 | 9.22 | 1.13 | 2.0 |
| 11 | **Civit** ( *Swintonia floribunda*) | 5 | 8 | 95 | 100 | 10.1 | 2.76 | 1.0 |
| 12 | **Gamar** (*Gmelina arborea*), | 12 | 22 | 81 | 100 | 3.46 | 1.71 | 1 |
| 13 | **Hartoki** (*Terminalia chebula*) | 12/60 | 22 | 70.0 | 100 | 5.24 | 4.97 | 1.5 |
| 14 | **Jarul** (*Lagerstroemia speciosa*) | 20 | 15 | 50 | 35.0 | 26.2 | 3.03 | 6.0 |
| 15 | **Jalpai** (*Elaeocarpus varunua*) | 16 | 22 | 65.0 | 60.0 | 35.4 | 3.89 | 6.0 |
| 16 | **Dakhijam** (Syzizium grande) | 25 | 23 | 83 | 100 | 7.85 | | 1 |
| 17 | **Kat-badam** (*Terminalia catappa* ) | 8 | 25 | 50 | 86.4 | 39.8 | 7.04 | 5.0 |
| 18 | **Hybrid acacia** *(Acacia auriculiformis X A. Mangium)* | 5 | 15 | 85.0 | 97.0 | 64.57 | 6.30 | 5.0 |
| 19 | **Chickrassi** *(Chukrassia velutina)* | 7 | 15 | 70 | 90.0 | 27.6 | 3.06 | 5.0 |
| 20 | **Amra** (*Spondias pinnata*), | | | | | | | |
| 21 | **Kalo-jam** ***(Syzygium cumini),*** | 19 | 10 | 89 | 100 | 3.70 | 1.36 | 1.0 |
| 22 | **Boilam** (*Anisotera glabra*), | 15 | 22 | 79 | 100 | 4.79 | 3.12 | 1.0 |
| 23 | **Dholi gargon** (*Dipterocarpus alatus)* | | | | | | | |
| 24 | **lambu** (*Khaya anthotheca)*, | | | | | | | |
| 25 | **Krishnachura** *(Delonix regia*), | 60 | 45 | 27 | 100 | 4.37 | 4.70 | 2.0 |
| 26 | **Bakul** *(Mimosops elengi)*, | | | | | | | |
| 27 | **Amloki** (*Phyllanthus* | 12/60 | 10/15 | 49 | 100 | 5.24 | 4.97 | 1.5 |
| 28 | **Chapalish** *(Artocarpus chama),* | 5 | 16 | 46 | 100 | 2.45 | 2.17 | 1.0 |
| 29 | **Toon** (*Toona ciliata*), | 8 | 26 | 64 | 100 | - | - | - |
| 30 | **Banderhola** *(Duabanga grandiflora*), | - | - | - | - | - | - | - |

Table 2. Germination trial of Sonalu (Cassia fistula)

| Seed typy | Control | | | Soaked for 6 hrs | | | Soaked for12 hrs | | |
|---|---|---|---|---|---|---|---|---|---|
| | Germination % | Ht.(cm) | Collar dia (mm) | Germination % | Ht.(cm) | Collar dia (mm) | Germination % | Ht.(cm) | Collar dia (mm) |
| Mixed | 55 | 680 | 2.66 | 62 | 6.67 | 2.63 | 64 | 6.44 | 3.94 |
| large | 73 | 5.92 | 2.86 | 76 | 7.65 | 2.90 | 81 | 6.43 | 2.47 |
| Small | 35 | 5.65 | 2.82 | 40 | 5.23 | 2.44 | 38 | 4.94 | 2.26 |

**Table 3. Seedling raising technique of Bohera (*T. bellerica)***

| Treatments | Germination % | Survival % | Height (cm) | Collar dia (mm) |
|---|---|---|---|---|
| control | 70 | 100 | 7.0 | 3.95 |
| Soaked in water for 24hr with coat | 82 | 100 | 10.0 | 4.05 |
| Soaked in water for 24hr without coat | 74 | 100 | 7.5 | 3.65 |
| Soaked in water for 48hr without coat | 80 | 100 | 9.0 | 3.50 |
| Soaked in water for 72hr without coat | 99 | 100 | 11.3 | 3.75 |
| Soaked in water for 96hr without coat | 94 | 100 | 9.16 | 3.28 |
| Soaked in water for 120hr without coat | 87 | 100 | 10.5 | 3.8 |

**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

2.10.2 Cost of the year : Tk. 1,50,000

2.10.3 Expenditure of the year : Tk. 1,50,000

2.10.4 Source of fund : GOB

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

**3 Study** : On-going

3.1 Programme Area : Biodiversity and Conservation.

**3.2 Title of the Study** : Conservation of indigenous/native forest tree species in6different agro-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 agro 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(s)** :

3.7.1 Study leader : Mohammed Shahid Ullah, DFO.

3.7.2 Associates : Nasrat Begum, SRO; Abdullah-Al-Masud Mazumder, RO. And Md. Rabiul Islam, FI.

**3.8 Progress** :

3.8.1 Previous year, if any : Raised 25 ha plantations with more than 80 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, Charaljani, Lawachara and Keochia research stations. | Collected seeds and raised 30,000 seedlings of different indigenous forest tree species at Charkai, Charaljani, 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. Development of water supply facilities Charkai research station's nursery. | Developed drainage system at Charkai research station's nursery. |
| d. Raising of 10.0 hectares plantations at Charkai, Charaljani, Lawachara and Keochia research stations. | Raised of 10.0 hectares plantations with 69 species at Charkai, Lawachara and Keochia research stations (Table-1) |
| e. Data analysis and reporting. | Collected data on seedlings survival%, height, and collar diameter of different species are shown in Table- 2,3, 4 & 5. |

**Table-1:** Area of plantations and name of species conserved/ planted at three SRS in 2015-2016

| Locations | Area of plantations | No. of Species | Name of species |
|---|---|---|---|
| Keochia, Chittagong | 3 ha | 20 | Kalo jam, golap jam, kanaidinga, neem, kumbi, bohera, sal, garjan, sonalu, champa, konnyari, minjiri, lohakath, tentul, arjun, agar, box badam, bon amra, khoier, civit, chikrashi, chapalish dhakijam chatian borta, amloki. |
| Lawachara, Moulavi bazar | 2.5 ha. | 34 | kalo jam, chapalish, mahogani, borta, golap jam, bonkao, chikrashi, arjun, banshpata, bokain, jambura, , gamar, lohakath, dharmara, shida jarul, kanta jarul, mini jarul, udal, jora badam, amloki, bohera, simul, dakroom, moskon, kanchyan, pitraj, kalo menda, chatian, civit, horina, kerenja, agar, dayphol garjon, batna, segun. |
| Charkai, Dinajpur | 5 ha. | 34 | Dhaki jam, kadam, pitali, pitraj, kanaidinga, neem, agar, jarul, bohera, titgila, kala koroi, Teli garjan, jolpai, khoier, khoia babla, jhau, arjun, bhela, bakul, tentul, deshi gab, chesra koroi, kanjal bhadi, tomal, ataphol, mahogany, silkoroi, debdaru, bel. utum, gandigazary, deb kanchan, sal. |

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

| Sl. No. | Species name | Survival | Height (cm) | Dia (cm) |
|---|---|---|---|---|
| 1 | Sal (*Shorea robusta*), | 73 | 43 | 4.40 |
| 2 | Putijam (*Syzygium fruticosum)* | 97 | 49 | 4.71 |
| 3 | Dhakijam (*Syzygium grande),* | 73 | 61 | 6.40 |
| 4 | Golapjam (*Syzygium jambos)* | 86 | 53 | 5.97 |
| 5 | Dharmara (*Stereospermum personatum*) | 91 | 35 | 6.59 |
| 6 | Kalojam (*Syzygium cumini)* | 71 | 51 | 5.04 |
| 7 | Putrongibi (*Putranjiva roxbourghii)* | 81 | 39 | 4.06 |
| 8 | Telsur (*Hopea odorata)* | 96 | 60 | 6.8 |
| 9 | Toon (*Toona ciliata)* | 10 | 32 | 6.03 |
| 10 | Simul (*Bombax ceiba)* | 88 | 60 | 5.99 |
| 11 | Kumbi (C*areya arborea)* | 94 | 38 | 4.68 |
| 12 | Bakul (*Mimosops elengi)* | 84 | 66 | 6.05 |
| 13 | Lohakath *(Xylia xylocarpa*), | 91 | 49 | 5.41 |
| 14 | Garjan (*Dipterocarpus turbinatus*) | 84 | 77 | 7.98 |
| 15 | Sonalu (*Cassia fistula)* | 90 | 44 | 4.41 |
| 16 | Chikrassi (*Chukrassia velutina)* | 92 | 81 | 6.24 |
| 17 | Kathal (*Artocarpus heterophyllus)* | 25 | 42 | 5.70 |
| 18 | Kalo koroi( *Albizia lebbeck)* | 86 | 64 | 5.9 |
| 19 | Pitraj (*Aphanamixis polystachya)* | 69 | 40 | 5.39 |
| 20 | Sil koroi (*A. procera*), | 82 | 64 | 5.92 |
| 21 | Amloki (*Phyllanthus emblica)* | 96 | 52 | 5.61 |
| 22 | Raintree*(Samanea saman*) | 75 | 58 | 5.77 |
| 23 | Ten tul (*Terminalia indica)* | 89 | 48 | 4.6 |
| 24 | Chatian (*Alstonia scholaris)* | 96 | 90 | 8.54 |
| 25 | Am (*Mangifera indica)* | 70 | 54 | 6.79 |
| 26 | Hijal *(Barringtonia acutangula)* | 89 | 28 | 4.95 |
| 27 | Agar (*Aquilaria malaccensis*) | 92 | 66 | 5.22 |
| 28 | Kata golapjam | 56 | 36 | 4.59 |
| 29 | Boilam (*Anisoptera scaphula)* | 42 | 61 | 7.27 |
| 30 | Chapalish (*Artocarpus chama)* | 48 | 46 | 6.41 |
| 31 | Civit (*Swintonia floribunda*) | 67 | 79 | 6.79 |
| 32 | Minjiri (*Senna siamea)* | 83 | 79 | 9.74 |
| 33 | Kanchan (*Bauhinia racemosa)* | - | - | - |
| 34 | Haritaki (*Terminalia chebula)* | 87 | 61 | 6.72 |
| 35 | Mahua (*Madhuca longifolia)* | 67 | 33 | 5.4 |
| 36 | Mahogani (*Swietenia mahogoni)* | 83 | 62 | 7.04 |
| 37 | Radachura (*Caesalpinia pulcherrima)* | 73 | 52 | 7.90 |
| 38 | Champa (*Michelia champaca),* | 75 | 58 | 6.86 |
| 39 | Chalta (*Dillenia indica)* | 54 | 38 | 6.03 |
| 40 | Beron (*Crateva magna)* | 86 | 58 | 3.37 |
| 41 | Kajubadam (*Anacardium occidentale)* | 57 | 35 | 6.36 |
| 42 | Udal (*Firmiana colorata*) | 36 | 12 | 3.79 |
| 43 | Box badam (*Sterculia foetida)* | - | - | - |
| 44 | Bon amra ( *Spondias pinnata)* | 39 | 17 | 3.61 |
| 45 | Deshi neem (*Azadirachta indica* | 24 | 66 | 4.30 |

**Table 3. Mean survival and growth of seedlings of 58 forest tree species at Lawachara Research Station (plantation-2014-2015).**

| Sl. No. | Species name | Survival | Height (cm) | Dia (cm) |
|---|---|---|---|---|
| 1 | Kathal (*Artocarpus heterophyllus)* | 69 | 62 | 5.75 |
| 2 | Minjiri (*Senna siamea)* | 72 | 51 | 7.22 |
| 3 | Painna jam (*Syzugium formosum)* | 68 | 94 | 5.98 |
| 4 | Krishnochura (*Delonix rejia)* | 59 | 178 | 8.11 |
| 5 | Sheora (*Streblus asper)* | 65 | 46 | 4.90 |
| 6 | Garjan (*Depterocarpus sp.)* | 80 | 46 | 6.47 |
| 7 | Pitali (*Mallotas nidiflorus)* | 68 | 49 | 6.21 |
| 8 | Tentul (*Terminalia indica*) | 67 | 56 | 6.67 |
| 9 | Pitraj (*Aphanamixis polystachya)* | 63 | 78 | 6.52 |
| 10 | Bonjam (*Syzygium fruticosum)* | 63 | 78 | 7.51 |
| 11 | Udal (*Firmiana colorata*) | 65 | 48 | 8.33 |
| 12 | Mendha *(Litsea monopetala)* | 60 | 40 | 8.74 |
| 13 | Chapalish (*Artocarpus chama)* | 65 | 69 | 6.17 |
| 14 | Borta (*Artocarpus lacucha)* | 67 | 53 | 7.62 |
| 15 | Bon simul (*Bombax insigne)* | 64 | 83 | 7.95 |
| 16 | Bokain (*Melia azederach)* | 65 | 76 | 7.90 |
| 17 | Dakrum (*Fernandoa adenophylla)* | 69 | 49 | 6.88 |
| 18 | Putijam (*Syzygium fruticosum)* | 69 | 46 | 5.26 |
| 19 | Agar (*Aquilaria malaccensis*) | 73 | 80 | 5.25 |
| 20 | Mahogani (*Swietenia mahogoni)* | 64 | 63 | 6.37 |
| 21 | Amloki (*Phyllanthus emblica)* | 73 | 75 | 7.61 |
| 22 | Lohakath *(Xylia xylocarpa)* | 69 | 61 | 6.54 |
| 23 | Sil koroi (*Albizzia procera*) | 68 | 96 | 6.54 |
| 24 | Dhakijam (*S. grande)* | 61 | 78 | 5.33 |
| 25 | Arjun (*Terminalia arjuna)* | 61 | 76 | 8.12 |
| 26 | Kanak (*Schima wallichii)* | 63 | 101 | 6.04 |
| 27 | Awal (*Vitex pinnata)* | 67 | 80 | 8.60 |
| 28 | Deshi jam *(Syzygium cumini)* | 64 | 85 | 7.17 |
| 29 | Bonkao ( *Garcinia cowa*) | 63 | 83 | 6.81 |
| 30 | Mini jarul (*Lagerstoemia indica)* | 64 | 79 | 5.94 |
| 31 | Gamar (*Gmelina arborea*) | 40 | 58 | 5.73 |
| 32 | Raintree (*Albizia saman)* | 73 | 160 | 12.8 |
| 33 | Lukluki (*Flacourtia jangomas)* | 76 | 34 | 3.75 |
| 34 | Boilam(*Anisoptera scaphula)* | 75 | 100 | 7.29 |
| 35 | Khoer (*Acacia catechu)* | 71 | 33 | 3.43 |
| 36 | Kalo jam ( *Syzygium cumini)* | 73 | 73 | 6.86 |
| 37 | Kanta jarul (*Lagerstoemia speciosa)* | 78 | 74 | 7.17 |
| 38 | Chatian (*Alstonia scholaris)* | 72 | 71 | 7.17 |
| 39 | Horina (*Vitex peduncularis)* | 72 | 52 | 5.01 |
| 40 | Segun (*Tectona grandis)* | 73 | 54 | 6.92 |
| 41 | Dharmara (*Stereospermum personatum*) | 75 | 53 | 6.72 |
| 42 | Peyara (*Pisidium guajava)* | 73 | 81 | 7.33 |
| 43 | Kanaidingha (*Oroxylum indicum)* | 72 | 70 | 4.11 |
| 44 | Amra (*Spondias pinnata)* | 73 | 52 | 4.43 |
| 45 | Golapjam (*Syzygium jambos)* | 73 | 81 | 7.33 |
| 46 | Kanchan (*Bauhinia racemosa)* | 72 | 70 | 4.11 |
| 47 | Raktan (*Lophopetalum fimbriatum)* | 73 | 52 | 4.43 |
| 48 | Motor koroi *(A. lucida)* | 77 | 88 | 6.90 |
| 49 | Moskon (*Pterospermum acerifolium)* | 73 | 94 | 4.48 |
| 50 | Kannayri (*Gardenia coronaria)* | 80 | 71 | 5.11 |
| 51 | Bohera (*Termanalia bellerica*) | 77 | 99 | 5.56 |
| 52 | Civit (*Swintonia floribunda*) | 77 | 44 | 4.94 |
| 53 | Badhi (*Lannea coromandalica)* | 76 | 50 | 5.37 |
| 54 | Jambura (*Citrus maxima)* | 79 | 54 | 3.66 |
| 55 | Mandar (*Erythrina variegate)* | 77 | 148 | 6.38 |

