

ANNUAL RESEARCH PROGRESS: 2012 – 2013



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

Contents of the Research Progress : 2012 – 13

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Summary of the Research Progress: 2012-13

FOREST MANAGEMENT WING

Sl.No.	Name of the Division/Section	Total Number of Studies		
		On-going	New	Total
01	Silviculture Research Division	07	00	07
02	Silviculture Genetics Division	04	00	04
03	Seed Orchard Division	06	00	06
04	Forest Botany Division	05	00	05
05	Forest Inventory Division	02	00	02
06	Forest Economics Division	01	02	03
07	Soil Science Division	04	00	04
08	Minor Forest Products Division	05	00	05
09	Mangrove Silviculture Division	07	00	07
10	Forest Protection Division	04	00	04
11	Plantation Trial Unit Division	07	01	08
12	Wildlife Section	01	02	03
13	Technology Transfer Unit	05	00	05
Sub-Total:		58	05	63
FOREST PRODUCTS WING				
14	Veneer and Composite Wood Products Division	01	00	01
15	Pulp and Paper Division	03	00	03
16	Wood Preservation Division	02	01	03
17	Forest Chemistry Division	00	02	02
18	Seasoning and Timber Physics Division	02	00	02
19	Wood Working and Timber Engineering Division	01	01	02
Sub-Total:		09	04	13
Total:		67	09	76

SILVICULTURE RESEARCH DIVISION

1. Study : On-going
- 1.1 Programme Area : Biodiversity and Conservation
- 1.2 Title of the Study : *Ex-situ* conservation of threatened forest tree species in different agro-ecological regions of Bangladesh.
- 1.3 Justification : Once Bangladesh was famous for its floral biodiversity. About 5700 species of angiosperms were available in Bangladesh (Hossain, 2001). More than 800 forest tree species were reported from Bangladesh. But in course of time due to different reasons the number has been decreasing. In the mean time some forest tree species have already been extinct and many are in the verge of extinction. Now a day's conservation of biodiversity is an important issue over the world. As a national institute on forestry research BFRI has a responsibility and should take necessary steps to conserve all the endangered forest tree species of Bangladesh. Therefore, the study has been undertaken.
- 1.4 Objective(s) :
- 1.4.1 To conserve selected threatened forest tree species in different agroecological regions of Bangladesh.
- 1.4.2 To observe their growth and suitability in particular sites.
- 1.5 Expected output : Fifty threatened indigenous forest tree species will be conserved over an area of fifty hectare in four agroecological regions of the country.
- 1.6 Study Period :
- 1.6.1 Starting year : 2006-2007
- 1.6.2 Completion year : 2012-2013
- 1.7 Personnel :
- 1.7.1 Project Leader: : N.G. Bhowmick, SRO
- 1.7.2 Associates : Mohammed Shahid Ullah, DFO; Nasrat Begum, SRO and A. Haque, FI
- 1.8 Progress
- 1.8.1 Previous years, if any: Raised 30.0 ha experimental plantations at Charkai, Charaljani, Keochia and Lawachara Silviculture Research (SR) Stations with 45 threatened forest tree species viz. haldu (*Adina cordifolia*), boilam (*Anisoptera scaphula*), civit (*Swintonia floribunda*), uriam (*Mangifera sylvatica*), gandhi-gazari (*Miliusa velutina*), moos (*Brownlowia elata*), dholi-garjan (*Dipterocarpus gracilis*), raktan (*Lophopetalum fimbriatum*), kannyari (*Gardenia coronaria*), menda (*Litsea monopetala*), udal (*Firmiana colorata*), barun (*Crataeva magna*), gila-batna (*Castanopsis tribuloides*), shil-batna (*Castanopsis indica*), toon (*Toona ciliata*), tali (*Palaquium polyanthum*), kanaidinga (*Oroxylum indicum*), dharmara (*Stereospermum personatum*), kanak (*Schima wallichii*), chalmugra (*Gynocardia odorata*), banspata (*Podocarpus neriifolius*), banderhola (*Duabanga grandiflora*), putranjiva (*Putranjiva roxburghii*), parul (*Stereospermum suaveolens*), bhutum (*Hymenodictyon orixensis*), bazna (*Zanthoxylum rhetsa*), gurja-batna (*Lithocarpus pachyphylla*), goda/awal (*Vitex peduncularis*), hargaza (*dillenia pentagina*), jawa/barela (*Holigarna caustica*), etc.
- 1.8.2 This year :

Action plan as per annual research programme	Progress
a. Collection of seeds and raising 15,000 seedlings of different threatened forest tree species namely barella, gutguttya, hijal, kainjal, banderhola, dhup, karpur, bon-sonalu and tali (other important species will also be included based on the availability of seeds) at HQ, Charkai, Charaljani, Keochia and Lawachara Research Stations.	Raised 15,000 seedlings of different species such as arjun (<i>Terminalia arjuna</i>), hartaki (<i>Terminalia chebula</i>), jayna (<i>Schleichera oleosa</i>), teligarjan (<i>Diptericarpus turbinatus</i>), dhaligargan (<i>Dipterocarpus gracilis</i>), sonalu (<i>Caccia fistula</i>), karamcha, gandhi-gazari (<i>Miliusa velutina</i>), pitraj (<i>Aphanamixis polystachya</i>), haldu (<i>Adina cordifolia</i>), khayer (<i>Acacia catechu</i>), dhup (<i>Canarium resiniferum</i>), udal (<i>Firmiana colorata</i>), dharmara (<i>Stereospermum personatum</i>), kannyari (<i>Gardenia coronaria</i>), ban amra (<i>Spondias sp.</i>), tali (<i>Palaquium polyanthum</i>), agar (<i>Aquillaria malacences</i>), tamal (<i>Garcinia xanthocymus</i>), telsur (<i>Hopea odorata</i>), kala menda (<i>Litsea spp.</i>), batna (<i>Castanopsis indica</i>), putranjiva (<i>Putranjiva roxburghii</i>), sida jarul (<i>Lagerstroemia spp.</i>), kadam (<i>Neolamarkia cadamba</i>), chikrashi (<i>Chukrasia tabularis</i>), khaya babla (<i>Pithecellobium dulce</i>), bakul (<i>Mimusops elngi</i>), balaz, box badam, tabbi, chuka kala at HQ, Charkai, Charaljani, Keochia and Lawachara Research Stations.

b. Maintenance of seedlings in the nursery through weeding, watering, sorting, rearrangement, etc.	Seedlings in the nursery were maintained through weeding, watering, sorting, rearrangement, etc.
c. Raising of 4.0 hectares experimental plantations at Charkai, Charaljani, Keochia and Lawachara SR stations.	Raised 4.0 hectares experimental plantations at Charkai, Charaljani, Keochia and Lawachara SR stations.
d. Maintenance of 30.0 ha last years' experimental plantations (2006-07 6 ha, 2007-08 4 ha, 2008-09 4 ha, 2009-10 6 ha, 2010-11 4 ha and 2011-12 6 ha) through weeding, vacancy filling, cleaning, climber cutting, pruning, etc.	Maintained 30.0 hectare last years' experimental plantations by weeding at Charkai, Charaljani, Keochia, Lawachara SR Stations and HQs,.
e. Collection of survival and growth (height and diameter at breast height) data at six months interval.	Survival and growth data from the experimental plantations were collected in the month of December 2011 and June 2012.
f. Compilation of data and reporting.	Field data were summarized and compiled.

1.9 Achievement (s), if any : Conserved 45 threatened species viz. haldu, boilam, civit, uriam, gandhi-gazari, moos, dholi-garjan, raktan, kannyari, menda, udal, barun, gila-batna, shil-batna, toon, tali, kanaidinga, dharmara, kanak, chalmugra, banspata, banderhola, putranjiva, parul, bhutum, bazna, gurja-batna, goda/awal, hargaza, jawa/barela, dhup, sidha-jarul, khayer, kainjal, Karang, ban amra, udal, kannyari, mahua, pitraj, sonalu, dharmara, haldu, bohera, hartaki in the conservation plots at four Silviculture Research Stations .

1.10 Financial statement :

1.10.1 Total cost : Tk. 25,00,000.00

1.10.2 Cost of the year : Tk. 3,25,000.00

1.10.3 Expenditure of the year : Tk. 3,25,000.00

1.10.4 Source of fund : GOB

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

2. Study : On-going

2.1 Programme Area : Plantation Techniques and Forest Management.

2.2 Title of the Study : Development of planting technique of Sal (*Shorea robusta*).

2.3 Justification: *Shorea robusta* (sal) is an important timber species of Bangladesh. It is a deciduous plant. It regenerates naturally through seed and coppice. Due to unregulated cutting and illicit felling and also due to encroachment, sal forest area has been decreasing day by day. Enrichment plantation is necessary to improve the vegetation of sal forest. In India it is found that direct sowing is the cheapest and best method of artificial propagation of sal, although stump plantings, planting out entire plants with balls of earth, and planting out container-grown seedlings are also employed. However, there is no record of sal plantation in Bangladesh. For this, nursery raising and plantation technique will be needed. So, the present study has been under taken.

2.4 Objective :

2.4.1 To develop suitable planting technique of sal.

2.4.2 To enrich the degraded sal forest through aided regeneration.

2.4.3 To monitor the change of biodiversity of sal forest overtime after establishing the plantation.

2.5 Expected Output : Techniques for restoration of degraded sal forest will be developed

2.6 Study period :

2.6.1 Starting year : 2010-2011

2.6.2 Completion year : 2014-2015

2.7 Personnel :

2.7.1 Project Leader: : Nasrat Begum, SRO.

2.7.2 Associates: : Mohammed Shahid Ullah, DFO; N.G. Bhowmick, SRO and Azizul Haque, FI.

2.8 Progress: :

2.8.1 Previous years, if any: Two hectare experimental plantations were established at Charaljani (1 ha) and Charkai (1 ha) SR Stations through planting seedlings and sowing seeds in thallis

2.8.2 This year :

Action plan as per annual research programme	Progress
a. Collection of 5000 seeds from the selected mother trees and raising 2,400 seedlings at Charaljani and Charkai SR Stations.	Two thousand four hundred seedlings were raised at Charkai (1200 nos.) and Charaljani (1200 nos.) SR Stations.
b. Maintenance of seedlings in the nursery through weeding, watering, sorting, rearrangement, etc.	Seedlings were maintained in the nursery through watering, sorting, rearrangement, etc.
c. Development of nursery bed at Charaljani SR station	A 40' X 36' cemented nursery bed has been constructed.
d. Raising of 1.0 ha experimental plantations at Charaljani (0.50 ha) and Charkai (0.5 ha) SR Stations by seedlings, stumps and direct seed sowing in thallis.	Raised of 1.0 ha experimental plantations at Charaljani (0.50 ha) and Charkai (0.50 ha) SR Stations by seedlings and direct seed sowing in thallis.
e. Maintenance of 2.0 ha last year's experimental plantations through weeding, vacancy filling, cleaning, climber cutting, etc.	Two hectare last year's experimental plantations were maintained through weeding at Charaljani and Charkai SR Stations.
f. Collection of survival and height growth data at four months interval.	Survival and growth data were collected at six months interval. Last data collected during June 2013.
g. Analysis of data and reporting.	Field data were summarized and compiled.

2.9 Achievement (s), if any : NA

2.10 Financial Statement :

2.10.1 Total cost : Tk. 5,00,000.00

2.10.2 Cost of the year : Tk. 1,14,400.00

2.10.3 Expenditure of the year : Tk. 1,14,400.00

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 : Plantation techniques and forest management.

3.2 Title of the Study : Study on the development of Oil Palm (*Elaeis guineensis*) cultivation in Bangladesh.

3.3 Justification : There is a great potentiality of oil palm plantation and production of palm oil in Bangladesh. Climatic condition of Bangladesh and different environmental requirements for oil palm plantation is also in favour. For the last few years oil palm has been planting in different places of Bangladesh which found very much promising. However, before going to large scale plantation of this commercial plant, standardization of nursery and plantation technique for Bangladeshi environment is imperative. So, the present study has been undertaken.

3.4 Objective (s) of the Study :

3.4.1 To determine present status of oil palm plantation in Bangladesh.

3.4.2 To standardize nursery raising technique and management.

3.4.3 To standardize plantation (spacing) and management technique of oil palm.

3.4.4 To study the reproductive biology of oil palm in plantations of Bangladesh.

3.4.5 To introduce and test the high yielding variety (HYV) of oil palm.

3.5 Expected output: Present status of oil palm in Bangladesh will be determined. Nursery and plantation technique will be standardized. Suitable variety of oil palm will be selected for large scale plantation in Bangladesh.

3.6 Study period :

3.6.1 Starting year : 2010-2011

3.6.2 Completion year : 2019-2020

- 3.7 Personnel :
- 3.7.1 Project Leader : Mohammed Shahid Ullah, DFO
- 3.7.2 Associates: : Nani Gopal Bhowmick, SRO, SRD; Rafiqul Islam, DO, FPD; Rafiqul Haider, DO, MFPD; Motiar Rahman, RO, SSD; Nusrat Begum, FI, SGD
- 3.8 Progress :
- 3.8.1 Previous years, if any: Raised 4.5 ha experimental plantations at Charaljani, Keochia and Hinguli Research Stations.
- 3.8.2 This year: :

Action plan as per annual research programme	Progress
a. Visit to oil palm plantations raised by Govt. agencies or private owners at different locations (Chittagong, Bandarabans, Sylhet, Moulavibazar, Tangail, etc.) for collection of information on growth, flowering, fruiting, disease infestation, etc.	a. Visited oil palm plantation at Satchari, Lawachara, Holodia, Lohagara and Chittagong Cantontment. Collected data on flowering, fruiting, leaf production, growth etc.
b. Collection of seeds and raising 1,500 seedlings in 9 X 6 polybag at Charaljani, Keochia and Charkai Research Stations (500 in each station).	b. Collected oil palm seeds and raised one thousand fifteen hundred seedlings at Charaljani, Keochia and Hinguli Research Station.
c. Collection of data on germination period, germination percentage, survival, growth, disease infestation, etc. of the seedlings at nursery and field level.	c. Germination of oil palm seeds was found to start after 32 days and complete within 58 days. Germination percentage was 67%. Witthin 6 months seedlings attain a height of 25.38 cm.
d. Maintenance of seedlings in the nursery through weeding, watering, sorting, rearrangement, etc.	d. Maintained seedlings in the nursery through weeding, watering, sorting, rearrangement, etc.
e. Raising of 4.5 ha new oil palm plantation with three spacings (viz. 5m x 5m, 6m x 6m, and 7m x 7m) with RCBD design at Charaljani, Keochia and Charkai Research Stations (1.5 ha in each station).	e. Raised 4.5 ha oil palm plantation with three spacings (viz. 5m x 5m, 6m x 6m, and 7m x 7m) with RCBD design at Charaljani, Keochia and Charkai Research Stations (1.5 ha in each station).
f. Maintainance of 9.0 ha last years' experimental plantations through weeding, gap-filling, cleaning, climber cutting, etc.	f. 9.0 hectare last year's experimental plantations were maintained through weeding, vacancy filling etc. at Charaljani, Keochia and Hinguli Research Stations.
g. Watering the seedlings in the last year plantation during dry season (Feb – May) with different treatments.	g. Watering the seedlings in the last year plantation was made during dry season (Feb–May).
h. Collection of data on survival, growth, number of fronds, etc.	h. Collected survival and growth data during December/12 and June/13.
i. Analysis of data and report writing.	i. Collected data were compiled.

- 3.9 Achievement (s), if any :
- 3.10 Financial statement :
- 3.10.1 Total cost : Tk. 15,00,000.00
- 3.10.2 Cost of the year : Tk. 1,99,500.00
- 3.10.3 Expenditure of the year : Tk. 1,99,500.00
- 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 : Breeding and Tree Improvement
- 4.2 Title of the Study : Growth performance of different forest tree species in research plots.
- 4.3 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 five Silvicultural 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 necessary data the experiment has been undertaken.

- 4.4 Objective (s) :
- 4.6.1 To assess the growth performance of different tree species in four agroecological regions of the country.
- 4.6.2 To determine the silvics of different forest tree species.
- 4.6.3 To develop future quality seed sources.
- 4.5 Expected output : Site suitable species and provenances for plantation development will be selected for different site quality index in different agroecological regions of Bangladesh. Silvicultural techniques (spacing, weeding, fertilization, pruning, thinning and coppicing) for plantation management will be developed for maximizing yield of the plantation.
- 4.6 Study period :
- 4.6.1 Starting year : 1996-1997
- 4.6.2 Completion year : 2014-2015
- 4.7 Personnel :
- 4.7.1 Project Leader : Mohammed Shaid Ullah, DFO.
- 4.7.2 Associates : Nasrat Begum, SRO; N. G. Bhowmick, SRO and Azizul Haque, FI.
- 4.8 Progress :
- 4.8.1 Previous years, if any: Up to 2011, raised 101.0 ha experimental plantations (species elimination trials; provenance trials, coppicing trials, spacing trials, mixed planting trials, underplanting trials, planting technique, arboretum of 36 species, etc.) at four Silviculture Research Stations. Maintained those plantations by weeding, cleaning, climber cutting, pruning, etc. Assessed biomass of three eucalyptus species viz. *Eucalyptus camaldulensis*, *E. tereticornis* and *E. brassiana* (3rd rotation) at Charkai SR Station. Compiled phenological data of 240 indigenous and exotic tree species.
- 4.8.2 This year :

Action plan as per annual research programme	Progress
a. Maintenance of 50.0 ha experimental plantations (species elimination and site suitability trial, provenance trial, mixed species trial plantations, broom grass plantations, bamboo plantations, etc) raised up to 2011 at Keochia, Lawachara , Charaljani and Charkai SR stations.	Maintained 50.0 ha previously raised experimental plantations (growth trial, eucalyptus coppicing trial, spacing trial, site suitability trial, and mixed species trial plantations) by weeding at Keochia, Lawachara, Charaljani and Charkai SR stations.
b. Collection of data on survival, height, diameter at breast height, length of clean bole, straightness of stem, total biomass, coppicing ability etc.	Collected survival and height growth data on older plantations.
c. Data analysis and reporting.	Collected data were compiled.

- 4.9 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 *A. mangium*, 3 provenance of *P. caribaea*, 3 provenance of *P. oocarpa*, 4 provenance of *Glericidia sepium*, 3, 2, 2, 2 provenance of *E. camaldulensis*, *E. brassiana*, *E. tereticornis*, *E. urophylla* respectively), established plantations of 70 indigenous and exotic tree species.
- 4.10 Financial statement :
- 4.10.1 Total cost : Tk. 40, 00,000.00
- 4.10.2 Cost of the year : Tk. 2,59,000.00
- 4.10.3 Expenditure of the year : Tk. 2,59,000.00
- 4.10.4 Source of fund : GOB
- 4.11 Beneficiaries : FD, Wood based industries, NGOs, Farmers, Educational Institutions and other tree planting agencies

5. Study : On-going
- 5.1 Programme Area : Production of quality planting materials.
- 5.2 Title of the Study : Large Scale Production of Quality Seedlings of important forest tree species.
- 5.3 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 conscious 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.

- 5.4 Objective (s) :
- 5.4.1 To determine age, height and root-shoot ratio of seedlings for dispatch from nursery to plantation.
- 5.4.2 To provide quality seedlings to planters for successful plantation establishment.
- 5.4.3 To develop linkages with planters for awareness development about quality seedling.
- 5.5 Expected output: Awareness development about quality seeds and seedlings. b) Increased yield of timber and fuel wood
- 5.6 Study period :
- 5.6.1 Starting year : 2006-2007
- 5.6.2 Completion year : 2014-2015
- 5.7 Personnel :
- 5.7.1 Project Leader : Nani Gopal Bhowmick SRO
- 5.7.2 Associates : Mohammed Shaid Ullah, DFO and Nasrat Begum, SRO.
- 5.8 Progress :
- 5.8.1 Previous progress, if any : Raised and distributed more than 10 lakh quality seedlings of about more than 56 forest tree species raised viz- acacia hybrid (*Acacia auriculiformis* X *A. mangium*), banderhola (*Duabanga grandiflora* (Roxb. ex DC.) Wall.), civit (*Swintonia floribunda* Griff.), teli-garjan (*Dipterocarpus turbinatus* Gaertn.), gamar (*Gmelina arborea* Roxb.), sal (*Shorea robusta* Gaertn.f.), shegun (*Tectona grandis* L.), lohakat (*Xylia kerrii* Craib & Huta), chickrassi (*Chukrassia velutina* W & A), eucalyptus (*Eucalyptus camaldulensis* Dehnm.), raintree (*Samanea saman* (Jacq.) Merr.), mahogany (*Swietenia mahagoni* (L.) N.J.Jacquiu), sonalu (*Cassia fistula* L.), kala-koroi (*Albizia lebbek* (L.) Benth), raj-koroi (*A. richardiana* King & Prain), sil-koroi (*A. procera* (Roxb.) Benth), chakua-koroi (*Albizia chinensis*), motor-koroi (*Albizia lucida*), arjun (*Terminalia arjuna* (Roxb.) Wt. & Arn.), pitraj (*Aphanamixis polystachya*), bohera (*Terminalia bellirica* (Gaertn.) Roxb.), haritaki (*Terminalia chebula* (Gaertn.) Retz.), menda (*Litsea monopetala* (Roxb.) Pers.), haldu (*Adina cordifolia*), katbadam (*Terminalia catappa* L.), palas (*Butea monosperma* (Lam.) Taub.), khayer (*Acacia catechu*), tamal (*Diospyros montana* Roxb.), krishnachura (*Delonix regia* (Bojer) Rafin), kalo-jam (*Syzygium cumini*), kanchan (*Bauhinia racemosa* Lamk.), jarul (*Lagerstroemia speciosa* (L.) Pers.), parul (*Stereospermum suaveolens* A. DC.), dhakijam (*Syzygium grandis*), chapalish (*Artocarpus chama*), telsur (*Hopea odorata*), champa (*Michelia champaca*), cryptocarya (*Cryptocarya amygdalina* and baobab (*Andansonia digitata*), kerung (*Pongamia pinnata* L.), boiam (*Anisoptera scaphula*), toon (*Toona ciliata*), chalmugra (*Gynocordia odorata*), goda/awal (*Vitex peduncularis*), raktan (*Lophopetalum fimbriatum*), udal (*Firmiana colorata*), sidha-jarul (*Lagerstroemia parviflora*), hargaza (*dillenia pentagyna*), dholi-garjan (*Dipterocarpus alatus*), kanaidinga (*Oroxylum indicum*), agar (*Aquilaria agallocha*), gandhi-gazari (*Miliusa velutina*), pakhiara (*Thespesia populnea*), mailam (*Bouea oppositifolia*), pine (*Pinus caribaea*), dharmara (*Stereospermum personatum*), punnyal (*Calophyllum inophyllum*) etc.
- 5.8.2 This year :

Action plan as per annual research programme	Progress
a. Development of nursery bed through fencing at HQs,.	Boundery of HQs nursery area (174') have been fenced with steel angle stand and net.
b. Collection of seeds of dominant/popular forest tree species from seed orchards, plantations and natural forests.	Seeds were collected from selected mother trees.
c. Raising of 30,000 seedlings at HQs.	Raised 30,000 seedlings of different forest tree species such as mahogany (<i>Swietenia mahagoni</i>), raintree (<i>Samanea saman</i>), shegun (<i>Tectona grandis</i>), jarul (<i>Lagerstroemia speciosa</i>), arjun (<i>Terminalia arjuna</i>), bohera (<i>Terminalia bellirica</i>), amra (<i>Spondias pinnata</i>), sil-koroi (<i>A. procera</i>), hortoki (<i>Terminalia chebula</i>), kat-badam (<i>Terminalia catappa</i>), amloki (<i>Phyllanthus emblica</i>), chickrassi (<i>Chukrassia velutina</i>), dhakijam (<i>Syzygium grandis</i>), toon (<i>Toona iliate</i>), telsur (<i>Hopea odorata</i>), prosopis (<i>Prosopis juliflora</i>), sal (<i>Shorea robusta</i>), teli-garjan (<i>Dipterocarpus turbinatus</i>), acacia hybrid (<i>Acacia auriculiformis</i> X <i>A. mangium</i>), etc. at HQs nursery.

d. Maintenance of seedlings in the nursery through weeding, watering, sorting, rearrangement, etc.	Maintained last year left over and this year seedlings in the nursery through watering, weeding, sorting, rearrangement, etc.
e. Collection of data on seedlings growth, collar diameter, root-shoot ratio of different species.	Collected data on seedlings growth, collar diameter, root-shoot ratio of different species.

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

5.10 Financial Statement :

5.10.1 Total cost : Tk. 15,00,000.00

5.10.2 Cost of the year : Tk.1,75,500.00

5.10.3 Expenditure of the year : Tk.1,75,500.00

5.10.4 Source of fund : GOB

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

6. Study : On-going

6.1 Programme Area : Plantation Techniques and Forest Management.

6.2 Title of the Study : Spacing trial of agar plantation (*Aquillaria malacences*).

6.3 Justification : In Bangladesh, specially in the Sylhet region history of agar plantation, production of agar oil, export of agar oil in the middle east country is from few decades ago. In recent years it is gaining great potentiality. Government of Bangladesh is also giving importance on this con-conventional exporting item. Bangladesh Forest Research Institute has been conducting research on various aspects for increasing production and processing of agar oil in the plantation. As a general rule higher biomass (timber) will give higher production of agar oil. In Bangladesh various govt. and private planters are raising agar plantation with different spacing. But spacing has a great role on the biomass production. So, the study has been undertaken to observe the effect of spacing on the biomass production of agar plantations and agar accumulation in particular.

6.4 Objective (s) :

6.4.1 To determine the optimum spacing for agar plantation.

6.4.2 To assess biomass production and effect of spacing on agar formation.

6.5 Expected output Optimum spacing for agar plantation will be determined. Biomass production and effect of spacing on agar formation will be determined.

6.6 Study period :

6.6.1 Starting year : 2010-2011

6.6.2 Completion year : 2016-2017

6.7 Personnel :

6.7.1 Project Leader : Mohammed Shaid Ullah, DFO

6.7.2 Associates : Nasrat Begum, SRO and Nani Gopal Bhowmick, SRO.

6.8 Progress :

6.8.1 Previous progress, if any : Raised 2.32 ha experimental plantations at Keochia and Charaljani SRS.

6.8.2 This year :

Action plan as per annual research programme	Progress
a. Collection of agar seeds and raising 6000 seedlings at Charkai, Charaljani and Keochia SR Stations.	Collected agar seeds and raised 6000 thousand seedlings at Charaljani (2000 nos.), Keochia (2000 nos.) and Charkai (2000 nos.) SR Stations.
b. Maintenance of seedlings in the nursery through weeding, watering, sorting, rearrangement, etc.	Maintained seedlings in the nursery through watering, sorting, rearrangement, etc.
c. Development of nursery bed at Charkai SR station	A 40' X 36' cemented nursery bed has been constructed.
d. Raising of 3.48 ha new agar plantation at four spacing (viz. 1.50m x 1.50m, 2.00m x 2.00m, 2.50m x 2.50m and 3.00m x 3.00m) at Charaljani, Keochia and Charkai SR Stations.	Raised of 3.48 ha new agar plantation at four spacing (viz. 1.50m x 1.50m, 2.00m x 2.00m, 2.50m x 2.50m and 3.00m x 3.00m) at Charaljani, Keochia and Charkai SR Stations.

e. Maintenance of 2.32 ha last year's experimental plantations through weeding, gap-filling, cleaning, climber cutting, pruning, etc.	Maintained 2.32 ha last year's experimental plantations through weeding at Charaljani and Keochia SR Stations.
f. Collection of data on survival and height growth of the seedlings in the plantations at six month interval.	Data on survival and height growth were recorded.
g. Analysis of data and reporting.	Collected data were compiled.

6.9 Achievement (s), if any :

6.10 Financial statement

6.10.1 Total cost : Tk. 5,40,000.00

6.10.2 Cost of the year : Tk. 1,68,000.00

6.10.3 Expenditure of the year : Tk. 1,68,000.00

6.10.4 Source of fund : GOB

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

7 Study : On-going

7.1 Programme Area : Biodiversity and Conservation.

7.2 Title of the Study : Regeneration study of tree species in Chunati wild-life sanctuary.

7.3 Justification : Up to 1960 natural regeneration in different forest areas of Chunati Wild Life Sanctuary was dense as documented in old work plans. Unfortunately, after 1980 the great biodiversity value of natural forest of Chunati became destroyed due to unregulated harvesting by the local people for meeting their demand for subsistence consumption. Keeping the view of controlling deforestation and conservation of biodiversity, mainly to conserve the forest land as elephant corridor forest Government of Bangladesh declared the Chunati forest (7,764ha) as Wildlife Sanctuary in 1986. The Chunati forest still has good habitat for elephant's corridor for visiting forest of Chittagong Hill Tracts (CHT). However there is no scientific information on important natural resources of tree species. In order to find out the ecosystem of natural tree species and their trends as well as the formulation of enrichment strategy the study has been undertaken.

7.4 Objective (s) :

7.4.1 To determine the regeneration status of tree species in chunati wild life sanctuary.

7.4.2 To determine the regeneration trends in chunati wild life sanctuary

7.5 Expected output: Regeneration status of the species in chunati wild life sanctuary will be known. Regeneration trends of chunati wild life sanctuary will be determined. Enrichment planting strategy will be formulated.

7.6 Study period :

7.6.1 Starting year : 2010-2011

7.6.2 Completion year : 2012-2013

7.7 Personnel :

7.7.1 Project Leader : Nasrat Begum, SRO.

7.7.2 Associates : Mohammed Shahid Ullah, DFO, N.G. Bhowmick, SRO.

7.8 Progress :

7.8.1 Previous years, if any : Sites were selected at Chunati Beat, Lohagara, Cambul and Pnuichari Beat, Banskhali, Chittagong. Twenty seven plots (20m X 20m sized) were laid out at three locations (9 plots in each location). Regeneration data of tree species were collected once from each location. Soil samples were collected from Punichari, processed and sent to SRDI for analysis.

7.8.2 This year :

Action plan as per annual research programme	Progress
a. Data collection on regeneration from last year's selected plots at Chunati Beat, Chambol Beat and Puichari Beat in Chunati Wild Life Sanctuary.	Collected regeneration data from last year's selected plots in Chunati Beat, Harbung Beat, Chambol Beat, Puichari Beat and Napura Beat at Chunati Wild Life Sanctuary.
b. Layout of plots (quadrate) to	Surveyed, selected sites and laid out plots (quadrate) at Aziznagar Beat,

observe regeneration at Jaldi Range. Collection of regeneration data (seedlings of ≥ 20 cm in height and samplings of each species will be counted).	Chunati Range and Jaldi Beat, Jaldi Range. - Eighteen 20.0m x 20.0m sized plots were laid out (9 plots in each site) Aziznagar Beat, Chunati Range and Jaldi Beat of Jaldi Range to observe regenerations. - Collected regeneration data (seedlings of ≥ 20 cm in height and samplings of each species counted).
c.Collection and analysis of soil samples (micro and macro nutrients, soil texture, pH, moisture content, bulk density, water holding capacity, etc).	Soil samples were collected from Aziznagar Beat, Chunati Range and Chambol Beat, Napora Beat and Jaldi Beat of Jaldi Range. Samples were processing for analysis.

- 7.9 Achievement (s), if any :
- 7.10 Financial statement :
- 7.10.1 Total cost : Tk.2,40,000.00
- 7.10.2 Cost of the year : Tk.58,600.00
- 7.10.3 Expenditure of the year : Tk.58,600.00
- 7.10.4 Source of fund : GOB
- 7.11 Beneficiaries : FD, NGOs, Farmers, Educational institutions and other tree planting agencies.

SILVICULTURE GENETICS DIVISION

- 1 Study : Ongoing
- 1.1 Programme Area : Bamboo and Non-Timber Economic Crops
- 1.2 Title of the Study : Mass propagation of bamboos (*Dendrocalamus giganteus*, *B. tulda*, *B. vulgaris*, *B. bambos*, *B. balcooa*, and *Dendrocalamus brandisii*) through branch cuttings and seedlings proliferation.
- 1.3 Justification : Bamboo has always been in great demand as raw materials for housing, agricultural implement and for handicrafts industries in the rural areas. Besides these, with the present rate of consumption and supply, bamboo has become a scarce commodity in Bangladesh. There is an urgent need to develop the bamboo resource base through massive programme for plantations with genetically improved planting stocks.
- 1.4 Objectives :
- 1.4.1 To make available bamboo propagules for wider 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 : 2003-2004
- 1.6.2 Completion year : 2013-2014
- 1.7 Personnel (s) :
- 1.7.1 Study Leader : Sharmila Das, DO
- 1.7.2 Associates : Nusrat sultana, FI, Saiful Alam Md. Tareq, FI
- 1.8 Progress :
- 1.8.1 Previous years, if any : Fifteen thousand raised seedlings of five bamboo species (*Dendrocalamus giganteus*, *Bambusa vulgaris*, *B. balcooa*, *B. bambos* and *B. tulda*) were distributed to the planters.
- 1.8.2 This year :

Activities of the study	Progress
a. Collection of planting materials of selected species.	a. Collected 4500 planting materials of selected species.
b. Production of ten thousand bamboo propagules (Five thousand through branch cuttings and five thousand through seed and seedling proliferation).	b. About 4000 propagules were raised through branch cuttings and 2000 through seedling proliferation.
c. Data collection on survival rate of cuttings.	c. The survival rate of cuttings of <i>Dendrocalamus giganteus</i> was about 18% and 70 – 90% for other species.

- 1.9 Achievement(s), if any : People’s awareness increased for bamboo production through planting branch cuttings propagules.
- 1.10 Financial statement :
- 1.10.1 Total cost : Tk. 12,50,000.00
- 1.10.2 Cost of the year : Tk. 1,27,400.00
- 1.10.3 Expenditure of the year : Tk. 1,27,400.00
- 1.10.4 Source of fund : GOB
- 1.11 Beneficiaries : BFRI, FD, NGO’s, Universities

- 2 Study : Ongoing
- 2.1 Programme Area : Bio-diversity and Conservation
- 2.2 Title of the Study : Conservation of threatened plant species through domestication.
- 2.3 Justification : In Bangladesh some important naturally grown tree species are gradually becoming threatened due to uncontrolled biotic interference. Forests of the humid tropics contain a large portion of the plant genetic resources of the earth and therefore, their destruction implies the extinction of a large part of genetic resources of the earth. Thus it is noble duty of plant scientists to work in preventing such “genetic erosion” and in some case “species erosion”.
- 2.4 Objectives :
- 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 gene resources conservation.
- 2.6 Study period :
- 2.6.1 Starting year : 2003-2004
- 2.6.2 Completion year : 2013-2014
- 2.7 Personnel (s) :
- 2.7.1 Study Leader : Sharmila Das, DO
- 2.7.2 Associates : Nusrat sultana, FI, Saiful Alam Md. Tareq, FI
- 2.8 Progress :
- 2.8.1 Previous years, if any : About fifteen thousand seedlings of twelve threatened tree species were raised in nursery and are being maintained in the nursery for conservation plots.
- 2.8.2 This year :

Activities of the study	Progress
a. Collection of seeds and seedlings of five threatened species	a. Seeds of available threatened species such as civit (<i>Swintonia floribunda</i>), chalmugra (<i>Hydnocarpus kurzii</i>), dharmara (<i>Stereospermum personatum</i>) and buddha narikal (<i>Pterygota alata</i>) 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 3000 seedlings of collected species and are being maintained in the nursery bed.
c. Raising one acre plantation as conservation plot in IFESCU campus	c.

- 2.9 Achievement(s), if any: 0.50 acre of conservation plots of 8 threatened species raised at Foy’s Lake as gene resource conservation plot.
- 2.10. Financial statement :
- 2.10.1 Total cost : Tk. 6,00,000.00
- 2.10.2 Cost of the year : Tk. 76,400.00
- 2.10.3 Expenditure of the year : Tk. 76,400.00
- 2.10.4 Source of fund : GOB
- 2.11 Beneficiaries : BFRI, FD, NGO’s, Universities

3. Study : Ongoing
- 3.1 Programme Area : Breeding and Tree Improvement
- 3.2 Title of the Study : Development of tissue culture techniques for different bamboo species viz. farua (*Bambusa polymorpha*), bhudum (*Dendrocalamus giganteus*), china bamboo (*D. latiflorus*), wappi (*Thyrsostachys sp.*) and pencha (*D. hamiltoni*)
- 3.3 Justification: With the passage of time the demand for bamboo are increasing while its availability is declining. Conventional bamboo propagation method is extremely difficult on account of long and often erratic flowering cycle. Micro-propagation of bamboo would be useful even with seed, seedling and adult tissue, as it would augment the supply of planting material and multiplying superior bamboo clumps on a large scale.
- 3.4 Objectives :
- 3.4.1 To develop easy micro-propagation techniques for the bamboo species
- 3.4.2 To produce a homogenous plant population
- 3.4.3 *In vitro* conservation of 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 : 2008-2009
- 3.6.2 Completion year : 2013-2014
- 3.7 Personnel (s) :
- 3.7.1 Study Leader : Shamila Das, DO
- 3.7.2 Associates : Nusrat sultana, F.I, Saiful Alam Md. Tareq, FI
- 3.8 Progress :
- 3.8.1 Previous years, if any : Culture establishment and multiple shoot (2010-2012) production farua (*Bambusa polymorpha*), budum (*Dendrocalamus giganteus*), dolu (*Schizostachyum dullooa*), membra (*D. membranaceus*), ora (*D. longistathus*), (*D. latiflorus*), wappi (*Thyrsostachys sp.*) and pencha (*D. hamiltonii*) bamboos have been done and rooted plantlets of brandisii were transferred to green house.
- 3.8.2 This year :

Activities of the study	Progress
a. Explants collection	a. Explants (nodal bud) of wappi bamboo (<i>Thyrsostachys sp.</i>) farua (<i>Bambusa polymorpha</i>), budum (<i>Dendrocalamus giganteus</i>) and pencha (<i>D. hamiltoni</i>) were collected.
b. Culture establishment and plantlets production.	b. Sprouted nodal buds of selected species have developed by applying two concentrations of BAP (6- Benzyl Amino Purine) with MS and B ₅ media (Table 1). Multiple shoot has been established from the sprouted nodal buds.
c. Root induction and maintenance of the plantlets.	c. Root induction process is in progress.
d. Transfer of the plantlets into soil for hardening.	d.
e. One thousand tissue culture bamboo seedlings will be produced.	e.

- 3.9 Achievement(s), if any :
- 3.10 Financial statement :
- 3.10.1 Total cost : Tk. 21,50,000.00
- 3.10.2 Cost of the year : Tk. 47,740.00
- 3.10.3 Expenditure of the year : Tk. 47,740.00
- 3.10.4 Source of fund : GOB
- 3.11 Beneficiaries : BFRI, FD, NGO's, Universities

Table 1. Percentage range of sprouted nodal bud as the effect of two concentrations of BAP (6-Benzyl Amino Purine) in five bamboo species

Species	Media without growth regulator		Media with growth regulator			
			BAP 0.5mg/l		BAP 1.0mg/l	
	MS	B5	MS	B5	MS	B5
<i>Dendrocalamus giganteus</i>	35 - 40	25 - 30	55 - 60	25 - 35	65 - 70	45 - 50
<i>D. latiflorus</i>	40 - 50	35 - 40	60 - 65	35 - 40	75 - 80	55 - 60
<i>D. hamiltonii</i>	20 - 30	15-25	35-40	25-30	45 - 50	30 - 40
<i>Bambusa polymorpha</i>	30 - 35	20-30	50-60	40-45	60 - 65	40 - 50
<i>Thyrsostachys sp.</i>	40 - 45	30 - 35	60 - 70	20 - 30	75 - 80	40 - 50

4. Study : Ongoing
- 4.1 Programme Area : Breeding and Tree Improvement
- 4.2 Title of the Study : Development of tissue culture techniques for 1) Timber trees: boilam (*Anisoptera scaphula*) tamal (*Diospyros montana*), 2) Medicinal plant: amloki (*Phyllanthus emblica*) and 3) Fruit tree: lotkon (*Baccaurea sapida*)
- 4.3 Justification: *In vitro* conservation and production of genetically unique huge plantlets of tree is possible for future demand.
- 4.4 Objectives :
- 4.4.1 To develop easy micro-propagation techniques for the species
- 4.4.2 To produce a homogenous plant population
- 4.4.3 *In vitro* conservation of 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 : 2008-2009
- 4.6.2 Completion year : 2013-2014
- 4.7. Personnel (s) :
- 4.7.1 Study Leader : Sharmila Das, DO
- 4.7.2 Associates : Nusrat sultana, FI, Saiful Alam Md. Tareq, FI
- 4.8 Progress :
- 4.8.1 Previous years, if any : Culture establishment and multiple shoot production of amloki and tamal have been done.
- 4.8.2 This year

Activities of the study	Progress
a. Selection of donor trees	a. Selected donor trees of the species.
b. Establishment of culture, production of multiple shoots.	b. Explant culture of amloki and tamal has been established. Induction of adventitious shoot of amloki has done (Table 1). The effect of growth regulator (different cytokinins) on development of multiple shoots from the established culture (seedling shoot tip) of amloki and shoot tip (from adult tree) of tamal is shown in Table 2 and Table 3.
c. Root induction and maintenance of the plant lets.	c. Developed multiple shoots of amloki and tamal have transferred on rooting media for root induction. The rest of the multiple shoots of the species are being maintained in the tissue culture laboratory for further shoot multiplication and root induction.
d. Transfer of the plantlets into soil for hardening.	d.

- 4.9 Achievement(s), if any :
- 4.10 Financial statement :
- 4.10.1 Total cost : Tk 6,00,000.00
- 4.10.2 Cost of the year : Tk 48,460.00
- 4.10.3 Expenditure of the year : Tk 48,460.00
- 4.10.4 Source of fund : GOB
- 4.11 Beneficiaries : BFRI, FD, NGO's, Universities

Table. 1 Effect of growth regulators (cytokinins) on seed germination and induction of adventitious shoot of (*Phyllanthus emblica*)

Growth regulators	Conc. mg/l	% of seed germination	Adventitious shoot length (cm)
BAP	Control	-	-
	0.50	40	1.0 - 1.5
	1.00	75	1.5 - 3.0
	1.50	30	0.3 - 0.8
Kn	Control	-	-
	0.50	30	0.5
	1.00	15	0.3 - 0.7
	1.50	10	0.2

Table 2 . Effect of different growth regulators (cytokinins) and their combination in MS on multiple shoot formation from seedling shoot tip of *Phyllanthus emblica* after eight weeks in culture

Growth regulators	Conc. mg/l	Shoot no. /explant	Shoot length (cm)	Node no./explant
BAP	Control	1 - 3	3.5	2 - 3
	0.50	10 - 25	0.5 - 5.0	2 - 5
	1.00	10 - 15	3.0 - 7.0	1 - 2
	1.50	4 - 5	1.0 - 3.0	
Kn	Control	1 - 3	3.5	2 - 3
	0.50	3 - 7	0.2 - 3.5	1 - 3
	1.00	2 - 3	0.2 - 2.5	1 - 2
	1.50	1 - 1.5	0.2 - 0.5	0.5 - 1
BAP + Kn	Control	1 - 3	3.5	2 - 3
	0.5 + 0.5	7 - 8	6.0	3 - 4
	1.0 + 0.5	-	-	-
	1.5 + 0.5	4 - 5	4.0	2 - 3

Table 3. Effect of growth regulators (cytokinins) on the culture establishment of tamal (*Diospyros montana*) from shoot tip

Growth regulators	Conc. mg/l	% of sprouted shoot tip	% of survivality of sprouted shoot tip
BAP	Control	-	-
	1.0	55	30
	1.5	40	25
	2.0	20	10
Kn	Control	-	-
	1.0	25	15
	1.5	15	8
	2.0	10	4

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 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
- 1.4 Objectives :
 - 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 :
 - Starting year : 1992-1993
 - Expected completion : 2015-2016
 - Year
- 1.7 Personnel:
 - 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, Md. Mukhlesur Rahman, FI
- 1.8 Progress :
 - 1.8.1 Previous years: Two thousand twenty nine plus trees of 28 different forest tree species namely-civit (*Swintonia floribunda*), boilam (*Anisoptera scaphula*), dholi-garjan (*Dipterocarpus alatus*), telsur (*Hopea odorata*), chapalish (*Artocarpus chama*), toon (*Toona ciliata*), acacia hybrid (*Acacia auriculiformis X A. mangium*), akasmoni (*Acacia auriculiformis*), gamar (*Gmelina arborea*), ghora-nim (*Melia sempervirens*), bohera (*Terminalia bellirica*), haritaki (*Terminalia chebula*), amloki (*Phyllanthus emblica*), arjun (*Terminalia arjuna*), neem (*Azadirachta indica*), raj-koroi (*Albizia richardiana*), champa (*Michelia champaca*), chickrassi (*Chukrasia velutina*), dhaki-jam (*Syzygium grandis*), teli-garjan (*Dipterocarpus turbinatus*), mangium (*Acacia mangium*), raintree (*Samanea saman*), sil-koroi

(*Albizia procera*), agar (*Aquilaria agallocha*), kadam (*Anthocephalus chinensis*), shegun (*Tectona grandis*), sidha-jarul (*Lagerstroemia parviflora*) and mahogany (*Swietenia mahagoni*) were selected and seeds are being collected. 9036 kg seeds of different forest tree species viz. dholi-garjan (*Dipterocarpus alatus*), telsur (*Hopea odorata*), toon (*Toona ciliata*), gamar (*Gmelina arborea*), bohera (*Terminalia bellirica*), haritaki (*Terminalia chebula*), amloki (*Phyllanthus emblica*), arjun (*Terminalia arjuna*), neem (*Azadirachta indica*), raj-koroi (*Albizia richardiana*), chickrassi (*Chukrasia velutina*), dhaki-jam (*Syzygium grandis*), kadam (*Anthocephalus chinensis*), shegun (*Tectona grandis*) distributed /sold to different tree planting agencies.

Seeds and scions were collected from selected PTs of garjan, acacia hybrid, teak, gamar and telsur were used for raising plantation and orchards.

1.8.2 This year: :

Activities of the study	Progress
a. Selection of 100 plus trees of raktan, bajna, batna, agar, kadam, sida jarul, kanak, civit, gamar, dharmara, gutguitya, goda, mahogani, uriam, lohakat, pitraj, teak and akashmoni .	a. A total 100 plus trees of raktan (5nos.), bajna(3nos.), batna(3nos.), agar(2nos.), kadam(3nos.), sida jarul(6nos.), kanak(3nos.), civit(7nos.), gamar(3nos.), dharmara(3nos.), gutguitya(11nos.), goda(4nos.), lohakat(4nos.), pitraj(25nos.), teak(8nos.), boilam(3nos.), mangium(5nos.), sil-kori(7nos.) and akashmoni(20nos.) at Hyankoo(14), Ukhia(13), Dulahazara(08), Ichamoti(23), Barshijura(09), Kaptai(22), Head quarter(5) and Salna (6) Seed Orchard Centres were selected.
b. Collection of 500 kg seeds from plus trees for distribution to Forest Department (FD) District Nursery Malik Samitee (DNMS) and other tree planters.	b. 500kg seeds of 43 different forest tree species were collected from plus trees and supplied to private planters, DNMS and other private organizations. The species namely-civit (<i>Swintonia floribunda</i>), boilam (<i>Anisoptera scaphula</i>), chapalish (<i>Artocarpus chama</i>), toon (<i>Toona ciliata</i>), acacia hybrid (<i>Acacia auriculiformis</i> X <i>A. mangium</i>), akasmoni (<i>Acacia auriculiformis</i>), gamar (<i>Gmelina arborea</i>), bohera (<i>Terminalia bellirica</i>), haritaki (<i>Terminalia chebula</i>), arjun (<i>Terminalia arjuna</i>), neem (<i>Azadirachta indica</i>), champa (<i>Michelia champaca</i>), chickrassi (<i>Chukrasia velutina</i>), dhaki-jam (<i>Syzygium grandis</i>), teli-garjan (<i>Dipterocarpus turbinatus</i>), mangium (<i>Acacia mangium</i>), raintree (<i>Samanea saman</i>), sil-koroi (<i>Albizia procera</i>), agar (<i>Aquilaria agallocha</i>), kadam (<i>Anthocephalus chinensis</i>), shegun (<i>Tectona grandis</i>), mahogany (<i>Swietenia mahagoni</i>), ghora-nim (<i>Melia sempervirens</i>), sidha-jarul (<i>Lagerstroemia parviflora</i>), babla (<i>Acacia nilotica</i>), bajna (<i>Zanthoxylum rhetsa</i>), batna (<i>Castanopsis indica</i>), dharmara (<i>Stereospermum personatum</i>), debdaru (<i>Polyalthia longifolia</i>), goda/Arsol (<i>Vitex glabrata</i>), gutguttya (<i>Protium serratum</i>), jarul (<i>Lagerstroemia speciosa</i>), jhau (), kainjal (<i>Bischofia javanica</i>), kala-koroi (<i>Albizia lebbeck</i>), kanak (<i>Schima wallichii</i>), lohakat (<i>Xylia kerrii</i>), nageswar (<i>Mesua nagassarium</i>), pitraj (<i>Amoora wallichii</i>), raktan (), sissou (<i>Dalbergia sissou</i>) and uriam (<i>Bouea oppositifolia</i>).

1.9 Achievements: Two thousand one hundred twenty nine plus trees of more than forty species were selected and 9536 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. 9,40,000.00

1.10.2 Cost of the year : Tk. 55,000.00

1.10.3 Expenditure of the year : Tk. 55,000.00

1.10.4 Source of the 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 have to be travel for collection of seeds. Abundant and easily harvested seeds could be make available for the plantation and nursery programme when a seed source as seed orchard is developed using the genetic materials from plus trees. 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 SPAs. Therefore, the study has been undertaken.
- 2.4 Objectives :
- 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 FD, NGOs, DNMSs and planters
- 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 : 1992-1993
- 2.6.2 Expected completion : 2019-2020
Year
- 2.7 Personnel :
- 2.7.1 Study leader : Hasina Mariam, DO
- 2.7.2 Associates : Sukla Rani Bashak, SRO, Md. Arifur Rahaman, RO, Md. Mezan-Ul-Haque, RO, A.K.M Azad, RO Md. Kamaluddin, RO, Md. Mukhlesur Rahman, FI
- 2.8 Progress :
- 2.8.1 Previous years: From different seed orchards 4029 kg seeds of teak, gamar, pine, telsur and eucalyptus were collected and distributed. 88,000 rootstocks were raised to establish clonal seed orchard of teak, mahogany, gamar, garjan, eucalyptus, akashmoni, dhakijam etc. Sixty six ha. seedling seed orchard of garjan, doligarjan (*Dipterocarpus pilosus*), dhakijam, chapalish, eucalyptus sp, akashmoni and gamar and 39 ha clonal seed orchard of teak, gamar, and mahogany were raised. Cultural operations viz. fertilizer application, weeding, mulching etc. was carried out in 105 ha orchards and experimental plantations. Nurseries at head quarters and 7 seed orchard centres were maintained.
- 2.8.2 b. This year :

	Activities of the study	Progress
	a. Raising of 7000 seedlings from 50 plus trees of akashmoni selected at SPA of Kaptai and Ichamati SOC	a. 7000 seedlings were raised (Head quarter-3500, Kaptai-3500) from 40 plus trees of akashmoni selected SPA at Kaptai and Ichamati SOC .
	b. Establishment of 6.5 ha seedling seed orchard of akashmoni (2), jarul (1 ha), champa (1 ha), chickrassi (1 ha), toon (1 ha), goda (0.5 ha) and gutgutya (0.5ha) at Ichamati, Salna, Hyanko, Kaptai and Dulahazara.	b. 9.50 ha seedling seed orchard of akashmoni (2.5ha) at Ichamati (1.5ha), Salna (0.5ha) and Kaptai (1.0ha); dhakijam (1.0ha) at Ichamati (0.5ha) and Dulahazara (0.5ha); jarul (1.5ha) at Hyanko (1.0ha) and Dulahazara (0.5ha); champa (0.5ha) at Hyanko; chickrassi (0.5ha) at Hyanko; gutgutya (0.5ha) at Hyanko and acacia hybrid (3.0ha) at Salna SOCs were established.
	c. Maintenance of existing 41 ha clonal seed orchard and 70 ha seedling seed orchards at Salna, Kaptai, Dulahazara, Ichamati and Hyankoo SOCs.	c. Existing 38.5 ha clonal seed orchard and 70 ha seedling seed orchards were maintained by weeding and making fire line at Salna (4.0ha), Kaptai(8.0ha), Dulahazara (18.5ha), Ichamati (13.0ha) and Hyankoo (66.0ha) SOCs.
	d. Collection of 200 kg teak seed and 100 kg gamar seed from Kaptai Seed Orchard Centre, 40 kg telsur seed from	d. 200 kg teak seed and 100 kg gamar seed from Kaptai, 40 kg telsur seed from Ichamati and 5 kg eucalyptus seed from

<p>Ichamati and 5 kg eucalyptus seed from Salna Seed Orchard Centre.</p> <p>e. Raising and maintenance of 17500 seedlings for establishment of 5.0 ha seedling seed orchard on next year of jarul (1.0 ha), champa (1.0ha), chikrassi (1.0 ha), toon (1.0ha), goda (0.5ha) and gutguttya (0.5ha).</p> <p>f. Maintenance of previous year's seedling at nursery of Head Quarter and Dulahazara, Ichamati, Hyankoo and Salna SOCs.</p> <p>g. Maintenance by gap filling in previously raised one year old 5 ha orchard at Ichamati, Kaptai, Dulahazara and Hyanko SOC.</p> <p>h. Maintenance of nurseries at Head Quarter and seven seed orchard centres.</p> <p>i. Production of 6000 rooted cuttings of hybrid <i>Acacia</i> at plant propagation unit of head quarter for distribution to DNMSs and 6 SOCs.</p> <p>j. Preparation of 2000 gamar ramets for clonal seed orchard establishment at Dulahazara and Hyankoo SOCs.</p> <p>k. Preparation of 2000 teak ramets for establishment clonal seed orchard at Kaptai</p> <p>l. Raising of 5000 teak rootstock for raising 5.0 ha clonal seed orchard at Kaptai.</p> <p>m. Raising of 5000 gamar rootstock for raising 5.0 ha clonal seed orchard at Dulahazara and Hyankoo SOCs.</p> <p>n. Establishment of 6 ha teak clonal seed orchard at Kaptai.</p> <p>o. Data collection from 6.0 hectare garjan SSO at Hyankoo and Dulahazara.</p> <p>p. Expenditure for collecting left over illicitly cutted wood logs from orchards</p>	<p>Salna SOCs were collected.</p> <p>e. 19000 seedlings of jarul at Dulahazara (1750) and Hyankoo (1750); champa at Ichamati (1750) and Hyankoo (1750); chickrassi at Dulaahzara (1750) and Hyankoo (1750); toon at Dulaahzara (1750); goda at Hyankoo (1750 ha); akasmoni at Salna (1500); dhakijam at Ichamati (1750) and gutguttya at Hyankoo (1750) were raised and maintained for establishment of 5 ha seedling seed orchard for the next year .</p> <p>f. Previous year's seedling were maintained at nursery of Head Quarter, Dulahazara, Ichamati, Hyankoo and Salna SOCs.</p> <p>g. 5 ha previously raised seedling seed orchard were maintained by weeding and gap filling at Ichamati, Kaptai, Dulahazara and Hyanko SOCs.</p> <p>h. Nurseries of Head Quarter and seven seed orchard centres were maintained.</p> <p>i. 6000 rooted cuttings of acacia hybrid were produced at Plant Propagation Unit (HQ) and distributed to DNMSs and different tree planters.</p> <p>j. 2000 gamar ramets were prepared for establishment of clonal seed orchard at Dulahazara (1000) and Hyankoo (1000) SOCs.</p> <p>k. 2000 teak ramets were prepared at HQ nursery.</p> <p>l. 5000 teak rootstock were raised at HQ nursery.</p> <p>m. 5000 gamar rootstock were raised for raising 5.0 ha clonal seed orchard at Dulahazara(2500) and Hyankoo(2500) SOCs.)</p> <p>n. 6 ha teak clonal seed orchard were established at Kaptai.</p> <p>o. Data were collected from 6.0 ha garjan and 2.0 ha akasmoni SSO at Hyankoo, Kaptai, Ichamati and Dulahazara SOCs.</p> <p>p. Left over illicitly cutted wood logs were collected from orchards at Hyankoo and Salna SOCs.</p>
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2.9 Achievements : At Hyankoo, Dulahazara, Ichamati, Salna and Kaptai SOC 32ha. clonal seed orchard of teak, gamar, and mahogany and 25 ha. seedling seed orchard of garjan, doligarjan, dhakijam, chapalish, eucalyptus (*Eucalyptus camaldulensis*, *E. tereticornis*, *E. europphylla*) akashmoni and gamar were established and seeds are being collected from teak and gamar seed orchard at Kaptai.

2.10 Financial Statement :

2.10.1 Total cost : Tk. 2,10,00,000.00

2.10.2 Cost of the year : Tk.12,03,660.00

- 2.10.3 Expenditure of the : Tk.12,03,660.00
year
- 2.10.4 Source of the fund : GOB
- 2.11 Beneficiaries : Forest Department (FD), Non Government Organizations (NGOs) , other tree planting agencies and privat 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.
- 3.4 Objectives :
- 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 : 1996-1997
- 3.6.2 Expected completion : 2015-2016
Year
- 3.7 Personnel :
- 3.7.1 Project leader : Hasina Mariam, DO
- 3.7.2 Associates : Md. Mezan-Ul-Haque, RO, Md. Kamal uddin, RO
- 3.8 Progress :
- 3.8.1 Previous years: About 230 kg seeds of akashmoni were collected from established SPA and distributed to DNMSs, 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.
- 3.8.2 b. This year :

Activities of the study	Progress
a. Collection of 30 kg seeds from SPA of Kaptai and Ichamati SOCs.	a. 30 kg seeds of akashmoni were collected from Kaptai (15) and Ichamati(15) SOCs and distributed to DNMS, NGOs and planters.
b. Maintenance of seed production area of akashmoni 1ha at Ichamati and 1 ha at Kaptai Seed Orchard Centre.	b. Seed production area of akashmoni at Ichamati (1ha) and Kaptai (1ha) were maintained by weeding and climber cutting.

- 3.9 Achievements : Two hectare SPA of akashmoni was established and seed collection and production are going on.
- 3.10 Financial Statement: :
- 3.10.1. Total cost : Tk. 3,90,000.00
- 3.10.2 Cost of the year : Tk. 11,280.00
- 3.10.3 Expenditure of the : Tk. 11,280.00
year
- 3.11 Beneficiaries : Forest Department (FD), Non Government Organizations (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 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.

- 4.4 Objectives :
- 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 : Farmers and planters will aware about quality forest tree seeds and planting materials. Productivity/yield of the plantation will increase
- 4.6 Study period :
- 4.6.1 Starting year : 2004-2005
- 4.6.2 Expected completion : 2016-2017
Year
- 4.7 Personnel: :
- 4.7.1 Study leader : Md. Mezan-Ul-Haque, RO
- 4.7.2 Associate : Hasina Mariam, DO
- 4.8 Progress :
- 4.8.1 Previous Years: :
- 4.8.2 This year :

Activities of the year	Progress
a. Raising of 25000 seedlings of mahogany, gamar, hybrid acacia, akashmoni, kadam, toon, jarul, silkroi, boilam, civit, champa, etc. considering the demands of earlier years.	a. 25500 seedlings of 12 different forest tree species (champa-5700, bohera-600, acacia hybrid-5200, raintree-2500, jalpai-800, haritoki-600, kadam-500, agar-800, chickrassi-4250, mahogany-3600, teak-500, kainjal-500) were raised at HQ nursery.
b. Distribution of seedlings among the farmers, planters and other users.	b. 25500 seedlings of different forest tree species were distributed among the farmers, planters and other users.

- 4.9 Achievements: Awareness has developed about use of quality seed and seedlings. Production of forest plantation and homestead plantation has increased where quality seeds and seedlings used by farmers.
- 4.10 Financial Statement :
- 4.10.1 Total cost : Tk. 17,80,000.00
- 4.10.2 Cost of the year : Tk. 75,000.00
- 4.10.3 Expenditure of the year : Tk. 75,000.00
- 4.10.4 Source of the fund : GOB
- 4.11 Beneficiaries: Forest Department (FD), Non Government Organizations (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 behavior.
- 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 procured seeds before they are distributed. It is also important to carry out research on seed germination and seed storage behaviour of some species. Therefore, the study has been undertaken.
- 5.4 Objectives :
- 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 :
- 5.6 Study period :
- 5.6.1 Starting year : 1992-1993

- 5.6.2 Expected completion : 2016-2017
Year
- 5.7 Personnel (s) :
- 5.7.1 Study leader : Md. Mezan-Ul-Haque, RO
- 5.7.2 Associate : Hasina Mariam, DO
- 5.8 Progress :
- 5.8.1 Previous years : Routine testing of the collected seeds were done prior to distribution of seeds. Laboratory facilities were strengthened
- 5.8.2 This year :

Activities of the year	Progress
a. Study on storage behavior of seeds of major forest tree species (e.g. agar, chapalish, civit, boilam).	a. The seed storage behaviour of civit was observed and data has been collected.
b. Germination, purity and viability tests of the collected seeds from seed orchard centers before distribution.	b. Germination, purity and viability of 25 forest tree species have been tested before distribution.

- 5.9 Achievement : Unified systems of seed distribution for akasmoni were developed. Seed storage and testing facilities were developed
- 5.10 Financial Statement :
- Total cost : Tk. 3,50,000.00
- Cost of the year : Tk. 25000.00
- Expenditure of the year : Tk. 25000.00
- Source of fund : GOB
- 5.11 Beneficiaries: Forest Department (FD), Non-Government Organizations (NGOs) and other Tree Planting Agencies and private land owners.

- 6 Study : On going
- 6.1.1 Programme area : Breeding and tree improvement
- 6.1.2 Title of the study : Centralization of high yielding clones of rubber (*Hevea brasiliensis*) and establishment of orchard.
- 6.1.3 Justification: Rubber has already emerged as a cash crop in Bangladesh. To become self-sufficient in this important commodity a large scale plantation 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 (*Hevea* sp.) for breeding research in rubber, the study has been undertaken.
- 6.4 Objectives :
- 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 increase.
- 6.6 Study period :
- 6.6.1 Starting year : 2008-2009
- 6.6.2 Expected completion : 2019-2020
Year
- 6.7 Personnels: :
- 6.7.1 Study leader : Hasina Mariam, DO
- 6.7.2 Associates : Sukla Rani Bashak, SRO; Md. Kamaluddin, RO; Md. Mezan-Ul-Haque, RO
- 6.8 Progress :
- 6.8.1 Previous years : One hundred twenty 120 trees were selected at Datmara Rubber estate, 20000 seedlings were raised to produce ramets by using selected clones. From 32 trees selected on the basis of latex yield were used in raising 2 ha clonal trial at Datmara rubber estate.
- 6.8.1 This year :

Activities of the year	Progress
a. Plus tree selection of rubber 50 numbers.	a. Plus tree of rubber (50nos) trees were selected at Hyankoo SOC.
b. Information collection on latex production and selection of rubber tree on the basis of latex yield and collection of seeds from the 50 selected trees.	b. 50 kg seeds of rubber were collected from the 50 selected trees at Hyankoo SOC..
c. Raising of 5000 seedlings in 9"X6" polybags.	c. 5000 nos. seedlings were raised in 9"X6" polybags at Hyankoo SOC.
d. Raising of 1.25 ha plantation at Hyankoo SOC.	d. 1.25 ha plantation established at Hyankoo SOC.
e. Maintenance of previously 2.0ha raised trial plantation at Hyankoo SOC.	e. 2.0ha previously raised trial plantation maintained by weeding at Hyankoo SOC.
f. Preparation of 500 rubber ramets at Hyankoo SOC.	f. 500nos. rubber ramets were prepared at Hyankoo SOC.
g. Fertilizing in the rubber clonal trial (two times) at Hyankoo SOC.	g. Fertilizer application were completed in the rubber clonal trial (two times) at Hyankoo SOC.

- 6.9 Achievements : A clonal trial of 32 clones was established by Hyanko SOC at Datmara rubber estate, Fatickchari, Chittagong.
- 6.10 Financial Statement :
- 6.10.1 Total cost : Tk. 28,50,000.00
- 6.10.2 Cost of the year : Tk. 1,18,060.00
- 6.10.3 Expenditure of the year : Tk. 1,18,060.00
- 6.10.4 Source of fund : GOB
- 6.11 Beneficiaries : BFIDC and other government and private entrepreneurs will be benefited

Forest Botany Division

1. Study : On-going
- 1.1 Programme Area : Biodiversity and Conservation
- 1.2 Title of the Study : Community based tree biodiversity conservation in Bandarban Hill District
- 1.3 Justification: The Tribal communities of Bandarban Hill District traditionally conserve community reserve forest around their village. This type of forests is called as para or kowa or mouza reserve or para ban or village common forest. It is managed under the traditional norm and rules of the society. The community reserve is conserved for fire protection, perennial water supply, and source of wild food and to maintain the local environment. Traditional system of community reserve is becoming extinct due to land scarcity, urbanization and loss of social norms. The Murang community of Bandarban Hill District is still conserving some community forest for water source. Therefore, this study has taken to develop awareness among the local community members for biodiversity conservation and enrichment plantation in the community reserve.
- 1.4 Objectives :
- 1.4.1 To promote community based tree biodiversity conservation involving local people and community.
- 1.4.2 To establish demonstration plot for conservation of indigenous species.
- 1.5 Expected output:
- a) Awareness of local people about values of local biodiversity and their conservation will be developed and this will help for future research work.
- b) Motivation for community based tree biodiversity conservation will be helpful for their perennial water source and better livelihoods.
- 1.6 Study period :
- 1.6.1 Starting year : 2008 – 09
- 1.6.2 Completion year : 2012 - 13

- 1.7 Personnel (s) :
- 1.7.1 Study leader : M. Mohiuddin, D.O.
- 1.7.2 Associates : Asim Kumar Paul, R.O; A. H. M. Jahangir Alam, R.O.
- 1.8 Progress :
- 1.8.1 Previous years: Five group meetings were conducted with the local people under the leaderships of Karbaries in Ampupara, Sita pahar para for community based biodiversity conservation and enrichment plantation in the reserve. PRA meetings were conducted for selecting new plantation in the community reserve. A list of 25 priority tree having water-holding capacity has been selected for enrichment. Last year 5,000 seedlings of twenty indigenous species have been distributed in Chimbuk para, Sitapahar para and Empu para for enrichment plantation in the reserve. The species were uriam, sil-koroi, bahera, civit, chapalish, telsur, arjun, horitoki, kadam, jarul, garjan, champaful, neem, jolpai. Local people reported that awareness for biodiversity conservation has been enhanced among the community members after the enrichment planting in the reserve.
- 1.8.2 This year :

Activities of the study	Progress
a. Four group meetings with the Karbaries (local leaders) and local peoples of Ampu para, Chimbukpara and Sitapahar para for awareness development for biodiversity conservation.	a. Four group meetings with the karbaries (local leaders) and local community people were conducted at Ampu para, and Sitapahar para of Bandarban Hill District for biodiversity conservation. Awareness has been developed among the community members for plantation in their community reserve. 25 priority species suitable for plantation in the community reserve has been selected by local community people. The priority species were mahogany, garjan, jarul, kainjal bhadi, civit, sil-koroi, rain-tree, bet, bot, champa and neem. They are not interested for deciduous trees in the reserve.
b. Motivate the local people for conservation of wild indigenous tree seedlings and enrichment planting with supplied indigenous species.	b. Local people committed to collect the wild seedlings from the natural forests and agreed to plant them in the reserve. Finally they reported that there is no seedling in the natural forest as there is no seed producing trees.
c. Motivate the local people for maintenance and conservation of planted species.	c. About 5500 seedlings of twenty indigenous species have been distributed to Ampu para, and Sitapahar para for enrichment plantation in the community reserve. The seedlings were haldu (<i>Adina cordifolia</i>), chakua-koroi (<i>Albizia chinensis</i>), sil-koroi (<i>Albizia procera</i>), rain tree (<i>Samanea saman</i>), kainjalvhadi (<i>bischofia javanica</i>), chapalish (<i>Artocarpus chaplasha</i>), bohera (<i>Terminalia bellirica</i>), kalo jam (<i>Syzygium cumini</i>), puti jam (<i>Syzygium fruticosum</i>), chikrassi (<i>Chukrasia tabularis</i>), neem (<i>Azadirachata indica</i>), champa (<i>Michelia champaca</i>), garjan (<i>Dipterocarpus</i> sp.), telsur (<i>Hopea odorata</i>), khayer (<i>Acacia catechu</i>), lohakat (<i>Xylia kerrii</i>), amloki (<i>Phyllanthus emblica</i>), arjun (<i>Terminalia arjuna</i>), mahogany (<i>Swietenia mahagoni</i>), kadam (<i>Anthocephalus chinensis</i>), jarul (<i>Lagerstroemia speciosa</i>), pitraj (<i>Aphanamixis polystachya</i>), haritaki (<i>Terminalia chebula</i>). All these seedlings has been planted by the local people around their village.
d. Reporting (Draft report).	d. A draft report is in progress.

- 1.9 Achievement: Biodiversity of the community reserve has enriched and awareness has created among the local people for biodiversity conservation.
- 1.10. Financial Statement :
- 1.10.1 Total cost : 5,00000.00
- 1.10.2 Cost of the year : 1,29,450.00
- 1.10.3 Expenditure of the year : 1,29,400.00
- 1.10.4 Source of fund : GOB
- 1.11 Beneficiaries : FD, Universities, NGOs and development agencies.

2. Study : : On-going
- 2.1 Program Area : Biodiversity and Conservation
- 2.2 Title of the study : Buddha-Bihar (*Kiyang*) based tree biodiversity conservation in Rangamati Hill District
- 2.3 Justification : The tree biodiversity in Chittagong Hill Tracts (CHT) is decreasing in an alarming rate due to number of causes. Buddha-Bihar (*Kiyang*) is the religious institution for the followers of Buddha. Most of the Buddha-Bihar (*Kiyang*) of Rangamati Hill District is situated at the top of the hills. During establishment they cut the natural vegetation of the area. After establishing the Buddha-Bihar the religion leaders and local people do not cut any tree species from Bihar areas and they considered these trees as sacred tree. At present the Buddha-Bihar is considered as important place for tree biodiversity conservation in CHT. Therefore, this study has taken to awareness development for tree biodiversity conservation and enrichment plantation around the Bihar area.
- 2.4 Objectives :
- 2.4.1 To conserve biodiversity by involving local religious leaders.
- 2.4.2 To enrich biodiversity in Buddha-Bihar (*Kiyang*) areas by participatory effort.
- 2.4.3 To develop a religious institution based biodiversity conservation model.
- 2.5 Expected output
- a) Religious leaders and local people will be motivated for indigenous tree plantation and conserve tree biodiversity in Buddha-Bihar (*Kiyang*) areas.
- b) Biodiversity of hill forest will be conserved and enriched for future research work.
- c) Awareness will create among religious leaders and local people for tree biodiversity conservation at local level.
- 2.6 Study period :
- 2.6.1 Starting year : 2008– 09
- 2.6.2 Completion year : 2013 – 14
- 2.7. Personnel(s) :
- 2.7.1 Study leader : M. Mohiuddin, D.O
- 2.7.2 Associates : Asim Kumar Paul, R.O.; A.H.M Jahangir Alam, R.O.
- 2.8 Progress :
- 2.8.1 Previous year : Six-consultation meetings were carried out with the religion leaders (*Bantheyas*) to focus about the importance of tree biodiversity conservation in Bihar area. PRA and group discussion meetings were carried out with the religion leaders (*Bantheyas*) and local people to list up the suitable species for Bihar areas. Local people were interested to plant indigenous species in selected site. The local people and religious leaders made a participatory map of the Bihar area for enrichment plantation. The Bantheyas and local people listed 27 priority species suitable for plantation around the Buddha-Bihar (*Kiyang*) area. The priority species were neem, champa, mahagony, garjan, arjun, bahera, jarul, kainjal bhadi, civit, kadam and sil-koroi. Five thousand seedlings of 27 indigenous species were distributed to three Bihar namely Bodhiopur Bonobihar, Khamarpara Adarsha Bonobihar, Nirbanpur Bonobihar of Manikchari area. Planted species were established around the Bihar areas. Necessary suggestion for mulching and weeding was given to religious leaders and community members. All these activities have created awareness among the religious leaders for the tree species conservation in the Bihar areas.
- 2.8.2 This year :

Activities of the study	Progress
a. Four awareness or sensitizing group meetings with the religions leaders and community people at Bodhipur, Nirbanpur and Khamarpara Buddha-Bihar towards the plantation around the Buddha-Bihar (<i>Kiyang</i>) areas.	a. Four awareness or sensitizing group meetings were conducted with the religion leaders (Bantheya) and local community people for biodiversity conservation. They selected fallow area around the Bihar by draw a PRA map for selecting new plantation sites for this year plantation. Local people and religion leaders selected 20 priority species suitable for plantation around the Buddha-Bihar (<i>Kiyang</i>) area. The main suitable species were garjan, jarul, uriam, bandarhola, kainjal bhadi, champaful, goda, deshi neem, chapalish, arjun, kadam, horitaki, uriam, and pitraj. Day by day create awareness has been developed among the religious leaders and local people for plantation and biodiversity conservation

b. Motivate the religions leaders and local people for wild seedlings collection from the natural forest for enrichment plantation around the Bihar areas.	b. A series of motivation meeting were conducted with local people and religion leaders for wild seedlings collection. They were agreed to collect wild seedlings from the nature.
c. Motivate the religion leaders and local people for maintenance and conservation of planted species	c. The religion leaders were convinced about the importance of tree biodiversity conservation. They maintain and look after the planted seedlings around the Bihar area. They also agreed to convey the message to the local people during monthly religious meetings. We made a list of natural and plantation tree species diversity around the Nirbanpur Bihar area. Five thousand seedlings of 16 indigenous species were distributed to Bodhiopur, Khamarpara Adarsha Bonobihar and Nirbanpur Bonobihar of Rangamati Hill District. The distributed species were champaful (<i>Michelia champaca</i>), sil-koroi (<i>Albizi procera</i>), jarul (<i>Lagerstroemia speciosa</i>), chikrassi (<i>Chukrasia velutina</i>), krishnachura (<i>Delonix regia</i>), mahogany (<i>Swietenia macrophylla</i>), lohakat (<i>Xylia kerrii</i>), neem (<i>Azadirachata indica</i>), chapalish (<i>Artocarpus chaplasha</i>), kadam (<i>Anthocephalus chinensis</i>), dhaki-jam (<i>Syzygium grandis</i>), rain tree (<i>Samanea saman</i>), garjan (<i>Dipterocarpus sp.</i>) telsur (<i>Hopea odorata</i>). These species were planted by the local people in the selected areas of Bihar
d. Reporting (Draft report).	g. A draft report is in progress.

- 2.9 Achievement(s) : Awareness has created among the religious leaders and local people for biodiversity conservation in the Bihar.
- 2.10 Financial Statement :
- 2.10.1 Total cost : 5,00000.00
- 2.10.2 Cost of the year : 1,21,950.00
- 2.10.3 Expenditure of the year : 1,21,900.00
- 2.10.4 Source of fund : GOB
- 2.11 Beneficiaries : Government Departments, Academic Institutes, NGOs, and local communities
3. Study : On-going
- 3.1 Program Area : Post Harvest Utilization- Physical Processing
- 3.2 Title of the Study : Anatomical variation of three timber species toon (*Toona ciliata*), sil-koroi (*Albizia procera*), rain-tree (*Samanea saman*) in relation to their four ecological regions of Bangladesh
- 3.3 Justification : The anatomical properties of wood vary depending on the different factors. Wood properties also vary with growing habitat of the species. The detail anatomical properties of these species were studied without considering the habitat. The present study is taken to determine the impact of habitat on the wood properties of these species.
- 3.4 Objectives :
- 3.4.1 To determine the detail gross and minute anatomical features of three species of occurring in different regions of Bangladesh.
- 3.4.2 To determine the anatomical variation of three species in relation to difference regions.
- 3.5 Expected output :
- a) Anatomical variation in relation to their ecological variation of three species will be known.
- b) BFRI xylarium will be enriched with the document.
- 3.6 Study period :
- 3.6.1 Staring year : 2009 – 10
- 3.6.2 Completion year : 2012 - 13
- 3.7 Personnel (s) :
- 3.7.1 Study leader : Asim Kumar Paul, R.O.
- 3.7.2 Associates : A.H.M.Jahangir Alam, R.O.

3.8 Progress :

3.8.1 Previous years : Wood samples of toon (*Toona ciliata*), rain-tree (*Samanea saman*) and sil-koroi (*Albizia procera*) were collected from Bogra, Jessore and Sylhet District. Their local names and local uses were documented. Gross anatomical features namely colour, texture, grain, parenchyma and ray type have been studied and recorded. Nine wood blocks of toon (*Toona ciliata*), rain-tree (*Samanea saman*) and sil- koroi (*Albizia procera*) were prepared. The prepared blocks were boiled in hot water for softening and microtome sectioning. 60 maceration slides of toon (*Toona ciliata*), rain-tree (*Samanea saman*) and sil-koroi (*Albizia procera*) were prepared. Vessel and fiber lengths of toon (*Toona ciliata*), rain-tree (*Samanea saman*) and sil- koroi (*Albizia procera*) at near pith, heartwood and sapwood were measured under the microscope.

3.8.2 This year :

Activities of the study	Progress
a. Microtome sections cutting of 24 wood blocks of three species for permanent slides.	a. Twenty four wood blocks of toon (<i>Toona ciliata</i>), rain-tree (<i>Samanea saman</i>) and sil- koroi (<i>Albizia procera</i>) were prepared. The prepared blocks were boiled in hot water for softening and microtome sectioning. Microtome sections of the two species namely rain-tree (<i>Samanea saman</i>) and sil-koroi (<i>Albizia procera</i>) and 40 permanent slides were made following the standard procedure.
b. Study of minute anatomical properties from permanent slides.	b. Sixty maceration slides of toon (<i>Toona ciliata</i>), rain-tree (<i>Samanea saman</i>) and sil-koroi (<i>Albizia procera</i>) were prepared. Vessel and fiber lengths of toon (<i>Toona ciliata</i>), rain-tree (<i>Samanea saman</i>) and sil-koroi (<i>Albizia procera</i>) at near pith, heartwood and sapwood were measured under the microscope. Among the species the highest vessel length was observed in sapwood (257 μm), followed by heartwood (291 μm) and near pith (256 μm). On the other hand highest fiber lengths was observed in sapwood (469 μm), followed by heartwood (334 μm) and near pith (205 μm).
c. Reporting (Draft report).	e. Preparation of draft of scientific report.

3.9 Achievement(s) :

3.10 Financial Statement :

3.10.1 Total cost : 1,20,000.00

3.10.2 Cost of the year : 20,400.00

3.10.3 Expenditure of the year : 20,000.00

3.10.4 Source of fund : GOB

3.11 Beneficiaries : FD, Universities, NGOs and development agencies

4. Study : Ongoing

4.1 Program Area : Post Harvest Utilization- Physical Processing

4.2 Title of the Study : Anatomical properties of Lambu (*Khaya anthotheca*) tree grown in Bangladesh.

4.3 Justification : *Khaya* (*Khaya anthotheca*) species belongs to family Meliaceae. It is an exotic tree species. This species has been introduced in southern part of Bangladesh from India. It is very fast growing species. Generally, Lambu is long and straight having clear bole with light branching species. This species is suitable for making furniture, pole, constructional purposes and other household articles. There is not detailed information about anatomical properties of Lambu (*Khaya anthotheca*) timber species with special reference to Bangladesh. So, this study has taken to develop database on anatomical properties of the species for determining better utilization.