**Table 4. Mean survival and growth of seedlings of 26 forest tree species at Charaljani Research Station (plantation-2014-2015).**

| Sl. No. | Species name | Survival% | Height (cm) |
|---|---|---|---|
| 1 | Neem (*Azadirachta indica)* | 91 | 79.55 |
| 2 | Sada karai (*Albizia procera)* | 88 | 86.81 |
| 3 | Raintree *(Albizia saman*) | 75 | 89.42 |
| 4 | Sida Jarul (*Lagerstroemia parviflora*) | 84 | 78.21 |
| 5 | Amloki (*Phyllanthus emblica)* | 70 | 77.94 |
| 6 | Rakta chandan (*Pterocarpus indicus)* | 88 | 69.11 |
| 7 | Jhau (*Tamarix ericoides)* | 82 | 58.5 |
| 8 | Chikrassi (*Chukrassia velutina)* | 84 | 79.94 |
| 9 | Radhachura (*Caesalpinia pulcherrima)* | 77 | 73.8 |
| 10 | Kalo koroi (*Albezia lebbek)* | 85 | 81.74 |
| 11 | Bokain *(Melia azederach)* | 87 | 82.46 |
| 12 | Rang *(Morinda angustifolia)* | 68 | 65.1 |
| 13 | Kalo jam *(Syzygium cumini)* | 80 | 70.13 |
| 14 | Sal (*Shorea robusta*) | 68 | 49.82 |
| 15 | Vutum (*Hymenodictylon orixensis)* | 62 | 45.38 |
| 16 | Arjun (*Terminalia arjuna)* | 82 | 84.88 |
| 17 | Bakul (*Mimosops elengi)* | 64 | 46.1 |
| 18 | Dhaki jam (*Syzygium grande),* | 76 | 74.02 |
| 19 | Kannayri (*Gardenia coronaria)* | 81 | 89.97 |
| 20 | Doli garjan (*Dipterocarpus alatus*), | 81 | 77.65 |
| 21 | Mahua (*Madhuca longifolia)* | 49 | 52.66 |
| 22 | Teli garjan (*Dipterocarpus turbinatus*) | 87 | 79.86 |
| 23 | Debdaru (*Polyalthia longifolia)* | 69 | 52.74 |
| 24 | Narikeli (*Pterygota alata)* | 69 | 64.56 |
| 25 | Agar (*Aquilaria malaccensis*) | 79 | 54.07 |
| 26 | Nagessar *Mesua nagessoriam* | 83 | 63.61 |

**Table 5. Mean survival and growth of seedlings of 45 forest tree species at Charkai Research Station (plantation-2014-2015).**

| Sl. No. | Species name | Survival | Height(cm) | Dia (cm) |
|---|---|---|---|---|
| 1 | Rong (*Morinda angustifolia)* | 83 | 59 | 3.95 |
| 2 | Kadam (*Neolamarckia cadamba)* | 88 | 73 | 7.18 |
| 3 | Jam (*Syzygium sp.)* | 88 | 58 | 11.11 |
| 4 | Khudijam (*Syzygium cymosum)* | 89 | 68 | - |
| 5 | Agar (*Aquilaria malaccensis*) | 88 | 85 | 5.73 |
| 6 | Kumvi (*Careya arborea )* | 87 | 58 | 4.31 |
| 7 | Pitraj (*Aphanamixis polystachya)* | 87 | 67 | 4.92 |
| 8 | Jiga (*Lannea coromandelica)* | 83 | 62 | 4.49 |
| 9 | Dhaki jam (*Syzygium grande)* | 69 | 53 | 3.35 |
| 10 | Kanjol badhi (*Bischofia javanica)* | 92 | 70 | 5.22 |
| 11 | Rakto chandan (*Pterocarpus indicus)* | 86 | 53 | 4.24 |
| 12 | Amloki (*Phyllanthus emblica)* | 91 | 56 | 4.92 |
| 13 | Arjun (*Terminalia arjuna)* | 97 | 72 | 7.28 |
| 14 | Kanaidinga (*Oroxylum indicum*) | 84 | 64 | 4.76 |
| 15 | Jhau (*Tamarix ericoides)* | 86 | 46 | 3.74 |
| 16 | Tentul (*Terminalia indica)* | 92 | 67 | 4.82 |
| 17 | Titgila (*Entada rheedii)* | 83 | 64 | 4.96 |
| 18 | Bohera (*Terminalia bellirica)* | 88 | 62 | 4.61 |
| 19 | Vutum (*Hymenodictylon orixensis)* | 82 | 56 | 4.43 |
| 20 | Kalo koroi (*Aibizzia. lebbeck)* | 87 | 64 | 5.34 |
| 21 | Chikrassi (*Chukrassia velutina)* | 83 | 66 | 5.35 |
| 22 | Neem (*Azadirachta indica)* | 77 | 56 | 3.99 |
| 23 | Sida jarul (*Lagerstroemia parviflora*) | 86 | 64 | 4.59 |
| 24 | Bhela (*Semecarpus subpenduriformis)* | 97 | 75 | 6.31 |
| 25 | Jolpai (*Elaeocarpus floribondus)* | 84 | 64 | 5.55 |
| 26 | Box badam (*Sterculia foetida)* | 92 | 90 | 6.1 |
| 27 | Haldu (*Haldina cordifolia)* | 86 | 59 | 4.22 |
| 28 | Sil koroi (*A. procera*), | 88 | 75 | 6.57 |
| 29 | Ata (*Annona squamosa)* | 75 | 59 | 4.25 |
| 30 | Pitali (*Mallotas nidiflorus)* | 86 | 60 | 4.90 |
| 31 | Kannayri (*Gardenia coronaria)* | 88 | 64 | 5.62 |
| 32 | Simul (*Bombax ceiba)* | 88 | 61 | 5.03 |
| 33 | Gamar (*Gmelina arborea*) | 88 | 69 | 5.59 |
| 34 | Bokain (*Melia azederach)* | 91 | 65 | 4.96 |
| 35 | Bakul (*Mimosops elengi)* | 100 | 60 | 4.27 |
| 36 | Sissoo (*Dalbergia sissoo)* | 91 | 71 | 5.42 |
| 37 | Ban Amra (*Spondias pinnata)* | 91 | 73 | 6.15 |
| 38 | Deshi gab (*Diospyros malabarica)* | 97 | 59 | 5.14 |
| 39 | Motor koroi *( Albizzia lucida)* | 91 | 61 | 3.75 |
| 40 | Kalo jam *(Syzygium cumini)* | 91 | 62 | 4.33 |
| 41 | Chatian (*Alstonia scholaris)* | 88 | 62 | 5.06 |
| 42 | Udal (*Firmiana colorata*) | 91 | 53 | 4.18 |
| 43 | Sida jarul (*Lagerstroemia parviflora*) | 86 | 63 | 6.70 |
| 44 | Bohera (*Terminalia bellirica)* | 88 | 60 | 5.0 |
| 45 | Hijal *(Barringtonia acutangula)* | 75 | 57 | 4.55 |
| 46 | Tamal (*Diospyros Montana)* | 91 | 63 | 3.75 |
| 47 | Palash *(Butea monosperma*) | 86 | 65 | 5.03 |

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

**3.10 Financial statement** :

3.10.1 Total cost : Tk. 30,00,000

3.10.2 Cost of the year : Tk. 6,50,000

3.10.3 Expenditure of the year : Tk. 6,50,000

3.10.4 Source of fund : GOB

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

**4 Study** : **On going**

4.1 Programme Area : Plantation Techniques 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

**4.7 Personnel(s)** :

4.7.1 Study leader : Mohammed Shahid Ullah, DFO.

4.7.2 Associates : Nasrat Begum, SRO; Abdullah-Al-Masud Mazumder, RO. And Md. Rabiul Islam, FI.

**4.8 Progress** :

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

4.8.2 This year :

| Action plan as per annual research programme | Progress |
|---|---|
| a. Collection/purchase of seeds and raising 6000 seedlings | Collected seeds and raised 6000 seedlings. |
| b. Maintenance of 4 ha last year experimental plantation. | Maintained 4 ha last year experimental plantations. |
| c. Raising trial plantation over an area of 2.0 ha (0.5 ha in each station) at four Silviculture Research Stations. | Raised trial plantation over an area of 2.0 ha (0.5 ha in each station) at four (Charkai, Charaljani, Lawachara and Keochia) Silviculture Research Stations. |
| d. Data collection and analysis | Collected data on survival and height growth (Table-1 & 2) |

**Table:-01: Survival and height growth of lambu (*Khaya anthothica*) two year (2014 - 2016) plantation at four SRS.**

| Location | Site condition | Spacing (m) | Survival (%) | Height (cm) | Dia(mm) |
|---|---|---|---|---|---|
| Charaljani 2014 | Plain land | 2.00 × 2.00 | 95. | 67.67 | - |
| | | 2.25 × 2.25 | 94 | 68.25 | - |
| | | 2.50 × 2.50 | 95 | 67.96 | - |

| | | | | | |
|---|---|---|---|---|---|
| Keochia 2014 | Hill slope | 2.0 × 2.0 (m) | 89 | 43 | 5.35 |
| | | 2.25 × 2.25 (m) | 89 | 42 | 5.49 |
| | | 2.5 × 2.5 (m) | 92 | 44 | 5.78 |
| Charkai 2014 | Plain land | 1.5 x 1.5 (m) | 88 | 97.77 | 5.98 |
| | | 2.0 × 2.0 (m) | 92 | 98.31 | 6.87 |
| | | 2.50 × 2.50 (m) | 89 | 98.1 | 6.79 |
| | | 3.00 × 3.00 (m) | 88 | 94.95 | 6.8 |
| Lawachara 14 | Plain land | 2.0 × 2.0 (m) | 68 | 150.60 | 22.82 |
| | | 2.25 × 2.25 (m) | 59 | 137.89 | 22.64 |
| | | 2.5 × 2.5 (m) | 61 | 136.56 | 23.45 |

**Table:-2: Survival and height growth of lambu (*Khaya anthothica*) one year (2015 -2016) plantation at four SRS.**

| Location | Site condition | Spacing (m) | Survival (%) | Height (cm) | Dia(cm) |
|---|---|---|---|---|---|
| Charaljani 2015 | Plain land | 2.00 × 2.00 | 88 | 56.38 | - |
| | | 2.25 × 2.25 | 90 | 41.00 | - |
| | | 2.50 × 2.50 | 93 | 41.41 | - |
| Charkai 2015 | Plain land | 1.5 x 1.5 (m) | 89 | 76.24 | 4.89 |
| | | 2.0 × 2.0 (m) | 90 | 78.93 | 4.79 |
| | | 2.50 × 2.50 (m) | 91 | 78.06 | 3.96 |
| | | 3.00 × 3.00 (m) | 90 | 78.73 | 4.86 |
| Keochia 2015 | Plain hill foot | 2.0 × 2.0 (m) | 88 | 45.00 | 7.56 |
| | | 2.25 × 2.25 (m) | 94 | 46.00 | 7.10 |
| | | 2.5 × 2.5 (m) | 95 | 43.00 | 7.82 |
| Lawachara | High hill slope | 2.0 × 2.0 (m) | D | - | - |
| | | 2.25 × 2.25 (m) | D | - | - |
| | | 2.5 × 2.5 (m) | D | - | - |

**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

4.10.2 Cost of the year : Tk. 1,20,000

4.10.3 Expenditure of the year : Tk. 1,20,000

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 Techniques 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 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 frodosa, 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(s)** :

5.7.1 Study leader : Nasrat Begum, SRO.

5.7.2 Associates : Abdullah-Al-Masud Mazumder, RO and M. R. Islam, FI.

**5.8 Progress** :

5.8.1 Previous year**,** if any :

5.8.2 This year :

| Activities for the year | Progress |
|---|---|
| a. Collection of seeds and raising 4000 seedlings of sal, sada koroi, kalo koroi, neem and garjan at Charkai research station. | a.Collected seeds and raised 4000 seedlings of sal, sada koroi, kalo koroi, neem and garjan at Charkai research station. |
| b. Collection of seed and raising 600 seedlings of jali bet and 600 babla for live-fence around the boundary of experimental plantation at Charkai research station. | b.Collected seed and raised 600 seedlings of jali bet and 600 babla for live-fence around the boundary of experimental plantation at Charkai research station. |
| c Maintenance of seedlings in the nursery through weeding, watering, sorting, rearrangement, etc. | c Maintained seedlings of babla and jail bet in the nursery through weeding, watering, sorting, rearrangement, etc. |
| d. Planting 1000 seedlings of jali bet and babla on boundary of experimental plantation at Charkai research station. | d. Planted 1000 seedlings of jali bet and babla on boundary of experimental plantation at Charkai research station. |
| e. Collection of data on seed germination, survival, height and collar dia. of the seedlings in the nursery. | f. Collected data on seed germination, survival, height and collar dia. of the seedlings in the nursery. |

**5.9 Achievement(s), if any** : **New study**

**5.10 Financial statement** :

5.10.1 Total cost : Tk. 5,00,000

5.10.2 Cost of the year : Tk. 50,000

5.10.3 Expenditure of the year : Tk. 50,000

5.10.4 Source of fund : GOB

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

**6 Study** : **New**

6.1 Programme Area : Biodiversity and Conservation

**6.2 Title of the Study** : Effect of betel leaf cultivation by The Khashia community on the vegetation and soil of Lawachara Forest

**6.3 Justification (For new study):** 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 Khashia 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(s)** :

6.7.1 Study leader : Abdullah-Al-Masud Mazumdar, RO.

6.7.2 Associates : Mohammed Shahid Ullah, DFO. Nasrat Begum, SRO. Md. Rabiul Islam, FI.

**6.8 Progress** :

6.8.1 Previous year if any :

6.8.2 This year :

| **Activities for the year** | Progress |
|---|---|
| a. Collection of baseline information. | a. Collected of baseline information. |
| b. Organize an awareness meeting with the Khasia community | b. Organized an awareness meeting with the Khasia community |
| c. Site selection and field layout. | c. Site selected and field layout completed. |
| c. Maintenance of previously raised 4.75 ha rubber plantation (3 times) at Dantmara Rubber Estate, Hyanko. | c. Maintained 4.75 ha previously raised rubber plantation by weeding and fertilizing at Dantmara Rubber Estate, Hyankoo SOC. |
| d. Establishment of demonstration plots. | d. Established demonstration plots. |
| e. Determination of soil loss | e. Processing. |

**6.9 Achievement(s), if any** : New study.

**6.10 Financial statement** :

6.10.1 Total cost : Tk. 6,00,000

6.10.2 Cost of the year : -

6.10.3 Expenditure of the year : Tk. 1,02,000

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.

## Soil Science Division

**1 Study** : On-going

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 Objective(s)** :

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 Personnel(s)** :

1.7.1 Study leader Md. Motiar Rahman, Senior Research Officer

1.7.2 Associates : Dr. Mohammed Mohiuddin, Divisional Officer

**1.8 Progress** :

1.8.1 Previous years, (2014-2015) : Secondary soil and compost samples were analyzed and recorded. One hudred forty four mature rubber trees in Dantmara rubber estates were selected for applying different treatments (compost and NPK fertilizers dose) on latex yield and compost were applied in new rubber plantation.

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 and completed. Ten new heaps were made for composting of litter falls |
| 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, 2015 to June, 2016 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(s), if any** : 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

1.10.2 Cost of the year : Tk. 2,03,820

1.10.3 Expenditure of the year : Tk. 2,01,420

1.10.4 Source of fund : GOB

**1.11 Beneficiaries** : BFIDC and private rubber planters

**Table 1:** Initial soil nutrient status of the experimental sites at Dantmara Rubber Estate, Fatikchari, Chittagong

| Soil depth (cm) | pH | OC | N | K | Ca | Mg | P | S | Mn | Zn | B | Cu | Fe |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | % | | meq/100gm | | | µg/gm | | | | | | |
| 0-15 | 4.5 | 1.47 | 0.10 | 0.12 | 1.78 | 0.16 | 3.75 | 7.10 | 2.1 | 0.6 | 0.3 | 0.8 | 14.5 |
| 15-30 | 4.4 | 1.12 | 0.08 | 0.09 | 0.67 | 0.06 | 3.0 | 5.75 | 0.9 | 0.9 | 0.4 | 2.0 | 23.4 |
| 30-50 | 4.5 | 0.86 | 0.05 | 0.08 | 0.54 | 0.06 | 5.35 | 4.45 | 0.1 | 0.5 | 0.5 | 0.1 | 10.6 |

**Table 2:** Nutrient status of rubber leaf litter compost under different treatments

| Treatment | N | P | K | S | Ca | Mg | B | Cu | Fe | Mn | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | | | | | | ppm | | | | |
| $T_1$ | 1.88 | 0.05 | 0.14 | 0.05 | 0.84 | 0.54 | 143.0 | 8.70 | 1955 | 238 | 27.83 |
| $T_2$ | 1.83 | 0.06 | 0.10 | 0.01 | 0.84 | 0.60 | 101.2 | 7.58 | 1886 | 251 | 28.08 |
| $T_3$ | 1.61 | 0.22 | 0.23 | 0.01 | 0.85 | 0.59 | 137.4 | 11.22 | 2032 | 231 | 26.92 |
| $T_4$ | 1.99 | 0.09 | 0.16 | 0.01 | 0.74 | 0.60 | 174.0 | 16.38 | 2063 | 289 | 25.83 |

$T_1$ = Litter fall & weeds (110 kg per pit)
$T_2$ = Litter fall & weeds + cowdung (110 kg + 30 kg per pit)
$T_3$ = Litter fall & weeds + PKS fertilizers (110 kg + 10 kg per pit)
$T_4$ = Litter fall & weeds + rubber effluent (110 kg + 50 litre per pit)

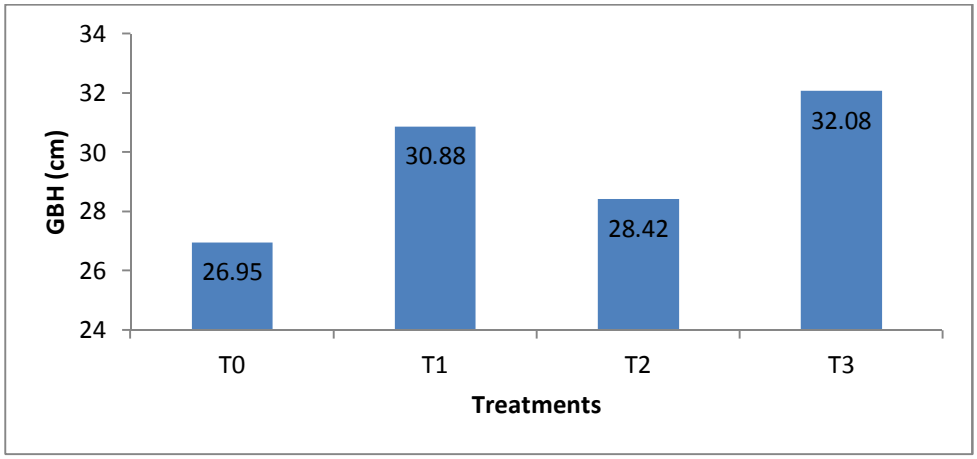



**Fig. 1:** Average girth at breast height (GBH) of rubber plantation in different cover and inter Crops (expt. 1)

$T_0$: 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

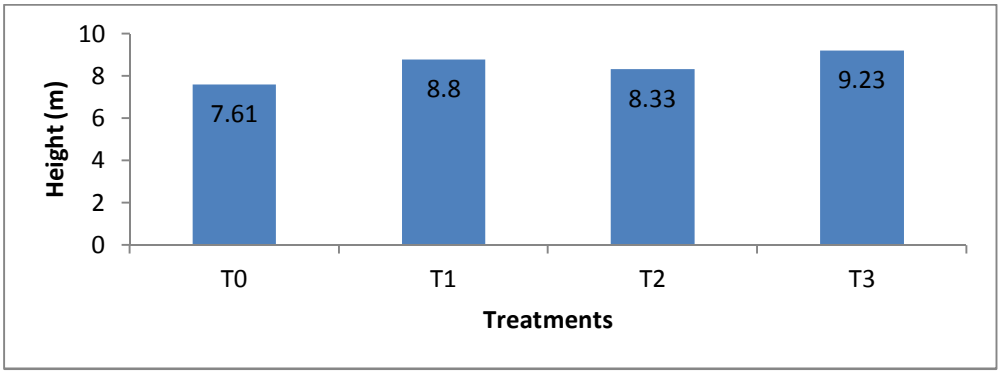



**Fig. 2:** Average height (m) of rubber plantation in different cover and inter crops (expt. 1)

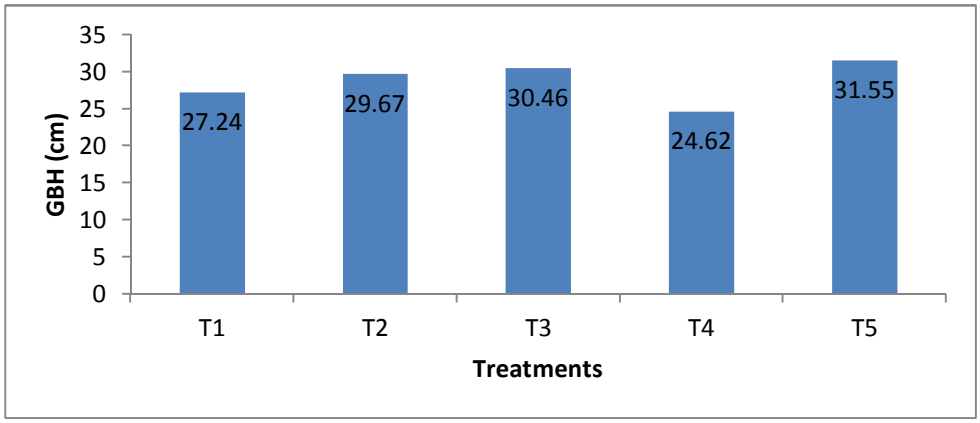



**Fig. 3:** Average girth at breast height (GBH) of rubber plantation in different treatments(expt. 2)

$T_1$: 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)

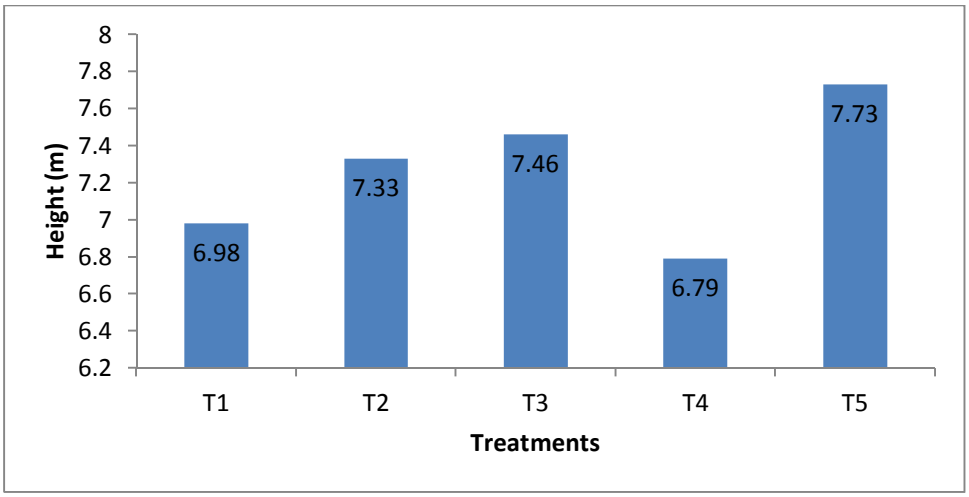



**Fig. 4:** Average height (m) of rubber plantation in different treatments (expt. 2)

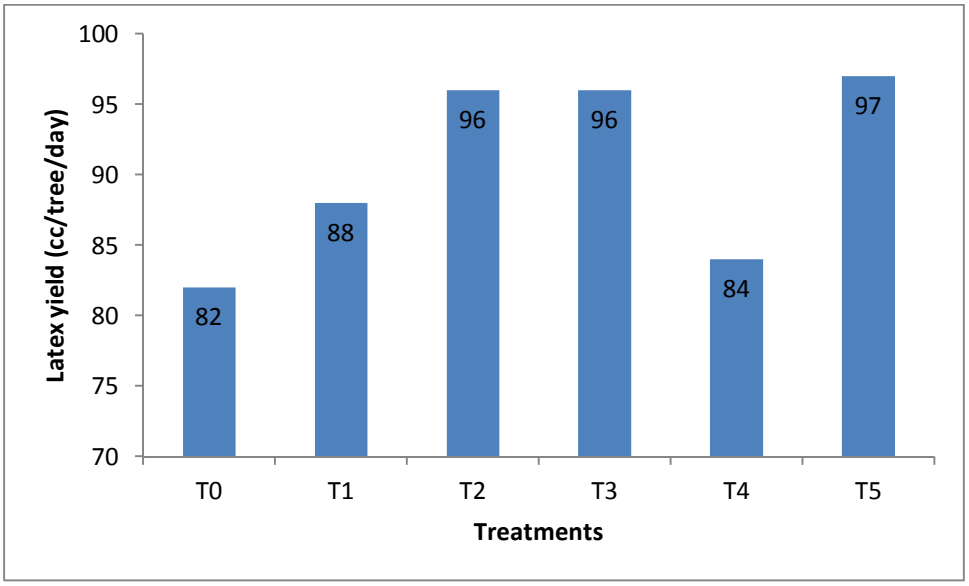



**Fig. 5:** Average latex yield (cc/tree/day) of rubber plantation in different treatments (expt. 3)

$T_0$: 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 Objective(s)** :

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 : 2010-2011

2.6.2 Completion year : 2016-17

**2.7 Personnel(s)** :

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

2.7.2 Associates : Dr. Mohammed Mohiuddin, Divisional Officer

**2.8 Progress** :

2.8.1 Previous years, if any (2014-2015)**:** Organic carbon content of 39 (thirty nine) species (12 mangrove, 13 forest and 14 bamboo 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 2 forest species will be collected at different forest areas for determination of carbon content | a. Root, stem, branch, twig and leaf samples of raj koroi forest tree species from different locations of Pirojpur (Bhandaria, Kawkhali, Mathbaria and Zianagar) & Jhalakathi (Kanthalia and Rajapur) districts 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(s), if any** : Cabon content of twenty five forest tree species were assessed for prepararion of data bank.