4.4 Objectives :

4.4.1 To determine the detail gross and minute anatomical features of the species grown in Bangladesh. :

4.4.2 To develop a database on anatomical properties of this species for determining better utilization. :

4.5 Expected output :

a) Data base on anatomical properties of Lambu (*Khaya anthotheca*) woods will be developed.

b) BFRI Xylarium will be enriched with wood collections and permanent slides.

4.6 Study period :

- 4.6.1 Starting year : 2011 – 12
 4.6.2 Completion year : 2013 - 14
 4.7 Personnel(s) :
 4.7.1 Project leader : Asim Kumar Paul, R.O
 4.7.2 Associates : A.H.M.Jahangir Alam, R.O ; Mohammed Mohiuddin, D.O
 4.8 Progress :
 4.8.1 Previous year : Wood samples were collected from Jessore District. Gross anatomical features namely colour, texture, grain, parenchyma and ray type have been studied and recorded.
 4.8.2 This year :

Activities of the study	Progress
a. Collection of wood samples from the different areas of Bangladesh.	a. Wood samples were collected from Jessore District.
b. Study of gross anatomical properties from pith to bark of the samples.	b. Gross anatomical features namely colour, texture, grain, parenchyma and ray type have been studied and recorded.
c. Microtome sections cutting and preparation of permanent slides.	c. The prepared wooden blocks from sapwood, heartwood and near pith portion for making permanent slides. The wooden blocks were boiled in hot water for softening and microtome sectioning.
d. Reporting (Draft report).	d. Preparation of draft of scientific report is under process.

- 4.9 Achievement(s) :
 4.10 Financial Statement :
 4.10.1 Total cost : 1,20,000.00
 4.10.2 Cost of the year : 30,000.00
 4.10.3 Expenditure of the year : 30,000.00
 4.10.4 Source of fund : GOB
 4.11 Beneficiaries : FD, BFIDC, Academic Institutes, NGOs and Wood Traders, Farmers

5. Study : On-going
 5.1 Program Area : Biodiversity and Conservation
 5.2 Title of the Study : Regeneration status of tree species in plantation and natural forest of Paithong areas of Bandarban Hill District.
 5.3 Justification : Paithong forest area covers 320 hecters of hilly land under Paithong Mauja in Lama Thana under Bandarban Hill District. It is controlled by the Aziznagar range Forest Department. This study area consists of medium and small hills with gentle slopes. Both bangali and tribal people are living in this area. There are some protected forest and private land. Tree species are naturally growing for long time in this area. Regeneration of saplings and survive are important for the restoration of the ecosystem of an area. Regeneration potential of planted and naturally grown forest area gives information about restoration behavior of a forest area. There is not detailed information about regeneration status of planted and natural grown species. The study will help us evaluate the sustainability of the natural resources and private plantation. The information on plant resources is getting importance for restoration of ecology, sustainable land use and local label biodiversity management of Bandarban Hill District. So, this study has taken to analyze the regeneration of phyto-sociological data with database both of plantation and natural forest.
 5.4 Objectives :
 5.4.1 To determine regeneration status of tree species in different habitats (planted and natural forest) in Paithong forest areas.
 5.4.2 To determine the vegetation dynamics of plantation and natural forest patches.
 5.5 Expected output :
 a. Data base on regeneration status and phyto-sociological information in planted and natural habitats of Paithong forest area will be developed.
 b. BFRI herbarium will be enriched with botanical specimens of the study area.

- 5.6 Study period :
 5.6.1 Starting year : 2011 – 12
 5.6.2 Completion year : 2013 – 14
 5.7 Personnel(s) :
 5.7.1 Study leader : M. Mohiuddin, D.O.
 5.7.2 Associates : Syedul Alam, RA-1
 5.8 Progress :
 5.8.1 Previous year : Five trips were carried out for regeneration status of tree species. Forty two sample plots were lay out representing various slopes (hill top and hill base) in natural and planted areas of Paithong forest areas. Naturally and planted seedlings from the permanent sample plots were listed and counted. Among them, kali batna, goda, kannayri, dharmara, assar, pitraj and putijam were most common tree seedling species. Fifty botanical specimen collection of the study area and processed for preservation.
 5.8.2 This year :

Activities of the study	Progress
a. Data collection on tree seedlings regeneration and phytosociological data in natural and planted forest.	a. Four field trips carried out at rangajhiri, green village, burir cikon ghona, munnar bagan and sutabhadi in Paithong forest area. Forty two permanent sample plots were lay out representing various slopes (hill top and hill base) in natural and planted areas of Paithong forest area. Listing of natural and planted regeneration tree seedlings of each plot was done. Natural regeneration of tree seedlings of 32 species was found in natural forest and seedlings of 30 tree species were found in the planted sample plots.
b. Botanical specimen collections and processing of the samples.	b. Sixty two seedlings and botanical samples were collected from the study area and processed for preservation in the herbarium.
c. Identification of species and data analysis.	c. Seedlings of Kurchi (<i>Holarrhena antidysenterica</i>), kachua (<i>Aporosa dioica</i>), dharmara (<i>Stereospermum personatum</i>), kannyari (<i>Gardenia coronaria</i>), putijam (<i>Syzygium fruticosum</i>), kalibatna (<i>Lithocarpus pachyphylla</i>), goda (<i>Vitex peduncularis</i>), menda (<i>Litsea glutinosa</i>), lana assar (<i>Pterospermum semisagittatum</i>), assar (<i>Grewia nervosa</i>) and muli bans (<i>Melocanna baccifera</i>) were the most occurrence in the both the sample plots.
e. Compilation of reports.	e. Preparation of draft of scientific report is under process.

- 5.9 Achievement(s) :
 5.10 Financial Statement :
 5.10.1 Total cost : 1, 00,000.00
 5.10.2 Cost of the year : 58,200.00
 5.10.3 Expenditure of the year : 58,000.00
 5.10.4 Source of Fund : GOB
 5.11 Beneficiaries : GOs, Academic Institutes, NGOs, Taxonomist & Wild life biologists

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).
1.3 Justification : Continuous Forest Inventory (CFI) is very much important for forest management. This study will be carried out as a part of CFI. Provisional site indices curves and yield tables for akashmoni and mahogany have been determined. These curves and tables need improvements. Again, information on changes of the growth rates at different stages of ages is required.
1.4 Objectives :
1.4.1 To generate information on growth and yield of the akashmoni and mahogany tree species in plantations forests of Bangladesh.
1.4.2 Setting physical rotation of these species.

- 1.5 Expected output :**
- 1.5.1** Site indices curves for these species grown in the plantation forests will be available.
- 1.5.2** Growth and yield of these species at different plantation sites will be available.
- 1.5.3** Physical rotation of these species will be available.
- 1.6 Study period :**
- 1.6.1 Starting year :** 2010-11
- 1.6.2 Completion year :** 2020 –21
- 1.7 Personnel :**
- 1.7.1** Project Leader : S. M. Zahirul Islam, RO
- 1.7.2** Associates : M .A. H. Shah Jalal, DO (C.C); Mofizul Islam Khan, FI
- 1.8 Progress :**
- 1.8.1 Previous years, if any:**Re-measurements of the trees in 71 PSPs from established 44 PSPs for mahogany at Faridpur Forest Division and 27 PSPs for akashmoni at Chitagong (12) & Cox’s Bazar,(15) Forest Division.
- 1.8.2. This year :**

Action plan as per annual research programme	Progress
a. Re-measurement of akashmoni and mahogany trees at Chitagong Cox’s Bazer and Faridpur District in the established PSPs	Yearly re-measurement from 71 PSPs of akashmoni and mahogany laid out in Cox’s Bazer , Chittagong and Faridpur Forest Division have been taken.
b.Summarization of collected data.	The summarized data shown in table -1,2,3

Table-1. Summarized data of akashmoni collected from Ukia , Ramu under Cox’s Bazar forest division

Plot Number	Year of Plantation	Age (year)	Number of Tree	GBH (cm)	Height (m)	Increment	
						GBH (cm)	Height (m)
1	2004	9.4	14	42.0	12.3	4.5	0.9
2	2004	9.4	4	45.4	14.9	4.8	3.7
3	2004	9.4	5	43.5	13.5	4.6	2.7
4	2006	7.4	21	42.5	14.2	5.7	0.7
5	2006	7.4	22	36.3	12.9	4.9	0.6
6	2006	7.4	27	32.3	13.1	4.4	0.5
7	2005	8.4	37	32.2	11.8	3.8	0.3
8	2005	8.4	38	34.3	11.6	4.1	0.3
9	2005	8.4	29	38.7	12.2	4.6	0.4
10	2003	10.4	37	34.4	12.3	3.3	0.3
11	2003	10.4	41	39.9	13.1	3.8	0.3
12	2003	10.4	47	33.5	12.1	3.2	0.3
13	2007	6.4	26	37.0	11.6	5.8	0.4
14	2007	6.4	28	33.7	11.1	5.3	0.4
15	2007	6.4	20	31.5	10.6	4.9	0.5

Table-2. Summarized data of akashmoni collected from Hiako, Andharmanik under Chittagong forest division

Plot Number	Year of Plantation	Age (year)	Number of Tree	GBH (cm)	Height (m)	Increment	
						GBH (cm)	Height (m)
1	2007	6.3	45	23.2	9.5	3.7	0.2
2	2007	6.3	41	25.0	10.8	3.9	0.3
3	2006	7.3	47	26.2	11.3	3.6	0.2
4	2006	7.3	48	26.0	11.1	3.5	0.2
5	2006	7.3	51	22.8	10.5	3.1	0.2
6	2005	8.3	32	30.2	10.8	3.6	0.3
7	2005	8.3	65	23.0	11.3	2.8	0.2
8	2003	10.3	11	46.5	14.3	4.5	1.3
9	2003	10.3	12	48.1	12.7	4.6	1.1
10	2004	9.3	27	46.4	16.1	5.0	0.6
11	2004	9.3	22	40.5	13.7	4.3	0.6
12	2004	9.3	22	35.0	12.2	3.7	0.6

Table-3. Summarized data of mahogany collected from Faridpur forest division.

Plot Number	Year of Plantation	Age (year)	Number of Tree	GBH (cm)	Height (m)	Increment	
						GBH (cm)	Height (m)
1	2000	13.4	42	43.1	14.1	3.2	0.3
2	1998	15.4	31	50.9	15.7	3.3	0.5
3	2000	13.4	31	50.6	13.9	3.8	0.4
4	2004	9.4	34	47.3	12.5	5.0	0.4
6	1991	22.4	59	37.1	11.5	1.7	0.2
7	2008	5.4	49	30.9	8.0	5.7	0.2
8	2002	11.4	24	59.6	14.1	5.2	0.6
9	1996	17.4	27	78.6	18.5	4.5	0.7
10	2000	13.4	26	61.5	16.4	4.6	0.6
11	2000	13.4	34	39.1	10.9	2.9	0.3
12	1997	16.4	14	59.3	14.0	3.6	1.0
13	1997	16.4	38	46.1	15.7	2.8	0.4
14	1994	19.4	16	74.0	15.6	3.8	1.0
15	1998	15.4	27	47.0	11.6	3.1	0.4
16	1994	19.4	27	64.3	12.7	3.3	0.5
17	1994	19.4	26	61.9	13.4	3.2	0.5
18	2008	5.4	32	23.6	6.0	4.4	0.2
19	2008	5.4	26	19.4	5.6	3.6	0.2
20	1995	18.4	30	57.3	13.9	3.1	0.5
21	1995	18.4	40	58.8	14.0	3.2	0.3
22	2005	8.4	23	45.0	11.4	5.4	0.5
23	2007	6.4	36	36.7	7.9	5.8	0.2
24	2007	6.4	36	34.3	10.2	5.4	0.3
25	2007	6.4	41	27.9	8.4	4.4	0.2
26	1994	19.4	17	33.9	10.7	1.7	0.6
27	1994	19.4	16	31.0	9.9	1.6	0.6
28	2007	6.4	25	38.1	7.9	6.0	0.3
29	2007	6.4	31	34.9	7.9	5.5	0.3
30	1993	20.4	18	52.8	17.2	2.6	1.0
31	1995	18.4	28	56.3	16.3	3.1	0.6
32	2002	11.4	37	36.6	10.4	3.2	0.3
33	2008	5.4	30	27.6	7.5	5.1	0.2
34	1990	23.4	30	67.9	16.1	2.9	0.5
35	1995	18.4	32	43.3	12.0	2.4	0.4
36	1995	18.4	44	38.8	11.5	2.1	0.3
37	2005	8.4	47	25.2	7.7	3.0	0.2
38	2002	11.4	48	40.3	14.4	3.5	0.3
39	2001	12.4	45	40.7	11.5	3.3	0.3
40	1997	16.4	23	55.1	15.6	3.4	0.7
41	1995	18.4	27	56.2	12.9	3.1	0.5
42	1995	18.4	46	40.7	10.5	2.2	0.2
43	1995	18.4	27	41.1	12.8	2.2	0.5
44	2001	12.4	30	43.5	11.9	3.5	0.4

1.9 Achievement(s), if any

1.9.1 Prepared growth and yield tables for the species gamar, moluccana, eucalyptus, young garjan, mangium, minjiri, akashmoni and pine in the plantations.

1.9.2 Prepared growth and yield tables for sissou, mahogany koroi, eucalyptus and bokain planted on the

- crop land
- 1.10 Estimated Cost :
- 1.10.1 Total cost : Tk. 5,00,000.00
- 1.10.2 Cost of the year : Tk: 41,200.00
- 1.10.3 Expenditure of the year : Tk. 41,200.00
- 1.10.4 Source of fund : GOB
- 1.11 Beneficiaries: Forest Department, development policy maker, researchers, forestry teachers, students, trainees and trainers, BFIDC, timber traders, universities and NGOs
- 2 Study : On going
- 2.1 Programme Area : Forest Inventory, Growth and Yield
- 2.2 Title Of the Study : Growth and yield assessment of keora (*Sonneratia apetala*) and baen (*Avicennia* sp.) in the coastal plantations of Bangladesh.
- 2.3 Justification : Provisional site indices curves and yield tables for keora and baen have been prepared in 1989. These curves and tables need to be improved including the new plantations raised on newly accreted lands.
- 2.4 Objectives :
- 2.4.1 To generate information on growth and yield of the keora and baen in the coastal plantations of Bangladesh
- 2.4.2 Setting physical rotation of these species
- 2.5 Expected output:
- 2.5.1 Site indices curves will be prepared for keore and baen grown in the coastal plantations of Bangladesh.
- 2.5.2 Growth and yield of the keore and baen at different sites will be available.
- 2.6 Study period :
- 2.6.1 Starting year : 1988-89
- 2.6.2 Completion year : 2010 –11
- 2.7 Personnel :
- 2.7.1 Project Leader : M. A. H. Shah Jalal, DO (C.C)
- 2.7.2 Associates : S. M. Zahirul Islam, RO; Mofizul Islam Khan. FI
- 2.8 Progress :
- 2.8.1 Previous years, if any: Re-measurements of eighty seven (87) permanent sample plots(PSPs) of keora and baen laid out at Salimpur of Chittagong, Moheshkhali of Cox’s Bazar under Chittagong Coastal Forest Division and Patharghata of Barguna, Rangabali of Galachipa under Patuahkali Coastal Forest Division have been taken.
- 2.8.2 This year :

Action plan as per annual research programme	Progress
a. Yearly re-measurement of the trees in the established PSPs at Chittagong and Cox’s Bazer Coastal Areas.	Yearly re-measurement from 33 PSPs laid out in Chittagong (18), Cox’s Bazer (15) costal areas have been taken.
b. Summarization of collected data.	The summarized data shown in table -4 and 5.

Table-4: Summarized data of baen collected from Moheshkhali under Cox's Bazer coastal forest division

Plot Number	Year of Plantation	Age (year)	Number of Tree	GBH (cm)	Height (m)	Increment	
						GBH (cm)	Height (m)
7A	1993	20.0	12	58.0	10.1	2.9	0.5
7B	1993	20.0	14	52.9	9.8	2.6	0.5
7C	1993	20.0	16	48.9	9.5	2.4	0.5
8A	1998	15.0	21	32.8	7.7	2.2	0.5
8B	1998	15.0	23	33.4	7.8	2.2	0.5
8C	1998	15.0	27	29.6	8.1	2.0	0.5
9A	1994	19.0	51	21.7	6.3	1.1	0.3
9B	1994	19.0	34	26.6	8.0	1.4	0.4
9C	1994	19.0	16	32.2	5.8	1.7	0.3
10A	1997	16.0	18	47.2	7.3	3.0	0.5
10B	1997	16.0	20	47.8	7.9	3.0	0.5
10C	1997	16.0	24	50.2	8.4	3.1	0.5

Table-5: Summarized data of keora collected from Kattoli under Chittagong coastal forest division

Plot Number	Year of Plantation	Age (year)	Number of Tree	GBH (cm)	Height (m)	Increment	
						GBH (cm)	Height (m)
1A	1986	27.5	11	52.7	13.0	1.9	1.2
1B	1986	27.5	13	54.0	12.9	2.0	1.0
1C	1986	27.5	6	54.2	14.3	2.0	2.4
2A	1996	17.5	12	39.8	10.8	2.3	0.9
2B	1996	17.5	14	37.9	10.1	2.2	0.7
2C	1996	17.5	25	47.7	12.8	2.7	0.5
3A	1993	20.5	16	44.9	13.2	2.2	0.8
3B	1993	20.5	7	45.3	9.0	2.2	1.3
3C	1993	20.5	5	55.8	11.6	2.7	2.3
4A	1990	23.5	17	47.2	14.6	2.0	0.9
4B	1990	23.5	10	62.3	15.8	2.6	1.6
4C	1990	23.5	12	64.1	16.1	2.7	1.3
5A	1985	28.5	7	50.9	14.1	1.8	2.0
5B	1985	28.5	4	57.8	15.3	2.0	3.8
5C	1985	28.5	10	57.6	15.1	2.0	1.5
6A	1994	19.5	14	49.8	13.1	2.6	0.9
6B	1994	19.5	11	62.2	14.1	3.2	1.3
6C	1994	19.5	28	40.9	11.5	2.1	0.4

2.9 Achievement(s), if any :

a. Prepared site indices curves and growth and yield tables for the species keora.

b. Fixation of physical and financial rotation of keora was determined. Considering the different factors of raising the coastal plantations, a rotation age is 12 years for site indices 15 and 18 meters dominant height and 15 years for site indices of 6, 9 and 12 meters dominant height at the same reference age.

2.10 Estimated Cost :

2.10.1 Total cost : Tk. 46,190.00

2.10.2 Cost of the year : Tk: 28,775.00

2.10.3 Expenditure of the year : Tk: 28,775.00

2.10.4 Source of fund : GOB

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

FOREST ECONOMICS DIVISION

- 1. Study :** On going
- 1.1 Programme Area : Forest Inventory and Economics
- 1.2 Title of the Study : Impact analysis of bamboo plantations raised by branch cutting and bamboo groves management technique.
- 1.3 **Justification :** Bamboo plays a vital role in rural life and used extensively for agricultural and housing materials. It is also an important raw material for pulp and paper and rayon industries. Bamboo plantations of conventional method through offset and rhizomes are found costly and poorly increased in its field. Pressure on bamboo resource are being increased day to day due to its' multipurpose uses. So, bamboo branch cutting technique is found to be suitable for large scale bamboo plantations and scientific management of bamboo grove can be ensured to reduce the gap between demand and supply in this sector. The present study is, therefore, undertaken to evaluate the economic impact assessment of the plantations raised by bamboo branch cutting and scientifically managing bamboo groves of bamboo growers.
- 1.4 **Objectives :**
- 1.4.1 To evaluate economic benefit of bamboo plantations using branch cutting technique.
- 1.4.2 To assess the bamboo grower's interest of bamboo plantations using branch cutting technique.
- 1.4.3 To determine the economic impact of bamboo groves management technique.
- 1.5 Expected output : Economic gain of the bamboo plantations using branch cutting and bamboo groves management technique on economy of rural people will be determined
- 1.6 Study period : 2011-12 to 2013-14
- 1.6.1 Starting year : 2011-12
- 1.6.2 Completion year : 2013-14
- 1.7 Personnel (s) :
- 1.7.1 Study leader : M.A Taher Hossain; RO.
- 1.7.2 Associates : Hasina Mariani; DO, Md. Melon; FI; Forzana Yasmin; RA-1.
- 1.8 Progress :
- 1.8.1 Previous years (2011-12) : Information on the bamboo plantation raised by bamboo branch cutting & offset method and its' plantation establishment cost were collected from Faithong of Cox's bazaar district and Social forest division (SFD) of Dinajpur district. The Net present value of benefit (NPVB) per hectare on bamboo branch cutting and offset method were Tk. 0.803 & 0.725 million for SFD Dinajpur Tk. 0.534 and 0.453 million for Faithong of Cox's bazaar district respectively.
- 1.8.2 This year :

Activities of the study	Progress
a. Survey at Bagarpara of jessore and jamalgonj of Sunamgonj and Sylhet District.	a. Group discussion meeting were been arranged with the bamboo growers that had been received training on technique of bamboo plantation through bamboo branch cutting and bamboo grove management. Among the participant, 25 bamboo growers from each location were been selected randomly for interview.
b. Collection of data through pre designed schedule from the selected bamboo plantations.	b. Desired information was able to collect only from the raised bamboo plantations under Sylhet Forest Division and moderately raised private bamboo plantations at Jamalgonj of Sunamgonj. Data on bamboo plantations establishment cost, yield of bamboo culms, market price of bamboo culms, bamboo plantation area raised by the technique of bamboo branch cutting and rhizomes as well as the attitude of bamboo growers for the bamboo propagation by using bamboo branch cutting were recorded. However, no bamboo plantation by branch cutting was found in Jessore where the branch cutting technique had been disseminated.
c. Compilation and analysis of data.	c. A comparison of bamboo plantation cost, bamboo resource yield and its' financial return in both type of plantation were assessed. Assessment of bamboo plantations were made for the period of 16 years. Compilation of basic data and results of economic analysis are in table 1 & 2.

Tab.1 Basic information on bamboo plantation.

Variable	Locations	
	Sunamgonj	Sylhet FD
1. Total bamboo planted area (ha)	-	1205
2. Average bamboo planted area (ha)	0.032	-
3. Plantation through bamboo branch cutting (%)	40	60
4. Average price of bamboo branch cutting (Tk./ unit)	40	12
5. Average price of rhizome (Tk./unit)	130	120
6. Collection of average rhizome cost (Tk/unit)	30	30
7. Bamboo branch cutting/ Rhizome planted (nos/ha)	494	494
8. Existing clumps (%) of bamboo branch cutting	80	80
9. Existing clumps (%) of rhizome	75	75
10. Average price of a bamboo culm (Tk./unit)	130	120
11. ARR	10%	

Tab.2 Results of economic indicators for the bamboo branch (B.B) cutting and rhizome based bamboo plantation in Sylhet Forest Division and Sunamgonj districts.

Economic Indicator	Sylhet FD		Sunamgonj	
	B.B cutting	Rhizome	B.B cutting	Rhizome
IRR (Internal Rate of Return in %)	49	33	45	34
NPW (Net Present Worth Tk/ha. in '000')	780.15	684.36	943.55	750.65
B-C ratio (Benefit- Cost ratio)	4.07	3.21	6.34	3.30
Le (Land Expectation Value ,Tk/ha in '000')	217.01	190.37	262.46	208.81
EAEnpv (Equal Annual Equivalent, Tk/ha '000')	99.72	87.47	120.60	95.95

1.9 Achievement (s), if : N.A
any

1.10 Financial Statement :

1.10.1 Total cost : Tk. 3,20,000.00

1.10.2 Cost of the year : Tk. 72,000.00

1.10.3 Expenditure of the : Tk. 72,000.00
year

1.10.4 Source of fund : GOB.

1.11 Beneficiaries : FD ,Bamboo grower, Private Entrepreneurs, NGOs.

2. Study : New

2.1 Programme Area : Forest Inventory and Economics

2.2 Title of the Study : Determination of financial rotation of babla (*Acacia nilotica*) plantations in Bangladesh

2.3 Justification : Babla plantations have so far been raised largely in coastal area by Forest Department (FD) and NGOs. The plantations have been raised in embankment and road side in short and long term rotations. The planters are used to face the problems in determining the harvesting age (rotation), the actual timber volume as well as prices of standing trees of their plantations. So, the study has been undertaken to determine the financial rotation to ensure optimum profitable management of the plantations

- 2.4 Objective
- 2.4.1 To determine the financial rotation of babla (*Acacia nilotica*) based on its the existing utilization.
- 2.5 Expected output : Optimum rotation of babla (*Acacia nilotica*) will be determined.
- 2.6 Study period : 2011-12 to 2013-14
- 2.6.1 Starting year : 2011-12
- 2.6.2 Completion year : 2013-14
- 2.7 Personnel (s) :
- 2.7.1 Study leader : M.A Taher Hossain; RO.
- 2.7.2 Associates : Hasina Mariam; DO, Md. Melon; FI; Forzana Yasmin; RA-1.
- 2.8 Progress :
- 2.8.1 Previous years (2011-12): Data were collected from mixed and mono plantations of babla species raised within 1990-91 to 2005-06 and 1996-97 to 2005-06 under Social Forest Division of Bagerhat and Coastal Afforestation Division of Noakhali respectively. Collected data were analyzed and rotation will be fixed up after data collection and analysis of all locations of the study area.
- 2.8.2 This year :

Activities of the study	Progress
a. Contact the DFO office of Barisal and Bhola to collect the details information on babla plantations.	a. . Year wise information on the background of existing babla plantations were collected from the respective areas of Barisal Social Forest Division and Bhola C/A Division.
b. Data collection and analysis.	b. Data were collected from the sample plots (Size 0.01 ha) of mixed and mono plantations of babla species raised within 1983-84 to 2000-01 and 1976-77 to 2003-04 under Social Forest Division of Barisal and Coastal Afforestation Division of Bhola respectively. The collected information were height, girth, total number of trees/plot, number of babla trees/plot, price of babla seed, plantation management cost, market price of babla timber and babla fire wood. Basic information and analysis are in table 1, 2 & 3.

Tab 1. Basic information on babla species plantation.

Items	Unit
1. Babla tree seed (Tk/kg)	12
2. Babla seed (Kg/ha)	20
3. Average fuel wood price (Tk/40 kg)	80
4. Average babla tree round log size in 45 to 60cm. (Tk/30 cm.)	170
5. Average babla tree round log size in 60 to 75cm. (Tk/30 cm.)	270
6. Average babla tree round log size in 75 to 105 cm. (Tk/30 cm.)	325

Tab 2. Financial analysis of babla species plantation in Barisal Social Forest Division

Plantation year	Age (year)	Mean-GBH (cm)	PVC(Tk)	NPV(Tk)	IRR (%)	B/C ratio	Le	EAEnpv (Tk)	EAEle (Tk)
1983-84	28	106	61127	64015	17	2.05	4770	6879	513
1984-85	27	96	42797	28946	14	1.68	2390	3134	259
1990-91	21	83	60316	50754	17	1.84	7930	5868	917
1993-94	18	71	61405	50382	18	1.74	11049	6143	1347
1996-97	15	63	49769	20200	15	1.41	6358	2656	836
1999-00	12	36	36611	-5265	8	0.86	-2462	-773	-361
2000-01	11	55	56998	32536	20	1.57	17557	5009	2703

Tab. 3 : Financial analysis of babla species plantation in Bhola C/A Division

Plantation year	Age	Mean-GBH (cm)	PVC(Tk)	NPV(Tk)	IRR (%)	B/C ratio	Le	EAEnpv (Tk)	EAEle (Tk)
1976-77	36	112	30011	13717	12	1.46	459	1418	47
1992-93	20	68	41988	13798	13	1.33	2409	1621	283
1994-95	18	47	37071	5082	11	1.14	1115	620	136
1995-96	17	73	41502	13312	13	1.32	2919	1623	356
1996-97	16	63	54745	29441	15	1.47	8311	3775	1066
2003-04	9	53	49457	15511	17	1.31	11422	2693	1983

- 2.9 Achievement (s), if any : N.A.
- 2.10 Financial Statement : Tk. 3,10,000.00
- 2.10.1 Total cost :
- 2.10.2 Cost of the year : Tk. 76,020.00
- 2.10.3 Expenditure of the year : Tk. 76,020.00
- 2.10.4 Source of fund : GOB.
- 2.11 Beneficiaries : FD, Private Planters. NGOs etc.
- 3 Study : New
- 3.1 Programme Area : Forest Inventory and Economics
- 3.2 Title of the Study : Impact of the Coastal afforestation of Bangladesh in respect of financial and socioeconomic conditions of local people.
- 3.3 Justification (For new study) : 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 based for 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.
- 3.4 Objectives
- 3.4.1 To find out production system through intercropping of seasonal and/or annual crop in the forest floor of afforestation areas.
- 3.4.2 To assess income generation of local people.
- 3.4.3 To make financial analysis of afforestation in Coastal zone.
- 3.4.4 To estimate the sequestrated carbon in the selected years of plantations of Coastal Afforestation
- 3.5 Expected output : Generation of employment & income, production system, input- out-put ratio of local people and the economic profitability of afforestation in Coastal zone.
- 3.6 Study period : 2012-13 to 2014-15
- 3.6.1 Starting year : 2012-13
- 3.6.2 Completion year : 2014-15
- 3.7 Personnel (s) :
- 3.7.1 Study leader : M.A Taher Hossain; RO
- 3.7.2 Associates : Hasina Mariam; DO, Md. Melon; FI; Forzana Yasmin; RA-1
- 3.8 Progress :
- 3.8.1 Previous years, if any : N.A

3.8.2 This year :

Activities of the study	Progress
a. Conduct pilot survey and selection of participants with the help DFO office of Noakhali C-A division	a. Pilot survey was conducted to determine the required number of sample plots for the forest resource assessment of strip plantation raised during 1993-94 to 2000-01. Group discussion were arranged with the local participant of three forest range area that would directly or indirectly have benefit form strip plantation. Among the participant of strip plantation from each range, 25 beneficiaries were selected randomly for interview regarding their production, employment and income .
b. Data collection and analysis.	b. The required number of samples size for the study area was determined as 200 plots (size 100 sq. meter) at 7.55% margin of error through pilot survey. These sample plots were allocated stratum (year-wise) wise proportionately for required data collection. The collected information were GBH/DBH of trees and number of tree species per plot, tree round log price of different size and species, fuel wood price, nursery and plantation management cost etc. The Stratified Random Sampling was employed to assess the number tree stocking, tree biomass and forest carbon storing of the strip plantation raised during 1993-94 to 2000-01 under Noakhali C/A division only. Results of the strip plantations assessment are in table 1, 2, 3, 4,& 5. The financial and socioeconomic analysis of the strip plantations are on going and that will be submitted later on.

Tab 1 : Strip Plantations Raised under Noakhali Coastal Afforestation (C/A) Division during 1993-94 to 2000-01

Name of Upazilla	Year of Plantation (ha)								
	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	Total
Sadar (Noakhali)		3.6	7.4	10.8	26	20	19.28	21.2	108.28
Sobarnachar			1.6	6.4	10	10.4	14.8	16	59.2
Kompanigonj	1.6	2.4	1.8		2	5.6	9.6	16	39
Senbag	2.4	1.6	0.8	2.4		3.2	4.4	10.4	25.2
Begumgonj				0.4		0.4	6	4	10.8
Shonaimori				0.4		2.4		4.8	7.6
Kabirhat				0.8			7.4	12.12	20.32
Chatkhil						2.4	3.2	4.4	10
Sadar (Laxmipur)	3.6	1.6	5.6	15.2	29.2	34	52	64.8	206
Roypur	1.2			8.8	12.4	18.8	5.2	8	54.4
Kamolnagar	1.6		8	5	9.6	8.8	11.2	13.6	57.8
Ramgoti	0.8			5	12	14.8	7.6	9.6	49.8
Ramgonj		2	8.4	10	18	21.6	10.4	16.4	86.8
Hatia		0.8	4	6.4	10.8	10	13.6	11.2	56.8
Total	11.2	12	37.6	71.6	130	152.4	164.68	212.52	792

Tab-2 : Percentage of tree species existed in road side intra stratum (year) under Noakhali C/A division during 1993-94 to 2000-01

Name of Species	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-100	2000-01
	%	%	%	%	%	%	%	%
Akashmoni	33.33		45.97	35.82	32.89	30.78	44.34	19.47
Arjun				0.5	2.24	0.75		0.78
Babla			1.61		0.45	6.9	0.77	0.16
Kat-Badam					0.22		0.38	0.31
Bokain		8.33		1.49	3.13	0.56		1.25
Bot						0.19		
Chatian						0.19		
Gamar			0.81	2.49	2.68	5.97	6.53	1.09
Hijol								0.16
Ipilipil				1.99	0.22	0.56		1.25

Jarul					0.22	0.37		0.31
Jam							0.19	0.16
Jhau				0.5	0.89	8.02	9.02	3.74
Kadam							0.19	0.16
Kanthal					3.58	2.24	0.38	
Krishnachura							0.19	
Mehogoni	9.52			13.93	5.59	6.53	12.09	9.5
Manjium					0.22		5.95	1.09
Minjiri				2.49				
Natai		8.33	23.39	6.97	6.04	5.97	0.77	4.05
Neem		4.17						
Raintree	47.62	75	16.13	27.86	29.08	25.19	12.28	50.78
Rajkoroi					0.22			0.47
Sadakoroi				1.99	0.67	1.49	0.38	0.78
Chapalish							0.19	
Silkoroi	4.76			0.50		0.19	4.99	0.16
Simul					0.22	0.37		
Sissoo	4.76	4.17	12.1	3.48	11.41	3.73	0.77	4.21
Sonalu							0.38	
Tetul							0.19	0.16
Total	100	100	100	100	100	100	100	100

Tab-3 : Girth at Breast Height (GBH) class-wise existing tree species (%) of strip plantation under Noakhali C/A division during 1993-94 to 2000-01

Name of Species	Girth at breast height (cm)							Total %
	>60	60-89	90-119	120-149	150-179	180-209	210-239	
	%	%	%	%	%	%	%	
Akashmoni	13.59	14.03	3.82	0.4	0.12			31.96
Arjun	0.52	0.2	0.08					0.79
Babla	1.27	0.56						1.83
Kat-Badam	0.2							0.2
Bokain	0.4	0.52	0.24	0.04				1.19
Bot	0.04							0.04
Chatian		0.04						0.04
Gamar	1.79	1.63	0.16	0.04				3.62
Hijol		0.04						0.04
Ipilipil	0.16	0.32	0.12	0.04				0.64
Jarul	0.2							0.2
Jam	0.08							0.08
Jhau	1.23	2.38	1.03	0.08				4.73
Kadam	0.08							0.08
Kanthal	0.72	0.48						1.19
Krishnachura	0.04							0.04
Mehogoni	5.56	2.74	0.12	0.08				8.51
Manjium	0.32	0.72	0.32	0.20				1.55
Minjiri	0.08	0.12						0.2
Natai	1.99	2.38	0.79	0.12	0.04			5.33
Neem	0.04							0.04
Raintree	5.13	10.21	8.31	4.41	1.59	0.48	0.04	30.17
Rajkoroi		0.08	0.08					0.16
Sadakoroi	0.32	0.32	0.24					0.87
Chapalish		0.04						0.04
Silkoroi	0.91	0.20	0.08					1.19
Simul	0.04	0.04	0.04					0.12
Sissoo	3.5	1.35	0.12	0.04				5.01
Sonalu	0.08							0.08
Tetul	0.08							0.08
Total								100

Tab-4 : Summary of Stratified Random Sample information (n=200)

Stratum	Plantations/Stratum		Sample	Estimated value of per hectare						
				Tree stocking		Above ground Tree biomass		Carbon content		
(Year)	Total unit (Nh*)	(Ha)	(nh)	Mean (nos)	SD	Mean (cu-m)	SD	Mean (Ton)	SD	Ton/year
1	1120	11.20	3	700	100	358.17	190.41	179.083	95.205	9.949
2	1200	12.00	3	800	400	492.63	169.29	246.316	84.645	14.489
3	3760	37.60	9	1378	249	396.11	170.06	198.054	85.032	12.378
4	7160	71.60	18	1117	296	301.90	131.46	150.949	65.729	10.063
5	13000	130.00	33	1355	209	385.68	155.21	192.838	77.604	13.774
6	15240	152.40	38	1408	378	257.83	86.18	128.917	43.088	9.917
7	16468	164.68	42	1240	319	223.83	158.41	111.915	79.204	9.326
8	21252	212.52	54	1189	197	221.07	87.67	110.535	43.834	10.049
Total	79200		200							

*indicate- unit number (100 sq. meter in size) of stratum-wise strip plantation population

Tab-5: The results of Stratified Random Sampling

Variable	Estmed (Total)	SE	95% C.I.
Tree stocking of the strip plantations during 1994-2001(nos)	996796	15790	30948
Above ground biomass of the strip plantations (Ton)	219706	7194	14101
Above ground Carbon content of the strip plantation (Ton)	109853	3597	7051

- 3.9 Achievement : NA
 3.10 Financial statement :
 3.10.1 Total cost of the study : Tk 6,50,000.00
 3.10.2 Cost of the year : Tk 81,980.00
 3.10.3 Expenditure of the year : Tk. 81,980.00
 3.10.4 Source of fund : GOB
 3.11 Beneficiaries : FD, Private Planters, NGOs etc.

SOIL SCIENCE DIVISION

1. Study : Ongoing
 1.1 Programme Area : Plantation technique and forest management
 1.2 Title of the Study : Effect of integrated soil fertility management in rubber plantation 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, stylosanthes, 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% (Yogaratanam, 2007). Rubber plantation can reduce air pollution and help to maintain ecological balance. While the

world is facing the affects of climate change, rubber trees can protect us from its bad effect. Properly managed plantations are self-suitable ecosystems and could maintain a fair degree of biodiversity. In view of developing suitable models of ISFM in combination with appropriate selection of intercrops for increasing latex yield and income in the rubber plantation the present research work has been initiated.