**2.10 Financial statement** :

2.10.1 Total cost : Tk. 6,00,000

2.10.2 Cost of the year : Tk. 1,12,620

2.10.3 Expenditure of the year : Tk. 1,12,620

2.10.4 Source of fund : GOB

**2.11 Beneficiaries** : FD, NGO and academician

**Table 1:** Average carbon content (%) of rajkoroi tree species from different locations of Pirojpur and Jhalakathi districts

| **Location** | **Age group (Years)** | **Carbon content (%)** | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Leaf** | **Twigs** | **Branch** | **Stem** | **Root** | **Mean** |
| Kanua, Bhandaria, Pirojpur | 1-5 | 52.16 | 53.51 | 54.62 | 54.65 | 55.85 | 54.16 |
| Telikhali, Zianagar, Pirojpur | 6-10 | 54.84 | 54.62 | 56.76 | 55.86 | 55.98 | 55.61 |
| Bhagirathpur, Mathbaria, Pirojpur | 11-15 | 54.67 | 54.42 | 56.63 | 57.30 | 56.84 | 55.97 |
| Shenerhat, Kawkhali, Pirojpur | 16-20 | 53.30 | 53.83 | 56.57 | 57.46 | 56.07 | 55.45 |
| Baghari, Rajapur, Jhalokathi | 21-25 | 54.96 | 53.94 | 56.75 | 56.83 | 55.25 | 55.55 |
| Binapani, Kathalia, Jhalokathi | 26-30 | 53.47 | 54.55 | 56.72 | 56.35 | 55.66 | 55.35 |
| **Mean** | | **53.90** | **54.15** | **56.34** | **56.41** | **55.94** | **55.35** |

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

| Location | Bulk density (g/cm3) | | Organic carbon (%) | | Total carbon (t/ha.) | |
|---|---|---|---|---|---|---|
| | 0-15 | 15-30 | 0-15 | 15-30 | 0-15 | 15-30 |
| Kanua, Bhandaria, Pirojpur | 1.35 | 1.40 | 0.97 | 0.71 | 19.64 | 14.91 |
| Telikhali, Zianagar, Pirojpur | 1.38 | 1.42 | 1.02 | 0.84 | 21.11 | 17.89 |
| Bhagirathpur, Mathbaria, Pirojpur | 1.36 | 1.37 | 1.46 | 0.86 | 29.78 | 17.67 |
| Shenerhat, Kawkhali, Pirojpur | 1.35 | 1.38 | 1.25 | 0.98 | 25.31 | 20.29 |
| Baghari, Rajapur, Jhalokathi | 1.36 | 1.51 | 1.46 | 1.01 | 29.78 | 22.88 |
| Binapani, Kathalia, Jhalokathi | 1.39 | 1.48 | 1.30 | 0.98 | 27.11 | 21.76 |

**3 Study** : On-going

3.1 Programme Area : Soil conservation and watershed management

**3.2 Title of the Study** : Effect of using preservative treated bamboo materials on soil properties and production of betel leaf in betel leaf cultivation

**3.3 Justification** : The deep green heart shaped leaves of betel vine are known as *Paan* in Bangladesh. The scientific name of betel vine is *Piper betel* L. and it belongs to the family Piperaceae, i.e. the Black Pepper family. The most probable place of origin of betel vine is Malaysis. In spite of its alienness, the plant is much more popular in Bangladesh than in any other country of the world since the antiquity. The vine is a dioeciously (male and female plants are different) shade loving perennial root climber. It grows best under the shaded, tropical forest ecological conditions with a rainfall of about 2250-4750 mm, relative humidity and temperature ranging from 40-80% and 15-40°C respectively. A well-drained fertile sandy or sandy loam or sandy clay soil with pH range of 5.6-8.2 is considered suitable for its cultivation. The vine is raised by vegetative propagation from the cuttings under partially shaded and humid environment inside the *Boroj*, which is a small hut like structure of approximately 2 m in height and 0.02 ha in area. It is constructed with the locally available materials like bamboo stems, jute sticks, paddy straw & petioles and leaves of banana etc. wherein the vines are grown on elevated beds imitating the natural ecological conditions suitable to the crop. Bamboos of different sizes are generally used for fencing and poles in betel leaf farms. Bamboo sticks are used as climber for betel leaf vine. These bamboo materials have very short service life because there are being used without having any preservative treatment. After treatment, the service life of the materials can be increased by four to five times. To increase the service life of bamboo sticks used in the betel leaf farms are treated by soaking methods using water borne preservatives copper sulfate ($CuSO_4$. $5H_2O$), sodium dichromate ($Na_2Cr_2O_7$. $2H_2O$) and boric acid ($H_3BO_3$). Since Bangladesh has long rainy season, some preservative chemicals are leached out from treated bamboo materials with rain water. So, there is at risk of leaching materials to contaminate the soil and water as well as plant nutrients. In this regard, the study has been taken to find out the effect of preservative chemicals on soil properties and the production of betel leaf in the betel leaf cultivation.

**3.4 Objective(s)** :

3.4.1 To monitor the changes in soil properties for using preservative treated bamboo materials in betel leaf cultivation

3.4.2 To assess the yield and quality of betel leaf in the betel leaf farms

**3.5 Expected output** : Conservation of soil properties and sustainable production of betel leaf

**3.6 Study period** :

3.6.1 Starting year : 2013-14

3.6.2 Completion year : 2015-16

**3.7 Personnel(s)** :

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

3.7.2 Associates : Dr. Mohammed Mohiuddin, Divisional Officer

**3.8 Progress** :

3.8.1 Previous year, if any : An experimental plot was set up at shitakunda, initial & secondery soil and leaf samples were collected. Initial samples analysed last year and secondery samples analysis is under proseging.

3.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a. Land management (weeding, furrowing, etc.) maintenance (repairing fence, shade, etc.) will be done of the experimental plots | a. Land management and maintenance was done. |
| b. Soil and betel leaf samples will be collected from the experimental plots for analysis of soil and plant nutrients | b. Soil samples were analyzed but analysis of betel leaf samples were under progress (Table 1). |
| c. Data on production of betel leaf will be collected from the experimental plots | c.Yield data were collected and recorded (Fig. 1). |
| d. Data analysis and report writing | d. Data were analyzed and compiled. |

**3.9 Achievement(s), if any** : Tissue culture protocols of Farua and Bhudum bamboo were developed.

**3.10 Financial statement** :

3.10.1 Total cost : Tk. 4,00,000

3.10.2 Cost of the year : Tk. 1,03,560

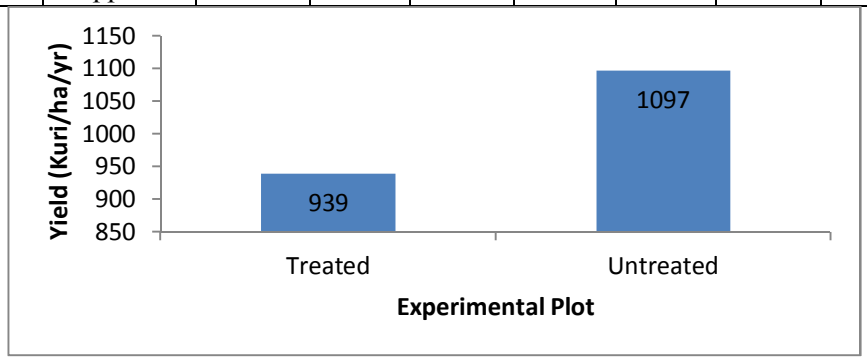
3.10.3 Expenditure of the year : Tk. 1,03,560

3.10.4 Source of fund : GOB

**3.11 Beneficiaries** : Betel leaf farmers, researchers and academician

**Table 1:** Chemical properties of soil in the experimental plots under three soil depths during 2015-16

| Soil properties | Unit | Initial | | | Treated plot | | | Untreated plot | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 0-15 | 15-30 | 30-50 | 0-15 | 15-30 | 30-50 | 0-15 | 15-30 | 30-50 |
| pH | | 7.95 | 7.70 | 7.70 | 8.50 | 8.15 | 7.80 | 7.45 | 7.45 | 7.35 |
| Organic carbon | % | 0.34 | 0.27 | 0.34 | 0.41 | 0.49 | 0.41 | 0.41 | 0.37 | 0.26 |
| Nitrogen | | 0.022 | 0.021 | 0.020 | 0.032 | 0.031 | 0.045 | 0.026 | 0.016 | 0.021 |
| Calcium | meq/100g | 8.45 | 9.40 | 9.70 | 4.15 | 4.25 | 5.35 | 4.35 | 5.15 | 4.35 |
| Magnesium | | 2.85 | 3.15 | 3.15 | 1.45 | 1.45 | 1.85 | 1.50 | 1.75 | 1.70 |
| Potassium | | 0.29 | 0.28 | 0.22 | 0.11 | 0.11 | 0.11 | 0.11 | 0.10 | 0.08 |
| Phosphorus | µg/ml | 17.05 | 11.55 | 9.60 | 55.95 | 46.2 | 23.55 | 35.75 | 33.09 | 18.15 |
| Sulfure | | 6.25 | 10.30 | 8.45 | 5.30 | 2.45 | 2.65 | 3.95 | 3.95 | 4.30 |
| Boron | | 0.12 | 0.11 | 0.10 | 0.11 | 0.14 | 0.15 | 0.12 | 0.14 | 0.15 |
| Cupper | | 1.20 | 1.15 | 1.10 | 1.95 | 1.85 | 1.95 | 1.70 | 1.95 | 2.05 |
| Iron | | 21.5 | 20.5 | 19.5 | 34.0 | 22.0 | 16.5 | 27.0 | 26.5 | 15.0 |
| Manganese | | 4.35 | 3.35 | 2.65 | 3.45 | 2.60 | 1.80 | 2.80 | 2.80 | 1.55 |
| Zinc | | 2.36 | 2.16 | 2.01 | 0.60 | 0.50 | 0.46 | 0.49 | 0.54 | 0.11 |
| Cromium | ppm | 36.75 | 43.45 | 43.65 | 52.35 | 53.25 | 49.03 | 48.00 | 48.23 | 49.53 |




1 Kuri = 20 Kanta, 1 Kanta = 2 Biras and 1 Bira = 72 nos

**Fig.:** Yield of betel leaf in the experimental plots

# Wildlife Section

**1 Study** : On-going
1.1 Programme Area : Biodiversity and conservation
**1.2 Title of the Study** : Development and maintenance of wildlife Museum
**1.3 Justification :** Wildlife museum have played a unique role in successful preserve of wildlife specimens, which bear a proof of a country's wildlife resources. And also it is a part of nature study out of the natural environment both for the beginners and discoverers. Wildlife specialists, students and people of all walks of life come to observer the preserved wildlife specimens in the museum, thus it helps them to identify the wildlife in the nature and arise conservation consciousness. So, this study has been taken for the collection of different wildlife specimens specially rare and threatened species having importance to preserve and display.
**1.4 Objective(s)** :
1.4.1 **To collect wildlife species and displaying objects**
1.4.2 To preserve wildlife specimens for future demonstration and research
**1.5 Expected output** : Enrichment of information on the morphological, taxonomical and ecological aspects of the wildlife resources
**1.6 Study period** :
1.6.1 Starting year : 2004-2005
1.6.2 Completion year : 2015-2016
**1.7 Personnel(s)** :
1.7.1 Study leader : M.A. Rahman, R.O
1.7.2 Associates : M. K. Islam, RA (Gr-1); S.M. Mainuddin, (FI)
**1.8 Progress** :
1.8.1 Previous years, if any : A total of 60 (Sixty) wildlife specimens were collected and Preserved in the Wildlife museum.
1.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a) Collection of wildlife specimens and preservation | a) A Skin of Barking Deer (*Muntiacus muntjak*) has been Collected. |
| b) Preparation of videos, posters, still pictures of collected wildlife specimen | b) Ten (10) still Pictures (10R size with lemenating) have been printed and two (02) Specimen Racks (Glass & wooden) have made and five specimens glass jar, a dissecting Table have been collected. |
| c) Report writing and printing | c) Report writing is going on. |

**1.9 Achievement(s), if any** : NA
**1.10 Financial statement** :
1.10.1 Total cost : Tk. 5,00,000
1.10.2 Cost of the year : Tk. 3,97,216
1.10.3 Expenditure of the year : Tk. 60,000
1.10.4 Source of fund : GOB
**1.11 Beneficiaries** : Researchers, Students and Teachers of different educational Institutions and Forest Department and NGOs

**2 Study** : On-going
2.1 Programme Area : Biodiversity and conservation
**2.2 Title of the Study** : Status of wildlife in Baraiyadhala National Park
**2.3 Justification :** Now there are 37 protected areas (PAs) in Bangladesh. But current status wildlife most of these PAs are not available. In order to formulate effective management of PAs updated and trend of wildlife population is needed in Baraiyadhala National Park and it's adjacent areas are rich in different wildlife species but there is no published information. In this national park the existing status wildlife needs to be present to the visitor coming from home and abroad.
**2.4 Objective(s)** :
2.4.1 Establishment of sampling transects based on Google earth map of the site and field visit.

2.4.2 To evaluate the status of wildlife population in Baraiyadhala National Park

**2.5 Expected output** : Formulation of effective way to monitoring wildlife status and conservation measures for NP.

**2.6 Study period** :

2.6.1 **Starting year** : 2014-2015

2.6.2 **Completion year** : 2016-2017

**2.7 Personnel(s)** :

2.7.1 Study leader : S.M. Rabiul Alam, SRO

2.7.2 Associates : M.A. Rahman, RO; M.K. Islam, RA (Gr-1); S.M. Mainuddin, (FI)

**2.8 Progress** :

2.8.1 **Previous years, if any :** During survey 81 species of bird, 22 species of mammals, 17 species of reptiles and 07 species of amphibians were recorded

2.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a) Reconnaissance and field visit to establish trail | a) Six out of nine field visits were done in Baraiyadhala National Park areas. During survey GPS was used to determine transects position and coverage areas in the National Park region. |
| b) Baseline survey for wildlife specimen | b) Periodical survey were made in the Baraiyadhala National Park following sample line transect method. Binocular and camera were used for observation and pictures collection of wildlife. Camera traps were used for nocturnal mammals. During survey 102 species of birds, 22 species of mammals, 17 species of reptiles and 07 species of amphibians were recorded. Assamese Macaque were recorded for the first time from this national park. |
| c) Report writing and printing | c) Report writing is going on. |

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

**2.10 Financial statement** :

2.10.1 Total cost : Tk. 4,50,000

2.10.2 Cost of the year : Tk. 1,49,800

2.10.3 Expenditure of the year : Tk. 2,80,000

2.10.4 Source of fund : GOB

**2.11 Beneficiaries** : Researchers, Students and Teachers of different educational Institutions and Forest Department and NGOs

**3 Study** : New

3.1 Programme Area : Biodiversity and conservation

**3.2 Title of the Study** : Mammalian species diversity in Hazarikhil wildlife sanctuary of Bangladesh

**3.3** 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.

**3.4 Objective(s)** :

3.4.1 To find out mammalian species diversity of Hazarikhil WS.

3.4.2 To estimate the population density of these mammalian species.

3.4.3 To identify major threats to the mammalian species in this WS.

**3.5 Expected output** : Information will help to develop a management plan for sustainable conservation for mammalian species .

**3.6 Study period** :

3.6.1 **Starting year** : 2015-2016

3.6.2 **Completion year** : 2016-2017

**3.7 Personnel(s)** :

3.7.1 Study leader : M.A.Rahman RO

3.7.2 Associates : S.M. Rabiul Alam, SRO; M. K. Islam, RA -1; S.M. Mainuddin, FI

**3.8 Progress** :

3.8.1 Previous year: : NA

3.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a) Field visit for establishing trails. | a) Field visits were done nine 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. | b) 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 18 species of mammals were recorded shown in appendix-II. |
| c) Report writing and printing. | c) Report writing is going on. Three display boards have been printed. |

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

**3.10 Financial statement** :

3.10.1 Total cost : Tk. 8,00,000

3.10.2 Cost of the year :

3.10.3 Expenditure of the year : Tk. 2,00,000

3.10.4 Source of fund : GOB

**3.11 Beneficiaries** : Researchers, Students and Teachers of different educational Institutions and Forest Department and NGOs

## Appendix I. List of Specimens in Wildlife Museum of Wildlife Section

| SL. No. | Name of the Class | Bengali name of the Specimens | English Name | Scientific Name |
|---|---|---|---|---|
| 1 | Amphibia | কটকটি ব্যাঙ | Skipper frog | *Euphlyictis cyanophlyctis* |
| 2 | | গেছো ব্যাঙ | Tree Frog | *Polypedates leucomystax* |
| 3 | | কোলা ব্যাঙ | Bull Frog | *Hoplobatrachus tigerinus* |
| 4 | Reptilia | মিঠা পানির কুমিরেরবাচ্চা | Baby of Marsh Crocodile | *Crocodylus palustris* |
| 5 | | মিঠা পানির কুমিরের একদিনের বাচ্চা | Baby of Marsh Crocodile(1day aged) | *Crocodylus palustris* |
| 6 | | মিঠা পানির কুমিরের ডিম | Eggs of Marsh Crocodile | *Crocodylus palustris* |
| 7 | | মিঠা পানির কুমিরের মল | Stool of Marsh Crocodile | *Crocodylus palustris* |
| 8 | | মিঠা পানির কুমিরের দাঁত | Teeth of Marsh Crocodile | *Crocodylus palustris* |
| 9 | | ঘড়িয়ালের ডিম | Egg of Gharial | *Gavialis gangeticus* |
| 10 | | হলুদ পাহাড়ী কাছিম | Elongated tortoise | *Indotestudo elongata* |
| 11 | | হলুদ পাহাড়ী কাছিমের ডিম | Egg of Elongated tortoise | *Indotestudo elongata* |
| 12 | | জলপাই রং কাছিম | Olive Ridley Turtle | *Lepidochelys olivacea* |
| 13 | | জলপাই রং কাছিমের ডিম | Eggs of Olive Ridley Turtle | *Lepidochelys olivacea* |
| 14 | | তারকা কচছপ | Starred Tortoise | *Geocelone elegans* |
| 15 | | ধুম কাছিম | Peacock Softshell | *Aspideretes hurum* |
| 16 | | হলদে কাইট্টা | Yellow Turtle | *Morenia petersi* |
| 17 | | সুন্দী কাছিম | Spotted flapshell turtle | *Lissemys punctate* |
| 18 | | অজগর সাপের বাচচা | Hatchling of Rock Python | *Python molurus* |
| 19 | | অজগর সাপের ডিম | Egg of Rock Python | *Python molurus* |
| 20 | | অজগর সাপের লেজ | Tail of Rock Python | *Python molurus* |
| 21 | | গুই সাপের চামড়া | Skin of Grey Lizard | *Varanus bengalensis* |
| 22 | | গুই সাপের বাচচা | Young of Grey Lizard | *Varanus bengalensis* |
| 23 | | তক্ষক/ টোটেং | Wall Lizard | *Gekko gecko* |
| 24 | | লাউডগা সাপ | Common Vine Snake | *Ahaetulla nasutus* |
| 25 | | ভোঁতা নাক লাউডগা সাপ | Short Nosed Vine Snake | *Ahaetulla prasina* |
| 26 | | গোখরো সাপ | Monocelate Cobra | *Naja kaouthia* |
| 27 | | খয়া গোখরো সাপ | Binocelete Cobra | *Naja naja* |
| 28 | | দারাজ সাপ | Rat Snake | *Coluber mucosus* |
| 29 | | কালনাগিনী সাপ | Ornate Flying Snake | *Chrysopelea ornate* |
| 30 | | ঘরগিন্নি সাপ | Common Wolf Snake | *Lycodon aulicus* |
| 31 | | হেলেনা দুধরাজ | Common Trinket Snake | *Coelognathus helena* |
| 32 | | শংখিনি সাপ | Banded Krait | *Bangarus fasciatus* |
| 33 | Aves | ময়ুরের বাচচা | Baby of Common Peafowl | *Pavo cristatus* |
| 34 | | ময়ুরের ডিম | Egg of Common Peafowl | *Pavo cristatus* |
| 35 | | বাবুই পাখির বাসা | Nest of Baby Weaver | *Ploceus philippinus* |
| 36 | | কাঠ ঠোকরার বাসা | Nest of Lesser Rufous-bellied woodpecker | *Dendrocops hyperythrus* |
| 37 | | হলদে পাখির বাসা | Nest of Black Headed Oriol | *Oriolus xanthornus* |
| 38 | | টুনটুনি পাখির বাসা | Nest of Tailor Bird | *Orthotomus sutorius* |
| 39 | | বুলবুলি পাখির বাসা | Nest of Red Vented bulbul | *Pycnonotus cafer* |

| | | | | |
|---|---|---|---|---|
| 40 | | ফুলঝুড়ি পাখির বাসা | Nest of Tickell's Flowerpecker | *Dicaeum erythrorynchos* |
| 41 | | হাঁড়িচাচা পাখির বাসা | Rofous Treepie | *Dendrocitta vegabunda* |
| 42 | | ফুলঝুড়ি পাখির | Tickell's Flowerpecker | *Dicaeum erythrorynchos* |
| 43 | | নীলটুনি পাখি | Purple Sunbird | *Nectarinia asiatica* |
| 44 | Mammalia | বাঘের বাচচা | Baby of Royal Bengal Tiger | *Panthera tigris* |
| 45 | | বাঘের চোয়াল | Jaw of Royal Bengal Tiger | *Panthera tigris* |
| 46 | | চিত্রা হরিণের বাচচা | Baby of Spotted Deer | *Cervus axis* |
| 47 | | চিত্রা হরিণের মল | Stool of Spotted Deer | *Cervus axis* |
| 48 | | শিয়ালের খুলি | Skull of Jackel | *Canis aureus* |
| 49 | | মায়া হরিণের চামড়া | Skin of Barking Deer | *Muntiacus muntjak* |
| 50 | | বানরের খুলি | Skull of Rhesus Macaque | *Macaca mulata* |
| 51 | | বনগরুর খুলি | Skull of Gaur | *Bos gaurus* |
| 52 | | বনগরুর চোয়াল | Jaw of Gaur | *Bos gaurus* |
| 53 | | বনছাগলের শিং | Horns of Serow | *Capricornis sumatrensis* |
| 54 | | সজারু | Indian crested Porcupine | *Hystrix indica* |
| 55 | | সজারু কাটা | Horns of Porcupine | *Hystrix indica* |
| 56 | | নেংটি ইঁদুর | House Mouse | *Mus musculus* |
| 57 | | মেঠো ইঁদুর | Indian Field Mouse | *Mus Booduga* |
| 58 | | হাতির মল | Stool of Asian Elephant | *Elephus maximus* |
| 59 | | হাতির পা | Femur of Asian Elephant | *Elephus maximus* |
| 60 | | বড় বাগডাশের চামড়া | Skin of large Indian civet | *Viverricula zibetha* |
| 61 | | শুশুকের কঙ্কাল | Skul of Irrawaddy Dolphin | *Orcaella brevirostris* |

## Appendix II. Mammals of Hazarikhil Wildlife Sanctuary for the year of 2015-2016

| Sl. No | Order | Family | Scientific Name | Common English Name | Local Name |
|---|---|---|---|---|---|
| 1 | Primmates | Cercopithecidae | *Macaca mulatta* | Rhesus Macaque | Banor |
| 2 | | Colobidae | *Trachypithecus pileata* | Capped Langur | Mokhpora Hanuman |
| 3 | Carnivora | Viverridae | *Vivericula indica* | Small Indian Civet | Khatash |
| 4 | | Herpestidae | *Herpestes edwardsi* | Common Indian Mongoose | Benji |
| 5 | | Felidae | | Leopard cat | Chita Biral |
| 6 | | | *Prionailurus viverrina* | Fishing cat | Mecho Biral |
| 7. | | | *Felis chaus* | Jungle cat | Bono Biral |
| 8 | Rodentia | Sciuridae | *Callosciurus pygerythrus* | Pallas's Squarrel | Badami Kat Birali |
| 9 | | | *Dremomys loriah* | Orange Bellied Squarrels | Kalo Kat Birali |
| 10 | | Hystricidae | *Hystrix indica* | Indian Porcupine | Sajaru |
| 11 | | Muridae | *Bandicota indica* | Bandicoot Rat | Boro Indur |
| 12 | Artiodactyla | Suidae | *Sus scrofa* | Wild Boar | Shukor |
| 13 | | Cervidae | *Muntiacus muntjac* | Barking Deer | Maya Horin |
| 14 | | | *Arctonyx collaris* | Hog-Badger | Gor khodok |
| 15 | Insectivora | Soricidae | *Suncus murinus* | Grey musk Shrew | Chika |
| 16 | Chiroptera | Pteropodidae | *Pteropus giganteus* | Flying fox | Badur |
| | | | *Megaderma lyra* | False Vampire Bat | Daini Badur |
| 17 | | Vespertilionidae | *Pipipstrellus coromandra* | Indian Pipistrel | Cham Chika |

# 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 : Agar wood/ *Aquilaria* tree, a highly prized non-timber forest product used for fragrances, incense, medicines. The healthy wood is not scented but under certain external factors or pathological condition the heart wood becomes saturated with resin. Although wounding has been suggested to cause agarwood, the typical types of wounds that are produced in trees generate no resins or very low with inferior quality. The present study is undertaken to develop a simple and efficient method by inoculating different chemical media into the tree that will produce best grade of agarwood within a shorter period. This chemical inoculation technique will be a simple and efficient method to induce qualified agarwood formation throughout the whole tree.

In this technique water soluble different resin-inducing chemicals will be applied to the cell surrounding the wound or into the xylem part of the *Aquilaria* trees on trial and error basis. These chemical agents will be chosen according to their some special properties so that they may kill some living parenchyma cells around the wounded region of the xylem or interact with the cellular system that will stimulate the secretion of agar resin. Due to water transportation, the water soluble inducers will be transported to the localized areas of the tree around the zone of application.

**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(s)** :

1.7.1 Study leader : M. Jakir Hossain, SRO

1.7.2 Associates : S. Akhter, 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 : Around 20 types of individual or blended chemical inducers were applied into agar trees of different areas of Bangladesh namely: Korer Hat Agarwood Garden, Chittagong; Fashiyakhali agar wood Garden, Cox's Bazar; Holudia agar wood Garden, Banderban and LatiTila agar wood Garden, Moulovibazar with the help of the scientists of BCSIR Labs. Chittagong.Within very short period of time (three to six months) the white wood became black around the zone of application and mostly in the longitudinal direction. The burning of those black parts smelled special smell that is only found in agar wood.

1.8.2 This year :

| Activities for the study | Progress (2015-16) |
|---|---|
| a. Microscopic investigation of the anatomy of agarwood. | Optical micrographs had been taken. |
| b. Preparation nanoparticles for inducement. | Around 10 types of individual or blended chemical inducing agents or synthesized nanoparticles hydrosols were prepared. |

| | |
|---|---|
| c. In vitro application of suitable chemical inducing agent(s) as well as nanoparticles. | Synthesized nanoparticles hydrosols were applied into agar trees of different areas of Bangladesh namely: KorerhatAgarwood Garden, Mirsarai, Chittagong, FashiyakhaliAgarwood Garden, Cox's Bazar; HoludiaAgarwood Garden, Banderban, Minister Agarwood Garden at Banshkhali, Chittagong and BCSIR Laboratories Chittagong Campus Agarwood Trees with the help of the scientists of BCSIR Labs. Chittagong. All of the inoculated trees were visited several times after inoculation. From the investigation it was observed that most of the inoculai 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 Figure. But after 18 months later initially formed black wood became rotten which make the tree hollow. Interestingly, a new layer of agarwood with improved quality was formed around the hollow part. |

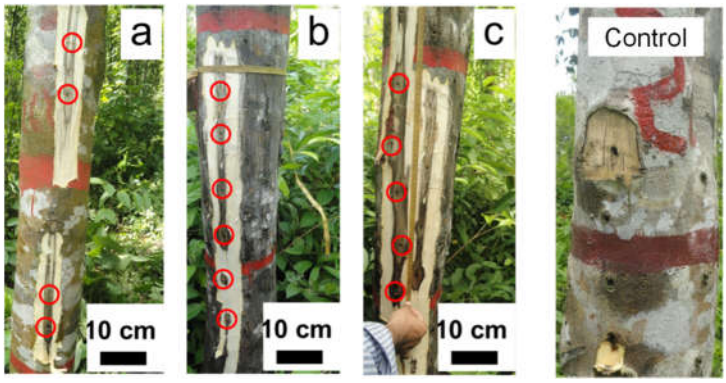



**Fig.1.** The black discoloration indicates the deposition of agar resins after application of chemical inducing-agent after six months. (a) and (b) HoludiaAgarwood Garden, Banderban district. (c) FashiyakhaliAgarwood Garden, Cox's Bazar.