- 1.4 Objectives
 - 1.4.1 To utilize litter fall of rubber trees as organic compost
 - 1.4.2 To assess the effect of compost on growth and latex production in new and mature rubber plantation
 - 1.4.3 To evaluate the role of different nitrogen fixing crops in new rubber plantation
- 1.5 Expected output : Increasing soil fertility and latex production of rubber plantation
- 1.6 Study period :
 - 1.6.1 Starting year : 2010-11
 - 1.6.2 completion year : 2014-15
- 1.7 Personnels :
 - 1.7.1 Study leader : M. Zahirul Alam, Assistant Soil Scientist
 - 1.7.2 Associates : Md. Jahangir Alam, Divisional Officer; Md. Motiar Rahman, Asst. Soil Scientist
- 1.8 Progress :
 - 1.8.1 Previous years (2011-12) : Initial soil and compost samples were analyzed and recorded. One hundred 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 November, 2012 to May, 2013 from selected mature rubber plantation (Table 3).
d. Field management by two times weeding of 1.50 acre established plantation, repairing of fence, land preparation for intercropping	d. Field management were done through weeding and land preparation was completed as per schedule for cover crops
e. Cover crops (pueraria-Pueraria phaseoloides and thai lazzabati-Mimosa invisa) will be broadcast and shrubby crop (arhar-Cajanus cajan) seed sown as intercrop in new established rubber plantation	e. Cover crops (pueraria-Pueraria phaseoloides and thai lazzabati-Mimosa invisa) were broadcast and shrubby crop (arhar-Cajanus cajan) seed sown as intercrop in new established rubber plantation.
f. Data analysis and report writing	f. Data were analyzed and compiled

Table 1: Nutrient status of compost and rubber effluent

Sl. No.	Parameters	Unit	Compost				Rubber effluent
			T ₁	T ₂	T ₃	T ₄	
01	pH		5.75	5.65	5.50	5.40	5.12
02	Organic carbon (OC)	%	-	-	-	-	-
03	Nitrogen (N)		-	-	-	-	0.18
04	Potassium (K)	meq/100 gm	1.64	1.58	4.09	1.66	3.07
05	Calcium (Ca)		6.74	7.48	10.48	7.23	0.0155
06	Magnesium (Mg)		4.52	2.88	3.70	2.88	2.88
07	Phosphorus (P)	µg/gm	640	1400	3350	650	1100
08	Sulphur (S)		1350	1500	1450	1300	300
09	Manganese (Mn)		155	220	200	145	0.1168
10	Iron (Fe)		450	550	450	350	1.5838
11	Boron (B)		410	450	500	450	0.62
12	Copper (Cu)		6.0	4.0	7.5	4.5	2.0
13	Zinc (Zn)		35	65	40	30	0.5960

T₁ = Litter fall & weeds (110 kg per pit)

T₂ = Litter fall & weeds + cowdung (110 kg + 30 kg per pit)

T₃ = Litter fall & weeds + PKS fertilizers (110 kg + 10 kg per pit)

T₅ = Litter fall & weeds + rubber effluent (110 kg + 50 litre per pit)

Table 2: 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 3: Average latex yield (cc/tree/day), GBH (cm) and height (m) data from selected mature rubber plantation during November, 2012 to May, 2013

Parameters	Treatment					
	T ₀	T ₁	T ₂	T ₃	T ₄	T ₅
Latex yield	98.99	82.34	84.92	81.36	88.61	99.66
GBH	59.95	55.62	55.37	54.49	57.37	57.49
Height	7.0	7.77	8.38	7.0	6.70	7.0

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

1.10 Financial Statement :

1.10.1 Total cost : Tk. 5,00,000.00

1.10.2 Cost of the year : Tk. 1,38,950.00

1.10.3 Expenditure of the year : Tk. 1,38,950.00

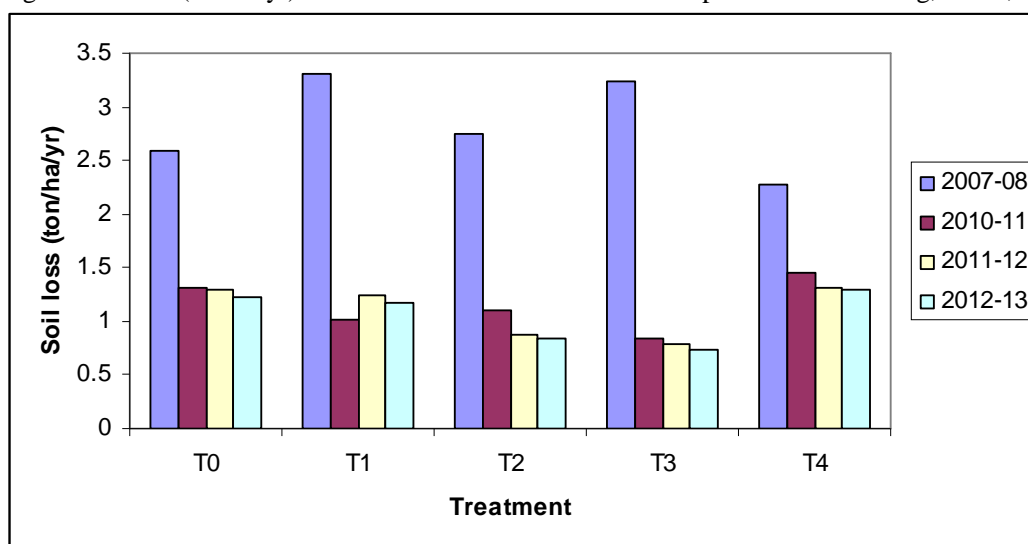
- 1.10.4 Source of fund : GOB
- 1.11 Beneficiaries : BFIDC and private rubber planters
2. Study : Ongoing
- 2.1 Programme Area : Soil consevation and watershed management
- 2.2 Title of the Study : Minimization of soil erosion in teak through trails by mixed planataions at Faitong, Lama, Bandarban Hill District
- 2.3 Justification : Teak (*Tectona grandis*), an important timber plant is cultivated as monoculture in Bangladesh since long time (*Brandis, 1879*). It has long been a general belief that monoculture of teak cultivation deteriorates the soil health. Moreover, in teak plantation there occurs destruction of organic matter due to clear felling and burning of native vegetation, exposure of the surface to insulation, relative absence of ground flora, increased erosion and laterization (*Singh, 1962*). It is often noticed that the teak plantations of Chittagong, Chittagong Hill Tracts and Sylhet area are devoid of undergrowth vegetation and there occurs severe soil erosion that eventually causes land degradation. Researchers and forest managers agreed to combat that. Its mitigation is urgent. In this regard no notable work could be cited. BFRI researcher's findings supported to infer that under planting in teak was unable to stop soil erosion even the introduced species did not survive (*Emdad, 2000*). An attempt could be made to check soil erosion through biological manipulation. To address the problem in teak plantations, mixed plantation with teak may be approached. Some silvicultural practices have been suggested to guard against erosion in teak plantations. These include strict fire protection (*Bloch, 1951*), encouraging undergrowth (*Vevekananda, 1931*), mulching (*Copestone, 1919*), mixed cropping (*White, 1991*), planting teak in strips separated by unplanted strips (*Bell, 1973*) and under planting with legumes (*Alphen de Veer, 1957*). Among these approaches mixed planting of teak with different species may be suitable. So, it is necessary to find out the compatible tree species in teak plantation.
- 2.4 Objectives
- 2.4.1 To compare soil loss in mono and mixed plantations of teak
- 2.4.2 To determine appropraite species for mixed plantaions of teak
- 2.5 Expected output : Appropriate tree combination with teak to reduce soil erosion
- 2.6 Study period :
- 2.6.1 Starting year : 2007-08
- 2.6.2 completion year : 2014-15
- 2.7 Personnels :
- 2.7.1 Study leader : M. Zahirul Alam, Assistant Soil Scientist
- 2.7.2 Associates : Md. Jahangir Alam, Divisional Off.; Md. Motiar Rahman, Asst. Soil Scientist
- 2.8 Progress :
- 2.8.1 Previous years (2011-12) : Data on height, girth and survival were recorded and found that maximum height (7.02 m), girth (31.26 cm) and survival (70%) was hybrid acacia. Soil loss was assessed by scaling method and found T₀ (Teak), T₁ (Teak+Mehogany), T₂ (Teak+Hybrid acacia), T₃ (Teak+Eucalyptus) and T₄ (Teak+Garjan) were 1.29, 1.25, 0.88, 0.79 and 1.32 ton/ha/yr respectively.
- 2.8.2 This year :

Activities of the study	Progress
a. One hectare established plantation will be maintained through weeding and pruning	a. One hectare established plantation was maintained through two times weeding and pruning.
b. Data on height, girth and survival percentage will be collected from established plantation	b. Data on height, girth and survival percentage were collected from established plantation and recorded (Table 1).
c. Soil loss will be assessed by scaling method	c. Soil loss was assessed by scaling method (Fig. 1).
d. Data analysis and report writing	d. Data were analyzed and compiled.

Table 1: Height, girth and survival percentage of five year mixed plantations in different treatments

Treatment	Species	Height (m)	Girth (cm)	Survival (%)
T ₀	<i>Tectona grandis</i>	2.71	10.66	67.33
T ₁	<i>Tectona grandis</i>	2.73	10.43	61.66
	<i>Swietenia macrophylla</i>	3.70	13.85	43.33
T ₂	<i>Tectona grandis</i>	1.92	6.85	26.93
	Hybrid acacia	11.49	41.88	64.66
T ₃	<i>Tectona grandis</i>	2.62	9.97	54.33
	<i>Eucalyptus camaldulensis</i>	8.35	27.39	51.66
T ₄	<i>Tectona grandis</i>	2.07	7.68	43.33
	<i>Dipterocarpus turbinatus</i>	2.98	12.83	50.66

Fig. 1: Soil loss (ton/ha/yr) under different treatments in mixed plantation at Faitong, Lama, Bandarban



- 2.9 Achievement : Established 1.0 hectare mixed plantation at Faitong, Lama Bandarban Hill District
- 2.10 Financial Statement : Tk. 2,00,000.00
- 2.10.1 Total cost :
- 2.10.2 Cost of the year : Tk. 24,800.00
- 2.10.3 Expenditure of the year : Tk. 24,800.00
- 2.10.4 Source of fund : GOB
- 2.11 Beneficiaries : FD and private planters
3. Study : Ongoing
- 3.1 Programme Area : Soil conservation and watershed management
- 3.2 Title of the Study : Effect of arhar (*Cajanus cajan*) as a mixed crop on soil erosion minimization in zinger cultivation in the hills of CHTs
- 3.3 Justification : Thousands of hectares of slope land in the Chittagong Hill Tracts (CHTs) are covered by zinger cultivation every year irrespective of slope gradient. Simultaneously, it is thought that traditional zinger cultivation system is largely involved with increased soil erosion in the sloping uplands. Cultivation of zinger in this region starts from March-May through loosing the soil by a spade and planting rhizome in the furrow of up and down direction of the hills. Harvesting of crop is done in December-February in every year (Islam and Majumder, 2008). During this cultivation

period, particularly in the months of June-August, monsoon downpour removes loose soil. Depending on the slope gradient, slope position, cycle of fallow period, management operations different rate of erosion occurs. In a study, it was found that higher soil erosion rate (9-113 t/ha) was estimated during rainy season and lower (9-67 t/ha) during post harvest phase (Anon. 1997). Zinger is mostly used as spices, but it is also popular for its medicinal values worldwide (Brady, 1992). Along with removal of top soil, traditional zinger cultivation simultaneously disrupts soil nutrient pool by carrying away soil organic matter (SOM), nitrogenous elements, phosphorus and other essential plant nutrients. This also results in increased bulk density, poor water holding capacity and low microbial activities of the soil. Thus, the fertile zinger cultivation site turns into a degraded land (Farhad, 2006).

Introduction of arhar (*Cajanus cajan*), a leguminous crop may effectively contribute to the adverse impacts of traditional zinger cultivation system through its proper management. Arhar, a multipurpose cash crop is capable of growing on a wide range of soil. As a leguminous crop it supplies additional nitrogen to the soil and used for green manure. Spatial and temporal arrangement of arhar plant through hedgerow formation in the zinger cultivation system is useful to reduce soil erosion. Moreover, this crop yields up to 2.25 t/ha which can be used as pulse and poultry feeds. It gives 47.63 t/ha biomass and 2.95 t/ha stem/liter production (Gowda, 1982). In general, improved management of arhar is necessary to develop for the purpose of sustainable slope land productivity in zinger cultivation. Aiming at this present research activity was undertaken

3.4 Objectives

3.4.1 To quantify soil and nutrients loss in zinger cultivation in hilly area

3.4.2 To assess the effect of arhar planting in zinger fields in hill slope on soil conservation

3.5 Expected output: Minimization of soil erosion for sustaining soil fertility and zinger production in hill slopes

3.6 Study period : 2009-10

3.6.1 Starting year :

3.6.2 completion year : 2012-13

3.7 Personnels :

3.7.1 Study leader : Md. Motiar Rahman, Assistant Soil Scientist

3.7.2 Associates : Md. Jahangir Alam, Divisional Officer; M. Zahirul Alam, Assistant Soil Scientist

3.8 Progress :

3.8.1 Previous years (2011-12) : Fifteen decimal hilly lands were cultivated for zinger and arhar production. Analyzed data showed soil erosion was higher (38.85 ton/ha/yr) in the traditional system than that of experimental plots (31.24 and 26.41 ton/ha/yr). Soil nutrient loss was also higher in the traditional system. Yield of zinger was higher (15 ton/ha) than that of traditional system (12 ton/ha).

3.8.2 This year :

Activities of the study	Progress
a. Fifteen decimal established experimental plots will be maintained	a. Fifteen decimal established experimental plots were maintained through furrowing.
b. Nine composite soil samples (0-15, 15-30 and 30-50 cm soil depth) will be collected for analysis of soil nutrients	b. Composite soil samples were collected from the experimental plots and sent to SRDI, Comilla for nutrients analysis
c. Yield data of zinger will be collected	c. Yield data of zinger were collected and recorded (Fig. 1)
e. Soil erosion and existing nutrient status will be assessed	e. Soil erosion and existing nutrient status was assessed (Fig. 2 and Table 2))
f. Data analysis and report writing	f. Data were analyzed and compiled

Table 1: Initial soil status of the experimental plots at wagga, Kaptai, Rangamati Hill tracts

Plot No.	Soil depth (cm)	pH	SOM (%)	Total-N (%)	P	S	K	Ca	Mg
					$\mu\text{g/g soil}$	Meq/100g soil			
T ₀	0-15	5.4	3.12	0.28	3.0	13.0	0.36	2.23	1.51
	15-30	4.8	2.20	0.24	3.0	12.0	0.36	2.20	1.50
	30-50	4.9	1.89	0.20	2.5	12.0	0.35	2.15	1.45
T ₁	0-15	5.2	3.01	0.27	2.0	10.0	0.28	1.27	1.00
	15-30	5.0	2.38	0.24	2.0	9.0	0.27	1.25	1.01
	30-50	4.9	2.41	0.17	2.0	9.0	0.27	1.20	0.98
T ₂	0-15	5.1	2.84	0.17	2.0	8.0	0.27	0.86	0.53
	15-30	4.9	2.10	0.16	2.0	8.0	0.26	0.82	0.55
	30-50	4.6	1.46	0.17	1.8	8.0	0.25	0.80	0.50

Fig. 1: Yield of zinger in the experimental plots

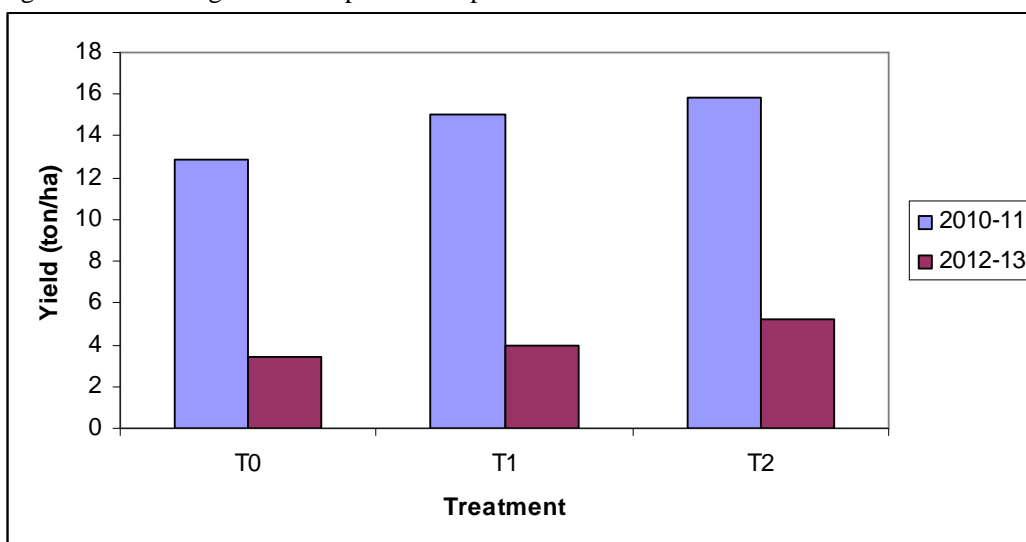


Fig. 2: Soil loss (ton/ha/yr) of the experimental plots at Wagga, Kaptai, Rangamati Hill District

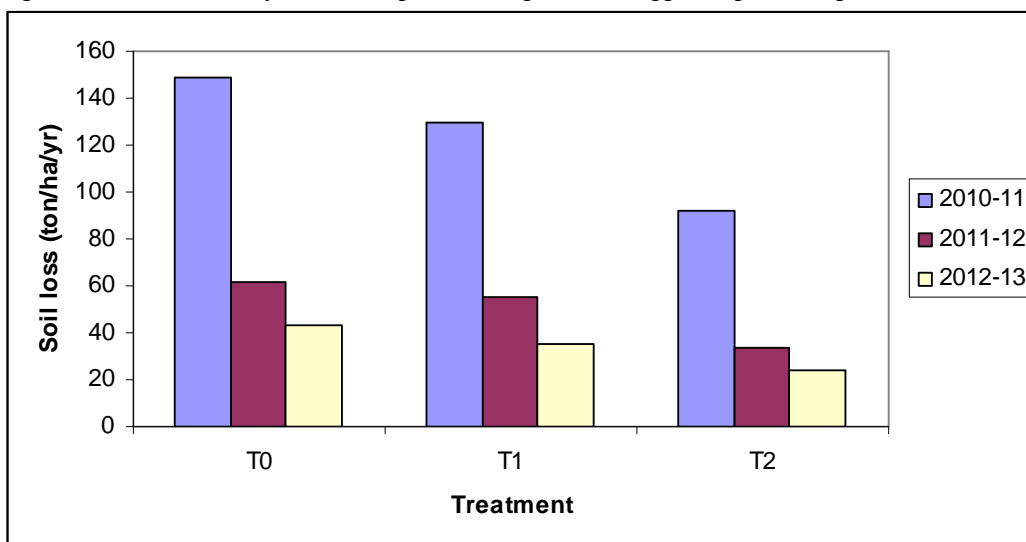


Table 2: Estimation of soil nutrient loss (kg/ha/yr) in the experimental plots at 35% slope

Soil nutrients	2010-11			2011-12		
	T ₀	T ₁	T ₂	T ₀	T ₁	T ₂
Organic matter	3950.63	2640.78	2577.89	1630.58	1125.06	955.40
Nitrogen	207.92	181.23	146.78	85.82	77.21	54.40
Phosphorus	0.79	0.65	0.42	0.32	0.27	0.16
Potassium	27.77	18.64	16.42	11.46	7.94	6.09
Sulfur	2.30	1.27	0.73	0.95	0.54	0.27
Calcium	99.35	67.18	42.57	41.01	28.62	15.78
Magnesium	24.65	12.56	16.60	10.17	5.35	6.15

3.9 Achievement : Established fifteen decimal experimental plots at Wagga, Kaptai, Rangamati Hill District.

3.10 Financial Statement :

3.10.1 Total cost : Tk. 3,00,000.00

3.10.2 Cost of the year : Tk. 70,740.00

3.10.3 Expenditure of the year : Tk. 70,740.00

3.10.4 Source of fund : GOB

3.11 Beneficiaries : Zinger cultivators, hill farmers and private planters

4. Study : Ongoing

4.1 Programme Area : Soil conservation and watershed management

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

4.3 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 green house 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 CO₂ 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.

4.4 Objectives

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

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

- 4.5 Expected output: Prepared data bank on carbon storage trends from different forest tree species and soil
- 4.6 Study period :
- 4.6.1 Starting year : 2010-11
- 4.6.2 completion year : 2014-15
- 4.7 Personnels :
- 4.7.1 Study leader : Md. Motiar Rahman, Assistant Soil Scientist
- 4.7.2 Associates : Md. Jahangir Alam, Divisional Off.; M. Zahirul Alam, Asst. Soil Scientist
- 4.8 Progress :
- 4.8.1 Previous years (2011-12) : Organic carbon content of twenty four species (12 mangrove, 7 forest and 5 bamboo species) and soil samples from adjacent selected tree species were analyzed and recorded.
- 4.8.2 This year :

Activities of the study	Progress
a. Root, stem, branch, twig and leaf samples from 5 forest species and 5 bamboo species will be collected at different forest areas for determination of carbon content	a. Root, stem, branch, twig and leaf samples of 2 forest tree species (<i>Shorea robusta</i> and <i>Acacia mangium</i>) were collected and analyzed for carbon content (Table 1 & 2). Carbon content of different parts of 5 bamboo species (<i>B. polymorpha</i> , <i>B. nutans</i> , <i>D. longispachus</i> , <i>S. dullooa</i> and <i>S. siamensis</i>) were also determined (Table 3).
b. Soil profile will be excavated and soil samples will be collected from adjacent selected trees	b. Soil profile was excavated and composite soil samples under 0-15 and 15-30 soil depth at each selected tree & bamboo species were collected and analyzed (Table 4).
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.

Table 1: Carbon content (%) of different parts of Sal (*Shorea robusta*) at different GBH class

GBH Class (cm)	Carbon content (%)					
	Root	Stem	Branch	Twig	Leaf	Mean
1-10	53.36	55.42	56.06	55.62	56.03	55.30
11-20	54.68	56.27	56.74	55.71	55.45	55.77
21-30	55.46	55.78	56.58	54.68	55.52	55.60
31-40	56.65	57.03	57.13	55.35	56.41	56.51
41-50	54.09	55.83	56.50	55.54	56.45	55.68

Table 2: Carbon content (%) of different parts of Mangium (*Acacia mangium*) at different age class

Age Class (year)	Carbon content (%)					
	Root	Stem	Branch	Twig	Leaf	Mean
1-5	-	-	-	-	-	-
6-10	-	-	-	-	-	-
11-15	57.32	57.61	57.32	55.78	55.29	56.66

Table 3: Carbon content (%) of five bamboo species at mature and immature stages

Sl. No.	Species	Mature	Immature
01	Mukla (<i>Bambusa nutans</i>)	54.06	54.21
02	Ora (<i>Dendrocalamus longispathus</i>)	51.63	51.67
03	Thai barua (<i>Thyrsostachys siamensis</i>)	55.07	53.03
04	Pharua (<i>Bambusa polymorpha</i>)	52.81	54.04
05	Dolu (<i>Schizostachyum dullooa</i>)	53.39	56.73

Table 4: Soil organic carbon content (%) at adjacent selected tree species under 0-15 and 15-30 cm soil depth

Sl. No.	Species	Soil depth (cm)	
		0-15	15-30
01	Sal (<i>Shorea robusta</i>)	0.44	0.25
02	Mangium (<i>Acacia mangium</i>)	0.67	0.56
03	Mukla (<i>Bambusa nutans</i>)	1.50	1.24
04	Ora (<i>Dendrocalamus longispathus</i>)	2.00	1.89
05	Thai barua (<i>Thyrsostachys siamensis</i>)	1.96	1.92
06	Pharua (<i>Bambusa polymorpha</i>)	1.24	1.05
07	Dolu (<i>Schizostachyum dullooa</i>)	1.81	1.43

- 4.9 Achievement : Carbon content of twenty five forest tree species were assessed for preparation of data bank
- 4.8.2 This year :
- 4.10 Financial Statement :
- 4.10.1 Total cost : Tk. 6,00,000.00
- 4.10.2 Cost of the year : Tk. 65,510.00
- 4.10.3 Expenditure of the year : Tk. 65,510.00
- 4.10.4 Source of fund : GOB
- 4.11 Beneficiaries : FD, NGO and academician

MINOR FOREST PRODUCTS DIVISION

1. Study : On-going
- 1.1. Programme Area : Bamboo and Non-timber Economic Crops
- 1.2. Title of the Study : Nursery, plantation and management techniques, and conservation of ten rattan species available in Bangladesh.
- 1.3 Justification : Rattan is one of the important natural resources in Bangladesh. Besides ecological importance, this natural resource has been used as raw materials in cottage industries and has potential economic value. Once the country was rich in rattan population. But due to improper management and over exploitation, this valuable natural resource is now at the verge of disappearance. Realizing its importance as natural resources, Forest Department took initiative to rehabilitate rattan species primarily in natural habitats. As part of this initiative to provide technical support, it is necessary to develop nursery raising and plantation management techniques and conservation strategy of rattans species.
- 1.4. Objective(s)
- 1.4.1 To develop suitable techniques for production of quality planting materials of ten rattan species.
- 1.4.2 To develop appropriate plantation techniques and site suitability of ten rattan species.
- 1.4.3 To determine the optimum harvesting age and sound management system for maintaining sustainable

production of different rattan species.

- 1.5. Expected output : Appropriate technique will be available for production of quality planting materials for plantation raising and management of different rattan species will be available. Conservation and centralization of all rattan species available in Bangladesh will be possible Permanent seed source of different rattan species will be created.
- 1.6 Study period :
- 1.6.1 Starting year : 2002-2003
- 1.6.1 Completion year : 2014-2015
- 1.7 Personnel(s) :
- 1.7.1 Study Leader : Md. Sah Alam, RO
- 1.7.2 Associates : Rafiqul Haider, DO; S.R. Merry, SRO
- 1.8 Progress :
- 1.8.1 Previous years, if any: Fruit maturing time, weight of seed per kg. for ten rattan species were studied. Seed germination period and germination percentage, root-shoot ratio of seedlings and seedling-growth in the nursery of four species like, jali (*Calamus tenuis*), kerak (*C. viminalis*), golla (*Daemonorops jenkinsiana*) and udum (*C. longisetus*) were completed 5.0 ha experimental plantations and conservation plots of jali (*Calamus tenuis*), kerak (*C. viminalis*) golla (*Daemonorops jenkinsiana*) udum (*C. longisetus*) and sundi (*Calamus guruba*) at BFRI Headquarter and Hinguli Research Station were established
- 1.8.2 This year :

Action plan as per annual research programme	Progress
Seed collection of different rattan species from three to four locations.	Collected 30 kgs rattan seeds (jali, kerak, golla and sita) from different locations (Sylhet, Bandarban, Teknaf, Salna, Sita pahar, kaptai and Chittagong University.)
Nursery trial for bhudum (<i>C. latifolius</i>), sundi (<i>C. guruba</i>), and sita (<i>Calamus erectus</i>) rattan species.	Germination (%) of sundi bet are given in Table.1
Raising 20,000 seedlings of different rattan species for trial plantation, establishment of conservation plots and remaining seedlings for distribution on payment basis.	Raised 20,000 seedlings of jali, kerak and golla bet in the nursery. Distributed 10,000 seedlings to the interested farmers and different organizations, earned Tk. 40,000.00 as revenue
Maintenance of seedlings in the nursery through weeding, watering, manuring, etc.	Seedlings were maintained in the nursery through weeding, watering, manuring, etc
Raising trial plantations of 1.0 hectare at BFRI Headquarter and Hinguli Research Station.	Raised 1.0 ha. trial plantation with three species (kerak, jali and golla) at Hinguli Research Station (0.5ha) and BFRI campus (0.5 ha).
Maintenance of 5.0 hectare old trial plantation and conservation plots at BFRI Headquarter and Hinguli Research Station through vacancy filling, weeding and other tending operations.	Maintained 5.0 hectare old plantation at BFRI Headquarter and Hinguli Research Station through weeding, vacancy filling, etc

Table. 1 Germination (%) of sundi bet in different treatments

Treatment	R ₁	R ₂	R ₃	Mean (%)
T ₀ (Whole fruit)	42	38	40	40
T ₁ (Seed with pulp)	48	53	49	50
T ₂ (Clean seed)	73	78	74	75

Table 1. Growth performance of rattan at BFRI Headquarter and Hinguli Forest Research Station

Locations	Year of Plantation	Spacing	Av. Survival (%)	Av. Height (cm)
BRFI	2012	1m x 1m	70	35.2
		1.5m x 1.5 m	72	37.2
		2 m x 2 m	72	38.4
	2011	1m x 1m	69	77.6
		1.5m x 1.5 m	69	85.2
		2 m x 2 m	70	90.5
Hinguli	2012	1m x 1m	85	33.2
		1.5m x 1.5 m	92	35.2
		2 m x 2 m	92	37.4
	2011	1m x 1m	83	85.6
		1.5m x 1.5 m	85	90.2
		2 m x 2 m	86	93.5

- 1.9 Achievement(s),if any : Nursery and plantation techniques of jali, kerak and golla have been developed.
- 1.10 Financial Statement :
- 1.10.1 Total cost : Tk. 8, 00,000.00
- 1.10.2 Cost of the year : Tk. 1, 40,650.00
- 1.10.3 Expenditure of the year : Tk. 1, 40,650.00
- 1.10.4 Source of fund : GOB
- 1.11 Beneficiaries: FD, NGO's, Private planters, Farmers, Educational Institute, Rattan industries and BSCIC
2. Study : On-going
- 2.1 Programme Area : Bamboo and Non-timber Economic Crops
- 2.2 Title of the Study : Nursery and plantation techniques of selected medicinal plants
- 2.3 Justification : Once Bangladesh was rich in medicinal plants. The natural and the homestead forests used to support various species of medicinal plants. Unfortunately due to lack of proper attention and management practices, this valuable resource has greatly declined. It is necessary to cultivate medicinal plants considering the importance of herbal drug. For this it is necessary to know the technical know-how on seedling raising, plantation and management techniques of medicinal plant.
- 2.6 Objective(s)
- 2.4.1 To develop nursery techniques for production of planting materials.
- 2.4.2 To develop plantation and sound management techniques for sustained yield.
- 2.5 Expected output : Improved and easy nursery raising, plantation and management technique of valuable medicinal plant.
- 2.6 Study period :
- 2.6.1 Starting year : 2002-2003
- 2.6.2 Completion year : 2012-2013
- 2.7. Personnel(S) :
- 2.7.1 Project Leader : Md. Sah Alam, RO
- 2.7.2 Associates : Rafiqul Haider, DO; S.R. Merry, SRO
- 2.8 Progress :
- 2.8.1 Previous years, if any : Nursery and plantation technique of different medicinal plants such as aswagandha, basak, satamuli, simul, sarpagandha, arjun, ulatkambal, dhutura, mehedi, bach, bel, bahera, raktakambal, shinduri, sonalu, sajna, haritaki, akand, kantikari, have been developed.

2.8.2 This year :

Action plan as per annual research programme	Progress
Collection of propagating materials and raising 1500 seedlings (300 for each species) of five medicinal plants such as, chalmugra (<i>Hydnocarpus kurzii</i>), ritha (<i>Sapindus mukorossi</i>), kuchila (<i>Strychnos nux-vomoca</i>), apang (<i>Achyranthes aspera</i>), bish katali (<i>Polygonum hydropiper</i>).	Selected medicinal plants seeds like chalmugra, ritha, kuchila, apang, bishkatali were collected. Plan-wise experiments were conducted to MFP Headquarter nursery. Data on germination percentage and germination period are given in Table 1.
Maintenance of seedlings in the nursery	Maintained seedlings in the nursery properly.
Establishment of 0.25 hectare experimental plantations with five selected medicinal plants Hinguli Research Station.	Established experimental plantation of 0.25 hectares with five species like ritha, neem, chalmugra, shorpagandha, basak at Hinguli Research Station.
Maintenance of 1.0 hectare trial plantations at BFRI Headquarter and Hinguli Research Station.	Maintained old experimental plantation at Hinguli Research Station and BFRI Headquarter through weeding and other tending operations.
Collection of data on survival, growth from raised plots of BFRI Headquarter and Hinguli Research Station.	Data on chalmugra, shimul, agar, neem, sonalu, bahera, bansonalu, chalta, jolphai, basak, chanchon were collected on growth and survival from raised plot of Hinguli Research Station. (Table. 2)
Report writing and printing.	Two folders on medicinal (basak and tushi) plants have been submitted to TTC for publication.

Table 1. Germination performance of different medicinal plants species at MFPD nursery

Name of Species	Treatment	Av. Germination (%)	Av. Germination days
<u>Ritha:</u>	T ₁ (Soaking seeds in hot water for 10 second)	50	35-100
	T ₂ (Cold water treatment for 12 hours)	45	40-115
	T ₃ (Cold water soaking for 36 hours)	47	40-118
	T ₀ (Control)	45	42-120
<u>Kuchila</u>	T ₁ (Soil: cowdung)	35	51-110
	T ₂ (Soil: cowdung:sand)	45	52-103
	T ₃ (Soil: cowdung: cocomos)	56	50-100
<u>Chalmugra</u>	T ₁ (Cold water soaking for 12 hours)	25	35-55
	T ₂ (Cold water soaking for 24 hours)	45	30-50
	T ₃ (Cold water soaking for 36 hours)	43	30-51
	T ₀ (Control)	20	35-60

<u>Apang</u>	T ₁ (Cold water treatment for 12 hours)	93	4-10
	T ₂ (Cold water treatment for 24 hours)	88	5-12
	T ₃ (Cold water treatment for 36 hours)	70	5-13
	T ₀ (Control)	72	5-14
<u>Bishkatali</u>	T ₁ (Cold water treatment for 24 hours)	80	5-12
	T ₂ (Cold water treatment for 36 hours)	69	5-13
	T ₃ (Cold water treatment for 12 hours)	56	7-15
	T ₀ (Control)	43	7-15

Table 2. Growth performance of different medicinal plants at Hinguli Forest Research Stations

Year of plantation	Name of species	Av. Survival(%)	Av.height (cm)
2012	Amlaki	77	50.28
	Bahera	80	76.96
	Arjun	88	60.12
	Neem	50	49.66
	Nisinda	79	85.42
	Jalpai	69	61.52
	Bel	86	48.35
	Kanchan	83	53.66
	Simul	55	103.4
	Sonalu	56	103.4
	Bon sonalu	53	98
	Chalta	62	46.7
2011	chalmugra	50	37.9
	Arjun	60	222
	Agar	55	119
	Bahera	60	87
	Amlaki	63	92.20
	Jalpai	69	98.52
Neem	86.66	86.66	

- 2.9 Achievement(s), if any : Five folders and five bulletins on flowering and fruit maturing time, nursery and plantation technique, uses, distribution, occurrence, etc. of different medicinal plants available in Bangladesh were published (in Bengali and English).
- 2.10 Financial statement :
- 2.10.1 Total cost : Tk. 3, 50,000.00
- 2.10.2 Cost of the year : Tk 76,205.00
- 2.10.3 Expenditure of the : Tk. 76,205.00
year
- 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 of specially people dwelling in the forests areas or near by forest. 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 both in-situ and ex-situ condition. That will serve as germplasm centre or gene pool and it will be helpful for its propagation and improvement and also 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 : To conserve the valuable medicinal resource for easy identification, use of herbal, drug processing companies, primary health care and as well as environmental improvement.
- 3.6. Study period :
 - 3.6.1 Starting year : 2002-2003
 - 3.6.2 Completion year : 2014-2015
- 3.7 Personnel (s) :
 - 3.7.1 Project Leader : Md. Sah Alam, RO
 - 3.7.2 Associates : Rafiqul Haider, DO; S.R. Merry, SRO
- 3.8 Progress :
 - 3.8.1 Previous years, if any : Germplasm of different perennial medicinal plants namely; neem, amloki, haritaki, bahera, ashok, nishinda, arjun, shinduri, deb-kanchan, akand, basak, shatchandan, agar, bel, naglingam, chalmugra, rakta-kambal, jalpai, kuchila, ritha, tejpata, kao-fal, karpur, daiful, supari, bara-mashla, bashpata, kajubadam, mahua, dadmardan, tejbahal, maillum, belimbi, etc. have been conserved in the BFRI headquarter nursery and Hinguli Research Station. Besides germplasms of more than 40 annual medicinal plants are being conserved in the BFRI Headquarter nursery.
 - 3.8.2 This year :

Action plan as per annual research programme	Progress
Collection of propagating materials for 25 annual and five perennial medicinal plants from Bogra, Dinajpur, Natore, Bandarban and Khagrachari districts of Bangladesh.	Seed/propagating materials of tukri nisinda, goniari, set punarnava, joymala, dontimul, eak-purush, nidradevi, bontulshi, Talmul, alkhushi, Benamul, teurimul, anantamul, were collected from different locations of Bangladesh.
Raising 4,000 seedlings of different medicinal plants for establishing conservation plots and left over seedling for distribution.	4,000 seedlings of tulsi, bahera, amlaki, ban-dharosh, apang, boch, stevia, satamuli, kalomagh, aswagundha, pathorkuchi, noyontra, pipul, arjun, thankuni, brammi, pudina, basak, ulotkumbal, jatropa, tamal, misridana, dadmordon, himsagar, kuch, kalkesuti, bhuikumra, were raised.
Maintenance of seedlings in the nursery.	Seedlings were maintained at MFPD Headquarter nursery.
Re-establishment of conservation plots for 40 annual and establishment of 10 new conservation plots with five perennial medicinal plants at HQs and Hinguli Research Station.	Re-established 66 annual and newly established 7 annual and 2 perennial medicinal plants at BFRI Headquarter nursery.
Maintenance of existing and new conservation plots at BFRI campus and Hinguli Research Station.	0.5 hectare old conservation plots of both annual and perennial plants were maintained at Hinguli Research Station and BFRI Headquarter nursery.

3.9 Achievement(s), if any: Conservation plots of medicinal plants are established at MFPD nursery and BFRI campus as permanent sources of propagating materials.

3.10 Financial Statement :

3.10.1 Total cost : Tk. 6,80,000.00

3.10.2 Cost of the year : Tk. 90,635.00

3.10.3 Expenditure of the year : Tk. 90,635.00

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 : Standardizing the nursery and plantation technique of khair (*Acacia catechu*)

4.3 Justification : Khair is a comically important tree species. Extract of its wood is used with pan (betel-leaf) and in medicine. It is also used in dyeing of cotton, silk and calico-printing. Rajshahi region was the particular area for khair cultivation in Bangladesh and was abundant a few years back. However, now it becomes scares in the area. Khair based cottage industries in the area are at stake due to shortage of khair wood. According to the famous media personality Hanif Sonket and local people, low germination rate of khair is the primary cause of people's unwillingness for cultivation of khair. BFRI's previous studies also indicate the similar notion. Considering the fact the study is under taken to develop appropriate nursery raising techniques and their growth behavior.