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

**1.9** **Achievement(s)** : Application of chemical inducing agent accelerates agarwood resin formation.

**1.10** **Financial statement** :

1.10.1 Total cost : Tk. 10,00,000

1.10.2 Cost of the year : Tk. 2,50,000

1.10.3 Expenditure of the year : Tk. 2,50,000

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** : Plants contain a wide variety of free radical scavenging molecules, such as flavonoids, anthocyanins, cartenoids, tannins, saponins, steroids, terpenoids and rotenoids which are rich in antioxidant activities. Antioxidants play a protective role in health and against diseases, and their consumption lower risk of cancer, heart disease, hypertension and stroke. The major groups of phytochemicals that may contribute to the total antioxidant capacity of plant include polyphenols and vitamins (C and E). Phenolic compounds of plants are hydroxylated derivatives of benzoic acid and cinnamic acids and have been reported to possess antioxidative and anticarcinogenic effects. Phenolic compounds including flavonoids are important in plant defense mechanisms against invading bacteria and other types of environmental stress. Flavonoids have long been recognized to possess anti-inflammatory, anti-allergic, antiviral and antiproliferative activities. Several reports indicate that the antioxidant potential of medicinal plants may be related to the concentration of their phenolic compounds which include phenolic acids, flavonoids, anthocyanins and tannins. These compounds are of great value in preventing the onset and/or progression of many human diseases. In Bangladesh more than 700 medicinal plants are identified but majority of them are not evaluated in terms of their chemical ingredients or antioxidant properties. Therefore, the present study is undertaken to evaluate the efficacy of some medicinal plants those chemical compositions were partially determined or yet to be determined through phytochemical analysis and antioxidant activity.

Due to the adverse effect of synthetic drugs, natural medicine is becoming popular. In this context, chemical analysis of medicinal plants is very important for their exploration and efficacy determination.

**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(s)** :

2.7.1 Study leader : M. JakirHossain, 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 Progress :** Five less explored medicinal plants viz. Ashoke *(Saracaasoca),* Khonachhal (*Oroxylumindicum),* Dudhiya*(Euphorbia hirta),* Mutha/VadalGhas (*Kyllinganemoralic)*, Shetodrone (*Leucasindica/aspara)* sampleswere collected and dried in shade and also preserved for extraction and antioxidant value determination related works.

2.8.2 This year :

| Activities for 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. |

**Table :Phytochemical Screening Results:**

| No. | **Phytochemicals** | **Khonasal** | **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** : **NA**

**2.10 Financial statement** :

2.10.1 Total cost : Tk. 5,00,000

2.10.2 Cost of the year : Tk. 2,50,000

2.10.3 Expenditure of the year : Tk. 2,50,000

2.10.4 Source of fund : GOB

**2.11 Beneficiaries** : Pharmaceuticals and Ayurvedic Industries, Medicinal plants producers and traders.

## Pulp and Paper Division

**1 Study** : On-going

1.1 Programme Area : Post Harvest Utilization-Chemical Processing.

**1.2 Title of the Study** : **Oxygen delignification of kraft pulp of stem and branches of rubber tree *(Hevea brasiliensis*)**

**1.3 Justification :** Bangladesh Forest Industries Development Corporation, Chittagong Hill Tract Development Board and other private organizations have planted rubber trees (*Hevea brasiliensis*) in a large scale for latex production. The stem and branches of harvested rubber tree was found suitable for pulp production. In order to determine the end use of the pulp, bleaching response need to be observed. Recently, oxygen delignification of pulp is regarded as the environment friendly bleaching process. In this study the kraft pulp of stem and branches of rubber tree (*Hevea brasiliensis*) would be bleached with the supply of oxygen gas at various pressures.

**1.4 Objective(s)** :

1.4.1 To investigate the bleaching response of rubber wood pulp for using as high quality paper

**1.5 Expected output** : High quality pulp for making printing and writing paper.

**1.6 Study period** :

1.6.1 Starting year : 2011-2012

1.6.2 Completion year : 2015-2016

**1.7 Personnel(s)** :

1.7.1 Study leader : Daisy Biswas, DO

1.7.2 Associates : Md. Misbahuddin, FI and Urbashi Roy, FI.

**1.8 Progress** :

1.8.1 Previous years, if any: Bleachable grade kraft and soda pulp from stem and branch of rubber wood were prepared. The colour of the pulp of rubber stem was more brownish compared to branch. Some hardened rubber particle was found during stem pulp washing. It seemed that during cooking the latex leached out from the chips and on cooling it became hardened. Some bleaching experiments were done on kraft pulp prepared with 18% active alkali. It was found that the kappa number reduced from 27 to 16 for stem pulp and 18 to 12 for branch pulp. The pulps of stem and branches of rubber tree (*Hevea brasiliensis*) were bleached at 110 psi oxygen pressure for 60 min. at 95ºC. Kappa number was determined. It was found that the kappa number reduced from

22.5 to 18.7 for stem pulp and 15.5 to 11.7 for branch pulp produced in kraft process. The similar trend was observed for pulps produced in soda process

1.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a) Preparation of hand sheets of bleached pulp | Chlorine dioxide was prepared. Then 26 pulps have been bleached by following $D_0E_pD_1$ bleaching sequence.<br>$D_0$ ----2% Chlorine dioxide<br>$E_p$---- Peroxide reinforced alkaline extraction<br>$D_1$----1% Chlorine dioxide |
| b) Evaluation of physical strength properties of hand sheets. | In all 312 no of hand sheets of bleached pulp in three different freeness level have been made. The sheets were then conditioned at 23±1ºC and 50±1% relative humidity. The test samples were prepared and strength properties likely tear tensile and burst were determined. |

**1.9** Achievements, if any: Delignification was found easier in case of branches compared to stem.

**1.10 Financial statement** :

1.10.1 Total cost : Tk. 3,00,000

1.10.2 Cost of the year : Tk. 60,000

1.10.3 Expenditure of the year : -

1.10.4 Source of fund : GOB

**1.11 Beneficiaries** : Pulp and Paper Industries .

**2 Study** : New

2.1 Programme Area : Post Harvest Utilization-Chemical Processing.

**2.2 Title of the Study** : **Production of nano composite from fibers of *Acacia hybrid* and simul (*Bombax ceiba*) tree species of Bangladesh**

**2.3** Justification (For new study) : 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.

**2.4 Objective(s)** :

2.4.1 To develop modern technique for extraction of nanocellulose from wood pulp

2.4.2 To produce environment friendly packaging materials

2.4.3 To produce ethanol from hemicelluloses of wood

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

**2.6 Study period** :

2.6.1 **Starting year** : 2013-2014

2.6.2 **Completion year** : 2017-2018

**2.7 Personnel(s)** :

2.7.1 Study leader : Md. Misbahuddin, FI.

2.7.2 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.

**2.8 Progress** :

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

Six kraft pulps 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. Six soda pulps were prepared with and without anthraquinone by varying alkali doses of 14, 16 and 18%. The black liquor of pulps were analysed for residual alkali.

2.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a) Determination of chemical constituent of the treated simul (*Bombax ceiba*) chips | ---------- |
| b) Preparation of kraft pulp | Twelve kraft pulps at 15 and 25% sulphidity level and six soda-AQ pulps of simul wood were prepared with the untreated chips by maintaining 2000 H-Factor. The alkali doses were varied from 16 to 20% at 2% increments. The black liquor of pulps were analysed for residual alkali |
| c) Determination of kappa number and yield | Kappa number of *Acacia* hybrid pulps was determined. |
| d) Preparation and characterization of nanocellulose from pulp/wood | ---------- |

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

**2.10 Financial statement** :

2.10.1 Total cost : Tk. 25,00,000

2.10.2 Cost of the year : Tk. 1,50,000

2.10.3 Expenditure of the year : -

2.10.4 Source of fund : GOB

**2.11 Beneficiaries** : Pulp, Paper and Pharmaceutical Industry.

**3 Study** : New

3.1 Programme Area : Post Harvest Utilization-Chemical Processing.

**3.2 Title of the Study** : **Suitability of *Acacia* hybrid and rubber tree (*Hevea brasiliensis*) for making hardboard**

**3.3 Justification (For new study):** *Acacia mangium* and *Acacia auriculiformis* was introduced in Bangladesh as shade tree in tree gardens. At present thousands of hectares of *Acacia* hybrid and rubber tree (*Hevea brasiliensis*) have been planted by Forest Department and also local people. 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. 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.

**3.4 Objective(s)** :

3.4.1 To investigate the suitability of *Acacia* hybrid and rubber tree (*Hevea brasiliensis*) for making hardboard

**3.5 Expected output** : Better utilization of raw materials for making hardboard, as environment friendly value added product.

**3.6 Study period** :

3.6.1 Starting year : 2014-2015

3.6.2 Completion year : 2016-2017

**3.7 Personnel(s)** :

3.7.1 Study leader : Nazma Khatun, RO.

3.7.2 Associates : Md. Misbahuddin, FI; Urboshi Roy, FI. and Daisy Biswas, DO

**3.8 Progress** :

3.8.1 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 and tested.

3.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a) Evaluation of strength properties of hardboard made from *Acacia* hybrid | The sample of size 12.7 cm x 5.08 cm were prepared from the hardboards made with steamed, NaOH , $Na_2SO_3$ and mixture of NaOH and $Na_2SO_3$ treated chips. These were conditioned and tested to determine water absorption, thickness swelling and modulus of rupture (Table 1 and 2). Treated chips prior mechanical refining produce stronger hardboards than steamed cooked chips.<br>However, the boards are less water resistant |
| b) Processing of rubber chips | Collection of rubber wood is in under process |
| C) Making hardboard from treated rubber chips at different freeness level. | ---------- |
| d) Reporting. | ---------- |

**3.9** Achievements, if any : Nil.

**3.10 Financial statement** :

3.10.1 Total cost : Tk. 3,00,000

3.10.2 Cost of the year : Tk. 1,60,000

3.10.3 Expenditure of the year : -

3.10.4 Source of fund : GOB

**3.11 Beneficiaries** : Hard board Industry and local people.

**Table:1 Strength and water resistant properties of steamed *Acacia* hybrid chips.**

| Cooking condition | | Freeness in Seconds | Modulus of Rupture (MOR) kg/cm² | Water absorption (%) | |
|---|---|---|---|---|---|
| | | | | Change in weight | Change in thickness |
| Digester pressure (kg/cm²) | Steaming time (hour) | | | | |
| 7.03 | ½ | 24.57<br>20.78<br>18.86 | 45.03<br>44.94<br>38.06 | 80.83<br>46.66<br>38.06 | 58.72<br>46.45<br>86.90 |
| | 1 | 22.2<br>21.2<br>22.8 | 59.3<br>58.17<br>58.68 | 76.68<br>38.60<br>43.35 | 49.58<br>28.62<br>29.65 |
| | 1½ | 29.5<br>29.4<br>28.6 | 112.41<br>87.33<br>79.94 | 12.53<br>16.05<br>16.62 | 9.42<br>11.01<br>10.72 |
| 10.55 | ½ | 17.85<br>20.71<br>34.97 | 31.05<br>35.16<br>79.83 | 123<br>108.71<br>11.94 | 77.77<br>74.30<br>12.63 |
| | 1 | 24.19<br>23.42<br>25.30 | 48.39<br>53.02<br>61.40 | 77.06<br>60.29<br>58.03 | 56.55<br>43.13<br>43.24 |
| | 1½ | 21.16<br>20.13<br>20.42 | 63.67<br>53.75<br>46.22 | 56.05<br>37.95<br>30.76 | 38.71<br>28.21<br>26.63 |

Table:2. The effect of chemical pre treatment of *Acacia* hybrid chips on the properties of hardboard

| Chemicals | Freeness in Seconds | Modulus of Rupture (MOR) kg/cm² | Water absorption | |
|---|---|---|---|---|
| | | | Change in weight , % | Change in thickness, % |
| 1% NaOH | 30.58<br>39.67<br>34.27 | 92.28<br>153.12<br>182.94 | 126.27<br>116.63<br>107.05 | 92.59<br>86.05<br>79.47 |
| 2% NaOH | 32.33<br>30.27<br>30.34 | 136.74<br>169.74<br>180.25 | 127.06<br>127.85<br>120.14 | 93.54<br>94.86<br>89.97 |
| 3% NaOH | 28.46<br>30.68<br>30.15 | 129.31<br>179.29<br>185.42 | 135.81<br>122.41<br>130.0 | 104.7<br>74.21<br>95.77 |
| 3% Mixture $NaOH+Na_2SO_3$ | 41.02<br>38.93<br>39.84 | 198.32<br>206.11<br>198.82 | 124.88<br>116.56<br>124.69 | 92.97<br>85.12<br>89.94 |
| 3% $Na_2SO_3$ | 32.37<br>41.88<br>22.69 | 42.27<br>54.31<br>35.42 | 121.31<br>100.49<br>130.75 | 90.77<br>81.04<br>94.24 |

**4 Study** : New

4.1 Programme Area : Post Harvest Utilization-Chemical Processing.

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

**4.3** Justification (For new study) : 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 three 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.

**4.4 Objective(s)** :

4.4.1 To determine the optimum harvesting time of the species with respect to yield and quality pulp

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

**4.6 Study period** :

4.6.1 **Starting year** : 2015-2016

4.6.2 **Completion year** : 2017-2018

**4.7 Personnel(s)** :

4.7.1 Study leader : Daisy Biswas, DO.

4.7.2 Associates : Md. Misbahuddin, FI; Urboshi Roy, FI. and Nazma Khatun, RO

**4.8 Progress** :

4.8.1 **Previous year, if any** **:** New

4.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a) Collection of gamar wood of three different age groups | Related literature has been reviewed.<br>Gamar logs of 4, 6, 8, 10 and 12 age groups were collected. |
| b) Processing of chips and determination of chemical constituents | ---------- |
| C) ) Preparation of kraft and soda pulp by varying alkali dose, sulphidity and pulping time | ---------- |
| d) Reporting. | ---------- |

**4.9 Achievement(s), if any** : **Nil**
**4.10 Financial statement** :
4.10.1 Total cost : Tk. 5,00,000
4.10.2 Cost of the year : Tk. 1,00,000
4.10.3 Expenditure of the year : -
4.10.4 Source of fund : GOB
**4.11 Beneficiaries** : Pulp, Paper and Pharmaceutical Industry.