4.4. Objective(s) :

4.4.1 To observe the seed germination percentage with different treatments.

4.4.2 To observe the seed germination period, seedlings growth, etc. under different treatments.

4.4.3 To find out survival and growth performance of seedlings with different spacing.

4.5 Expected output : Improved nursery and plantation technique of Khair will be known.

4.6 Study period :

4.6.1 Starting year : 2010-2011

4.6.2 Completion year : 2013-2014

4.7 Personnel(s) :

- 4.7.1 Project Leader : Rafiqul Haider, DO
 4.7.2 Associates : S.R. Merry, SRO; Md. Sah Alam, RO
 Progress :
 4.8.1 Previous years, if any: Germination percentage, germination period of seeds and root-shoot ratio of khair seedlings were studied. Raised 0.5 hectare experimental plantations.
 4.8.2 This year :

Action plan as per annual research programme	Progress															
Seed collection, placing of seeds with different treatments in nursery bed (soaking of seeds in hot water for 30 seconds, and in cold water for one and two days).	Seeds were collected from Birampur, Dinajpur and sowing in the nursery bed.															
Observing germination percentage, germination period, seedlings growth in the nursery.	<table border="1"> <thead> <tr> <th>Treatments</th> <th>Germination period (days)</th> <th>Germination percentage</th> </tr> </thead> <tbody> <tr> <td>T₀ (Control)</td> <td>07- 20</td> <td>56%</td> </tr> <tr> <td>T₁ (24 hours soaking in cold water)</td> <td>05-13</td> <td>77%</td> </tr> <tr> <td>T₂ (48 hours soaking in cold water)</td> <td>05-18</td> <td>67%</td> </tr> <tr> <td>T₃ (30 second soaking in lukewarm water)</td> <td>05-13</td> <td>65%</td> </tr> </tbody> </table>	Treatments	Germination period (days)	Germination percentage	T ₀ (Control)	07- 20	56%	T ₁ (24 hours soaking in cold water)	05-13	77%	T ₂ (48 hours soaking in cold water)	05-18	67%	T ₃ (30 second soaking in lukewarm water)	05-13	65%
Treatments	Germination period (days)	Germination percentage														
T ₀ (Control)	07- 20	56%														
T ₁ (24 hours soaking in cold water)	05-13	77%														
T ₂ (48 hours soaking in cold water)	05-18	67%														
T ₃ (30 second soaking in lukewarm water)	05-13	65%														
Raising 1500 seedlings and maintenance at MFP HQs. Nursery, raising experimental plantation at HQs and Hinguli research Station.	Raised 1500 seedlings and maintained at BFRI Headquarter nursery.															
Field layout (three treatments, three replications, 9 plots), pit preparation, transportation of seedlings from nursery to the field and planting seedlings (100 seedlings in each plot/treatment at).	Established 0.25 hectare trial plantation of khair with three spacing (1.5mx1.5m, 2mx2m, 2.5mx2.5m) and three replication at Hinguli Research Station.															
Maintenance of experimental plantation through weeding, watering, manuring, etc	Maintained 0.50 (0.25+0.25) hectare last two years khair plantation at Hinguli Research Station through weeding, vacancy filling, etc.															
Survival and growth data collection at three months interval.	Growth performance and survival data have been recorded from the experimental plantation and provided in (Table 1&2)															

Table 1. Seedlings growth of *Acacia catechu* at different age (up to 24 months) in the nursery

Age of seedlings (month)	Survival %	Av. length of roots (cm)	Av. length of shoot (cm)
3	98	9	20
6	98	12	42
12	95	19	64
24	95	26	98

Table 2. Survival and growth performance of khair at Hinguli Research station

Spacing	Year of plantation			
	2010		2011	
	Survival (%)	Height (cm)	Survival (%)	Height (cm)
1.5m x 1.5 m	90	170	85	94
2.0 m x 2.0 m	93	203	89	102
2.5 m x 2.5 m	88	198	76	98

- 4.9. Achievement(s), if :
any
- 4.10. Financial statement :
Total cost : Tk. 5,00,000.00
- 4.10.2 Cost of the year : Tk. 87,985.00
- 4.10.3 Expenditure of the : Tk. 87,985.00
year
- 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 : Bamboo and Non-timber Economic Crops.
- 5.2 Title of the Study : Study on nursery and plantation technique of dhup (*Canarium resiniferum*).
- 5.3 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 Bazar 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
- 5.4 Objective(s) :
- 5.4.1 To observe the physiological character of dhup
- 5.4.2 To standardize nursery techniques of dhup.
- 5.4.3 To developed plantation techniques of dhup.
- 5.5 Expected output : Improved nursery and plantation technique of dhup
- 5.6 Study period :
- 5.6.1 Starting year : 2011-2012
- 5.6.2 Completion year : 2015-2016
- 5.7 Personnel (s) :
- 5.7.1 Study Leader : Rafiqul Haider, DO
- 5.7.2 Associate : S. R. Merry, SRO; Md. Sah Alam, RO
- Previous progress if any :

5.8.1 This year :

Action plan as per annual research programme	Progress
Collection of Seed from different locations in Bangladesh.	Flowering –July-August, Fruit maturing – Sept.-Oct
Placing seeds with different treatments (soaking seeds in hot water for 30 seconds, in cold water for one and two days) in nursery bed.	Collected dhup seeds (21 kgs.) from Adampur, Moulvibazar. Seeds are sown in the nursery bed according to the plan.
Observing seed germination percentage, germination period, seedlings growth in the nursery.	Germination: Germination start after one month of sowing Germination percentage- -- - large – 2 to 16 cm -25.6% medium – 10 to 12 cm- 10.0% small - 5 to 10 cm – 5%
Raising 300 seedlings and maintenance at MFP HQs nursery for raising experimental plantation at HQs and Hinguli research Station	Raised 50 seedlings and maintained at MFPD headquarter nursery.
Raising seedlings though cutting with two rooting hormone –IAA and IBA (500ppm and 1000ppm)	
Site selection and preparation (jungle cutting, debris clearing, etc.) for raising experimental plantation	Sites were selected and prepared by jungle cutting, debris clearing, etc. for raising experimental plantation.
Field layout (three plots with 2x2 meter spacing), pit preparation, transportation of seedlings from nursery to the field and planting seedlings (100 seedlings in each plot/treatment at).	Raised 0.025 hectare plantation as per plan.

Table- 1.Germination performance of dhup with rooting hormone IBA under different concentrations

Concentration	250ppm	
	wood	tip
250ppm	10 (2)	10 (0)
500ppm	10 (2)	10 (1)
750ppm	10 (3)	10 (1)
1000ppm	10 (0)	10 (0)
Control	10 (2)	10 (1)

Table-2. Growth performance of dhup

Name of Location	Year of Plantation	Av. Survival (%)	Av. Height (cm)
BRFI	2012	90	70.5
Hinguli	2012	75	50.2

- 5.9. Achievement (s) if any :
- 5.10 Financial statement :
- 5.10.1 Total cost : Tk. 5, 00,000.00
- 5.10.2 Cost of the years : Tk. 84,290.00
- 4.10.3 Expenditure of the : Tk. 84,290.00
year
- 5.10.4 Source of fund : GOB
- 5.11 Beneficiaries : FD, NGOs, Private planters, Farmers, Educational Institutes, Herbal drug producers, etc.

Selected medicinal plants seeds like ritha, kuchila), apang, bishkatali were purchased. According to the plan, experiments were conducted to MFP headquarter nursery. Data were recorded on germination period, germination percentage and growth.

Ritha:

Soaking seeds in hot water for 10 second showed (50%),
Cold water treatment for 12 hours (45%)
Scratching seed by rubbing in the floor (47%).
Control (45%),
Germination starts 30-35 days and completed in 4 months.
Average height 19.5 cm. at age of 5 months

Kuchila

Experiment was conducted according to plan
Soil: cowdung = 35%
Soil: cowdung:sand = 44%
Soil: cowdung: cocomo= 56%
Germination starts 45-50 days and completed in 4 months.
Average height 20 cm. at age of 3 months

Chalmugra-

Experiment was conducted by cold water treatment in different time range with control.
Cold water soaking for 12 hours—25%
Cold water soaking for 24 hours—45%
Cold water soaking for 36 hours—43%
Control (Seeds were sown without any treatment)—20%
After 8-10 days of germination top of the seedlings of chalmugra dropped down at a certain height and die.

Apang

Experiment was conducted by cold water treatment in different time range with control.
Cold water treatment for 12 hours (80%),
Cold water treatment for 24 hours (83%)
Cold water treatment for 36 hours showed highest germination (93%), and control (72%).
Germination starts 3-4 days and completed within 7-10 days.

Bishkatali:

Cold water treatment for 24 hours showed highest germination (80%), Cold water treatment for 36 hours (69%),
Cold water treatment for 12 hours (56%)
and control (43%).
Germination starts 5-7 days and completed within 10-15 days

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 Objectives :
- 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 : 2007-2016
- 1.6.1 Starting year : 2007-08
- 1.6.2 Completion year : 2015-16
- 1.7 Personnel (s) :
- 1.7.1 Study leader : Dr. M. M. Rahman, DO
- 1.7.2 Associate : S. M. M. Hasnin, SRO; A. S. M. Helal Siddiqui, RO
- 1.8 Progress :
- 1.8.1 Previous years, if any : Thirty Permanent Sample Plots (PSPs) were maintained. Data on species composition, number of trees of different species, height, DBH, regeneration of the seedlings recruitment of mangrove species were recorded from 30 PSPs. Seedlings recruitment of major mangrove species were recoded from the PSPs. Average seedlings recruitment in the year 2010 was found 33,133/ha/year. Among them, *Heritiera fomes* constituted 43.16%, *Excoecaria agallocha* 31.89%, *Ceriops decandra* 10.76%, *Bruguiera sexangula* 3.52%, *Avicennia officinalis* 1.01%, *Aegiceras corniculatum* 3.92%, *Xylocarpus mekongensis* 0.91%, *Sonneratia apetala* 0.20%, *Amoora cuculata* 2.41%, *Cynometra ramiflora* 1.21%, *Nypa fruticans* 0.10%, *Phoenix paludosa* 0.20%, *Rhizophora mucronata* 0.31%, *Acanthus illicifolius* 0.10% and *Brownlowia teresa* 0.30%. Average seedlings recruitment in the year 2011 was found 35,317/ha/year. Among them, *Heritiera fomes* constituted 26.75%, *Excoecaria agallocha* 24.96%, *Ceriops decandra* 23.55%, *Bruguiera sexangula* 11.46%, *Avicennia officinalis* 7.02%, *Aegiceras corniculatum* 0.76%, *Xylocarpus mekongensis* 2.27%, *Amoora cuculata* 2.41%, *Cynometra ramiflora* 0.48%, *Phoenix paludosa* 0.07% and *Rhizophora mucronata* 0.03%. Height and DBH class of Sundri and Gewa were analysed. Highest number of sundri trees (51%) was found under DBH class $>5 \leq 10$ cm and only 3.5% Sundri trees was found above 30cm DBH. Highest number of gewa trees (74%) was found under DBH class $>5 \leq 10$ cm and only 1.5% gewa trees was found above 20cm DBH. Highest number of sundri trees (41%) was found under height class $>5 \leq 10$ m and only 2.3% sundri trees was found above 15m height. Highest number of gewa trees (47%) was found under height class $>5 \leq 10$ m and only 14% gewa trees was found above 10m height.

1.8.2 This year :

Activities of the study	Progress
a) Maintenance (Demarcation of plots, replacement of damaged signboards, number-plates, jungle cutting etc.) of 30 PSPs in different salinity zones throughout the Sundarban.	a) Thirty PSPs in different salinity zones (10 PSPs in each saline zone) of the Sundarban were maintained (Table-1).
b) Collection of data on regeneration, salinity and siltation from the PSPs.	b) Data on regeneration, salinity and siltation from the PSPs were collected.
c) Compilation and analysis of data.	c) Thirty Permanent Sample Plots(PSPs) were maintained. Data on regeneration of major mangrove species were recorded from 30 PSPs. Seedlings recruitment of major mangrove species were recoded from the PSPs. Average seedlings recruitment in the year 2012 was found 29,444/ha/year. Among them, <i>Heritiera fomes</i> constituted 28.11%, <i>Excoecaria agallocha</i> 21.02%, <i>Ceriops decandra</i> 18.34%, <i>Bruguiera sexangula</i> 14.68%, <i>Avicennia officinalis</i> 1.74%, <i>Aegiceras corniculatum</i> 7.13%, <i>Xylocarpus mekongensis</i> 7.36%, <i>Amoora cuculata</i> 0.49%, <i>Cynometra ramiflora</i> 0.83%, <i>Phoenix paludosa</i> 0.11% and <i>Rhizophora mucronata</i> 0.11%. Height and DBH class of Sundri and Gewa were analysed and shown in Fig.1,2,3,and 4.

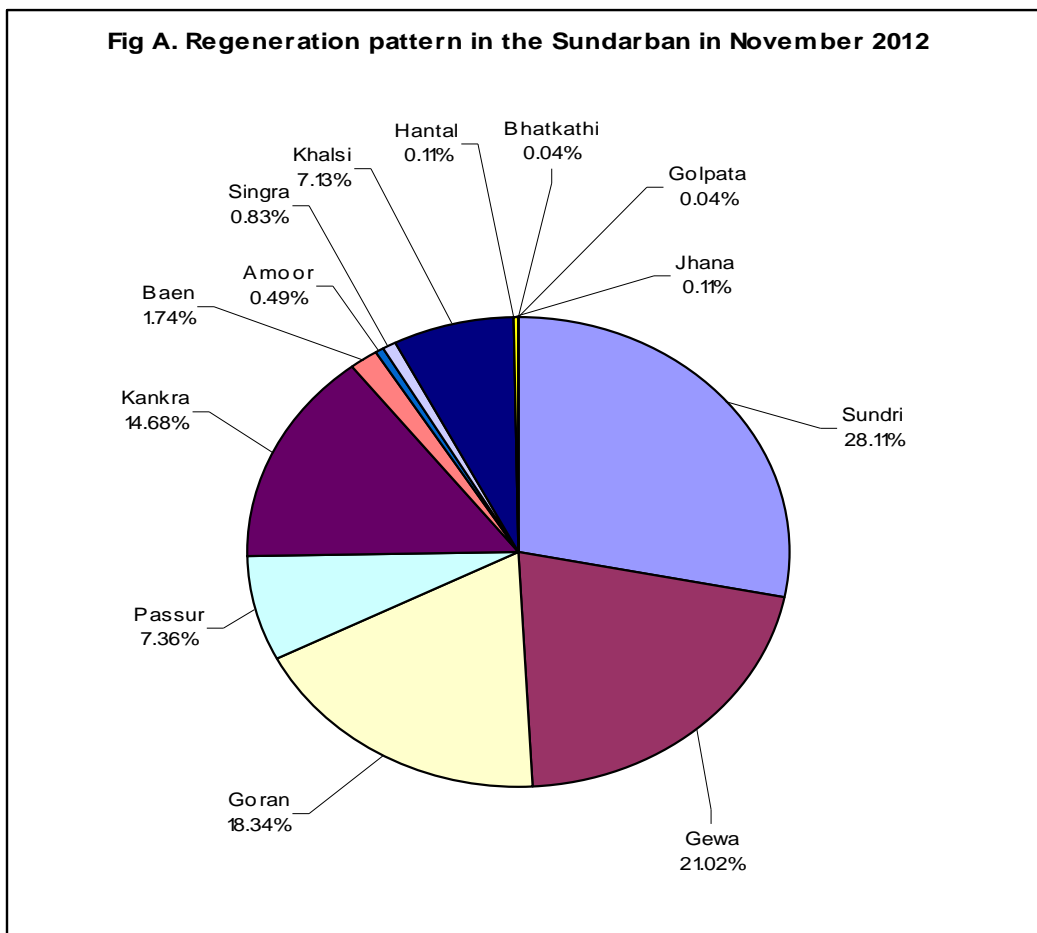
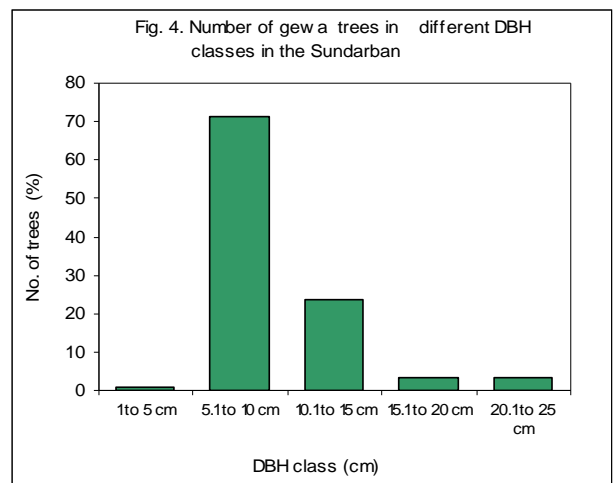
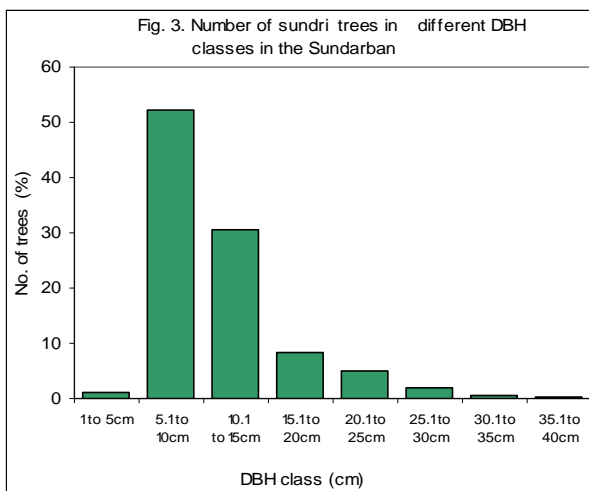
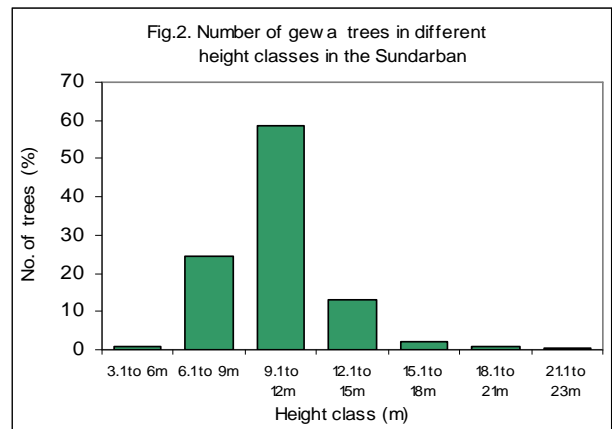
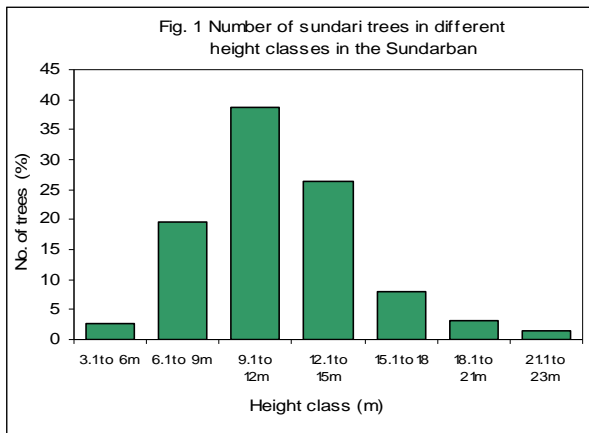


Table 1. Salinity basis PSPs in the Sundarban

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



- 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 Objectives:
- 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 : 2006-2016
- 2.6.1 Starting year : 2006-07
- 2.6.2 Completion year : 2015-16
- 2.7 Personnel (s) :
- 2.7.1 Study leader : A. S. M. Helal Siddiqui, RO
- 2.7.2 Associate : Dr.M. M. Rahman, DO; S. M. M. Hasnin, SRO
- 2.8 Progress :
- 2.8.1 Previous years, if any(..year): 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 Munshiganj in the strong saline zone of the conservation plots. Dhundul (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 :

Action plan as per annual research programme	Progress
a) Demarcation of boundary lines of three plots by clearing jungle and painting of trees.	a) Boundary lines of three plots by clearing jungle and painting of trees were demarcated.
b) Raising of 7,200 seedlings of three mangrove species namely Dhundul, Singra and bakul kankra for raising experimental plantation.	b) A total of 7,200 seedlings of three mangrove species namely Dhundul, Singra and bakul kankra were raised for raising experimental plantation.
c) Gap filling and maintenance of previously raised plantation of Goran (0.9 ha), Khalshi (0.9 ha), Amur (0.9ha) and Hantal (0.9 ha).	c) Gap filling were done and maintained the previously raised experimental plantations of Goran (0.9 ha), Khalshi (0.9 ha), Amur (0.9ha) and Hantal (0.9 ha).
d) Maintenance of previously raised experimental plantations of kirpa (1.8 ha), passur (0.9 ha), jhana (0.6 ha), khalshi (1.8 ha), amur (1.8 ha) bakul kankra(0.9 ha), amdhekur(0.9ha) and Marichabaen(0.9 ha). Bhatkathi (Rhizophora apiculata), Kankra (Bruguiera gymnorhiza), Goran and Dhundul (Xylocarpus	d) Previously raised experimental plantations of kirpa (1.8 ha), passur (0.9 ha), jhana (0.6 ha), khalshi (1.8 ha), amur (1.8 ha) bakul kankra(0.9 ha), amdhekur(0.9ha) and Marichabaen(0.9 ha). Bhatkathi (Rhizophora apiculata), Kankra (Bruguiera gymnorhiza), Goran and Dhundul

granatum).	(<i>Xylocarpus granatum</i>) were maintained.
e) Collection of survival and growth data from the experimental plantations twice a year.	e) Survival and growth data from the experimental plantations were collected twice a year.
f) Compilation and analysis of data.	Growth performances of different mangrove species planted in different years in the Sundarbans are shown in Table-1, 2, 3 and 4.

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

Name of Location	Year of plantation	Spacing	Av. Height (m)	Av. Dbh (cm)	Av. Survival (%)
Munshigonj	2004	(1x1) m.	2.36	-	95
		(1.5x1.5) m	2.30	-	98
		(2x2) m	2.89	-	92
	2006	(1x1) m.	3.14	-	92
		(1.5x1.5) m	3.43	-	96
		(2x2) m	3.55	-	92
Dhangmari	2004	(1.5x1.5) m	4.88	6.21	88
		(1.75x1.75) m	4.99	6.34	93
		(2x2) m	5.07	6.50	79
	2006	(1.5x1.5) m	3.60	-	98
		(1.75x1.75) m	3.62	-	96
		(2x2) m	3.82	-	98

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

Name of Location	Name of species					
	Passur		Khalshi		Jhana	
	Av. ht. (m)	Av. Surv %	Av. ht. (m)	Av. Surv %	Av. ht. (m)	Av. Surv %
Dhangmari	1.42	88	2.29	92	4.00	71
Munshiganj					1.75	15
Bogi	1.23	8	1.66	12	1.52	1

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

Name of Location	Name of species					
	Baen		Singra		Amur	
	Av. ht. (m)	Av. Surv. %	Av. ht. (m)	Av. Surv. %	Av. ht. (m)	Av. Surv. %
Dhangmari	1.66	25	-	-	0.86	95
Munshigonj	-	-	-	-	0.99	31
Bogi	-	-	0.85	39	1.05	54

Table-4 Growth performance of different mangrove species planted in 2011 in 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	0.91	16	0.46	-	0.73	65
Munshigonj	-	-	0.57	100	1.06	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. 3,05,000/=
- 2.10.3 Expenditure of the year : Tk. 3,05,000/=
- 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 Objectives
- 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 : 2006-2016
- 3.6.1 Starting year : 2006-07
- 3.6.2 Completion year : 2015-16
- 3.7 Personnel (s) :
- 3.7.1 Study leader : A. S. M. Helal Siddiqui, RO
- 3.7.2 Associate : Dr.M. M. Rahman, DO; S. M. M. Hasnin, SRO
- 3.8 Progress :
- 3.8.1 Previous years, if any(..year) : 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 and 3.
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Table-1. Growth performance of Jarul planted at Katakhal and Bogi

Research Station	Year of plantation	Spacing	Height (m)	DBH (cm)
Dhangmari	1996	1.5m x 1.5m	11.60	15.68
		1.75m x 1.75m	7.14	16.53
		2.0m x 2.0m	7.89	14.98
Bogi	1993	1.5m x 1.5m	12.41	14.62
		1.75m x 1.75m	12.28	12.49
		2.0m x 2.0m	11.38	13.31

Table-2. Growth performance of different mangrove species at Burigoalini in different years of the Sundarbans.

Name of Location	Year of plantation	Name of species	Av. ht. (m)	Av. dbh (cm)	Av. Surv. (%)
Burigoalini	1995	Sundri	2.83	-	14
		Gewa	5.93	4.98	52
		Kirpa	6.89	6.95	63
	1999	Gewa	5.13	-	66
		Goran	2.34	-	74
		Kankra	4.99	5.26	23
		Khalshi	4.01	4.77	82
		Jhana	9.00	13.20	2

Table-3. Growth performance of mangrove species at different locations in the Sundarbans.

Name of Location	Year of plantation	Name of species	Av. height (m)	Av.dbh (cm)	Av.Survival (%)
Khashitana	1997	Gewa	5.75	5.51	76
		Goran	2.87	-	51
		Jhana	7.14	7.77	26
	1998	Gewa	2.64	-	67
		1999	Sundri	1.81	-
Andermanik	1999	Goran	2.01	-	60
		Gewa	3.44	4.59	61
Kadamtala	2000	Sundri	1.55	-	42
		Gewa	3.58	-	84
		Amur	0.88	-	5

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.2,20,000/=
- 3.10.3 Expenditure of the year : Tk. 2,20,000/=
- 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 Objectives :
- 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 : . 2008-2016
- 4.6.1 Starting year : 2008-09
- 4.6.2 Completion year : 2015-16
- 4.7 Personnel (s) :
- 4.7.1 Study leader : S M. M. Hasnin, SRO
- 4.7.2 Associate : Dr. M. M. Rahman, DO; A. S. M. Helal Siddiqui, RO
- 4.8 Progress :
- 4.8.1 Previous years, if any(,.year) : Museum room was renovated. One digital camera, two iron racks, one multipurpose almirah, 2 display board, two wooden plant press, 20 glass containers, 5 gallons formaldehyde and 15 camera films were purchased. Twelve wood samples of mangrove tree species were prepared. Thirty floral specimens (propagules, fruits) and 20 fish specimens were collected and preserved in the museum. Fifteen herbarium specimens of mangrove species have been prepared. One documentary film of Sundarban was prepared and 100 still pictures were printed.
- 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 videos, still pictures, digital pictures and lamination of still pictures.	c) 150 nos of still pictures of different sizes were printed and laminated.
d) Reprocessing of hides of tiger, deer, lizard.	d) One number of tiger hide and one piece of deer hide were reprocessed and stuffed as well as demonstrated in the Mangrove museum.

- 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 twelve wood samples of mangrove tree species.
- 4.10 Financial Statement :
- 4.10.1 Total cost : Tk.10,00,000/=
- 4.10.2 Cost of the year : Tk.1,00,000/=
- 4.10.3 Expenditure of the year : Tk. 1,00,000/=
- 4.10.4 Source of fund : GOB
- 4.11 Beneficiaries :

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 Objectives:
- 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 : 2010-2015
- 5.6.1 Starting year : 2010-11
- 5.6.2 Completion year : 2014-15
- 5.7 Personnel (s) :
- 5.7.1 Study leader : Dr. M. M. Rahman, DO
- 5.7.2 Associate : S. M. M. Hasnin, SRO; A. S. M. Helal Siddiqui, RO
- 5.8 Progress :
- 5.8.1 Previous years, if any(..year) : A total number of 15,000 propagules (seeds) of khalshi were collected from the Sundarban and 9,000 seedlings were raised for experimental plantations in three salinity zones of the Sundarban. 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.
- 6.8.2 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.

Table-1. Growth performance of khalshi at different locations in three salinity zones of the Sundarbans

Salinity Zones	Year of plantation	Name of Location	Compartment No.	Spacing	Av. Height (m)	Av. Survival (%)
Less saline zone	2011	Bholarpar	24	1mX1m	0.33	63
Moderate saline zone	2011	Hularchar	31	1mX1m	0.70	100
Strong saline zone	2011	Munshigong	46	1mX1m	0.55	100

- 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. 3,05,000/=
- 5.10.3 Expenditure of the year : Tk. 3,05,000/=
- 5.10.4 Source of fund : GOB
- 5.11 Beneficiaries :

6. Study : On going

- 6.1 Programme Area : Post harvest utilization-Chemical processing
- 6.2 Title of the Study : Investigation on the unused part of harvested golpata (*Nypa fruticans*) from the Sundarban
- 6.3 Justification: Golpata (*Nypa fruticans*) is an economically important mangrove species in the Sundarbans. A huge amount of golpata leaves are harvested annually. At the time of harvesting the unused part of leaves are left in the Sundarbans. That is why the better utilization and management with the unused part of harvested golpata are to be determined.
- 6.4 Objectives :
- 6.4.1 To explore the remaining part of harvested golpata for better utilization and management.
- 6.5 Expected output : Determination of better utilization and management with the remaining part of harvested golpata.
- 6.6 Study period : 2011-2013
- 6.6.1 Starting year : 2011-2012
- 6.6.2 Completion year : 2012-13
- 6.7 Personnel (s) :
- 6.7.1 Study leader : Dr. M. M. Rahman, DO
- 6.7.2 Associate : S. M. M. Hasnin, SRO; A. S. M. Helal Siddiqui, RO
- 6.8 Progress :
- 6.8.1 Previous years, if any(..year) : Golpata extraction areas of the Sundarban were visited. Materials (remaining part of harvested golpata) were collected for lab analysis.
- 6.8.2 This year :

Action plan as per annual research programme	Progress
a) Field visit and survey of golpata extraction areas in the Sundarban.	a) Golpata extraction areas of the Sundarban were visited.
b) Collection of materials (remaining part of harvested golpata) for lab analysis.	b) Materials (remaining part of harvested golpata) were collected for lab analysis.
c) Data compilation and reporting.	c) Data have been collected and colated.

Table: -01. Different parameters of golpata in different salinity zones of the Sundarbans.

Sl. No.	Description	Salinity zone		
		Fresh Water zone	Moderate salinity Water zone	Strong salinity water zone
1	Water Salinity (ppt)	3	12	23
2	Pair of leaflets in a leaf (No.)	49	47	38
3	Length of leaf (m)	4.63	4.12	3.27
4	Number of leaves per stump	7	6	5
5	Cut able number of leaves per stump	4	4	2

Table: -02. Different parameters of unused part of golpata leaves in three salinity zones of the Sundarbans.

Sl. No.	Description	Salinity zone		
		Fresh Water zone	Moderate salinity Water zone	Strong salinity water zone
1	Length of leaves (m)	1.62	1.26	1.07
2	Green weight piece (kg)	2.13	1.51	1.06
3	Dry weight piece (kg)	0.77	0.52	0.30

Table: -03. Different parameters of used part of golpata leaves in three salinity zones of the Sundarbans.

Sl. No.	Description	Salinity zone		
		Fresh Water zone	Moderate salinity Water zone	Strong salinity water zone
1	Length of leaves (m)	3.01	2.86	2.20
2	Green weight piece (kg)	2.28	1.98	1.50
3	Dry weight per piece (kg)	1.03	0.77	0.58

Table: -04. Chemical analysis of unused leafless midrib (stump) of Golpata plants in the Fresh Water zone

Sl. No.	Name of Location	Co mpt No.	Chemical contents of unused midrib of Golpata plants									
			Organic Carbon (%)	Total Nitrogen (%)	Phosphorus (P) (%)	Potassium (K) (%)	Sulphur (S) (%)	Zinc (Zn) (%)	Calcium (Ca) (%)	Magnesium (Mg) (%)	Boron (B) (ppm)	Copper (Cu) (ppm)
1	Karimer Khal	01	40.56	0.36	0.10	2.08	0.06	0.003	0.67	0.43	35	1.78
2	Alibanda Khal	01	39.0	0.51	0.09	1.14	0.07	0.02	0.49	0.27	32	1.58
3	Dhabri Khal	24	39.0	0.40	0.17	1.61	0.06	0.06	0.47	0.39	35	1.18

Table: -05. Chemical analysis of unused leafless midrib (stump) of Golpata plants in the Moderate salinity Water zone

Sl. No.	Name of Location	Co mpt No.	Chemical contents of unused midrib of Golpata plants									
			Organic Carbon (%)	Total Nitrogen (%)	Phosphorus (P) (%)	Potassium (K) (%)	Sulphur (S) (%)	Zinc (Zn) (%)	Calcium (Ca) (%)	Magnesium (Mg) (%)	Boron (B) (ppm)	Copper (Cu) (ppm)
1	Nandobala Khal	26	36.27	0.34	0.09	1.14	0.36	0.003	0.48	0.33	35	1.79
2	Jongra Khal	30	35.1	0.48	0.11	1.04	0.37	0.01	0.67	0.33	33	1.58
3	Dhang mari Khal	31	35.1	0.45	0.09	0.93	0.57	0.004	0.78	0.21	32	1.58

Table: -06. Chemical analysis of unused leafless midrib (stump) of Golpata plants in the Strong salinity water zone

Sl. No.	Name of Location	Co mpt No.	Chemical contents of unused midrib of Golpata plants									
			Organic Carbon (%)	Total Nitrogen (%)	Phosphorus (P) (%)	Potassium (K) (%)	Sulphur (S) (%)	Zinc (Zn) (%)	Calcium (Ca) (%)	Magnesium (Mg) (%)	Boron (B) (ppm)	Copper (Cu) (ppm)
	Passurta la	46	32.76	0.58	0.09	1.55	0.05	0.03	0.36	0.48	34	5.54
	Poboner char	46	37.44	0.60	0.08	1.55	0.08	1.01	0.37	0.46	33	3.96
	Kalagachia	46	37.05	0.79	0.09	1.35	0.42	0.004	0.25	0.35	34	3.16

- 6.9 Achievement(s), if any : Not applicable
 6.10 Financial Statement :
 6.10.1 Total cost : Tk.2,50,000/=
 6.10.2 Cost of the year : Tk. 1,00,000/=
 6.10.3 Expenditure of the year : Tk. 1,00,000/=
 6.10.4 Source of fund : GOB
 6.11 Beneficiaries :

7. Study : On-going
 7.1 Programme Area : Breeding and Tree Improvement
 7.2 Title of the Study : Selection and development of the top dying tolerant sundri (*Heritiera fomes*) trees in the Sundarban.
 7.3 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.
 7.4 Objectives :
 7.4.1 To develop a pure line of top dying tolerant sundri trees
 7.5 Expected output : Selection and development of top dying resistant sundri trees in the Sundarban.
 7.6 Study period : 2008-2016
 7.6.1 Starting year : 2008-2009
 7.6.2 Completion year : 2015-16
 7.7 Personnel (s) :
 7.7.1 Study leader : Dr. M. M. Rahman, DO
 7.7.2 Associate : S. M. M. Hasnin, SRO; A. S. M. Helal Siddiqui, RO
 7.8 Progress :
 7.8.1 Previous years, if any(..year) : 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 average height, bole height and DBH of the selected healthy (disease free) sundari trees were 10.8m, 7.5m and 16.2cm respectively at Bholarpar (compt. No. 24) in the less saline zone. The average height, bole height and DBH of the selected healthy (disease free) sundari trees were 10.6m, 6.3m and 16.6cm respectively at Bojbaja (compt. No. 37) in the moderate saline zone. The average height, bole height and DBH of the selected healthy (disease free) sundari trees were 10.1m, 4.9m and 17.8cm respectively at Kalabogi (compt. No. 33) in the moderate saline zone. The average height, bole height and DBH of the selected healthy (disease free) sundari trees were 15.8m, 8.3m and 22.7cm respectively at Kalabogi Khal (compt. No. 32) in the moderate saline zone. Average DBH and height of selected sundri trees at different locations of the Sundarban are shown in Fig. 1. The water salinity of Bholarpar (compt. No. 24), Bojbaja (compt. No. 37), Kalabogi (compt. No. 33) and Kalabogi Khal (compt. No. 32) were recorded 2ppt, 21ppt, 19ppt and 20ppt respectively in May, 2009. The soil pH of Bholarpar (compt. No. 24), Bojbaja (compt. No. 37), Kalabogi (compt. No. 33) and Kalabogi Khal (compt. No. 32) were 4.2, 5.4, 6.0 and 6.2 respectively. Inundation was regular in all the experimental sites. Siltation / erosion gauge have been placed in each location.

7.8.2 This year :

Action plan as per annual research programme	Progress
a) Planting of previously raised seedlings of selected sundari trees at three locations of the Sundarban.	a) Raised seedlings of selected sundari trees at three locations of the Sundarban have been planted.
b) Observation of flowering and fruiting behaviors in the selected trees.	b) Flowering and fruiting behaviors of the selected trees have been 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 have been collected.
d) Collection of seeds from the selected trees.	d) Ten thousand seeds from the selected sundari trees have been collected.
e) Raising seedlings at H/Q, Bogi and Dhangmari Research Stations for next year plantations.	e) Six thousand seedlings have been raised at 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 have been recorded.
g) Data compilation	g) Germination success, average height before planting and growth performance of sundari in different locations of the Sundarban are shown in Table – 1, 2 and 3. Average DBH and height of selected sundari trees at different locations of the Sundarbans is shown in figure-3.

Table-1. Raising nursery with sundari seeds collected from different locations of the Sundarban in 2011.

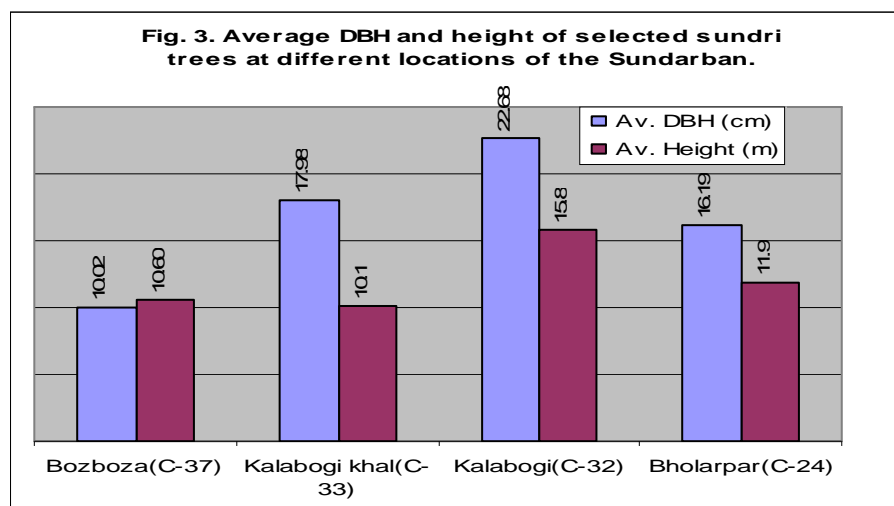
Sl. No.	Location	Compt. No.	No. of seeds sown	Initiation of germination (days)	Completion of germination (days)	Germination Success (%)	Average height at the age of 10 months (cm)
1.	Kalabogi	32	2000	9	55	85	30
2.	Kalabogi Khal	33	2000	6	44	76	27
3.	Bojbaja	37	2000	11	51	71	26
4.	Bhola Nadir Par, Sarankhola	24	2000	7	48	87	34

Table-2. Growth performance of sundari in different locations of the Sundarban.

Year of Plantation	Spacing	Location	Compt. No.	Av. height (cm)	Av. Survival (%)
2010	1m X 1m	Bogi	01	115	87
		Dhangmari	31	82	51

Table-3. Growth performance of sundari in different locations of the Sundarban.

Year of Plantation	Spacing	Location	Compt. No.	Av. height (cm)	Av. Survival (%)
2011	1m X 1m	Bogi	01	51	66
		Dhangmari	31	62	99



7.9 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.

7.10 Financial Statement : Tk. 12,50,000/=

7.10.1 Total cost :

7.10.2 Cost of the year : Tk. 2,20,000/=

7.10.3 Expenditure of the year : Tk. 2,20,000/=

7.10.4 Source of fund : GOB

7.11 Beneficiaries :

8. Study : On-going

8.1 Programme Area : Biodiversity and conservation

8.2 Title of the Study : Enrichment and Conservation of Mangrove Ecosystem

8.3 Justification: The problems of the Sundarban are diversified due to its complex ecosystem and hence the proposed research agenda includes both bio-ecological and socio-economic investigations in order to improve and maintain sustained productivity as well as in reducing of natural disasters and to increase their adaptation to the long term effect of climate change.

8.4 Objectives :

8.4.1 To enrich mangrove ecosystem and determine better silvicultural techniques for major mangrove

8.4.2 species. To conserve a wider range of mangrove forest gene resources for future generations.

8.4.3 To develop the appropriate management strategies for sustainable yield and protective services from mangrove ecosystems.

8.5 Expected output : The study will help to introduce the threatened mangrove species such as psssur(*Xylocarpus mekongensis*), sundari(*Heritiera fomes*), dhundhul(*Xylocarpus granatum*), kirpa(*Lumnitzera racemosa*), jhana(*Rhizophora mucronata*), khalshi(*Aegiceras corniculatum*) and shingra(*Cynometra ramiflora*) in the newly accreted char land, poorly regenerated area, NCC(non commercial cover) area of the Sundarban. The swampy and low lying area adjacent to the Sundarban will also be covered by the mangrove species. As a result the productivity of the forest will be increased as well as the improvement of livelihood towards the mangrove dwellers. It will improve the natural ecosystems and biodiversity of the forest and provide positive impact on national poverty alleviation programs of the country. Thus environmental disaster as well as tsunami, cyclone, sidr will be decreased and forestry sector must be improved.

8.6 Study period : 2010-2014

8.6.1 Starting year : 2010-2011

8.6.2 Completion year : 2013-14

8.7 Personnel (s) :

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

8.7.2 Associate : S. M. M. Hasnin, SRO, A. S. M. Helal Siddiqui, RO

8.8 Progress :

8.8.1 Previous years, if any(..year) : A total of 20,000 healthy seeds / propagules of khilshi, kirpa, sundari,

passur, goran and kankra were collected from the Sundarban. The average of germination percentage of Sundri (*Heritiera fomes*), Pasur (*Xylocarpus mekongensis*), Baen (*Avicennia officinalis*), Kankra (*Bruguiera gymnorrhiza*), Singra (*Cynometra ramiflora*) and Kirpa (*Lumnitzera ramiflora*) were 70, 81, 75, 93, 55 and 29 respectively. Three experimental sites were selected for mangrove species trials in three salinity zones of the Sundarban. These were barren and covered with grasses or non-commercial species like gila lata (*Derris trifoliata*), chanda lota (*Dalbergia candenatensis*), shun grass (*Saccharum spontaneum*), hargoja (*Acanthus ilicifolius*), hanthal (*Phoenix paludosa*), tiger fern (*Acrostichum aureum*), bhola (*Hibiscus tiliaceus*), nal khagra (*Phragmites karka*), hogla (*Typha elephantina*), kutum kata (*Caesalpinia crista*), dhanshi (*Myriostachya wightiana*) and kewa katta (*Pandanus foetidus*). The experiment was laid out in all the three salinity zones of the Sundarban. The seedlings were planted during September. The number of seedlings per species planted 567 at each location. Six mangrove species were planted at each site. The heights of the seedlings varied between 14cm and 81cm at the time of planting depending on the species. The average height before planting of Sundri (*Heritiera fomes*), Pasur (*Xylocarpus mekongensis*), Baen (*Avicennia officinalis*), Kankra (*Bruguiera gymnorrhiza*), Singra (*Cynometra ramiflora*) and Kirpa (*Lumnitzera ramiflora*) were 57cm, 78cm, 24cm, 40cm, 15cm and 20cm respectively. Planting was carried out over an area of 1.5ha in three experimental sites of the Sundarban.

8.8.2 This year :

Action plan as per annual research programme	Progress
a) Field visit to the Sundarban before collecting seeds/propagules.	a) The Sundarban have been visited before collecting seeds/propagules.
b) Seeds/propagules collection.	b) A total of 21,000 healthy seeds / propagules of khalshi (<i>Aegiceras corniculatum</i>), kirpa (<i>Lumnitzera ramiflora</i>), sundri (<i>Heritiera fomes</i>), passur (<i>Xylocarpus mekongensis</i>), goran (<i>Ceriops decandra</i>), kankra (<i>Bruguiera gymnorrhiza</i>) and dhundul (<i>Xylocarpus granatum</i>) were collected from the Sundarban.
c) Seeds/propagules sorting, treatment and storage.	c) Collected seeds/propagules sorting, treatment and storage have been done.
d) Nursery raising (soil collection and preparation, bag filling, bed preparation, shed preparation, fencing, seed sowing, mulching etc.) for next year plantation.	d) 14,000 seedlings of khalshi, kirpa, sundari, passur, goran, kankra and dhundul have been raised in three research stations of the Sundarban.
e) Raising plantations with the raised seedlings in the different locations of the Sundarban.	e) The experiment was laid out in Randomized Complete Block Design (RCBD) with seven replications in all three sites. Five mangrove species, viz., sundri (<i>Heritiera fomes</i>), pasur (<i>Xylocarpus mekongensis</i>), goran (<i>Ceriops decandra</i>), kankra (<i>Bruguiera gymnorrhiza</i>), khalshi (<i>Aegiceras corniculatum</i>) and dhundul (<i>Xylocarpus granatum</i>) were planted at each site.
f) Maintenance of nurseries and plantations.	f) Nurseries and plantations have been maintained.
g) Selection of promising seedlings at nursery stage for plantation.	g) Promising seedlings have been selected at nursery stage for plantation.
h) Data collection, collation and reporting.	h) Nursery with seven different mangrove species has been maintained in different locations of the Sundarban. Three experimental sites were selected for mangrove species trials in three salinity zones of the Sundarban. The experiment was laid out in Randomized Complete Block Design (RCBD) with seven replications in all three sites. Five mangrove species, viz., sundri (<i>Heritiera fomes</i>), pasur (<i>Xylocarpus mekongensis</i>), goran (<i>Ceriops decandra</i>), kankra (<i>Bruguiera gymnorrhiza</i>), khalshi (<i>Aegiceras corniculatum</i>) and dhundul (<i>Xylocarpus granatum</i>) were planted at each site.

Table-1. List of mangrove species tried in the poorly regenerated lands of the Sundarban

Sl. No.	Vernacular name	Scientific name	Family
1.	Khalshi	<i>Aegiceras corniculatum</i>	Myrsinaceae
2.	Kirpa	<i>Lumnitzera ramiflora</i>	Combretaceae
3.	Sundri	<i>Heritiera fomes</i>	Sterculiaceae
4.	Passur	<i>Xylocarpus mekongensis</i>	Meliaceae
5.	Goran	<i>Ceriops decandra</i>	Rhizophoraceae
6.	Kankra	<i>Bruguiera gymnorrhiza</i>	Rhizophoraceae
7.	Dhundul	<i>Xylocarpus granatum</i>	Meliaceae

Table-2. Growth performance of different mangrove species at Dhangmari (Compartment No.- 31) of the Sundarban

Name of Location	Year of plantation	Spacing	Name of species	Av. heit (cm)	Av. Survival (%)
Dhangmari	2010	1m X 1m	Sundri	57	98
			Pasur	126	77
			Baen	75	80
			Kankra	112	100
			Singra	29	100

Table-3. Growth performance of different mangrove species at Munshiganj (Compartment No.-46) of the Sundarban

Name of Location	Year of plantation	Spacing	Name of species	Av. height (cm)	Av. Survival (%)
Munshiganj	2010	1m X 1m	Sundri	50	14
			Pasur	83	16
			Kirpa	102	32
			Kankra	95	42
			Amur	115	75

Table-4. Growth performance of different mangrove species at Bogi (Compartment No.-1) of the Sundarban

Name of Location	Year of plantation	Spacing	Name of species	Av. height (cm)	Av. Survival (%)
Bogi	2010	1m X 1m	Sundri	103	85
			Passur	148	74
			Baen	64	43
			Kankra	87	100
			Singra	45	80

Table-5. Growth performance of different mangrove species at Dhangmari (Compartment No.- 31) of the Sundarban

Name of Location	Year of plantation	Spacing	Name of species	Av. heit (cm)	Av. Survival (%)
Dhangmari	2011	1m X 1m	Sundri	65	94
			Pasur	104	97
			Goran	38	90
			Kankra	70	92
			Khalshi	73	92

Table-6. Growth performance of different mangrove species at Munshiganj (Compartment No.-46) of the Sundarban

Name of Location	Year of plantation	Spacing	Name of species	Av. height (cm)	Av. Survival (%)
Munshiganj	2011	1m X 1m	Sundri	69	40
			Pasur	86	83
			Goran	26	72
			Kankra	46	57
			Dhundul	74	85

Table-7. Growth performance of different mangrove species at Bogi (Compartment No.-1) of the Sundarban

Name of Location	Year of plantation	Spacing	Name of species	Av. height (cm)	Av. Survival (%)
Bogi	2011	1m X 1m	Sundri	86	97
			Passur	104	89
			Baen	27	76
			Kankra	71	80
			Goran	21	84

The growth performance of six mangrove tree species i. e. Sundri (*Heritiera fomes*), Pasur (*Xylocarpus mekongensis*), Baen (*Avicennia officinalis*), Kankra (*Bruguiera gymnorrhiza*), Singra (*Cynometra ramiflora*) and Kirpa (*Lumnitzera ramiflora*) in three salinity zones of the Sundarban was shown in Table no. 2, 3, 4, 5, 6 and 7. It is observed that the best growths were recorded in less saline zone and relatively lower growths were recorded in strong saline zone of the Sundarban.

- 8.9 Achievement(s), if any :
 8.10 Financial Statement :
 8.10.1 Total cost : Tk. 16,40,000/=
 8.10.2 Cost of the year : Tk. 6,55,000/=
 8.10.3 Expenditure of the year : Tk. 6,55,000/=
 8.10.4 Source of fund : IDA, IFAD & GOB through BARC
 8.11 Beneficiaries :

Forest Protection Division

1. Study : On-going
- 1.1 Programme Area : Forest Pests and Diseases
- 1.2 Title of the Study : Development of improved techniques of initiation for agar in agar trees (*Aquilaria malaccensis* Lam.)
- 1.3 Objectives :
- 1.3.1 To develop improved techniques of artificial initiation of agar in agar trees.
- 1.3.2 To train agar entrepreneurs with advanced knowledge on agar production and extraction
- 1.4 Expected output : Increased production of agar will be ensured
- 1.5 Study period :
- 1.5.1 Starting year : 2011-2012
- 1.5.2 Completion year : 2012-2013
- 1.6 Personnel :
- 1.6.1 Study Leader : Md. Rafiqul Islam, D.O.
- 1.6.2 Associates : Md. Zillur Rahman (RA-1), Kazi Asad-uz-zaman (F. I), Shameema Nasreen (F.I)
- 1.7 Progress :
- 1.7.2 This year :

Action plan as per annual research programme	Progress
a. Harvesting & assessment of samples	Samples were collected from selected site of Agar plantation viz. Fasiakhali (Cox's Bazar), Baroduara (Chittagong south), Korerhut Chittagong (North) and Bagyhut (Rangamati north).
b. Collection & identification of fungi	Agar-enriched wood core samples were collected from previously nailed and drilled agar trees. Identification of following fungi, viz. <i>Aspergillus</i> sp., <i>Curvularia lunata</i> , <i>Penicillium</i> sp., <i>Venturia</i> sp., <i>Mucor</i> sp., <i>Rhizopus</i> sp., <i>Yeast</i> sp., <i>Alternaria solani</i> , and <i>Fusarium solani</i> .
c. Visit to new agar plantation	Not done

- 1.8 Achievement(s), if any :
Nailing distance of 4cm shows best performance for agar formation. It is also noticed that nailed agar trees of 10-15 years gave highest production of agar. Primary result suggested that the site of Moulazvibazar showed better for agar formation than another site.
- 1.9 Financial Statement :
- 1.9.1 Total cost : Tk. 1,36,000/- (approx.)
- 1.9.2 Cost of the year : Tk. 67,000/- (approx.)
- 1.9.3 Expenditure of the year : Tk. 26,440/- (approx.)
- 1.9.4 Source of fund : GOB
- 1.10 Beneficiaries : Forest Department, agar industry owners, agar planters, NGOs and general public.
2. Study : On-going
- 2.1 Programme Area : Forest Pests and Diseases
- 2.2 Title of the Study : Major pests and diseases of commercially important medicinal plants and their management
- 2.3 Objective(s) :
- 2.3.1 To identify pests and pathogens of commercially important medicinal plants
- 2.3.2 To determine the nature and extent of damage by each pest and pathogen
- 2.3.3 To know the biology and ecology of key pests and pathogens
- 2.3.4 To develop/adapt suitable management techniques for key pests/pathogens
- 2.4 Expected output : Increased production of commercially important medicinal plants will be ensured
- 2.5 Study period :
- 2.5.1 Starting year : 2007-2008

- 2.5.2 completion year : 2012-2013
 2.6 Personnel(s) :
 2.6.1 Study Leader : Md. Rafiqul Islam, D.O.
 2.6.2 Associates : Md. Zillur Rahman (RA-1)
 2.7 Progress :
 2.7.2 This year :

Action plan as per annual research programme	Progress
a. Laboratory and field trial	Neem oil, Urea, Garlic juice, Kerosin oil treatments were applied to control mite of ashwagandha. Neem oil @ 2-4ml /lit. is applied of tulsi for control scale insect. Observation and data recorded. Bordeaux mixture is apply to control the sooty mould fungus of sarpogandha Primary result showed that Bordeaux mixture successfully controlled the disease. Different fungicides and Bordeaux mixture were applied to control the root rot of tulsi, collar rot of kalomegh and root rot of ashwaganda.
b. Collection of pest and disease sample	Insects and diseases samples were collected from medicinal plants from FPD and MFPD nursery of BFRI campus and Northern part of Bangladesh. Sooty mould fungus of sarpogandha, die-back and red mite of basak and ashwagandha. Scale insect, black aphid & Homopteran bug of tulsi were collected and recorded. Powdery mildew of tulsi, root rot of ashwagandha also recorded. Root rot of tulsi and collar rot of kalomegh were recorded first time.
c. Record of nature & extent of damage	Nature & extent of damage are recorded. Tulsi (Black and white) is infested by scale insect (90%), black aphid (35%) and Homopteran bug (60%). Basak & ashwagandha are infested by red mite (98%). Sarpogandha leaves are infested by sooty mould fungus (98%). Collar rot of kalomegh (40%), root rot of ashwaganda (70-90%) root rot of tulsi (60%). Powdery mildew (90%) and die-back of basak (95%).
d Rearing/culture and identification.	Root rot of tulsi, collar rot of kalomegh , root rot of ashwagandha, powdery mildew of tulsi. die- back of basak cultured in media in the laboratory. <i>Fusarium solani</i> and <i>F. oxysporum</i> are identified from root rot of tulsi and ashwagandha respectively. <i>Erisiphae</i> sp is recorded first time from tulsi causing powdery mildew disease.
e. Development of nursery	Regular observation and data collection were done. Weeding, soil management, fertilization (Organic), watering, sample collection and management practices are going on.

- 2.8 Achievement(s), if any :
 Red mite of ashwagandha was controled by 1% urea. Aphid, jassid, mealybug. were controlled by Chilly powder and Garlic juice@ 10-20 ml/L of water. Scale insect of Tulsi and Ashwagandha were controlled by Neem oil @2ml./L of water. Powdery mildew of tulsi was controlled by Bordeaux mixture. Root rot and Leaf blight of Ashwagandha were controlled by Dithane M-45 & Bordeaux mixture respectively.

- 2.9 Financial Statement :
 2.9.1 Total cost : Tk. 10,00,000/- (approx.)
 2.9.2 Cost of the year : Tk. 1,39,790/- (approx.)
 2.9.3 Expenditure of the year : Tk 1,39,790/-
 2.9.4 Source of fund : GOB
 2.10 Beneficiaries : Forest Department, NGOs and general public

3. Study : On-going
 3.1 Programme Area : Forest Pests and Diseases
 3.2 Title of the Study : Major pests and diseases of forest seeds and their management
 3.3 Objective(s):
 3.3.1 To identify pests and pathogens of forest seeds in the field and storage condition
 3.3.2 To determine the nature and extent of damage by each pest and pathogen
 3.3.3 To develop suitable management techniques of key pests and pathogens
 3.4 Expected output : Pest and disease-free seeds will be made available that leads to better germination and production of healthy and sound seedlings

- 3.5 Study period
 3.5.1 Starting year : 2007-08
 3.5.2 completion year : 2012-2013
 3.6 Personnel(s) :
 3.6.1 Study Leader : Md. Rafiqul Islam, D.O.
 3.6.2 Associates : Md. Zillur Rahman (RA-1), Kazi Asad-uz-zaman (F. I), Shameema Nasreen (F.I),
 3.7 Progress :
 3.7.1 This year :

Action plan as per annual research programme	Progress
a. Setting up laboratory experiments for seed pest / disease management	Previous collected seeds (sil koroi, ipil ipil, Jarul, akasmoni, acacia hybrid, teak, mahogany) are dried and kept with Neem oil mixture, Sevin powder, Classic, Malathion and Bavistin for observation. Data collected and recorded.
B Collection of pest/disease samples and recording .	Pest and diseases samples of sil koroi, kalo koroi, ipil ipil, akasmoni, acacia hybrid, mahogany seeds from different areas of Dhaka, Mymensingh and Gazipur. Besides these kankra, sundry were also collected from Sundarban.
c. Nature and extent of damage	Nature and extend of damage were recorded from collected seeds.
d. Rearing/culture and identification	<i>Mucor</i> sp., <i>Aspengilles</i> sp., <i>Penicillium</i> sp., <i>Fusarium</i> sp., <i>Cladosporium</i> sp., <i>Alternaria</i> sp. And <i>Fusarium moniliformae</i> were isolated form infected seeds of kalo koroi, koroi ipil-ipil, Jarul, Mahogani and teak.

- 3.9 Achievement(s), if any : Bruchids, scolytids and a moths were recorded from kankra seeds. Some fungi were also isolated from different seeds.
 3.10 Financial Statement :
 3.10.1 Total cost : Tk. 15,00,000/- (approx.)
 3.10.2 Cost of the year : Tk. 93,210/-(approx.)
 3.10.3 Expenditure of the year : Tk 93,210. /-(approx.)
 3.10.4 Source of fund : GOB
 3.11 Beneficiaries : FD, BFRI, NGOs, nursery owners, private planters and general public
 4 Study : On-going
 4.1 Programme Area : Forest Pests and Diseases
 4.2 Title of the Study : Phytosanitary study of *Paulownia* sp. existing in Bangladesh
 4.3 Objectives :
 4.3.1 To survey the present status to *Paulownia* sp. in Bangladesh
 4.3.2 To identify pest and pathogens of *Paulownia* sp.
 4.3.3 To determine present status of pest and diseases of *Paulownia* sp. in Bangladesh
 4.4 Expected output : Increased production of *Paulowina* sp. will be ensured
 4.5 Study period :
 4.5.1 Starting year : 2012-2013
 4.5.2 Completion year : 2014-2015
 4.6 Personnel :
 4.6.1 Study Leader : Md. Rafiqul Islam, D.O.
 4.6.2 Associates : Md. Zillur Rahman (RA-1), Kazi Asad-uz-zaman (F. I), Shameema Nasreen (F.I)
 4.7 Progress :
 4.7.1 This year :

Action plan as per annual research programme	Progress
a. Survey and determination present status of <i>Paulownia</i> sp. In Bangladesh.	
b. To collected information on pests and diseases of <i>Paulownia</i> sp. from nursery and plantation of Bangladesh..	Infested samples were collected from field visit. Two Lepidopteran moths were reared from <i>Paulownia</i> sp.. A large number of seedlings die (about 4000) due to root rot disease

- 4.8 Achievement(s), if any : Two Lepidopteran moths were reared from *Paulownia* sp..
- 4.9 Financial Statement :
- 4.9.1 Total cost :
- 4.9.2 Cost of the year : Tk. 1,20,000/-
- 4.9.3 Expenditure of the year : Tk. 350/-
- 4.9.4 Source of fund : GOB
- 4.10 Beneficiaries : FD, NGO's, Farmers, Educational institutions and other tree planting agencies.

PLANTATION TRIAL UNIT DIVISION

1. Study : On-going
- 1.1 Programme Area : Plantation technique and forest management
- 1.2 Title of the Study : Growth performance of different mangrove and non-mangrove species in the coastal areas of Bangladesh
- 1.3 Justification: The Forest Department started mangrove afforestation in the coastal belt of Bangladesh from 1966. About 1,72,000 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 maintained a continuous forest cover in the coastal belt, trial plantations of some major mangrove species under keora plantations and 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 of coastal forest management strategy.
- 1.4 Objective(s) :
- 1.4.1 To select site-suitable mangrove and mainland species for coastal areas of Bangladesh.
- 1.5 Expected output : Sustainable coastal forest management strategy is expected to be developed depending on the growth performance of mangrove and non-mangrove species.
- 1.6 Study Period :
- 1.6.1 Starting year : 2007-08
- 1.6.2 Completion year : 2012-13
- 1.7 Personnel (s) :
- 1.7.1 Study Leader : S. A. Islam, DO
- 1.7.2 Associates : M.G. Moula, RO, M.A. Habib, FI, M. G. Rasul, FI, M.A.Q. Miah, FI
- 1.8 Progress :
- 1.8.1 Previous years, if any : A total of 14.33 ha of older trials of mangrove (9.5 ha), non-mangrove (4.0 ha) and palm (0.83 ha) species were maintained by weeding, cleaning, climber cutting, fence repairing etc. Growth and survival data of mangroves species such as sundari, gewa, passur, goran, khalshi, hantal, kankra, shingra and golpata; non-mangrove species such as rain tree, jhao, payra, sada koroï and kalo koroï; and palm species such as palmyra palm, coconut, date palm and betel nut were recorded from the experimental plantations raised in different islands under Rangabali and Char Kukri-Mukri Research Stations. Growth data were compiled and analyzed.
- 1.8.2 This years :

Activities of the study	Progress
a. Maintenance of 14.33 ha of older trials of mangrove (9.5 ha), non-mangrove (4.0 ha) and palm (0.83 ha) species by weeding, cleaning, climber cutting, fence repairing etc. in different sites of Rangabali and Char Kukri-Mukri Research Stations.	A total of 14.33 ha of older trials of mangrove (9.5 ha), non-mangrove (4.0 ha) and palm (0.83 ha) species have been maintained by weeding, cleaning, climber cutting, barbed wire fence repairing, etc. at different islands under Rangabali and Char Kukri-Mukri Research Stations.

b. Collection of survival and growth data from the experimental plantations once a year.	Growth data have been collected from the experimental plantations.
c. Compilation and analysis of data.	Data have been compiled and analyzed.
d. Preparation of final report.	A scientific paper has been prepared and accepted for publication in BJFS.

Table 1. Growth performance of mangrove species planted at different locations of Rangabali island of Patuakhali coastal belt.

Species	Location	Age of trees (yrs)	Mean Survival (%)	Mean Height (m)	Mean DBH (cm)
<i>Heritiera fomes</i> (Sundari)	Char Kashem(N)	21	30.29	6.69	5.98
	Char Kashem (P)	21	67.07	8.75	7.03
	Soner Char	18	57.82	4.98	4.91
	Soner Char	17	46.59	5.21	3.59
	Madarbunia	16	54.92	5.34	7.82
<i>Excoecaria agallocha</i> (Gewa)	Char Kashem(N)	21	65.84	10.45	9.89
	Char Kashem (P)	21	41.70	13.00	11.62
	Soner Char	18	74.58	8.05	8.41
	Soner Char	17	54.40	9.10	10.22
	Madarbunia	16	72.29	5.97	9.01
<i>Xylocarpus mekongensis</i> (Passur)	Char Kashem(N)	21	52.34	7.14	8.91
	Char Kashem (P)	21	43.88	9.18	8.66
	Soner Char	18	42.34	4.95	5.83
	Soner Char	17	50.46	7.99	8.50
	Madarbunia	16	50.34	4.94	7.93
<i>Xylocarpus granatum</i> (Dhundul)	Soner Char	18	29.85	4.40	4.91
	Soner Char	17	11.18	4.34	4.78
	Madarbunia	16	49.92	5.37	6.03
<i>Bruguiera sexanula</i> (Kankra)	Char Kashem(N)	21	15.96	5.16	5.36
	Char Kashem (P)	21	15.58	5.85	6.51
	Soner Char	18	10.16	4.10	4.52
<i>Aegiceras corniculatum</i> (Khalshi)	Char Kashem(N)	21	61.06	6.06	6.09
	Char Kashem (P)	21	63.91	8.14	7.97
	Soner Char	18	64.33	4.72	4.91
	Soner Char	17	57.78	5.43	5.01
	Madarbunia	16	67.12	5.13	6.66
<i>Cynometra ramiflora</i> (Shingra)	Char Kashem(N)	21	42.00	7.21	5.75
	Char Kashem (P)	21	29.69	5.86	4.73
<i>Ceriops decandra</i> (Goran)	Char Kashem(N)	21	41.37	4.78	5.18
	Char Kashem (P)	21	16.34	5.45	5.83
	Soner Char	18	12.43	4.71	4.12
<i>Lumnitzera racemosa</i> (Kirpa)	Madarbunia	16	43.95	5.24	6.31
<i>Phoenix paludosa</i> (Hantal)	Char Kashem(N)	21	51.85	7.02	5.80
	Char Kashem (P)	21	57.57	6.40	6.81
	Soner Char	18	65.42	5.76	5.48
<i>Nypa fruticans</i> (Golpata)	Madarbunia	16	36.78	3.55	-
	Baher Char	16	43.33	5.63	-

N= Nursery Khal, P= Pashar Khal

Table 2. Growth performance of mangrove species planted at different locations of Char Kukri-Mukri island of Bhola coastal belt.

Species	Location	Age of trees (yrs)	Mean Survival (%)	Mean Height (m)	Mean DBH (cm)
<i>Heritiera fomes</i>	Zylar Khal	21	30.45	7.28	5.01
	Char Zamir	18	33.75	4.24	5.73
	Char Shafi	17	53.44	5.43	5.29
<i>Excoecaria agallocha</i>	Zylar Khal	21	69.84	10.04	8.51
	Char Zamir	18	54.23	8.49	9.55
	Char Shafi	17	51.84	9.33	10.42
<i>Xylocarpus mekongensis</i>	Char Shafi	17	26.18	6.84	7.34
<i>Aegiceras corniculatum</i>	Char Zamir	18	46.02	6.61	7.96
<i>Cynometra ramiflora</i>	Zylar Khal	21	18.38	4.96	4.27
<i>Lumnitzera racemosa</i>	Char Zamir	18	8.57	5.42	8.76
	Char Shafi	17	14.75	5.17	6.26
<i>Phoenix paludosa</i>	Zylar Khal	21	59.22	4.92	4.85
	Char Zamir	18	89.00	5.14	7.01
	Char Shafi	17	65.64	5.68	6.48
<i>Nypa fruticans</i>	Nursery Khal	18	56.00	3.43	-

Table 3. Growth performance of mesophytic species at the age of 14 years at Char kashem under Rangabali island.

Species	Survival %	Height (m)	DBH (cm)
<i>Samanea saman</i> (Rain tree)	83	9.15	21.17
<i>Thespesia populnea</i> (Sanboloi)	41	5.57	13.26
<i>Pithecellobium dulce</i> (Payra)	41	6.65	11.41
<i>Casuarina equisetifolia</i> (Jhao)	64	12.09	17.76
<i>Acacia nilotica</i> (Babla)	38	6.18	11.16
<i>Albizia procera</i> (Sada koroi)	33	8.40	17.75
<i>Albizia lebbek</i> (Kala koroi)	46	10.47	15.43

Table 4. Growth performance of palm trial plantations species at the age of 12 years at Char Kukri-Mukri.

Vernacular name	Scientific name	Survival %	Height (m)	DBH (cm)
Coconut	<i>Cocos nucifera</i>	80.55	11.46	33.33
Palmyra palm	<i>Borassus flabellifer</i>	65.27	8.52	62.97
Date palm	<i>Phoenix sylvestris</i>	81.94	7.69	40.31
Betel-nut	<i>Areca catechu</i>	60.18	9.66	12.38

1.9 Achievement(s), if any : A total of 14.33 ha experimental plantations of mangrove (9.5 ha), non-mangrove (4.0 ha) and palm (0.83 ha) species have been established at different islands under Rangabali and Char Kukri-Mukri Research Stations. Some major mangrove species *viz.* sundri, gewa, passur, hantal, khalshi, and golpata have been found promising for coastal plantation inside keora forests. Similarly, in the raised lands of coastal areas, promising performance among non-mangrove species has been recorded for jhao, sada koroi, kala koroi, raintree and payra. Among the palm species palmyra palm, coconut, date palm and betel nut have been found promising in the foreshore area of the coastal habitat. Some scientific papers have published in the renowned journals.

1.10 Financial Statement :

1.10.1 Total cost Tk. 16,00,000.00

- 1.10.2 Cost of the year : Tk. 1,90,000.00
 1.10.3 Expenditure of the year : Tk. 1,90,000.00
 1.10.4 Source of fund : GOB
 1.11 Beneficiaries : FD; Local Farmers and NGO.
2. Study : On-going
- 2.1 Programme Area : Production of quality planting materials
- 2.2 Title of the study : Establishment of Seed Production Areas and Demonstration plots for priority planting mangrove species
- 2.3 Justification : The main goal of any plantation is to produce maximum yield per unit area. It can be done by using improved seed sources from selected seed stands and from Plus Trees. Considering the urgent need of quality seeds for coastal afforestation programmes, it is imperative that Seed Production Areas (SPA) for priority mangrove species should be established as a source of improved seeds and propagules. This study have been undertaken with a view to provide improved seed sources by selecting superior phenotypes from nature-made stressed conditions and to established demonstration plots with seeds of SPA and PTs for getting maximum yield from major mangrove species.
- 2.4 Objective(s) :
- 2.4.1 To develop interim source of improved quality seeds of mangrove species.
- 2.4.2 To establish demonstration plots with PT/SPA seeds.
- 2.5. Expected output : Establishment of better quality seed sources of major mangrove species in the coastal areas of Bangladesh.
- 2.6 Study Period :
- 2.6.1 Starting year : 1997-98
- 2.6.2 Completion year : 2012-13
- 2.7 Personnel (s) :
- 2.7.1 Study Leader : M.G. Moula, RO
- 2.7.2 Associates : S. A. Islam, DO, M.A. Habib, FI, M. G. Rasul, FI, M.A.Q. Miah, FI
- 2.8. Progress :
- 2.8.1 Previous years, if any : A total of 6.0 ha demonstration plots with keora, baen and sundari were established at Char Kukri-Mukri, Rangabali and Char Osman Research Stations. Previously raised 3.2 ha demonstration plots of keora were maintained by weeding and fence repairing. Growth and survival data were recorded from the keora and baen demonstration plots.
- 2.8.1 This years :

Activities of the study	Progress
a) Maintenance of previously raised 6.0 ha demonstration plots of keora, sundari and baen at Char Kukri-Mukri, Rangabali and Char Osman Research Stations.	a) Previously raised 6.0 ha demonstration plots of keora, sundari and baen have been maintained at Char Kukri-Mukri, Rangabali and Char Osman Research Stations.
b) Collection of survival and growth data from the experimental plots once a year.	b) Survival, height and diameter growth data have been recorded from the experimental plots once a year.
c) Compilation and analysis of data.	c) Data have been compiled.

Table 1. Growth Performance of keora demonstration plots at the age of 4 years.

Treatment	Char Kukri-Mukri			Rangabali		
	Survival %	Height (m)	DBH (cm)	Survival %	Height (m)	DBH (cm)
Best tree seeds	50.33	6.36	7.94	85.66	5.76	11.49
Selected tree seeds	43.00	5.61	7.08	79.00	4.54	9.30
Mass collection	33.00	4.30	4.84	76.66	2.26	4.50

- 2.9 Achievement(s), if any : Four hectares of SPA for keora have been established at Char Taposhi of Patuakhali Forest Division and 1.6 hectares demonstration plots of keora have been successfully raised at Rangabali and Char Kukri-Mukri Forest Research Stations.
- 2.10 Financial Statement :

- 2.10.1 Total cost : Tk. 9,50,000.00
- 2.10.2 Cost of the year : Tk. 50,000.00
- 2.10.3 Expenditure of the year : Tk. 50,000.00
- 2.10.4 Source of fund : GOB
- 2.11 Beneficiaries : Forest Department, Coastal Farmers.

- 3. Study : On-going
- 3.1 Programme Area : Social Forestry
- 3.2 Title of the study : Study on the improvement of coastal homesteads through resource generation.
- 3.3 Justification : The coastal region of Bangladesh covers an area of about 47,201 km² (710 km long) extending along the Bay of Bengal. Bangladesh is one of the most densely populated countries in the world. The coastal zone constitutes 20% of the area and 28% of the population of the country. Homesteads represent a land use system involving deliberate management of multipurpose trees and shrubs in limited association with seasonal vegetables. It play a vital role in providing timber, fuelwood, fodder, fruits and vegetables. A higher percentage of the population living below the absolute poverty line in the coastal zone compared to the country as a whole. Moreover, the people of the coastal islands are very poor and their livelihood mostly depends on daily labour and fishing. Their homegarden can be a source of livelihood for many poor farmers. Therefore, this study have been undertaken to improve their livelihood status and to develop vegetation cover in the coastal homesteads through supplementing some resources for the poor farmers.
- 3.4 Objective(s) :
- 3.4.1 To improve livelihood status of coastal rural farmers through resource generation in coastal homesteads.
- 3.4.2 To assess and prepare database on existing and recreating numbers and areas of different resources.
- 3.5. Expected output : Improvement of livelihood status of coastal rural farmers through resource generations in the homesteads as well as enrich existing pattern of coastal vegetation.
- 3.6 Study Period :
- 3.6.1 Starting year : 2006-07
- 3.6.2 Completion year : 2013-14
- 3.7 Personnel (s) :
- 3.7.1 Study Leader : S. A. Islam, DO
- 3.7.2 Associates : M.G. Moula, RO, M.A. Habib, FI, M. G. Rasul, FI, M.A.Q. Miah, FI
- 3.8. Progress :
- 3.8.1 Previous year, if any : A total of 1250 seedlings of timber tree species such as rain tree, sil koroi, akashmoni, neem, and mehogni (250 seedlings for each species) were raised at Char Kukri-Mukri and Rangabali Research Stations. A total of 1200 seedlings of fruit tree species such as kalojam, kathal, amloki, tentul, amra and supari (100 seedlings for each species) were raised. Eight different types of vegetable seeds/ seedlings were procured and distributed to 62 selected farmers. A total of 1178 seedlings of rain tree, sil koroi, akashmoni, and mehogni and 992 seedlings of kalojam, kathal, amloki, tentul, amra and supari; 8 types of different vegetable seeds were distributed to the selected farmers for developing their resources. Data were collected and analyzed
- 3.8.2 This years :

Activities of the study	Progress
a) Raising of 3000 seedlings of timber tree species such as rain tree, sil koroi, kalo koroi, akashmoni, neem, and mehogni (500 seedlings for each species) at Rangabali and Char Kukri-Mukri Research Stations.	A total of 3000 seedlings of timber tree species such as rain tree, sil koroi, kalo koroi, akashmoni, neem, and mehogni (500 seedlings for each species) were raised at Rangabali and Char Kukri-Mukri Research Stations.
b) Raising of 1400 seedlings of fruit tree species such as kalojam, kathal, amloki, tentul, amra, jambura and lebu (200 seedlings for each species) at Rangabali and Char Kukri-Mukri Research Stations.	A total of 1400 seedlings of fruit tree species such as kalojam, kathal, amloki, tentul, amra, jambura and lebu (200 seedlings for each species) were raised at Rangabali and Char Kukri-Mukri Research Stations.

c) Procurement of different seasonal vegetable seeds/ seedlings and 186 seedlings of mango (improved variety).	Eight different seasonal vegetable seeds/ seedlings and 186 seedlings of mango (improved variety) have been procured.
d) Supply of timber and fruit tree seedlings and vegetable seeds/ seedlings to the selected 62 farmers to enrich vegetation in the farmer's homesteads.	A total of 1860 timber and 1302 fruit tree seedlings and vegetable seeds/ seedlings to the selected 62 farmers to enrich vegetation in the farmer's homesteads.
e) Collection and analysis of data.	e. Data have been collected and compiled.

Table 1. Growth performance of fruits tree species planted in the selected homesteads at Rangabali and Kukri-Mukri Island.

Name of Species	Group-A		Group-B		Group-C		Group-D	
	Survival%	Max. Height (m)	Survival%	Max. Height (m)	Survival%	Max. Height (m)	Survival%	Max. Height (m)
Coconut	64	3.23	59	3.30	80	3.07	72	2.83
Guava	55	3.21	21	1.78	43	2011	53	2.60
Jujube	29	1.56	17	1.65	29	1.75	35	1.91
Betel nut	52	1.58	48	1.18	58	1.03	70	0.90
Mango	37	1.24	47	0.74	50	0.98	57	0.69
Kalo Jam	44	2.00	66	0.61	57	1.33	62	0.59
Jack fruit	50	0.96	50	1.18	47	0.78	73	0.62
Tentul	55	0.59	69	0.89	52	1.26	68	0.44
Amra	31	0.95	16	1.17	20	2.11	33	1.48

Table 2. Growth performance of timber tree species planted in the selected homesteads at Rangabali and Kukri-Mukri Island.

Name of Species	Group-A		Group-B		Group-C		Group-D	
	Survival%	Max. Height (m)	Survival%	Max. Height (m)	Survival%	Max. Height (m)	Survival%	Max. Height (m)
Rain tree	66	1.57	55	1.48	68	1.75	70	1.09
Akashmoni	62	1.03	62	1.18	57	1.62	68	0.89
Mehogani	34	0.66	37	0.71	41	1.10	50	0.59
kalo koro	28	0.71	33	0.91	30	0.95	28	0.44
Silkoro	12	1.01	37	0.91	15	0.80	27	0.74
Neem	39	1.21	56	1.12	44	0.75	53	0.74

Table 3. Income generation of selected farmers through vegetable cultivation at Rangabali and Kukri-Mukri Island.

Farmers Group	Location	No. of family	Vegetable prod. (kg)	Vegetable's price	Family use (kg)	Sale (kg)	Sale (Tk.)
Group-A	Char Nazir	16	2627.25	50,049.00	1490.25	1137.00	21,660.00
Group-B	Char Nazir	16	2278.50	40,941.00	1359.50	919.00	16,513.00
Group-C	Aminpur	15	3202.00	59,465.00	1903.50	1298.50	24,115.00
Group-D	Babuganj	15	2574.75	39,127.00	1372.50	1202.25	18,270.00
Total		62	10682.50	189,582.00	6125.75	4556.75	80,558.00
Average			172.29	3057.77	98.80	73.49	1299.32

Table 4. Fruit production in 2012 in the farmer's homesteads at Rangabali and Kukri-Mukri.

Species	No. of homesteads	Total production kg/no.	Total production (Tk.)	Family use (kg/no.)	Total sale (kg)	Total sale (Tk.)
Papaya	32	1102	16,273.00	612	490	7250.00
Guava	33	503	18,000.00	312	191	6720.00
Jujube	16	123	4,820.00	97	26	1025.00
Coconut	16	129	2,580.00	129	-	-

- 3.9 Achievement(s), if any : A total of 62 farmers have been selected at Char Nazir and Char Kasem under Rangabali Research Station; and Char Aminpur, Shahabajpur and Babujanj under Char Kukri-Mukri Research Station. Seedlings of different salt tolerant timber and fruit species have been planted in their homesteads. Vegetation of coconut, guava apelkul, sundari and golpata, have already been developed in their homesteads.
- 3.10 Financial Statement :
- 3.10.1 Total cost : Tk. 10,30,000.00
- 3.10.2 Cost of the year : Tk. 2,30,000.00
- 3.10.3 Expenditure of the year : Tk. 2,30,000.00
- 3.10.4 Source of fund : GOB
- 3.11 Beneficiaries : Coastal rural farmers and NGOs.
4. Study : On-going
- 4.1 Programme Area : Plantation technique and forest management
- 4.2 Title of the study : Introduction of bamboo, rattan and golpata in the coastal homesteads of Bangladesh
- 4.3 Justification : The homegardens 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 aggregate 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 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 Sundarban. 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 belts 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.
- 4.4 Objective(s) :
- 4.4.1 To investigate the possibility for introduction of bamboo rattan and golpata in coastal homesteads of Bangladesh.
- 4.4.2 To select site suitability of bamboo, rattan and golpata in the coastal areas.
- 4.4.3 To increase the productivity of bamboo, rattan and golpata in the coastal areas.
- 4.5 Expected output : Production of bamboo, rattan and golpata in the coastal areas will be increased.
- 4.6 Study Period** :
- 4.6.1 Starting year : 2009-10
- 4.6.2 Completion year : 2014-15
- 4.7 Personnel (s) :
- 4.7.1 Study Leader : S. A. Islam, DO
- 4.7.2 Associates : M.G. Moula, RO, M.A. Habib, FI, M. G. Rasul, FI, M.A.Q. Miah, FI
- 4.8 Progress** :
- 4.8.1 Previous years, if any : Two awareness meeting were organized with coastal rural people for cultivating bamboo, rattan and golpata in the coastal homesteads at Char Kukri-Mukri and Char Osman Research Stations. A total of 8000 seedlings of rattan, 4000 seedlings of bamboo and 2000 seedling of golpata

were raised in the nursery at 4 research stations. Seedlings of bamboo (2564 nos.), rattan (2764 nos.) and golpata (1764 nos.) have been distributed to 294 coastal farmers. Data on survivability and growth were recorded and compiled.