# Seasoning and Timber Physics Division

**1 Study** : On-going
1.1 Programme Area : Post Harvest Utilization-Physical Processing.
**1.2 Title of the Study** : **Solar kiln for efficient seasoning of different thicknesses of wood**
**1.3 Justification :** Seasoning properties of about 20 wood species were determined using 2.54 cm thickness of wood sample. But little information's are available for 4.0 cm and 5.0 cm thicknesses of wood sample. As per demand of end users, the study has been undertaken using different thicknesses of wood samples.
**1.4 Objective(s)** :
1.4.1 To determine the seasoning characteristics of different thicknesses of wood
**1.5 Expected output**: Application of solar kiln for effective seasoning of different thicknesses of wood
**1.6 Study period** :
1.6.1 Starting year : 2011-2012
1.6.2 Completion year : 2015-2016
**1.7 Personnel(s)** :
1.7.1 Study leader : Md. Rowson Ali, RO
1.7.2 Associates : M. Jahangir Alam, DO and U. K. Rokeya, RO
**1.8 Progress** :
1.8.1 Previous years, if any:

Table-1: Seasoning schedule of different timber species in 3 conditions

| Species | Thickness (cm) | Seasoning conditions | | |
|---|---|---|---|---|
| | | Air dry (days) | Solar kiln (days) | Solar kiln with burner (days) |
| Ghora-neem (*Melia azadarach*) | 2.5 | 22-25 | 9-10 | 7-8 |
| | 4.0 | 27-32 | 12-14 | 9-11 |
| | 5.0 | 31-40 | 16-19 | 12-14 |
| Rain tree (*Samanea saman*) | 2.5 | 45-55 | 15-18 | 12-15 |
| | 4.0 | 55-64 | 24-28 | 20-22 |
| | 5.0 | 67-80 | 34-39 | 28-30 |

Table -2: Seasoning schedule of Silkoroi (*Albizia procera*) species in 2 conditions

| Species | Thickness (cm) | Moisture Level (%) | Seasoning conditions | |
|---|---|---|---|---|
| | | | Air dry (days) | Solar kiln (days) |
| Silkoroi (*Albizia procera*) | 2.5 | 15-20 | 45-50 | 22-28 |
| | 4.0 | 20-30 | 51-70 | 25-33 |
| | 5.0 | 20-30 | 55-88 | 19-39 |

Table-3: Seasoning schedule of gamar (*Gmelina arborea*) species in 2 conditions

| Species | Thickness (cm) | Moisture Level (%) | Seasoning conditions | |
|---|---|---|---|---|
| | | | Air dry (days) | Solar kiln (days) |
| Gamar (*Gmelina arborea*) | 2.5 | 15-20 | 114-129 | 44-51 |
| | 4.0 | 20-30 | 131-146 | 55-65 |
| | 5.0 | 20-30 | 135-149 | 59-72 |

Table-4: Seasoning schedule of mango and hybrid acacia timber species in 2 conditions

| Species | Thickness (cm) | Moisture Level (%) | Seasoning conditions | |
|---|---|---|---|---|
| | | | Air dry (Rainy season, May-July) in days | Solar kiln (Rainy season, May-July) in days |
| Mango (*Mangifera indica*) | 2.5 | 15-20 | 62-68 | 16-18 |
| | 4.0 | 20-30 | 71-77 | 20-22 |
| | 5.0 | 20-30 | 81-89 | 24-28 |
| *Hybrid acacia* | 2.5 | 15-20 | 68-72 | 18-20 |
| | 4.0 | 20-30 | 78-86 | 22-26 |
| | 5.0 | 20-30 | 89-99 | 28-32 |

1.8.2 This year :

| **Activities of the study** | **Progress** |
|---|---|
| a) Three standing trees of jam (*Syzygium cumini*) and three standing trees of jarul (*Lagerstroemia speciosa*) will be selected in the Southern part of Bangladesh and collection of 80 cft. round wood for preparation of 122-183 cm x 25-30 cm x 2.5-4.0-5.0 cm size planks. | a. 40 cft. round wood of jam *Syzygium cumini*) and 40 cft. round wood of *jarul* (*Lagerstroemia speciosa*) were collected from Bandarban Hill District and 122-183 cm x 25-30 cm x 2.5-4.0-5.0 cm planks size were prepared. |
| b) Testing of 60 sample planks for determination of seasoning efficiency in two seasoning conditions (air drying and solar kiln) | b. Testing of sample planks were done for determination of seasoning efficiency in two seasoning conditions (air dry and solar kiln) |
| c) Two solar kilns will be maintained through repairing and painting. | c. Existing solar kilns were maintained by repairing and painting. |
| d) Data analysis and report writing. | d. Data were recorded and shown in table-5 |

Table-5: Seasoning schedule of jam and jarul timber species in 2 conditions

| Species | Thickness (cm) | Moisture Level (%) | Seasoning conditions | |
|---|---|---|---|---|
| | | | Air dry (Rainy season, May-August) in days | Solar kiln (Rainy season, May-August) in days |
| Jam (*Syzygium cumini*) | 2.5 | 15-20 | 86-91 | 38-40 |
| | 4.0 | 20-30 | 93-99 | 42-44 |
| | 5.0 | 20-30 | 102-109 | 46-49 |
| Jarul (*Lagerstroemia speciosa*) | 2.5 | 15-20 | 84-88 | 36-38 |
| | 4.0 | 20-30 | 91-94 | 39-43 |
| | 5.0 | 20-30 | 97-106 | 44-48 |

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

1. Ali, M. Rowson, Alam, M. J., Rokeya,U. K. and Paul S. P. 2013. Determination of seasoning schedule of rain tree (*Samanea saman*) sawn wood with different thickness using solar kiln. *Scholarly Journal of Agricultural Science* 3 (7): 289-293

2. Ali, M. Rowson, Alam, M. J., Rokeya, U. K. and Paul, S. P. 2014. Drying characteristics of ghora-neem [*Melia sempervirens* (L.) All.] wood of different thickness using solar kiln. *Bangladesh Journal of Forest Science* 33(1&2):35-38

**1.10 Financial statement** :

1.10.1 Total cost : Tk. 7,84,550

1.10.2 Cost of the year : Tk. 2,10,600

1.10.3 Expenditure of the year : Tk. 2,10,600

1.10.4 Source of fund : GOB

**1.11 Beneficiaries** : BFIDC, FD, Wood Industries, University students, BFRI and others.

## 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** :

1.6.1 Starting year : 2014-2015

1.6.2 Completion year : 2019-2020

**1.7 Personnel(s)** :

1.7.1 Study leader : Dr. K. Akhter, DO

1.7.2 Associates : M. M. Rahaman, RO, M. Rakibul Islam, FI.

**1.8 Progress** :

1.8.1 **Previous progress :** Borak (*Bambusa balcooa*) bamboos were collected from Borkol upozilla 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 (*Bambusa tulda*). 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.

1.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a) Procurement of chemicals and other materials | Chemicals such as urea formaldehyde glue, borax, boric acid, copper sulphate etc and materials such as carbide saw, polythene tube, sprit, gala, hand gloves etc were procured. |
| b) Selection of design of doors and partition. | Design of doors and partition were selected. |
| 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 of borak bamboo were prepared, dried 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 were made using treated strips in hot press. Planner shavings are found during strips preparation. Bamboo chips were prepared in hammer mill machine. Bamboo mat over laying particle board were made using mat, bamboo chips and planner shaving Borax-boric acid (2%) was added with UF glue. Strength properties of Bamboo panel board and particleboard were determined.(Table-2) |
| f) Manufacturing of one door and one partition using bamboo composites | One door was prepared using bamboo panel board and bamboo mat overlaid particleboards. One partition was prepared using bamboo panel board in frame and bamboo mat overlaid particleboards. The bamboo composite products are kept in VCWP Division for service test. |
| g) Visit to Bamboo product shop & industries | Bamboo furniture shop in Dhaka (Banani) & industry in Chittagong (AK. Khan) 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. | Manufacturing cost were calculated.(Table-1) |

**Table: 1 Bamboo composite products and manufacturing cost**

| 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 | 7,500/- | 3,000/- |
| Bamboo partition | 5ft.×4ft | *Bambusa balcooa* and *Bambusa tulda* | Bamboo panel board and bamboo mat overlaid particle | 1,500/- | 1,000/- |

**Table 2: Strength properties of Bamboo panel board and particleboard**

| Bamboo species | Composite Products/Standard | Thickness (mm) | Density (Kg/m3) | Bending strength (MOR) (N/mm2 ) | Internal bond strength (N/mm2 ) |
|---|---|---|---|---|---|
| Bambusa balcooa | Bamboo panel board | - | 615-645 | 70.35 | 10.00 |
| | Bamboo particle board | 12.20 | 754 | 15.82 | 1.20 |
| | Bamboo mat overlaid particle board | 13.13 | 756 | 24.55 | 1.21 |
| | IS:3087 (Indian Standard) | 6-40 | 500-900 | 11.20 | 0.8 |
| | B:S 5669 (British standard) | 6-19 | - | 15.0 | 0.35 |

**1.9** Achievements, if any: NA

**1.10** **Financial statement** :

1.10.1 Total cost : Tk. 5,00,000

1.10.2 Cost of the year : Tk. 1,25,000

1.10.3 Expenditure of the year : Tk. 1,20,000

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 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** :

2.6.1 **Starting year** : 2014-2015

2.6.2 **Completion year** : 2019-2020

**2.7** **Personnel(s)** :

2.7.1 Study leader : M. M. Rahaman, RO

2.7.2 Associates : K. Akhter, DO, M. Rakibul Islam F.I, M. Uddin F.I

**2.8** **Progress** :

2.8.1 **Previous progress:** 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 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 cut with clipper machine and dried up to suitable moisture content (10-12%).

2.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a) Procurement of chemicals and other materials | Chemicals such as ammonium sulphate, ethyl alcohol and materials such as miter saw, polythene tube, spray gun, mobil, grease etc were procured. |
| b) Preparation of the rubber wood chips. | Chips were prepared in hammer mill machine. |
| c) Drying of rubber wood chips up to suitable moisture (8%). | The chips were screened using screen and dried up to suitable moisture content (8%) in batch oven. |
| d) Preparation of the pulp from rubber wood chips | Rubber chips were cooked at 120°C temperature and pulp were prepared using attrition mill. |
| e) Drying of pulp up to suitable moisture (4%) content | This pulp were dried in batch oven and stored in conditioning room 65±5% relative humidity and 20±2°C temperature |
| f) Visit particleboard industries | Star particle board industry in Dhaka was visited. |

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

**2.10 Financial statement** :

2.10.1 Total cost : Tk. 7,00,000

2.10.2 Cost of the year : Tk. 1,05,000

2.10.3 Expenditure of the year : Tk. 1,00,000

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 improve design of bamboo composite furniture and popularize the bamboo composite technology to the end-users.

**3.4 Objective(s)** :

3.4.1 To improve the design of bamboo composite furniture

3.4.2 To disseminate the information to the end-users

3.4.3 To provide technical support to the business initiators for development of entrepreneurship

**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** :

3.6.1 Starting year : 2015-2016

3.6.2 Completion year : 2019-2020

**3.7 Personnel(s)** :

3.7.1 Study leader : Dr. Khurshid Akhter, DO

3.7.2 Associates : M.M. Rahaman, RO; & M. R. Islam, F I.

**3.8 Progress** :

3.8.1 Previous years, if any : NA

3.8.2 This year :

| Activities of the study | Progress |
|---|---|
| a) Procurement of chemicals and other materials | Chemicals such as urea formaldehyde glue, borax, boric acid, copper sulphate etc and materials such as planner blade, polythene tube, sprit, gala, red oxide, hand gloves were procured**.** |
| b) Selection of design of furniture. | Design of one new bending chair, two armed chair and one tea table were selected. |
| 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)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 one bending chair, two new designed armed chairs and one tea table. This composites furniture are kept in VCWP Division. |
| g. Arrangement of motivational activities in plywood and particleboard industries | Officials of Star particle board industry and A.K. Khan plywood industry are interested to use the technology in the related field. |
| h. Arrangement of training programme in Khagrachori and Nawgaon**.** | Training programme were arranged in Khagrachori on 02-01-2016 and Nawgaon on 16-05-2016**.** Furniture maker /trader/NGO's here participated in the training programme |

**3.9** Achievements, if any : NA.

**3.10 Financial statement** :

3.10.1 Total cost : Tk. 7,50,000

3.10.2 Cost of the year : Tk. 1,60,000

3.10.3 Expenditure of the year : Tk. 1,50,000

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.

Table: 1 **Bamboo composite products and manufacturing cost**

| Furniture | Bamboo species | Composite products | Material cost | Manufacturing cost |
|---|---|---|---|---|
| One bending chair | *Bambusa balcooa* and *Bambusa tulda* | Bamboo panel board and bamboo mat overlaid particle | 1,500/- | 1,000/- |
| Two Armed chair | *Bambusa balcooa* and *Bambusa tulda* | Bamboo panel board and bamboo mat overlaid particle | 5,000/- | 3,000/- |
| One tea table | *Bambusa balcooa* and *Bambusa tulda* | Bamboo mat overlaid particle | 1,000/- | 1,000/- |

## Wood Prservation 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 (*Dendrocalamus giganteus*) 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(s)** :

1.7.1 Study leader : Mozammel Hoque Chowdhury, RO.

1.7.2 Associates : Dr. Khurshid Akhter, DO.; Abdus Salam, RO.

**1.8 Progress** :

1.8.1 **Previous progress :** Bamboo samples were treated by sap-displacement and soaking method with water-borne preservative. Penetration and retention were calculated. The treated samples were installed in the BFRI and Barisal stake yard for service test. Data were collected from previously installed wood and bamboo samples periodically, afterward data were analyzed for reporting.