4.8.2 This years :

Activities of the study	Progress
a) Organizing four awareness meetings with coastal rural people for cultivating bamboo, rattan and golpata in the coastal homesteads at Rangabali, Char Kukri-Mukri, Char Osman and Sitakundu/ Cox's Bazar Research Stations.	Four awareness meeting were organized with coastal rural people for cultivating bamboo, rattan and golpata in the coastal homesteads at Rangabali, Char Kukri-Mukri, Char Osman and Sitakundu Research Stations.
b) Collection of seeds of rattan (jalibet) and golpata for raising 6000 seedlings of rattan and 2000 seedlings of golpata.	Seeds of rattan (jali bet) and golpata were collected for raising 6000 seedlings of rattan and 2000 seedlings of golpata in poybags.
c) Raising 6000 seedlings of rattan species, 4000 seedlings (branch cutting) of bamboos (<i>Bambusa balcooa</i> / <i>B. vulgaris</i>) and 2000 seedlings of golpata.	A total of 6000 seedlings of rattan, 4000 seedlings of bamboo and 2000 seedling of golpata were raised in the nursery at 4 research stations.
d) Supplying of seedlings to the selected coastal farmers.	Seedlings of bamboo (1300 nos.), rattan (2300 nos.) and golpata (1200 nos.) have been distributed to 294 coastal farmers.
e) Maintenance and supervision of seedlings planted in previous years.	Seedlings of bamboo, rattan and golpata planted in 2010, 2011 and 2012 have been maintained.
f) Collection and analysis of data.	Data on survivability and growth have been recorded and compiled.

Table 1. Growth performance of bamboo, rattan and golpata in the coastal homesteads of Bangladesh planted in 2010.

Location	Bamboo				Rattan				Golpata		
	Sur %	New culms	Max ht. (m)	Max dia (cm)	Sur %	New culms	Max ht. (m)	Max dia (cm)	Sur%	New culms	Max ht. (m)
Rangabali	72	3.6	5.6	4.0	55	6.3	5.0	1.5	24	2.3	4.0
Char Kukri-Mukri	76	3.8	3.1	2.6	63	4.5	2.7	1.6	42	2.0	4.3
Char Osman	60	1.8	2.8	4.5	58	3.2	2.2	1.46	-	-	-
Cox's Bazar	40	2.8	3.1	4.3	32	2.5	2.1	-	-	-	-

Table 2. Seedlings of bamboo, rattan and golpata distributed to the coastal farmers in 2012.

Name of Station	No. of homesteads	No. of seedlings distributed		
		Bamboo	Rattan	Golpata
Rangabali	108	648	648	648
Char Kukri-Mukri	111	666	666	666
Sitakundu	25	750	950	450
Char-Osman	50	500	500	-
Total	294	2,564	2,764	1,764

Table 3. Seedlings of bamboo, rattan and golpata distributed to the coastal farmers in 2013.

Name of Station	No. of homesteads	No. of seedlings distributed		
		Bamboo	Rattan	Golpata
Rangabali	100	400	600	400
Char Kukri-Mukri	100	300	500	400
Sitakundu	40	400	800	400
Char-Osman	40	200	400	-
Total	280	1300	2300	1200

- 4.9 Achievement(s), if any : Total 774 coastal homesteads were selected till 2012 for introducing bamboo, rattan and golpata. A total of 11,314 seedlings of bamboo, 16,564 seedlings of rattan and 9160 seedlings of golpata have been distributed to the coastal farmers.
- 4.10 Financial Statement :
- 4.10.1 Total cost : Tk. 8,00,000.00
- 4.10.2 Cost of the year : Tk. 2,05,000.00
- 4.10.3 Expenditure of the year : Tk. 2,05,000.00
- 4.10.4 Source of fund : GOB
- 4.11 Beneficiaries : Forest Department and adjacent coastal dwellers.
5. Study : On-going
- 5.1 Programme Area : Plantation technique and forest management
- 5.2 Title of the study : Introduction of major bee foraging mangrove plant species in the coastal belts of Bangladesh.
- 5.3 Justification : The floristic composition of the natural Sundarban 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 dossata*. 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.
- 5.4 Objective(s) :
- 5.4.1 To develop better silvicultural techniques for plantations for each bee foraging mangrove plant species.
- 5.4.2 To provide the sources of honey plants.
- 5.5. Expected output : Knowledge on the proper methods and suitable sites for plantations for different bee foraging mangrove species in the coastal belts; and providing sources of honey. There will be a scope for introducing apiculture with bees.
- 5.6 Study Period :
- 5.6.1 Starting year : 2010-11
- 5.6.2 Completion year : 2014-15
- 5.7 Personnel (s) :
- 5.7.1 Study Leader : M.G. Moula, RO
- 5.7.2 Associates : . S. A. Islam, DO, M.A. Habib, FI, M. G. Rasul, FI, M.A.Q. Miah, FI
- 5.8 Progress :
- 5.8.1 Previous years, if any : A total of 7,200 seedlings of khalshi, 2500 of gewa, 4,800 of goran, 4800 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 baen have been raised at 4 Research Stations. Previously raised 2.4 ha experimental plantations were maintained. Data were collected and compiled.
- 5.8.2 This years :

Activities of the study	Progress
a) Collection of seeds of khalshi (<i>Aegiceras corniculatum</i>) gewa (<i>Excoecaria agallocha</i>), goran (<i>Ceriops decandra</i>), passur (<i>Xylocarpus mekongensis</i>) and baen (<i>Avicennia officinalis</i>) from the Sundarban.	a. Seeds of khalshi, gewa, goran, passur and baen were collected from the Sundarban.
b) Raising seedlings of khalshi (7,200 nos.) gewa (2400 nos), goran (4,800 nos), passur (4,800 nos.) and baen (2400 nos.) at Rangabali, Char kukri-Mukri, Stakundu and Char Osman Research Stations.	b. A total of 7,200 seedlings of khalshi, 2500 of gewa, 4,800 of goran, 4800 of passur and 2,400 of baen were raised at Rangabali, Char kukri-Mukri, Stakundu and Char Osman Research Stations.

c) Raising of 4.0 ha experimental mixed plantations of khalshi, gewa, goran, passur and baen at 3:1:2:2:1 ratio with 3 replications.	c. A total of 4.0 ha mixed plantations khalshi, gewa, goran, passur and baen at 3:1:2:2:1 ratio with 3 replications have been raised at 4 Research Stations.
d) Maintenance of 6.4 ha experimental plantations raised in previous years.	d. Previously raised 6.4 ha experimental plantations were maintained.
e) Collection and analysis of data.	e. Data have been collected and compiled.

5.9 Achievement(s), if any : A total of 6.4 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.

- 5.10 Financial Statement :
- 5.10.1 Total cost : Tk. 8,00,000.00
- 5.10.2 Cost of the year : Tk. 2,00,000.00
- 5.10.3 Expenditure of the year : Tk. 2,00,000.00
- 5.10.4 Source of fund : GOB
- 5.11 Beneficiaries : Forest Department and adjacent coastal dwellers.

6. Study : On-going
- 6.1 Programme Area : Plantation technique and forest management
- 6.2 Title of the study : Development of model vegetation to protect soil erosion, salt spray and other climatic changes in the coastal belt of Bangladesh.

6.3 Justification : The coastal belt of Bangladesh is 710 km long extending along the Bay of Bengal. It lies within the tropical zone between 21⁰ – 23⁰ N latitude and 89⁰ – 93⁰ E longitudes. Out of 64 districts of Bangladesh, the coastal zone now covers 19 coastal districts facing, or in proximity to, the Bay of Bengal. The coastal zone of Bangladesh is prone to multiple threats such as cyclones, storm surges, floods, soil erosion, salt spray as well as earthquakes, tsunamis, and all other climatic hazards. Mangrove forests are vegetated inter-tidal wetlands that provide goods and environmental services. Recently, mangroves and other types of coastal forest and vegetation have been considered as protection against cyclones, wind, salt spray, tsunamis and coastal erosion as green shelterbelts. The coastal forests can reduce wind and storm wave impact as well as current velocities. Choosing the types of trees and plantation model to be used for shelterbelts is very important for getting maximum environmental benefit. Therefore, this study has been undertaken to develop a better model plantation of suitable mangrove and non-mangrove species against climatic hazards in the coastal belt of Bangladesh.

6.4 Objective(s) :

6.4.1 To develop a better model plantation of suitable species against major climatic changes in the coastal belt of Bangladesh.

6.4.2 To select mangrove species that can tolerate cyclonic and salt hazard.

6.4.3 To increase the coastal forest product

6.5 Expected output : Model vegetation in the coastal belt will be developed against all climatic hazards.

6.6 Study Period :

6.6.1 Starting year : 2010-11

6.6.2 Completion year : 2014-15

6.7 **Personnel (s)** :

6.7.1 Study Leader : S. A. Islam, DO

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

6.8 **Progress** :

6.8.1 Previous years, if any : Seeds of keora, baen and golpata for newly accreted lands; sundari, kankra, passur, gewa and khalshi for moderately established lands; and karanja, payra, jhao and babla were collected for raised lands for raising model plantations. A total of 27 thousands seedlings of these mangrove and non-mangrove species were raised at Rangabali, Char kukri-Mukri, Char Osman and Sitakundu Research Stations. A total of 7.0 ha experimental model plantations in different length and size were raised.

6.8.1 This years :

Activities of the study	Progress
a) Collection of seeds of keora, baen and golpata for newly accreted lands; sundari, kankra, passur, gewa and khalshi for moderately established lands; and karanja, payra, jhao and babla were collected for raised lands for raising model plantations.	Seeds of keora, baen and golpata for newly accreted lands; sundari, kankra, passur, gewa and khalshi for moderately established lands; and karanja, payra, jhao and babla were collected for raised lands for raising model plantations.
b) Raising 30 thousands seedlings of theses species at Rangabali, Char kukri-Mukri, Char Osman and Sitakundu Research Stations.	A total of 24 thousands seedlings of theses mangrove and non-mangrove species have been raised at Rangabali, Char kukri-Mukri, Char Osman and Sitakundu Research Stations.
c) Procurement of Refract meter and Wind meter for measuring water/soil salinity and wind velocity.	-
d) Raising of 7.0 ha experimental model plantations of these species at 4 Research Stations.	A total of 5.44 ha experimental model plantations in different length and size have been raised.
e) Establishment of 36 siltation gauge in the experimental plantations for measuring siltation/ soil erosion.	-
f) Collection of data on different climatic parameters and from experimental plantations.	Data have been collected from previously raised experimental plots.

Table 1. Growth performance of mesophytic and mangrove species in different site condition of coastal areas of Bangladesh

Location	Year of plantation	Treatment	Species	Survival %	Height (cm)
Sitakundu Research Station	2012	Raised land	Jhao	90	158.0
			Karanja	92	96.0
			Babla	85	175.0
			Payra	87	147.0
Char Osman Research Station	2012	New accretion	Keora	80	24.0
			Baen	77	62.0
	2012	Moderately raised land	Sundari	83	72.0
			Kankra	82	43.0
			Passur	83	84.0
			Gewa	84	64.0
			Khalshi	80	16.0

6.9. Achievement(s), if any : A total of 7.0 ha experimental model plantations in different length and size were raised.

6.10 Financial Statement :

6.10.1 Total cost : Tk. 20,00,000.00

6.10.2 Cost of the year : Tk. 2,35,000.00

6.10.3 Expenditure of the year : Tk. 2,35,000.00

6.10.4 Source of fund : GOB

6.11 Beneficiaries : Forest Department and adjacent coastal dwellers

- 7. Study** : On-going
- 7.1 Programme Area : Plantation technique and forest management
- 7.2 Title of the study : Establishment of pilot plots of six mangrove species as under planting in keora plantations
- 7.3 Justification : Coastal man-made forest in Bangladesh faces serious threats of erosion due to rapid geomorphological changes, inadequate regeneration of exiting mangrove species, high frequency of inundation and intense human pressure for land. The Plantation Trial Unit Division of BFRI generated plantation techniques of some major mangrove species as underplanting in the differently inundated coastal habitats. It is now needed to raise plantations in pilot scale of these mangrove species to confirm and modernized this technology.
- 7.4 Objective(s)** :
- 7.4.1 To establish pilot plots of site-suitable mangrove species in differently inundated coastal habitats.
- 7.5. Expected output : Coastal vegetation is expected to be enriched and sustained.
- 7.6 Study Period** :
- 7.6.1 Starting year : 2008-09
- 7.6.2 Completion year : 2012-13
- 7.7 Personnel (s) :
- 7.7.1 Study Leader : S. A. Islam, DO
- 7.7.2 Associates : M.G. Moula, RO, M.A. Habib, FI, M. G. Rasul, FI, M.A.Q. Miah, FI
- 7.8. Progress** :
- 7.8.1 Previous years, if any : A total of 10,000 seedlings of these six mangrove species (sundari, passur, kankra, khalshi, gewa, and hantal) were raised in polybags at Rangabali and Kukri-Mukri Research Stations. Two ha pilot plots were established with these 6 mangrove species at Rangabali and Char Kukri-Mukri. Previously raised 9.0 ha experimental plots were maintained by weeding and cleaning. Data were collected and compiled.
- 7.8.2 This years :

Activities of the study	Progress
a) Raising and maintenance of 10,000 seedlings of 6 mangrove species (sundri, passur, gewa, khalshi, kankra and hantal) in the nursery.	A total of 10,000 seedlings of these six mangrove species were raised and maintained in polybags at Rangabali and Kukri-Mukri Research Stations.
b) Establishment of 2.0 ha pilot plots with these 6 mangrove species under established keora plantations.	One ha pilot plot with these 6 mangrove species have been established at Char Kukri-Mukri.
c) Maintenance of previously raised 9.0 ha experimental plots.	Previously raised 9.0 ha experimental plots have been maintained by weeding and cleaning.
d) Collection and compilation of data.	Data have been collected and compiled.

Table 1. Growth performance of pilot plots of mangrove species in 2009.

Name of species	Char Digol (Kukkri)		Madarbunia (Rangabali)	
	Survival %	Height (cm)	Survival %	Height (cm)
Sundari	51.95	52.00	47.33	88.00
Gewa	63.54	63.00	62.90	88.00
Passur	42.59	91.00	32.33	86.00
Kankra	40.46	56.00	26.59	80.00
Khalshi	61.67	111.00	40.94	89.00
Hantal	42.75	45.00	6.12	53.00

Table 2. Growth performance of pilot plots of mangrove species in 2010.

Name of species	Char Dighal		Madarbunia	
	Survival %	Height (cm)	Survival %	Height (cm)
Sundari	62.00	59.00	40.07	82.00
Gewa	51.97	53.00	48.43	91.00
Passur	56.00	68.00	25.73	81.00
Kankra	50.37	38.00	24.75	73.00
Khalshi	65.00	54.00	24.21	74.00
Hantal	35.00	36.00	-	-

7.9 Achievement(s), if any : Nine hectares experimental plantations of six mangrove species (sundari, passur, kankra, khalshi, gewa, and hantal) have been established at Char Kukri-Mukri and Rangabali Research Stations.

7.10 Financial Statement :
 7.10.1 Total cost : Tk. 8,00,000.00
 7.10.2 Cost of the year : Tk. 1,55,000.00
 7.10.3 Expenditure of the year : Tk. 1,55,000.00
 7.10.4 Source of fund : GOB
 7.11 Beneficiaries : Forest Department and adjacent coastal dwellers.

8. Study : New
 8.1 Programme Area : Conservation of Biodiversity.
 8.2 Title of the study : Ecological succession in the man-made coastal forests in relation to age and other related factors.

8.3 Justification : There are 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 1,72,000 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.

8.4 Objective(s) :
 8.4.1 To observe the changes of vegetation and natural regeneration in the coastal man-made forests.
 8.4.2 To determine the impact of related climatic factors, which are responsible for the ecological succession in the coastal forests.
 8.4.3 To increase coastal forest resources of the country.
 8.5. 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.

8.6 Study period :
 8.6.1 Starting year : 2012-13
 8.6.2 Completion year : 2016-17
 8.7. Personnel (s) :
 8.7.1 Study leader : S. A. Islam, DO
 8.7.2 Associates : M. G. Moula, RO, M. A. Habib, FI, M. G. Rasul, FI, M.A.Q. Miah, FI
 8.8 Progress :
 8.8.1 Previous years, if any : New study

8.8.2. This year :

Activities of the study	Progress
a) Establishment of Temporary Sample Plots (TSP) in the man-made forests according to age class at different islands of the coastal belt of Bangladesh.	A total of 81 Temporary Sample Plots (TSP) have been established in the man-made forests according to age class at different islands of Char Kukri, Rangabali and Hatia.
b) Procurement of Refract meter for measuring water/soil salinity.	-
c) Recording data on siltation, soil erosion, soil/water salinity, inundation frequency, and impact of human and animal interferences.	Siltation gauge have been established. Data on water salinity and inundation frequency have been recorded.
d) Collection of growth data of the plantations and status of natural regenerations.	Data on growth of plantations and natural regenerations have been collected..

Table 1. Total number of regeneration (seedlings, saplings, poles and trees) in the planted keora forests of the coastal areas of Bangladesh.

Sl. no.	Species	Rangabali				Char Kukri-Mukri				Hatia			
		Seedling	Sapling	Pole	Tree	Seedling	Sapling	Pole	Tree	Seedling	Sapling	Pole	Tree
1.	Gewa	1314	453	79	48	3723	2676	144	85	588	577	65	12
2.	Sundari	52	40	10	4	29	55	28	29	-	-	-	-
3.	Passur	7	9	2	-	1	-	-	-	-	-	-	-
4.	Kankra	26	-	-	-	4	-	-	6	-	-	-	-
5.	Khalshi	765	25	2	-	-	-	-	-	-	-	-	-
6.	Shingra	26	10	-	-	1	-	-	-	-	-	-	-
7.	Hantal	29	25	4	3	28	-	-	-	-	-	-	-
8.	Baen	159	27	-	-	28	-	-	-	-	-	-	-
9.	Mander	-	1	-	-	-	-	-	2	-	-	-	-
10.	Nonajhao	77	15	-	83	3	3	-	1	-	-	-	-
11.	Golpata	-	4	4	-	-	-	-	-	-	-	-	-
	Total:	2455	609	101	138	3817	2734	172	123	588	577	65	12

- 8.9 Achievement(s), if any : Not applicable.
8.10 Financial statement :
8.10.1 Total cost : Tk.20,00,000.00
8.10.2 Cost of the year : Tk. 1,35,000.00
8.10.3 Expenditure of the year : Tk. 1,35,000.00
8.10.4 Source of fund : GOB
8.11 Beneficiaries : Forest Department, planers and NGOs

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 : NA

- 1.4 Objectives :
- 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 : 2004-2005
- 1.6.1 Starting Year :
- 1.6.2 Completion year : 2015-2016
- 1.7. Personnel :
- 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 year :
- 1.8.2 This year :

Activities of the study	Progress
a) Collection of wildlife specimens and preservation	a) A total of 2 (Two) specimen were collected and preserved in the wildlife museum.
b) Preparation of videos, posters, still pictures of collected wildlife specimen.	b) Routine cure has been done.
c. Report writing and printing	c) Report writing is going on.

- 1.9.1 Achievement : NA
- 1.10 Financial statement :
- 1.10.1 Total cost : Tk. 5, 00, 000/-
- 1.10.2 Cost of the year : Tk.7,200/-
- 1.10.3 Expenditure of the year : Tk. 7,200/-
- 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 : New
- 2.1 Programme Area : Biodiversity and conservation
- 2.2 Title of the Study : Avian species diversity of Hazarikhil Wildlife Sanctuary, Chittagong
- 2.3 Justification : Bangladesh is a country of rich Biodiversity. There are about, 9,900 species of birds in the world of which a total of 690 species is expected to occur in Bangladesh. There are 34 notified protected areas in Bangladesh till January, 2012. Many protected areas do not even have a checklist of birds species. Bird is not only as part of the biodiversity of an area, but also as useful indicators for habitat status and efficacy of management measures. Hazarikhil wildlife Sanctuary (1177.33 ha) is a new protected area notified on 6, April, 2010. No scientific and systematic monitoring of birds has yet done there. To make out an avian species diversity of the Sanctuary is very important for taking further sophisticated initiatives of future sustainable conservation of this sanctuary's biodiversity. So this study has been taken for the assessment of avian species diversity of the Sanctuary.
- 2.3.1 To establish a Checklist on avian species of Hazarikhil Wildlife Sanctuary (WS), Chittagong
- 2.3.2 To make out development needs for sustainable conservation of birds of the WS

- 2.4 Expected output : Development of management plan for sustainable conservation of avian species in the PA's of Bangladesh.
- 2.5 Study period :
- 2.5.1 Starting year : 2012-2013
- 1.5.2 Completion year : 2013 – 2014
- 2.6 Personnels :
- 2.6.1 Study leader : M.A. Rahman, R.O
- 2.6.2 Associates : M. K. Islam, RA (Gr-1), S.M. Mainuddin, (FI)
- 2.7 **Progress** :
- 2.7.1 Previous year :
- 2.7.2 This year :

Activities of the study	Progress
a) Periodical survey will be done. During the survey the day and night observation will be made by transect method to know the species composition using Binocular and camera. If failed to identify any species in the field, pictures of birds will be taken and later on identified in the library consulting books and also consulting with Ornithologist.	a. Periodical survey were made in the Hazarikhil Wildlife Sanctuary following transect method. Binocular and camera were used and pictures of birds are taken. During survey 108 of different bird species were recorded under 12 Order and 27 Family. Table- 1:
b. Report writing and printing	b. Data analysis and report writing is going on.

- 2.8.1 Achievement : NA
- 2.9 **Financial statement** :
- 2.9.1 Total cost : Tk. 2, 20,000/-
- 2.9.2 Cost of the year : Tk. 1, 05, 200/-
- 2.9.3 Expenditure of the year : Tk. 1, 05, 200/-
- 2.9.4 Source of fund : GOB
- 2.10 **Beneficiaries** : Researchers, Students and Teachers of different educational Institutions, Forest Department and
3. Study : New
- 3.1 Programme Area : Biodiversity and conservation
- 3.2 Title of the Study : Present status of Phayre's leaf monkey (*Trachypithecus phayrei*), Pig- tailed macaque (*Macaca nemestrina*) and Capped leaf monkey (*Trachypithecus pileatus*) in hill forest of Bangladesh
- 3.3 Justification : Worldwide, many primate species are in critical danger and threatened with extinction. This is the case for most non human primate species. Although those are often considered as well known, data on their present status including population numbers, distribution, and population trends are insufficient for most species. Available information suggests that most non human primate species are experiencing a decline in numbers and/or distribution. In Bangladesh, the harbor of ten species of non-human primates. Among those species Phayre's leaf monkey (*Trachypithecus phayrei*), Pig tailed macaque (*Macaca nemestrina*) are critically endangered (CR) and Capped leaf monkey (*Trachypithecus pileatus*) is endangered (IUCN, 2000). Hilly forested areas of the country which are exist in Chittagong and Sylhet are the major habitat of these species. As wildlife has been available in the protected area because of good protection, conservation and well management so survey will be done in protected areas. Only seven hilly protected areas Rema-Kalenga wildlife sanctuary, Lawachara national park(NP), SatchariNP of Sylhet and FashiakhaliWS, ChunatiWS, Teknaf WS, HimchariNP, of Chittagong and PablakhaliWs and Kapti NP of CHT support these species (M.M.H. Khan, 2008). But specific data on the those

species present status, population and major threats to its existence are scarce. So the study has been taken to make out above aspects supportive for future sustainable conservation of the species.

- 3.4 Objective :
- 3.4.1 To evaluate the distributions and population of the non human primate species in hill forest of Bangladesh for sustainable conservation
- 3.5 Expected Output : Formulation of effective conservation measures for the species in hill forest of Bangladesh
- 3.6 Study Period :
- 3.6.1 Starting Year : 2012-2013
- 3.6.2 Completion year: : 2014-2015
- 3.7 Personnel :
- 3.7.1 Study leader : M.A.Rahman
- 3.7.2 Associates : 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) Determination of distribution and assessment of population of three non-human primates species using line transect surveys and total count methods in Fashiakhali WS, Teknaf NP, Himchari NP, Chittagong.	a. Survey was made in Fashiakhali WS, Teknaf NP and Himchari NP, Chittagong. Phayre's leaf monkey (<i>Trachypithecus phayrei</i>) and Pig-tailed macaque (<i>Macaca nemestrina</i>) were not found in any surveyed area. One troops of Capped leaf monkey (<i>Trachypithecus pileatus</i>) consist of 6(six) member in Fashiakhali WS and other troops consist of 6 (six) member of same species in Teknaf NP were found. Table-2
b. Report writing and printing	b. Data analysis and report writing is going on.

- 3.9 Achievement(s) : NA
- 3.10 Financial statement :
- 3.10.1 Total cost of the study : Tk.8, 00, 000/-
- 3.10.2 Cost of the year : Tk.1, 87,600/-
- 3.10.3 Expenditure of the year : Tk.1, 87,600/-
- 3.10.4 Source of fund : GOB
- 3.11 Beneficiaries : Researchers, students and teachers of different educational Institutions and Forest Department / NGOs

TECHNOLOGY TRANSFER UNIT

1. Study : On going
- 1.1 Programme area : Training and Technology Transfer
- 1.2 Title of the study : Training for BFRI Staff Members and stakeholders
- 1.3 Justification : To increase the efficiency of human resource, there is no alternative to training. Training makes a govt. servant enable to manage his works efficiently. Training disseminates the technology and makes a technology familiar to the mass people.
- 1.4 Objectives :

- 1.4.1 To develop capacity of BFRI staff members
- 1.4.2 To enhance capacity of stakeholders in their respective area
- 1.4.3 To disseminate BFRI technology to the stakeholders
- 1.5 Expected output : Knowledge and skills of BFRI resource persons and stakeholders will be enhanced. Capacity of individual level will be developed
- 1.6 Study period :
- 1.6.1 Starting year : 2006-2007
- 1.6.2 Expected completion : 2015-2016
Year
- 1.7 Personnel :
- 1.7.1 Study leader : Kabir Uddin Ahmed
- 1.7.2 Associates : Md. Akter Hossain
- 1.8 Progress: :
- 1.8.1 Previous years : Fifty nine training programmes were organized during 2010-11& 2011- 2012 and 1500 persons were participated in the training programme.
- 1.8.2 This year :

Activities of the study	Progress
1. Institutional development	30 Training programme were organized on 14 technologies
2. Preservative treatment	
3. Nursery pest and disease management	
4. Nursery pest and disease management of medicinal plants	
5. Apiculture in hilly area	
6. Bamboo branch cutting technique	
7. Bamboo grove management	
8. Cultivation technique of medicinal plants	
9. Mother tree selection technique	
10. Nursery development and mixed plantation technique	
11. Bamboo composite furniture	
12. Nursery development and management of coastal tree species	
13. Propagation techniques and plantation of palm tree..	
14. Propagation techniques and plantation of golpata.	
15. Nursery development and management of mangrove tree species	

- 1.9 Achievements : wood and bamboo merchants, farmers and nursery owners are using BFRI technologies in the field.
- 1.10 Financial statement :
- 1.10.1 Total cost :
- 1.10.2 Cost of the year : Tk. 800000.00
- 1.10.3 Expenditure of the year : Tk. 800000.00
- 1.10.4 Source of the fund : GOB
- 1.11 Beneficiaries : BFRI's staff members and the stakeholders

- 2. Study : On going
- 2.1 Programme area : Training and Technology Transfer
- 2.2 Title of the study : Workshops and Seminars
- 2.3 Justification : Stakeholders are not familiar with BFRI technologies. Introduction of BFRI technologies by workshop and seminar will be promulgated throughout Bangladesh.
- 2.4 Objectives :
- 2.4.1 To disseminate BFRI technologies to the stakeholders
- 2.4.2 To share knowledge and experiences among scientists and stakeholders
- 2.4.3 To nurture scientific culture and enhance linkage among the scientists and stakeholders.
- 2.5 Expected output : BFRI technologies will be disseminated to the stakeholders. Sharing of knowledge and experiences will benefit both BFRI scientists and stakeholders
- 2.6 Study period :

- 2.6.1 Starting year : 2006-2007
 2.6.2 Expected completion : 2014-2015
 Year
 2.7 Personnel :
 2.7.1 Study leader : Kabir Uddin Ahmed
 2.7.2 Associates : Md. Akter Hossain
 2.8 Progress :
 2.8.1 Previous years : During 2010-11 & 2011-12 four workshop were organized, at upazilla level in Satkania of Chittagong and three in district level at Cox's Bazar, Moulovibazar. And Bhola District. 520 persons were participated on those programme
 2.8.2 **This year** :

Activities of the study	Progress
1. Dissemination of BFRI technologies at 5 (2+3) districts and upazillas (to be decided) with the help of district administrative.	BFRI technologies were disseminated at Brahmanbaria and Borguna District.
2. Workshop on Annual Research Progress for 2010-11 and Research Programme for 2011-12	Workshop on Annual Research Progress for 2011-12 and Research Programme for 2012-13 were arranged
3. Seminar: Monthly seminars on topics of recent interest (title to be decided)	

- 2.9 Achievements : Dissemination of BFRI technologies and information through workshop and seminar
 2.10 Financial Statement :
 2.10.1 Total cost :
 2.10.2 Cost of the year : Tk. 2,50,000.00
 2.10.3 Expenditure of the year : Tk. 2,00,000.00
 2.10.4 Source of the fund : GOB
 2.11 Beneficiaries : Nursery owners, private entrepreneurs, Forest Department, Bangladesh Forest Industries and Development Corporation (BFIDC) and other forest or forest produce related stakeholders

3. Study : On going
 3.1 Programme area : Training and Technology Transfer
 3.2 Title of the study : Publicity and Advertisement
 3.3 Justification : Peoples and stakeholders will be familiar with BFRI technologies and activities
 3.4 Objectives :
 3.4.1 To create awareness about BFRI technologies to the stakeholders and mass people
 3.4.2 To disseminate BFRI technologies to the end users
 3.5 Expected output : People will be made aware about BFRI technologies. BFRI Technologies will reach to the people.
 3.6 Study period :
 3.6.1 Starting year : 2006-2007
 3.6.2 Expected completion : 2015-2016
 Year
 3.7 Personnel :
 3.7.1 Project leader : Kabir Uddin Ahmed
 3.7.2 Associates : Md. Akter Hossain
 3.8 Progress :
 3.8.1 Previous years : Participated in tree fair at Dhaka, Chittagong, Environment Fair and furniture me

3.8.2 This year :

Activities of the study	Progress
1. Participation: Tree Fair, Environment Fair. 2. Advertisement in print media on: <ul style="list-style-type: none"> • Bamboo branch cutting • Preservative treatment • Plus tree selection • Nursery raising and development • Nursery pest and disease management • Bamboo grove management • Use of treated bamboo sticks at <i>Pan boroj</i> 	1. Participated in national tree fair-2013, Environment fair-2013, Forest Division tree fair ctg,-2013, Village livelihood fair chokoria, Ctg.-2013 Thousands of people visited BFRI stalls and more than 1500 peoples put their comments in the visitor's book. More than 30,000 printed materials were distributed among the visitors. 2. In 20 national and local dailies and in monthly Ekushey patrika, 7 advertisements were circulated in 34 spots.
3. Advertisement in electronic media Telecast BFRI invented technology as advertisement on TV channels.	3. Two advertisements were circulated in 7 spots in BTV.

3.9 Achievements : Awareness has been created among the mass people through demonstration of BFRI technologies in the fairs.

3.10 Financial Statement :

3.10.1 Total cost :

3.10.2 Cost of the year : Tk. 9,50,000.00

3.10.3 Expenditure of the year : Tk. 9,50,000.00

3.10.4 Source of the fund : GOB

3.11 Beneficiaries : People at all levels

4. Study : On going

4.1 Programme area : Training and Technology Transfer

4.2 Title of the study : Audio-video documentation

4.3 Justification : BFRI technologies will be communicated to the mass people

4.4 Objectives :

4.4.1 To document BFRI technologies in audiovisual form.

4.4.2 To disseminate BFRI technologies among the mass people and stakeholders

4.5 Expected output : Awareness will be created among the mass people about BFRI technologies. BFRI technologies will be disseminated to the mass people.

4.6 Study period :

4.6.1 Starting year : 2005-2006

4.6.2 Expected completion : 2015-2016
Year

4.7 Personnel :

4.7.1 Study leader : Kabir Uddin Ahmed

4.7.2 Associate : Md. Akter Hossain

4.8 Progress :

4.8.1 Previous Years : Documentaries of 11 technologies and Introduction of BFRI were prepared.

4.8.2 This year :

Activities of the year	Progress
Update of audio-visual documentation on BFRI introduction (translation in English).	nil

4.9 Achievements : Peoples are adopting BFRI technologies.

4.10 Financial Statement :

4.10.1 Total cost :

4.10.2 Cost of the year : Tk. 50,000.00

- 4.10.3 Expenditure of the year :
 4.10.4 Source of the fund : GOB
 4.11 Beneficiaries : People at all levels
5. Study : On going
- 5.1 Programme area : Training and Technology Transfer
- 5.2 Title of the study : Printing Materials and Publicity
- 5.3 Justification : Peoples and stakeholders will be familiar with BFRI technologies and activities
- 5.4 Objectives :
- 5.4.1 To document BFRI technologies in printed form
- 5.4.2 To disseminate BFRI technologies among the mass people and stakeholders
- 5.5 Expected output :
- 5.6 Study period :
- 5.6.1 Starting year : 2005-2006
- 5.6.2 Expected completion Year : 2014-2015
- 5.7 Personnel (s) :
- 5.7.1 Study leader : Kabir Uddin Ahmed
- 5.7.2 Associate : Md. Akter Hossain
- 5.8 Progress :
- 5.8.1 Previous years : Leaflets, booklets, posters and folders were printed
- 5.8.2 This year :

Activities of the year	Progress
Leaflet	
<ol style="list-style-type: none"> 1. <i>KwA Kjg cxiZtZ enkPvl</i> 2. <i>enki Svo e'e'icbv</i> 3. <i>enki goK `gb e'e'icbv</i> 4. <i>cib eitR e'euZ enki kjv, Lj, Kibg I Qtbi e'enwiK Avqjvj epx</i> 5. <i>ivmqibK msiYx cQqM Aumeve I ibgP KufR e'euZ KufVi Avqjvj epx</i> 6. <i>eY Pviv tiicY I cuiPhP</i> 7. <i>NlytcvKvi AvugY I Zvi ibqSY</i> 8. <i>tKv_vq iK MQ j uMteb</i> 	9000 leaflet of 8 types were printed
Folder <ol style="list-style-type: none"> 1 <i>enki thwRZ cY` (Kt=umRU tcMw±m)</i> 2 <i>tgnMbi Wwv uQ` Kvix tcvKvi AvugY I Zvi ibqSY</i> 3 <i>tm_tbi cvZvtfvRx tcvKv I Zvi ibqSY</i> 4 <i>Aumeve I Mq mgP mgMkZ ivmqibK `te'i e'envi</i> 5 <i>Aumeve I Mq mgP mgMkZ i vevi KufVi e'envi</i> 6 <i>Kuli Rvgi AvBtj tiicY thwR eY-</i> 7 <i>MqibgP mgMm mte mtgU e'UW cwtKj teW®</i> 8 <i>eb exRZjvi wfbatim I Zvi cZKvi</i> 9 <i>enki tUKmB Ni</i> 10 <i>tmSi wKj b KiW umRb Kivi mnR cxiZ</i> 11 <i>ve Gd Avi AvB Gi tdvi vi</i> 12 <i>ebvTj tgsgmQ cij b</i> 13 <i>evsjv`tk iKi MtQi goK I cZKvi</i> 14 <i>ve Gd Avi AvB dtBj</i> 15 <i>ve Gd Avi AvB ivBils c'w</i> 	14000 folders of 15 types were printed
Posters <ol style="list-style-type: none"> 1 <i>Av`k@vZ,eY</i> 2 <i>ev msiY</i> 3 <i>enk Svo e'e'icbv</i> 4 <i>QtgnMbi Wwv uQ` Kvix tcvKvi AvugY I Zvi ibqSY</i> 5-<i>cib eitR enki kjv</i> 	2500 posters of 5 types were printed

Bulletin

1. ebR eḡḡi eḡR msḡḡ-----

2. e Gd Avi AvB teḡḡDi

3' Mḡḡ ebR I djR Diḡḡ i ḡḡZKi ḡcḡKḡḡKi

4 Transferable technologies and useable information of BFRI

800 bulletin of 4 types were printed

5.9 Achievement : BFRI technologies were disseminated and awareness developed to all sector people through these printing materials.

5.10 **Financial Statement** :

5.10.1 Total cost :

5.10.2 Cost of the year : Tk.4,00,000.00

5.10.3 Expenditure of the year : Tk. 2,95,000.00

5.10.4 Source of fund : GOB

5.11 Beneficiaries : People at all levels

Forest Products Wing
Veneer and Composite Wood Products Division

1. Study : On-going
- 1.1 Programme Area : Post Harvest Utilization -Physical Processing
- 1.2 Title of the Study : Design and fabrication of furniture using bamboo composites.
- 1.3 Justification : The furniture industries of Bangladesh are mainly wood-based industries, collect raw materials from natural forest. These industries are now facing problems due to shortage of raw materials. To reduce dependent on timber resources, it is necessary to use alternative materials instead of wood, which will increase environmental protection and conservation.
Bamboos grow more rapidly than trees and start to yield within three or four years of planting. It is mainly used as housing materials in our country. Due to its unique structural properties, bamboo can be used for furniture making. Manufacture of furniture using bamboo composite products and bamboo woven products will create income-generating opportunities for bamboo growers of our country. It is possible to manufacture export quality bamboo furniture using bamboo composite products.
- 1.4 Objectives :
 - 1.4.1 To assess the potential of bamboo composites for making quality furniture.
 - 1.4.2 To assess economic feasibility of commercially valuable furniture made of bamboo composites.
- 1.5 Expected output : Development of cost effective technology for manufacturing bamboo-composite furniture.
- 1.6 Study period : 2005-15
 - 1.6.1 Starting year : 2005-06
 - 1.6.2 Completion year : 2014-15
- 1.7 Personnel(s) :
 - 1.7.1 Study Leader : K. Akhter, DO
 - 1.7.2 Associates : M. M. Rahaman, RO
- 1.8 Progress :
 - 1.8.1 Previous Years : Different types of composite products such as, bamboo mat wood veneer board, bamboo ply and flattened bamboo ply were made using muli (*Melocanna baccifera*) bamboo. One chair, one shelf and one table were prepared and kept for service test. Bamboo mat overlaid particleboard and bamboo ply were made using bhyjja (*Bambusa vulgaris*) bamboo. Twelve molded chair and two tables were made and distributed for popularizing the technology. Four molded chairs were made using bamboo mat wood veneer board and bamboo ply and kept for service test. Twelve molded chairs and three tables were fabricated by composite products of borak (*Bambusa balcooa*) bamboo and kept as exhibits in Director,s office, CRO,s office, BFRI show rooms, Dhaka and Chittagong, for exhibit and dissemination of the technology. Two shelves, one dining Table and four chairs were fabricated and kept for service test in VCWP Division. Four armed chairs and one almirah were fabricated using bamboo particleboard and bamboo Ply. Two single sofa and one three seated sofa, two book shelves and one computer table were prepared using bamboo ply and bamboo strips overlaid particle board . One show case, four moulded chair and one alna were prepared using bamboo ply and bamboo mat overlaid veneer board The bamboo composite furniture are kept in VCWP division for service test.
 - 1.8.2 This year :

Activities of the study	Progress
a) Visit to Bamboo plantation area and furniture shop & industries (Dhaka and Shylet)	Bamboo plantation area in Sylhet and furniture shop & industries in Dhaka were visited. End-users were encouraged and advised to visit BFRI.
b. Improvement of furniture design.	Bamboo composite product was selected for making furniture. One Sofa set was designed.
c) Procurement of bamboo culms (<i>Bambusa vulgaris/Bambusa balcooa</i>)	Borak (<i>Bambusa balcooa</i>) bamboos were collected from Bansh khali, Chittagong.
d) Preparation and processing of strips and mats	Strips were prepared and treated with borax-boric acid solution. Bamboo mats were prepared using Mitinga (<i>Bambusa tulda</i>). Mats were treated with borax-boric acid solution.

e) Manufacturing of furniture components	Bamboo composite products such as bamboo particleboard and bamboo mat over laying particle board were made using borak (<i>Bambusa balcooa</i>) bamboo. Bamboo particleboard was made by using bamboo chips and planner shaving. Borax - boric acid was added with UF glue. -Bamboo strips over laying particleboard were made using bamboo strips and planner shavings.
f) Fabrication of one sofa set using bamboo composite.	Bamboo mat overlaid particle board were prepared for making one sofa set. The bamboo composites board are kept in VCWP Division for conditioning.

Table: 1 Different bamboo furniture made from composite products

Furniture	Size	Bamboo species	Composite products	Material cost	Manufacturing cost
Show case	5 ft. ×4 ft.	<i>Bambusa balcooa</i>	Bamboo ply board	7,500/-	6,000/-
Alna	4 ft. ×1ft	<i>Bambusa balcooa</i>	Bamboo ply board	1500/-	1000/-
Moulded chair		<i>Bambusa balcooa</i>	Bamboo ply board and bamboo mat veneerboard	900/-	800/-
Tea table	2ft.× 2ft.	<i>Bambusa balcooa</i>	Bamboo ply board	1200/-	800/-
Sofa	2ft.× 2ft.	<i>Bambusa balcooa</i> & <i>Bambusa tulda.</i>	Bamboo ply board, Bamboo particle board & Bamboo mat overlaid particle board	3,000/-	2,000/-

1.9.1 Achievement(s) : Bamboo composites can be used as furniture materials which can be promoted to exportable commodity.

1.10 Financial statement :

1.10.1 Total cost : Tk 9,50,000.00

1.10.2 Cost of the year : Tk 87,500.00

1.10.3 Expenditure of the year : Tk.80,000.00

1.10.4 Source of fund : GOB

1.11 Beneficiaries : Furniture industries, plywood and particleboard industries, farmers/bamboo growers, general people, village women, NGOs.

Pulp and Paper Division

1. Study : On-going

1.1. Programme area : Post Harvest Utilization – Chemical Processing

1.2 Title of the study : Production of high yield pulp from bagasse, wastes of sugar mill of Bangladesh

1.3 Justification : The demand of forest resources increases gradually with the continuous increase of population. However, the incremental rates of our demand and supply of the natural resources are not same. As a result the forest resources are becoming scarce everyday. On the otherhand, the consumption of paper, board and newsprint has been growing at a robust rate of 20% annually in the last five years. But the paper mill could not reach their targeted levels of daily paper production due to the scarcity of raw material supply. Therefore, immediate action is necessary to find

out new source of raw materials for pulp and paper mills to cope up with the future demand for attaining self-sufficiency in paper production.

Bagasse, a fibrous residue, obtains after extraction of sugar from sugarcane and is available in the sugar mills of Bangladesh. Previously, bagasse was found suitable for the production of kraft and soda pulp. However, there is no study on the production of CTMP and KOH-MAQ pulp to improve the pulp yield. With this aim, in view this study has been undertaken.

- 1.4 Objective (s) :
- 1.4.1 Pulping process improvement for the production of high yield pulp.
- 1.5 Expected output : Supplementation of the raw material would be enhanced.
- 1.6 Study period :
- 1.6.1 Starting year : 2010-11
- 1.6.2 Completion year : 2013-14.
- 1.7 Personnel (s) :
- 1.7.1 Study Leader : Daisy Biswas, DO (in-charge)
- 1.7.2 Associates : Md. Misbahuddin, FI. And Urbashi Roy, FI
- 1.8 Progress :
- 1.8.1 Previous years : Related information had been collected.
- 1.8.2 This year :

Activities of the study	Progress
a. Collection, processing and pretreatment of raw materials	a. Bagasse was collected from Faridpur Sugar Mills Ltd., Modhukhali, Faridpur. These were depithed in hydropulper to minimize the problem arises during pulping like requirement of high cooking chemicals inferior quality of pulp and poor black liquor properties. The dry matter content is 85% and preserved for pulping.
b. Preparation of pulp with KOH-MAQ by varying pulping time	b. Pulps will be prepared in the next year.
c. Determination of kappa number and yield	c. Will be done in the next year.

- 1.9 Achievements, if any : Nill
- 1.10 Financial Statement :
- 1.10.1 Total cost of the study : Tk. .2,00,000
- 1.10.2 Cost of the year : TK. 66,000
- 1.10.3 Expenditure of the year : TK. 66,000
- 1.10.4 Source of fund : GOB.
- 1.11 Beneficiaries : Pulp and Paper Industries.
- 2. Study : On-going
- 2.1 Programme Area : Post Harvest Utilization – Chemical Processing
- 2.2 Title of the study : Oxygen delignification of kraft pulp of stem and branches of rubber tree (*Hevea brasiliensis*).
- 2.3 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.
- 2.4 Objective (s) :
- 2.4.1 To investigate the bleaching response of rubber wood pulp for using as high quality paper .
- 2.5 Expected output : High quality pulp for making printing and writing paper.
- 2.6 Study period :
- 2.6.1 Starting year : 2011-12
- 2.6.2 Completion year : 2013-14

- 2.7 Personnel (s) :
- 2.7.1 Study Leader : Daisy Biswas, DO (in-charge)
- 2.7.2 Associates : Md. Misbahuddin, FI and Urbashi Roy, FI.
- 2.8 Progress :
- 2.8.1 Previous years : Stem and branches of rubber tree were collected from Dantmara rubber state. These were converted into planks of size 3" ×3"×length of the bolt and preserved in the division for air drying.
- 2.8.2 This year :

Activities of the study	Progress
a. Processing of stem and branches of rubber tree.	Stem and branches of rubber tree were possessed.
b. preparation of kraft pulp with 18 % active alkali by maintaining 150 minute cooking time to suite 20-25 kappa number.	Kraft pulps were prepared with 18% active alkali by maintaining 150 minute cooking time & temperature 170°C. Kappa number and yield of the pulp were determined.
c. Bleaching of the prepared pulp with oxygen at various pressure	The prepared pulps were bleached The bleaching conditions were: Oxygen pressure:110 psi; Time: 60 min.; Temperature: 95°C; Consistency-10%
d. Determination of kappa number and yield	Yield and kappa number of bleached pulp were determined. The values are given in Table -1.

- 2.9 Achievements, if any : Nil
- 2.10 Financial statement :
- 2.10.1 Total cost : Tk. 2,00,000
- 2.10.2 Cost of the year : Tk. 98,000
- 2.10.3 Expenditure of the year : Tk. 98,000
- 2.10.4 Source of fund : GOB
- 2.11 Beneficiaries : Pulp and Paper Industries

Table-1 Yield and kappa number of unbleached and bleached kraft pulp of rubber stem and branch (*Hevea brasiliensis*)

Species	Process	A.A . %	Sulphidity %	Yield %	Kappa no	
					Before delignification	After delignification
Rubber stem,	kraft,	18	25%,	42.26	38.29	20.64
Rubber branch	kraft,	18	25%	51.71	24.71	14.87
Rubber stem	kraft,	18	15%, AQ- 0.1%	46.21	26.53	15.87
Rubber branch	kraft	18	15%, AQ-0.1%	52.75	17.72	12.47
Rubber stem	kraft	20	25%	46.84	22.52	--
Rubber branch	kraft,	20	25%	51.62	15.53	--
Rubber stem	soda	18	--	47.40	23.56	--
Rubber branch	soda	18	--	53.05	18.37	--

3. Study : On-going
- 3.1 Programme area : Post Harvest Utilization – Chemical processing
- 3.2 Title of the study : Pulp making characteristics of baizya (*Bambusa vulgaris*) in a mixture with hardwood species.
- 3.3 Justification : In the past, Karnaphuli paper mill used entirely muli bamboo (*Melocanna baccifera*) for pulp production. Later on, wood is used widely along with village bamboos likely *Bambusa vulgaris* for smooth pulp production but there is no information regarding the optimum use of bamboo with wood in producing chemical pulp.
There is an anatomical and chemical variation exists between wood and bamboo. The pulp quality

might differ with the variation of wood: bamboo ratio. In this study optimum ratio of bamboo and wood would be ascertained with respect of both yield and quality of pulp

- 3.4 Objective(s) :
- 3.4.1 Determination of the optimum ratio of bamboo and wood with respect to yield and quality pulp.
- 3.5 Expected output : Rational utilization of the raw material would be enhanced.
- 3.6 Study period :
- 3.6.1 Starting year : 2011-12
- 3.6.2 Completion year : 2013-14
- 3.7 Personnel(s) :
- 3.7.1 Study Leader : Daisy Biswas, DO(in-charge)
- 3.7.2 Associates : Md. Misbahuddin, FI and Urbashi Roy, FI.
- 3.8 Progress :
- 3.8.1 Previous year, if any : *Bambusa vulgaris* and *Albizia richardiana* were collected from KPM and Boalkhali, a village of Chittagong respectively. The dry matter content of the material was measured. Kraft pulps were prepared with 16, 18 and 20 % active alkali by maintaining 150 min cooking time and 170°C. Yield of the pulp was determined.
- 3.8.2 This year :

Activities of the study	Progress
a Collection and processing of wood and bamboo material.	a. Baizzya (<i>Bambusa vulgaris</i>), kadam (<i>Anthocephalus chinensis</i>), rubber wood(<i>Hevea brasiliensis</i>) were collected and processed for pulping.
b. Preparation of kraft pulp by varying alkali dose and pulping time with the chips of bamboo and wood.	Kraft pulps were prepared by varying wood and bamboo ratio with 16,18 and 20% active alkali by maintaining 150min. cooking time and 170°C temperature.
c. Determination of kappa number and yield.	Determination of yield and kappa number are in progress.
d. Preparation of hand sheets of kraft pulp made from chips of bamboo and rajkori wood in previous year.	Hand sheets of kraft pulp in three different freeness level were made.
e). Evaluation of physical strength properties.	The sheets were then conditioned at 23±1 ⁰ c and 50±1% relative humidity. The test sample were prepared and strength properties were determined (Table 1).

- 3.9 Achievement(s), if any : Nil.
- 3.10 Financial statement :
- 3.10.1 Total cost : Tk. 4,50,000
- 3.10.2 Cost of the year : Tk. 1,36,000
- 3.10.3 Expenditure of the year : Tk. 1,36,000
- 3.10.4 Source of fund : GOB
- 3.11 Beneficiaries : Pulp and Paper Industries

Table 1: Yield, kappa number and strength properties of the pulps made from bamboo and wood in mixture (pulping conditions: liquor to wood ratio, 4:1; temperature: 170°C

<i>B. vulgaris:</i> <i>A. richardiana</i>	A.A (kappa no) %	Yield (reject) (%)	Tear index mNm ² /g		Tensile index Nm/g		Burst index KPa.m ² /g	
			CSF, mL		CSF, mL		CSF, mL	
			450	250	450	250	450	250
100:00	16 (30.3)	47.0 (3.4)	16.59	13.05	58.34	70.56	7.82	8.78
	18 (25.2)	46.3 (2.1)	16.37	12.73	60.74	72.04	9.91	11.45
	20 (18.9)	44.7 (1.5)	14.70	11.64	64.44	79.40	9.86	11.36

70:30	16 (31.1)	46.5 (4.0)	12.07	10.29	62.97	80.47	4.18	5.20
	18 (19.3)	45.1 (2.0)	12.04	10.08	61.66	73.16	3.53	5.03
	20 (19.0)	42.3 (1.7)	11.71	9.41	59.83	75.55	3.76	5.48
50:50	16 (28.7)	48.9 (4.1)	7.73	7.11	75.45	56.07	3.38	3.83
	18 (21.3)	47.5 (3.3)	9.32	7.98	76.51	74.69	3.92	6.20
	20 (18.5)	46.6 (1.3)	9.39	8.47	77.83	76.54	3.70	5.19
30:70	16 (23.7)	48.9 (1.3)	7.07	6.97	55.63	76.89	3.31	4.97
	18 (18.9)	48.8 (1.3)	7.16	6.64	58.41	74.49	3.40	5.34
	20 (18.9)	47.7 (0.4)	7.89	6.67	51.84	74.52	3.89	5.11
00:100	12 (21.8)	48.6 (2.0)	7.75	6.85	50.5	68.4	3.70	4.79
	14 (19.0)	48.2 (1.0)	7.40	6.68	45.1	54.5	3.53	4.60
	16 (18.5)	46.8 (0.5)	7.32	6.35	40.2	49.1	3.30	4.46
	18 (16.3)	44.6 (Nil)	7.20	5.83	38.5	45.5	3.15	4.17

Wood Preservation Division

1. Study : On-going
- 1.1 Programme Area : Post Harvest Utilization –Chemical Processing
- 1.2 Title of the Study : Extension of preservation treatment technology to the end-users
- 1.3 Justification : Rural houses are primarily made from bamboo, sungrass and similar materials, which are very susceptible to biodegrading agents and needs to be replaced after 2-3 years. Extension of preservative treatment methods developed at BFRI for enhancing service life of low cost housing materials will help people to save their hardly earned income.
- 1.4 Objectives :
 - 1.4.1 To motivate people through training, workshop, group discussions, personal contacts etc.
 - 1.4.2 To provide technical support to the business initiators for development of entrepreneurship in preservative treatment
- 1.5 Expected output : Use of preservative treatment technology by common people and development of local entrepreneurship.
- 1.6 Study period : 2007 –2013
 - 1.6.1 Starting year : 2007– 2008
 - 1.6.2 completion year : 2012 – 2013
- 1.7 Personnels :
 - 1.7.1 Study Leader : Abdus Salam, RO
 - 1.7.2 Associates : Mozammel Hoque Chy,RO.; Dr. Khurshid Akhter,DO.
- 1.8 Progress :
- 1.8.1 Previous years :
 - Four training programmes were organized for 120 nos. of farmers on preservative treatment of wood, bamboo, sungrass and other house bulding materials at Zaldi, Banigram, Banshkhali and Baripara of Chittagong; Moheshkali, Cox’s Bazar district and distributed treated bamboo sticks of betel leaf farmers.
 - A treated bamboo model house was constructed at Sonapur, Feni Sadar for disseminating the treatment technology.

- Technical support was provided in developing and modifying the treatment plant at Feni Sadar, Charbata, Noakhali and Moheshkali under the guidance of BFRI scientists for disseminating the technology.

1.8.2 This year :

Activities of the study	Progress
a. Procurement of raw materials, chemicals and other inputs.	a. i. Chemicals such as Copper sulphate, Sodium dichromate, Boric acid etc.were procured. ii.Equipments such as hard ware, glass ware, laboratory gods etc. were procured
b. Treatment of demonstration materials for training and motivation programme.	b. Wood, bamboo, sungrass etc. demonstration materials were treatment for training and motivation programme. About 550 interested people from different areas took part in the training and motivation programme. Treatment process was demonstrated and necessary counseling were given to them.
c. Repair of Bamboo demonstration model house at display center in BFRI campus.	c. Demonstration model house was repaired at display center in BFRI campus.
d. Arrangement of training and motivational activities in Rajshahi, Sylhet, Barisal and Jessore .	d. i. Theoretical and practical training were organized at Khadim nagor in Sylhet & Rajshahi on the treatment of wood and bamboo 70 nos. of furniture maker. ii Motivated and trained on preservation technology were given to500 nos. of Emam of Bangladesh Emam Prosikhan Center, Chittagong
e. Monitoring of service life of previously established experiments in betel leaf & vegetable farms in Barisal and Jessore.	e. Evaluation was made on the service life of betel leaf sticks supplied in 2010 at Barishal and Jessore. It was observed that the treated bamboo sticks(mittinga) were in good condition where as the untreated ones were fully damaged after 10 months.
f. Distribution of 2000 nos. treated bamboo sticks at Barisal and Jessore betel leaf & vegetable farmers.	f. 1200 nos. bamboo sticks were treated with 10%, CCB solution by soaking method and supplied at Barisal betel leaf and vegetable farmers. Technical support was given to the business initiator in Barisal & Jessore.
g) Analysis and reporting	g) Analysis and reporting are in progress.

1.9 Achievement(s), if any : NA

1.10 Financial statement :

1.10.1 Total cost : Tk. 9,63,000 /-

1.10.2 Cost of the year : Tk.1,95,000/-

1.10.3 Expenditure of the year : Tk.1,94,684/-

1.10.4 Source of fund : GOB

1.11 Beneficiaries : NGOs and general public, particularly the users of wood, bamboo, sun grass and other materials.s

2. Study : On-going

2.1 Programme Area : Post Harvest Utilization –Chemical Processing

2.2 Title of the Study : Evaluation of CCB preservative and treatability & durability of wood and bamboo species.

2.3 Justification : This study was taken to determine the treatability and natural durability of different non-durable wood and bamboo using various treatment methods. Durability of non-durable wood can be increased by preservative treatment. Results of natural durability and treatability of wood and bamboo are required for preservative treatment and proper use.

2.4 Objectives :

2.4.1 To develop treating schedule for preservative treatment.

2.4.2 To determine outdoor service life of wood and bamboo species treated with CCB.

2.4.3 To disseminate the information to the end-users.

- 2.5 Expected output : Treatment schedule and service life of wood and bamboo species
- 2.6 Study period : 2007-2014
- 2.6.1 Starting year : 2007-2008
- 2.6.1 Completion year : 2013-2014
- 2.7 Personnels :
- 2.7.1 Study Leader : Mozammel Hoque Chy, R O.
- 2.7.2 Associates : Abdus Salam, R O.; Dr. Khurshid Akhter, D O.
- 2.8 progress :
- 2.8.1 Previous progress, if any :
- Baijja (*Bambusa vulgaris*)bamboo, Rubber(*Hevea brasiliensis*)wood, Rajrorai (*Albizia Richardiana*) wood were treated by soaking method using CCB solution. The treated samples were installed in the stake- yard for service test.
 - Underground portion of the untreated samples of Baijja(*Bambusa vulgaris*) were destroyed completely after 9 months and treated samples are still in sound condition.
 - Underground portion of the untreated samples of rubber (*Heavea brasiliensis*) wood were destroyed completely after 9 months and treated samples are still in good condition.
 - Underground portion of the untreated samples of Raj koro (*Albizia richardiana*) were destroyed completely after 6 months and treated samples are still in good condition.
- 2.8.2 This year :

Activities of the study	Progress
a) Procurement of CCB preservative, lambu (<i>Khaya</i> Sp.) wood and muli (<i>Melocanna baccifera</i>) bamboo.	a. Wood and bamboo were procured from different areas and different market.
b) Processing of timber & bamboo and preparation of samples for soaking and pressure process.	b. For preservative treatment 100 nos of samples of wood and bamboo were prepared as follows : Wood : 50.80 cm í 5.0 8 cm í 2.54 cm 20.32 cm í 10.16 cm í10.16 cm 20.32 cm í 7.62 cm í10.16 cm Bamboo: 60.96 cm í dia 3.5 cm
c) Treatment of samples with 10% CCB solution by soaking and Lowry Empty cell pressure process for target retention of 8-16 kg/m ³ following standard schedule.	c. 81 numbers of samples wood and bamboo have been treated with 10% CCB solution using Lowry Empty cell pressure process (Table – 1)
d) Installation of treated and untreated 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 (PTU) in Barisal stake-yard for investigating service life.
e) Collection of data from treated rajkoro (<i>Albizia richardiana</i>) wood, , rubber (<i>H. brasiliensis</i>) wood, baijja (<i>Bambusa vulgaris</i>) bamboo, borak (<i>Bambusa balcooa</i>) bamboo samples at BFRI & Barisal stake yard.	e. Treated samples are still in sound condition.
f) Analysis of data and determination of treatability group.	f. Lambu: Highly treatable; Group: A Muli : Highly Treatable; Group: A
g) Reporting.	g. Analysis and reporting are in progress

- 2.9 Achievement(s),if any : NA
- 2.10 Financial statement :
- 2.10.1 Total cost : Tk. 3,08,833/-
- 2.10.2 Cost of the year : Tk. 98,920/-
- 2.10.3 Expenditure of the year : Tk. 70,605/-
- 2.10.4 Source of fund : GOB
- 2.11 Beneficiaries : NGOs, general public, particularly the users of wood and bamboo.

Table-1. Retention of preservatives in Lambu (*Khaya Sap.*) wood at different pressure and time periods

Pressure (kg/cm ²)	Period (hr)	Sample size (cm)	Average moisture content (%)	Average Retention (kg/m ³)	Remarks
7.05	1	20.32x10.16x10.16	28.03	9.20	-
7.05	2			11.71	-
7.05	3			12.06	-
8.81	1			9.80	-
8.81	2			11.96	-
8.81	3			16.97	Full treatment
10.57	1			12.90	-
10.57	2			18.44	Full treatment
10.57	3			22.78	Full treatment

3. Study : New
- 3.1 Programme Area : Post Harvest Utilization –Chemical Processing
- 3.2 Title of the Study : Investigation of preservative chemicals leaching from treated materials in water and soil.
- 3.3 Justification : Preservative treated bamboo and wood is an economical and durable material for the construction of houses and other purposes. But treated materials in contact with the ground or unprotected outdoors is at risk of leaching which decreases the durability and contaminate the soil and water. Since Bangladesh has long rainy season, some chemicals are leached out from treated materials with rain water. It is very important to determine the amount of leaching of preservative chemicals. Soil contamination problems are expected at wood preservation sites, stake yards and betel leaf farms where bamboo treated sticks are used. In sites where soaking method is used, there is a chance of spills of preservative directly in the soil. On the other hand, in sites where only pressure method took place, the expected soil contamination is comparatively low. The present study has been under taken to investigate the preservative chemicals leaching from treated materials in water and soil.
- 3.4 Objectives :
- 3.4.1 To investigate the water and soil contamination due to preservative treatment.
- 3.4.2 To disseminate the information to the end-users.
- 3.5 Expected output : The study will develop the information for the wood & bamboo users, betel leaf farmers , general public and cottage industries about the leaching of the preservative chemicals in soil and water.
- 3.6 Study period :
- 3.6.1 Starting year : 2012-2013
- 3.6.2 Completion year : 2014-2015
- 3.7 Personnels :
- 3.7.1 Study Leader : Dr. Khurshid Akhter, D O
- 3.7.2 Associates : Md. Matiar Rahman, ASS; Abdus Salam, R O & Mozammel Hoque, Chy, R O.
- 3.8 Progress :
- 3.8.1 Previous progress : NA
- 3.8.2 This year :

Activities of the study	Progress
a) Collection of raw materials.	a. Bamboo and Chemicals such as Copper sulphate, Sodium dichromate, Boric acid etc.were procured.
b) Treatment of bamboo/wood samples.	b) Bamboo strips were treated
c) Soaking of treated materials in water.	c) Treated materials were soaked under water
d) Collection of water samples after leaching.	d)Water samples were collected
e) Selection of contamination area.	e) Contamination area was selected at betal leaf farm, Batajor, Barisal.
f) Collection of soil samples.	f) Soil samples were collected.

g) Water and soil samples will be tested at BFRI laboratory and SRDI, Dhaka	g) Water and soil samples were given to Bangladesh Agricultural Research Institute, Gazipur, Dhaka for analysis.
h) Analysis of water and soil samples.	
i) Data analysis and report writing.	

- 3.9 Achievement(s),if any : NA
- 3.10 Financial statement :
- 3.10.1 Total cost : Tk. 6,00,000/-
- 3.10.2 Cost of the year : Tk. 98,920/-
- 3.10.3 Expenditure of the year : Tk.70,605/-
- 3.10.4 Source of fund : GOB
- 3.11 Beneficiaries : NGOs, general public, particularly the users of Wood and bamboo.

FOREST CHEMISTRY DIVISION

1. Study New
- 1.1 Programme Area Post Harvest Utilization-Chemical Processing
- 1.2 Title of the Study Extraction of agar (*Aquilaria malaccensis* Lam.) oil from artificial inoculated agar trees.
- 1.3 Justification : Agar wood, highly valuable resinous and fragrant heartwood produced from the plant of *Aquilaria* species and is used as incense for religious ceremonies, perfumes in the Arab countries and medicinal components in some oriental medicine. Agar is considered to be a pathological product produced when it is injured by insects, physical cuts, bacterial infections and chemical stimulation. In a natural environment, it often takes several years to form agar wood. Formation of agar is an internal phenomenon of trees and no external indication is found. Agar traders indiscriminately cut agar trees for agar oil. This results serious depletion of all *Aquilaria* species capable of producing agar wood. This makes these species endangered and listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since 2004. In many countries, research on artificial deposition of agar in agar trees is initiated. The common methods are the deliberate wounding of trees by hammering of nails into tree trunks. A chemical treatment method has also been developed. In 2005, a study was initiated by BFRI to enhance agar deposition in wood by artificial inoculation method. Two methods of wounding – nailing and drilling, were used, on the trunk of standing agar trees, in 5 agar plantations sites namely Sylhet, Chittagong (North), Chittagong (South), Cox's Bazar (North) and Chittagong Hill Tracts (North) Forest Divisions. The present study is taken to asses deposition of oil in the experimented trees and also the site and location factors and inoculation method on the yield and quality of agar formation. After completion the study, appropriate inoculation method, inoculation age and best location/sites for agar formation in agar trees can be recommended.
- 1.4 Objectives :
- 1.4.1 To determine suitable artificial inoculation method for formation of agar.
- 1.4.2 To evaluate the effect of wounding density in formation of oil in agar trees.
- 1.4.3 To asses the site and location factors on the yield and quality of agar.
- 1.5 Expected output : Suitable artificial inoculation method and site/location factors for higher formation of agar.
- 1.6 Study period
- 1.6.1 Starting year 2012-2013
- 1.6.2 Completion year 2014-2015
- 1.7 Personnels
- 1.7.1 Study leader S. Akhter, DO
- 1.7.2 Associates M. S. Rahman, RO; S. C. Nath, RA (Gr.-1)
- 1.8 Progress
- 1.8.1 Previous progress N/A

1.8.2 This year

Activities for the study	Progress
a. Collection of agar wood from experimental agar trees from experimental plots.	Six experimental agar plantation sites were visited and marked 167 nos. of experimental agar trees (table 1). After getting the permission of FD, trees will be collected for preparation of agar chips
b. Extraction of oil from agar wood in laboratory and pilot scale distillation apparatus.	Will be done next year after collection of agar trees.
c. Physical and chemical characterization of the extracted oils	Will be done next year after collection of agar trees.

- 1.9 Achievement N/A
- 1.10 Financial Statement
- 1.10.1 Total cost Tk, 7,00,000/-
- 1.10.2 Cost of the year Tk. 1,80,000/-
- 1.10.3 Expenditure of the year Tk. 1,80,000/-
- 1.10.4 Source of fund GOB
- 1.11 Beneficiaries FD, Agar producers and traders

Table 1. List of selected experimental agar trees in 6 different agar plantation sites

Sl. No.	Location	Year of plantation	No. of selected trees
1	Fasiyakhali, Cox's Bazar	1999-2000	36
2	Boroduara, Chittagong	2000-2001	39
3	Korer Hat, Chittagong	1999-2000	07
4	Lati Tila, Borolekha, Moulavibazar	1999-2000	39
5	Baghmara, Srimongal, Moulavibazar	1995-1996	34
6	Lawachara, Srimongal, Moulavibazar	1976-1977	12
	Total		167

2. Study New
- 2.1 Programme Area Post Harvest Utilization-Chemical Processing
- 2.2 Title of the Study Chemical characterization of wood and bamboo species for various end uses.
- 2.3 Justification : Wood quality determination is an important factor for proper utilization of wood. Different divisions of BFRI is studying wood quality parameters such as seasoning, wood working, natural durability and treatability properties, plywood and particle board, pulp making properties. Chemical constituents and extractives of wood also play and important factors for utilization of wood. For integrated recommendation, it is important to study the chemical parameters. Therefore the proposed study is undertaken for chemical characterization of wood and bamboo species. After completion of the study proper recommendation can be given for proper end uses
- 2.4 Objectives:
- 2.4.1 To evaluate chemical properties of different wood and bamboo species.
- 2.5 Expected output: Chemical characterization of the selective wood and bamboo species for specific end uses.
- 2.6 Study period
- 2.6.1 Starting year 2012-2013
- 2.6.2 Completion year 2014-2015
- 2.7 Personnels
- 2.7.1 Study leader S. Akhter, DO
- 2.7.2 Associates M. S. Rahman, RO; S. C. Nath, RA (Gr.-1)
- 2.8 Progress
- 2.8.1 Previous progress N/A

2.8.2 This year

Activities for the study	Progress
a. Collection of various wood viz. sil-koroi (<i>Albizia procera</i>), jhau (<i>Casuarina equisetifolia</i>), lambu (<i>Khaya sp.</i>), arjun (<i>Terminalia arjuna</i>), katbadam (<i>T. catappa</i>), jolpai (<i>Eleocarpus Robustus</i> Roxb.) and bamboo species viz. baijja (<i>Bambusa vulgaris</i>), barak (<i>B. balcooa</i>), ora (<i>Dendrocalamus longispathus</i>) and angoon (<i>Thyrsostachys oliveri</i>).	Various wood viz. katbadam (<i>Terminalia catappa</i>), jolpai (<i>Eleocarpus Robustus</i> Roxb.) jhau (<i>Casuarina equisetifolia</i>), lambu (<i>Khaya sp.</i>), arjun (<i>Terminalia arjuna</i>), and bamboo species viz. baijja (<i>Bambusa vulgaris</i>), borak (<i>B. balcooa</i>), ora (<i>Dendrocalamus longispathus</i>) and angoon (<i>Thyrsostachys oliveri</i>) were collected.
b. Preparation of specimen samples.	Specimen samples of bamboo species viz. baijja (<i>Bambusa vulgaris</i>), borak (<i>B. balcooa</i>), ora (<i>Dendrocalamus longispathus</i>) and angoon (<i>Thyrsostachys oliveri</i>) were prepared. Specimen samples of wood species will be prepared in the next year.
c. Determination of extractive contents.	Extractive contents of bamboo species viz. borak and angoon were determined (Table 2).
d. Determination of major chemical constituents such as holo-cellulose, alpha-cellulose, lignin etc.	Major chemical constituents of bamboo species were determined (Table 2).

2.9 Achievement	N/A
2.10 Financial statement	
2.10.1 Total cost	Tk. 6,00,000/-
2.10.2 Cost of the year	Tk. 1,20,000/-
2.10.3 Expenditure of the year	Tk. 1,20,000/-
2.10.4 Source of fund	GOB
2.11 Beneficiaries	Rubber garden owners, BFIDC, FD, Oil Industries

Table-2: Extractive contents and major chemical constituents of bamboo species.

Sl. No.	Name of the experiment	Name of bamboo species	
		Borak	Rangoon
1.	Moisture content (%)	7.0251	10.4150
2.	Cold water solubility (%)	5.2869	5.0573
3.	Hot water solubility (%)	6.1917	4.5350
4.	1% caustic soda solubility (%)	23.5739	21.3121
5.	Extractive content (%)	4.8465	3.2184
6.	Holo-cellulose (%)	70.5169	67.7621
7.	Alpha-cellulose (%)	44.1386	44.7535
8.	Lignin (%)	22.4270	27.4907

SEASONING AND TIMBER PHYSICS DIVISION

1. Study : On-going
- 1.1 Programme area : Post harvesting utilization- Physical processing.
- 1.2 Title of the study : Studies on 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 :
- 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 : 2011-12
- 1.6.2 Completion year : 2015-16
- 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 : Seasoning schedule of two timber species were determined (table-1)

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

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

- 1.8.2 This year :

Activities of the study	Progress
a. Collection of 40 cft. Round wood of silkoroi (<i>Albizia procera</i>) for preparation of 122-183 cm x 2.54-4.0 cm x 2.54-4.0-5.08 cm size planks.	a. 40 cft. Round wood of silkoroi (<i>Albizia procera</i>) were collected at Bandarban Hill District and 122-183 cm x 2.54-4.0 cm x 2.54-4.0-5.08 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 for determination of seasoning efficiency in two seasoning conditions are going on in the laboratory and solar kiln.
b. Maintenance of solar kilns.	c. Existing solar kilns were maintained by repairing and painting.
c. Data analysis and report writing.	d. Data are being recorded

- 1.9 Achievement (s), if any : NA
- 1.10 Financial Statement :
- 1.10.1 Total cost :
- 1.10.2 Cost of the year : Tk. 1, 70,600.00
- 1.10.3 Expenditure of the year : Tk. 1, 70,600.00
- 1.10.4 Source of fund : GOB
- 1.11 Beneficiaries : BFIDC, FD, Wood Industries, University students, BFRI and others.
2. Study : On going
- 2.1 Programme area : Training and technology transfer
- 2.2 Title of the study : Dissemination of solar kiln technology to the stakeholders for efficient seasoning of wood
- 2.3 Justification : Seasoning and Timber Physics Division has developed a technology on solar kiln for drying of different timber species. It is important to disseminate the benefits of solar kiln and proper seasoning schedule, installation cost of solar kiln and its merits and demerits. In this regards and as per demand of stake holders to aware

this technology to the end-user through training programme for better utilization of wood.

- 2.4 Objectives :
- 2.4.1 To disseminate solar kiln technology to the wood traders, furniture makers and wood based cottage industries.
- 2.5 Expected output : Capacity building and developed knowledge in solar kiln technology for drying of wood.
- 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 : M. Jahangir Alam DO
- 2.7.2 Associates : Md. Rowson Ali, RO and U. K. Rokeya RO
- 2.8 Progress :
- 2.8.1 Previous years, if : Three training programme on solar kiln technology were conducted at Kaliganj, Pabna Sadar and Satkhira
- 2.8.2 This year :

Activities of the study	Progress
a. Selection of stakeholders/trainee in different areas of Bangladesh (Chittagong Hill District, Sylhet, Rajshahi)	a. Total one hundred twenty stakeholders were selected and four training were conducted for different categories of wood traders; saw mill owners and furniture makers in Ruma Upazilla, Bandarban Hill Tracts, Sadar Upazila, Sylhet, Khagrachari Hill Tracts with the cooperation of Directorate of Agriculture Extension and Sadar Upazila, Chapainawabgong.
b. Preparation of training materials	b. Training materials were prepared
c. Arrangement of training programme	c. Four training programme were arrangement.
d. Collection of information and sharing of knowledge with stakeholders	d. Information and sharing knowledge were collected from different categories of stakeholders.
e. Report writing	e. Information were summarized and compiled

- 2.9 Achievement, if any : NA
- 2.10 Financial Statement :
- 2.10.1 Total cost :
- 2.10.2 Cost of the year : Tk. 79,400.00
- 2.10.3 Expenditure of the year : Tk. 59,550.00
- 2.10.4 Source of fund : GOB
- 2.11 Beneficiaries : BFIDC, FD, Wood Industries, University students, BFRI, and others.

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 : Potential uses of treated round bamboo for making quality furniture
- 1.3 Justification : Bamboo is a fast growing species and can be harvested within 3-5 years. The species is considered as a valueable resource for making furniture. The main drawback of bamboo furniture is it's low durability. It is affected quickly by decaying agent and destroys within 2-3 years. By using chemical treatment, durability can increase 5 times. Present study includes use of round bamboo for furniture after preservative treatment.
- 1.4 Objectives :
- 1.4.1 To establish round bamboo as a quality furniture material after preservative treatment.
- 1.4.2 To improve the design and quality of bamboo furniture.
- 1.4.3 To increase the uses of bamboo for making furniture as an alternative of timber.
- 1.5 Expected output : Better utilization of bamboo as furniture materials.
- 1.6 Study period :
- 1.6.1 Starting year : 2011-12
- 1.6.2 Completion year : 2013-14
- 1.7 Personnels :
- 1.7.1 Study leader : M Ramiz Uddin, DO

- 1.7.2 Associates : M N A Mridha, RO; T K Dey, RA-1
 1.8 Progress :
 1.8.1 Previous years : Research sample angoon bamboo (*Thyrsostachys Oliveri*) has been collected from Tangail.
 1.8.2 This year :

Activities of the year	Progress
a) Collection of research input.	Collection of research input was completed.
b) Collection of research sample (bamboo) from Sylhet.	Collection of research sample of Konkoi bamboo (local name) from Sylhet was completed.
c) Manufacturing of two chair and two reading table for service test.	Manufacturing of two chair and two reading table were completed. (Table-1)
d) Find out the suitable bamboo species for furniture.	Selection of suitable bamboo species is under observation.

- 1.9 Achievement : Specially thick wall and slim bamboo produce quality furniture
 1.10 Financial statement :
 1.10.1 Total cost : Tk 2,00,000.00
 1.10.2 Cost of the year : Tk 62,220.00
 1.10.3 Expenditure of the year : Tk. 62,220.00
 1.10.4 Source of fund : GOB
 1.11 Beneficiaries : Common people, Bamboo based Cottage, Industries, NGOs.

Table-1 shows cost comparison of bamboo chair and tea table.

Sl. No.	Item	Production Cost	Commercial Cost
1.	Chair	4000	4500
2.	Tea Table	3000	3500

2. Study : New
 2.1 Programme area : Post Harvest Utilization- Physical Processing.
 2.2 Title of the study : Potential use of lambu (*Khaya anthotheca*) wood for furniture and construction materials.
 2.3 Justification : Working and finishing properties of lambu wood have been completed. The study indicates that the species may suitable for furniture and construction materials. The present study has been taken to find out the performance of furniture and construction materials made from this non-conventional timber species using improved techniques. Performance of furniture and construction materials in service condition will provide final recommendation.
 2.4 Objectives :
 2.4.1 To assess the suitability of lambu wood for making furniture and construction materials using improved techniques
 2.4.2 To decrease the pressure on traditional timber species.
 2.5 Expected output : Better utilization of non-conventional timber species.
 2.6. Starting year :
 2.6.1 Study period : 2012-13
 2.6.2 Completion year : 2014-15
 2.7 Personnel (s) :
 2.7.1 Study leader : M Ramiz Uddin, DO
 2.7.2 Associates : M N A Mridha, RO; T K Dey, RA-1
 2.8 Progress :
 2.8.1 Previous years : N/A
 2.8.2 This year :

Activities of the year	Progress
a) Collection of research input.	Collection of research input was completed.
b) Chemical treatment of sawn timber will be done	Chemical treatment of sawn timber was completed.

from Wood Preservation Division.	
c) Manufacture of four book shelf six chair and six computer table using improved design and techniques for service test.	Manufacture of four book shelf six chair and six computer table using improved design and techniques were completed.(Table-2)
d) Distribution of furniture made by lambu in the office of CRO (M), CRO (P) and Six Product Division.	Distribution of furniture made by lambu in the office of CRO (M), CRO (P) and Six Product Division are in progress.

2.9 Achievement : Lambu wood produces medium grade furniture. Specially its mahogany colour adds extra attraction.

2.10 Financial statement :

2.10.1 Total cost : Tk 3,00,000.00

2.10.2 Cost of the year : Tk 1,77,780.00

2.10.3 Expenditure of the year : Tk 1,77,780.00

2.10.4 Source of fund : GOB

2.11 Beneficiaries : BFIDC, FD, NGOs, Wood based industries, Common people.

Table-2 Cost comparison of bookshelf, chair and computer table made by lambu wood.

Sl. No.	Item	Production Cost (BFRI)	Commercial Cost (FIDC)
1.	Book Shelf	(3'-6"x1'-2"x4'-6") 13000	(3'x1'-3"x4'-6") 14590
2.	Chair	4500	4790
3.	Computer Table	(3'-6"x1'-10"x2'-6") 9000	(3'x2'-10"x2'-6") 8660