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. |
| b) Processing of bamboo and preparation of samples for double-diffusion method. | b) For preservative treatment nine nos of bamboo samples were prepared as follows: 3.00 m× dia 15.40 cm.; 3.00 m× dia 14.30 cm.; 3.00 m× dia 13.80 cm. |
| c) Treatment of samples with preservative by double-diffusion method. | c) Nine numbers of bamboo samples have been treated using double-diffusion method. The average retention were calculated in table-1. |
| d) Installation of treated samples in stake yards at BFRI campus & Barisal PTU campus for service test. | d) Treated samples were installed at BFRI campus, Chittagong and Plantation Trial Unit stake-yard (PTU) in Barisal for investigating service life. |
| 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 in Table-2. |
| f) Analysis of data and determination of treatability group | f) Moderately Treatable *i.e.* Group : C. |
| g) Reporting. | g) Reporting are in progress |

**1.9** Achievements, if any :

**1.10 Financial statement** :

1.10.1 Total cost : Tk. 6,00,000

1.10.2 Cost of the year : Tk. 1,00,000

1.10.3 Expenditure of the year : Tk. 80,000

1.10.4 Source of fund : GOB

**1.11 Beneficiaries** : Betel leaf farms, Bangladesh Forest Industries Development Corporation (BFIDC) and general public.

**Table-1: Retention of preservatives through bhudum (*Dendrocalamus giganteus*) bamboo treated by double-diffusion method.**

| Charge No. | Size | Average moisture content (%) | Diffusion period (day) | Average Retention (kg/m$^3$) |
|---|---|---|---|---|
| 1 | 3.00 m× dia 15.40 cm. | 57- 60 | 7 | 4.30 |
| 2 | 3.00 m× dia 14.30 cm. | 57- 60 | 14 | 7.37 |
| 3 | 3.00 m× dia 13.80 cm. | 57- 60 | 21 | 13.42 |

**Table-2: Observation of treated and untreated bhudum bamboo sample in stake-yard.**

| SL. NO | Date of installation | Date of inspection | Name Of species | Treatment method & Name of preservative | Remarks |
|---|---|---|---|---|---|
| 01 | 02-01-2014 | 14-12-2015 | Bhudum (*Dendrocalamus giganteus*) bamboo | Untreated (Control) | Fully Damaged |
| 02 | 22-02-2015 | 14-12-2015 & 29-06-2016 | Bhudum (*Dendrocalamus giganteus*) bamboo | Sap-displacement, 20% CCB solution | Treated samples are still in good condition. |
| 03 | 05-03-2016 | 14-12-2015 & 29-06-2016 | Bhudum (*Dendrocalamus giganteus*) bamboo | Soaking method, 10% CCB solution | Treated samples are still in good condition. |
| 04 | 27-04-2016 | - | Bhudum (*Dendrocalamus giganteus*) bamboo | Double-diffusion method. CB-C solution | Treated samples are still in good condition. |

**2 Study** : On going

2.1 Programme Area : Post Harvest Utilization-Chmiical Processing.

**2.2 Title of the Study** : **Popularization of preservation treatment technology through training and entrepreneurship development**

**2.3 Justification:** Betel leaf & vegetable farm are made primarily from bamboo, bamboo sticks, jute stick, paddy straw, sungrass and similar materials, which are very susceptible to biodegrading agents, and needs to be replaced after 10-12 months. Extension of the preservative treatment technology developed at BFRI for enhancing service life of low cost housing materials like bamboo and other lignocellulose materials. This technology will help people to save their hardly earned income and reduce their maintenance cost. These activities are undertaken to disseminate and popularize the treatment technology to the end-users

**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

**2.5 Expected output**:

**2.6 Study period** :

2.6.1 Starting year : 2014-2015

2.6.2 Completion year : 2016-2017

**2.7 Personnel(s)** :

2.7.1 Study leader : Abdus Salam, RO.

2.7.2 Associates : Dr. Khurshid Akhter, DO;Md. Anisure Rahman, SRO; & Mozammel Hoque Chy, RO.

**2.8 Progress** :

2.8.1 **Previous progress:** Wood, bamboo and sungrass were treated using CCB (Copper-Chrome-Boron) solution for repairing bamboo model house at Bangladesh Forest Research Institute Campus and Safari park, Dulahajra, Cox's Bazar which were made in 2006 by BFRI, Ctg. Two training programme were organized on "Increasing the service life of wood, bamboo, sungrass etc. by preservative treatment technology" at Bagmara, Rajshahi and Ramgati, Laxmipur.

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 were procured. |
| b) Treatment of housing materials for repairing of show room at BFRI Campus. | b) Housing materials were treated and bamboo model house (show room) at BFRI campus have been repaired. |
| c) Arrangement of training and motivational activities in Panchagar, Rajshahi Lalmonirhat, Rangpur and Comilla. | c) Training and motivational activities were arranged in Lalmonirhat and Naoga |

| | |
|---|---|
| d) Service life Monitoring of previously installed treated bamboo stick in betel leaf & vegetable farms in Barisal and Gaibandha. | d) Monitoring of service life of previously established experiments in betel leaf & vegetable farms in Barisal and Gaibandha are in good condition where as untreated bamboo sticks were totally destroyed. |

**2.9 Achievement(s), if any** : NA
**2.10 Financial statement** :
2.10.1 Total cost : Tk. 6,00,000
2.10.2 Cost of the year : Tk. 1,45,850
2.10.3 Expenditure of the year : Tk. 1,45,850
2.10.4 Source of fund : GOB
**2.11 Beneficiaries** : NGOs, general public, particularly the users of wood and

## 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 increase 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(s)** :
1.7.1 Study 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 progress :** Twenty five cft. mango wood was procured to apply appropriate sawing technique for maximum yield of timber. Generally yield of timber depends on the shape and size of log. Different sawing techniques for medium density wood species were applied. Sawmills at two locations, namely- Demra, Karwan bazar, Khilgaon, Dhaka and Kalurghat, Boddarhat, Chittagong were visited and data on sawing status for different wood species were collected.

1.8.2 This year :

| Activities of the year | Progress |
|---|---|
| a) Collection of 50 cft. low density wood, gamar (*Gmelina arborea*). | Fifty cft. low density wood, gamar (*Gmelina arborea*) was collected. |
| b) Visit to sawmill at two locations, namely- Rajshahi and Kaptai. | Sawmill at two locations, namely- Rajshahi and Kaptai Noadapara, Kajla, binodpur were visited. |
| c) Collection of data on present sawing status for low density wood species from different sawmills at above locations. | Data on present sawing status for low density wood species was collected from different sawmills at above locations. |
| d) Implementation of sawing technique and collection of data on those techniques for low density group wood. | Sawing technique for low density wood species were applied and data were collected .Results of low density wood, gamar (*Gmelina arborea*) are shown in table 1. |
| e) Data analysis. | Data analysis is in progress. |

**1.9** Achievements, if any : N/A
**1.10** **Financial statement** :
1.10.1 Total cost : Tk. 5,00,000
1.10.2 Cost of the year : Tk. -
1.10.3 Expenditure of the year : Tk. 38,000
1.10.4 Source of fund : GOB
**1.11** **Beneficiaries** : Sawmill owners, timber traders, timber users, BFIDC and FD.

**Table 1: Sawing data of gamar wood (*Gmelina arborea*).**

| Log No. | Quantity of round log (cft.) | Board/ Lumber | | | Kerf (mm) | Wastage of sawing wood |
|---|---|---|---|---|---|---|
| | | Size | Quantity (cft.) | Total (cft.) | | |
| 1 | 4.76 | 2.25″×8.5″×7′ | 0.94 | 4.29 | 1.7 | 0.47 |
| | | 2.25″×9″×7′ | 1.00 | | | |
| | | 2.25″×10″×7′ | 1.10 | | | |
| | | 2″×7″×7′ | 0.69 | | | |
| | | 1″×4.75″×7′ | 0.22 | | | |
| | | 1″ ×4.25″ ×7′ | 0.20 | | | |
| | | 1″ ×3″ ×7′ | 0.14 | | | |
| 2 | 5.89 | 3.2″ ×8.25″ ×7′ | 1.30 | 5.11 | 1.8 | 0.78 |
| | | 3.2″ ×9.75″ ×7′ | 1.53 | | | |
| | | 3.2″ ×8.5″ ×7′ | 1.34 | | | |
| | | 1″ ×8.5″ ×7′ | 0.30 | | | |
| | | 1.5″ ×4″ ×7′ | 0.40 | | | |
| | | 1.5″ ×5.5″ ×4′ | 0.24 | | | |
| 3 | 4.76 | 2.6″ ×8″ ×7′ | 1.03 | 4.34 | 1.7 | 0.42 |
| | | 2.5″ ×8.5″ ×7′ | 1.04 | | | |
| | | 2.5″ ×8.25″ ×7′ | 1.11 | | | |
| | | 2.75″ ×6″ ×7′ | 0.46 | | | |
| | | 1″ ×5.5″ ×7′ | 0.26 | | | |
| | | 1.5″ ×5.75″ ×7′ | 0.44 | | | |
| 4 | 4.40 | 1.7″ ×8.25″ ×7′ | 0.68 | 3.6 | 1.8 | 0.80 |
| | | 1.7″ ×8.75″ ×7′ | 0.72 | | | |
| | | 1.6″ ×8.5″ ×7′ | 0.70 | | | |
| | | 2(1.5″×7.75″ ×7′) | 1.18 | | | |
| | | 1″ ×4″ ×7′ | 0.18 | | | |
| | | 1″ ×3″ ×7′ | 0.14 | | | |
| 5 | 4.62 | 1.5″ ×6.25″ ×7′ | 0.47 | 3.72 | 1.8 | 0.90 |
| | | 1″ ×2.75″ ×7′ | 0.13 | | | |
| | | 1.5″ ×6″ ×7′ | 0.46 | | | |
| | | 2(1.5″×7.75″ ×7′) | 1.18 | | | |
| | | 2(1.7″×6.25″ ×7′) | 1.00 | | | |
| | | 1″ ×4.25″ ×7′ | 0.20 | | | |
| | | 1″ ×6″ ×7′ | 0.28 | | | |
| 6 | 5.64 | 1.5″ ×8.75″ ×5′ | 0.47 | 5.14 | 1.7 | 0.50 |
| | | 1″ ×6.5″ ×5′ | 0.22 | | | |
| | | 1″ ×7″ ×5′ | 0.23 | | | |
| | | 1″ ×6″ ×5′ | 0.20 | | | |
| | | 1.5″ ×9.5″ ×5′ | 0.51 | | | |
| | | 1.5″ ×10″ ×5′ | 0.54 | | | |
| | | 4(1.5″×10.25″×5′) | 2.20 | | | |
| | | 1.5″ ×11.25″ ×5′ | 0.62 | | | |
| | | 1″ ×6.75″ ×5′ | 0.22 | | | |
| 7 | 8.18 | 1.5″ ×8.25″ ×7′ | 0.63 | 6.54 | 1.8 | 1.64 |
| | | 1.5″ ×7″ ×6′ | 0.45 | | | |
| | | 1″ ×9.5″ ×7′ | 0.44 | | | |
| | | 5(1.7″×10.25″×7′) | 4.15 | | | |
| | | 1.5″ ×7.5″ ×7′ | 0.57 | | | |

| Log No. | Quantity of round log (cft.) | Board/ Lumber | | | Kerf (mm) | Wastage of sawing wood |
|---|---|---|---|---|---|---|
| | | Size | Quantity (cft.) | Total (cft.) | | |
| | | 1.5″ ×3″ ×7′ | 0.14 | | | |
| | | 1″ ×4.25″ ×5′ | 0.14 | | | |
| 8 | 4.59 | 1″ ×7″ ×6′ | 0.28 | 3.99 | 1.7 | 0.60 |
| | | 1″ ×9″ ×6′ | 0.36 | | | |
| | | 1″ ×8″ ×6′ | 0.32 | | | |
| | | 1″ ×6.5″ ×6′ | 0.26 | | | |
| | | 5(1″ ×11″ ×6′) | 2.2 | | | |
| | | 1″ ×8.5″ ×6′ | 0.34 | | | |
| | | 1″ ×4.5″ ×6′ | 0.09 | | | |
| | | 1″ ×3.5″ ×6′ | 0.14 | | | |
| 9 | 4.59 | 1.5″ ×6.25″ ×6′ | 0.41 | 4.04 | 1.7 | 0.55 |
| | | 1.5″ ×6.75″ ×6′ | 0.44 | | | |
| | | 3(1.5″×8.75″ ×6′) | 1.71 | | | |
| | | 1.5″ ×9.5″ ×6′ | 0.62 | | | |
| | | 1.5″ ×7.75″ ×6′ | 0.51 | | | |
| | | 1″ ×6″ ×6′ | 0.24 | | | |

**2 Study** : New

2.1 Programme Area : Post Harvest Utilization-Physiical 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(s)** :

2.7.1 Study 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 year** **:** N/A

2.8.2 This year :

| Activities of the year | Progress |
|---|---|
| a) Collection of 50 cft hybrid acacia wood. | Fifty cft. hybrid acacia log was procured. |
| b) Determination of sawing qualities. | Sawing qualities of hybrid acacia wood were determined and sawing quality is medium. |
| c) Determination of working properties, such as- planning, shaping, boring, mortising and turning by machine and hand tools. | Working properties, such as- planning, shaping, boring, mortising and turning by machine and hand tools of hybrid acacia wood were determined. The working properties of hybrid acacia wood were carried out in two different methods, by, machine tools and hand tools. Hybrid acacia wood has acceptable (from good to excellent) Working properties. , namely: planing, shaping, boring, mortising and machining properties, namely: planing, shaping, boring, mortising and turning show excellent working qualities. . Results are shown in the table 2. |
| d) Evaluation of finishing properties. | - |

**2.9 Achievement(s), if any** : N/A

**2.10 Financial statement** :

2.10.1 Total cost : Tk. 5,00,000

2.10.2 Cost of the year : Tk. 1,80,000

2.10.3 Expenditure of the year : Tk. 1,80,000

2.10.4 Source of fund : GOB

**2.11 Beneficiaries** : Common people, timber traders, wood based industries, FD, BFIDC and NGOs.

**Table 2: Working and finishing properties of hybrid acacia wood.**

| Name of the species | Sawing Qualities | % of defect free samples (Machining) | | | | | % of defect free samples (Hand tools) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Planning | Shaping | Boring | Mortising | Turning | Planning | Shaping | Boring | Mortising |
| Hybrid acacia | Medium | 90 | 50 | 90 | 90 | 100 | 100 | 100 | 90 | 90 |