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Current Status and Potentiality of Forest Resources in a Proposed Biodiversity Conservation Area of Bangladesh

Md. Parvez Rana[1*], Mohammed Salim Uddin[1,2], Mohammad Shaheed Hossain Chowdhury[3], Md. Shawkat Islam Sohel[1], Sayma Akhter[1], and Masao Koike[3]

[1]*Department of Forestry and Environmental Science, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh*

[2]*Natural Resource Institute, University of Manitoba, Winnipeg, Manitoba, Canada*

[3]*Forest Policy Laboratory, Department of Forest Science, Faculty of Agriculture, Shinshu University, 8304 Minamiminowa-Mura, 399-4598 Nagano- Ken, Japan*

ABSTRACT : An exploratory study was conducted in Juri Forest Range-2, a proposed biodiversity conservation area of Bangladesh to explore the present growing stock of tree, regeneration condition and status of non-timber forest products (NTFPs). This conservation area contains both natural and artificial plantation was selected by using multistage random sampling method. For determination of plot size and sampling methods, the quadrate size (10 m×10 m) for tree stock measurement, (2 m×2 m) for regeneration survey, (20 m×20 m) for NTFPs survey was determined. Regarding tree stock survey, 14 species under eight families were found where *Tectona grandis* shows average number of stem/ha was 624 and basal area/ha was (10.36 m^2/ha) followed by *Acacia auriculiformis* (0.2 m^2/ha and 637 stem/ha), *Gmelina arborea* (0.2 m^2/ha and 600 stem/ha). In regeneration survey, 14 species were found belonging to 9 families where *Alstonia scholaris* shows highest (3,750) seedling per hectare. Regarding NTFPs, bamboo and cane are the most common resources. In last ten years, the total timber output was 1,28,596.14 cubic feet and total amount of revenue was 4,64,434 US$. The vacant area is 1,335.5 acre which contains 14% of total area. If this vacant area is planted with suitable species and take proper steps for appropriate management of this species it will be a good biologically diversified area.

Keywords : Forest resources, Bangladesh, Range, Stock, Regeneration.

INTRODUCTION

Forests cover almost 25% of the world's land and are critical in meeting human needs for water, food, shelter, medicine, fuelwood, fodder and timber (Hirakura, 2003). According to the World Bank (2002), more than 1.6 billion people throughout the world relying heavily on forests for their livelihoods and some 350 million people depends only on forest both for their subsistence and income. Bangladesh is a rural-based developing country located in the northeastern part of South Asia (North latitude $20^0 34^/$-$26^0 38^/$ East longitude $88^0 01^/$-$92^0 41^/$) (Hossain, 2001). The percentage of forest cover in relation to total land area is 10.2%; forest plantations were 625,000 ha in 2000 (FAO, 2005). The area of forestland is 2.53 million ha which is 17.5% of the country's total area. Bangladesh Forest Department (BFD) manages 1.53 million hectares of forestland (Roy, 2004). The natural forests of Bangladesh are considered as one of the richest and biologically diverse forest resources due to its unique geo-physical location (Hossain, 2001). About 5,000 plant species are estimated to occur here (Sattar, 1998). Per capita forestland in the country is around 0.02 ha and the existing natural forests are decreasing at a rate varying from 2.1% yr^{-1} (Choudhury, 2003) to 3.3% yr^{-1} (BBS, 2004). Although the accounted of the forests in the national economy is reasonable, the social and ecological importance is immense. Forests play an important role in maintaining the quality

* Corresponding author: (E-mail) parvez_200207@yahoo.com

of the local and national environment although their contribution to the national economy is passable. If environmental services and contribution in people's livelihood could have been properly accounted for, then the share of the forestry sector would have been much more. Beside the economic importance, the forests play vital role in people's livelihood (Iftekhar, 2006).

Juri Forest Range-2 which is a proposed biodiversity conservation area was located in north-eastern hilly forest area of Bangladesh. The total area of hill forests is 6,70,000 hectares, which is 4.7% of the country surface area and 44% of the total forest land managed by the Bangladesh Forest Department (Chowdhury, 2006). Hill forests are rich in diverse varieties of flora and fauna and spread over the areas of Chittagong Hill tracts, Chittagong, Cox's Bazar and Sylhet. The Sylhet Forest Division is extended over four districts, namely Sylhet, Sunamgonj, Moulovibazar, and Hobiganj under the central circle of the Forest Department. According to latest forest inventory, hill forest have a growing stock of 23.93 million m^3 of wood. The productivity of the forests declined to a range of 1.5 m^3 to 2.5 m^3 per hectare per annum from 7 m^3 to 8 m^3 twenty years ago but the forests still supply around 40% of the commercial timber production (Chowdhury, 2006).

Information on the species composition of a forest is essential for its wise management in terms of economic value and regeneration potential (Wyatt-Smith, 1987). For any feasible conservation activity the bioinventory of the area is inevitable. Correct inventorisation and assessment of biodiversity in different habitats is also necessary for evolving a long term strategy for rehabilitation of endangered species in similar, alternate habitats when original habitat gets destroyed (Rao, 1994) but very scanty or almost no information is available on the composition and distribution of tree species of this forest (Alamgir, 2003). Measuring biodiversity of a community or habitat has been one of the central issues of ecology and conservation because of their academic necessity and its utility in devising conservation strategies (Verghess and Menon, 1997). Evaluation of biological diversity from conservation point of view in disturbed areas focuses on measuring riches and not more complex indices of heterogeneity (Margules and Usher, 1981). More frequently the number of species in certain taxa and vegetation types are measured but occasionally abiotic features are used (Smith, 1984). In this context a detailed survey of trees was undertaken which, will provide complete information on the species composition, distribution and quantitative structure of tree species of this proposed biodiversity conservation area.

A lot of research work has been conducted on various aspects about tree stock, regeneration, non-timber forest products (NTFPs) on hill forest. But in considering southern part of the country (Chittagong Hill tracts, Chittagong, Cox's Bazar) (e.g., Ahmed and Bhuyian, 1994; Alamgir & Al-Amin, 2005; 2007), there was less research work conducted on north-eastern part (Sylhet Forest Division). Despite of biologically enriched area, less attention has been given on Sylhet Forest division. Growing stock is an important parameter required for sound forest management and planning. General information about the stock available per unit area is the key information desired for forest inventories. Therefore, considering above information, this research will show the present status of tree stock which will help policy makers to get an actual idea of the present status of forest of proposed biodiversity conservation area.

MATERIALS AND METHODS

Study area

Among the 13 these forest ranges of Sylhet Forest Division, Juri Forest Range-2 (Sub forest division) was selected randomly and it is a proposed biodiversity conservation area. It is located in Barlekha Upazilla of Maulvibazar district and important strategic focal point between $24^{o}40^{/}$-$24^{o}50^{/}$ N and $92^{o}02^{/}$-$92^{o}16^{/}$ E and is bounded by India on the east, Golabganj and Beanibazar upazillas on the north, Kulaura Upazilla on the south. Kulaura and Fenchuganj upazillas on the west (Banglapedia, 2006). Average temperature of the area from April to October is 30°. Maximum temperature in May remains around 32° and minimum temperature remains between 12° to 14° from

December to February (BMD, 2004). In this range, total artificial planted area is 1130 ha and rest of them are naturally planted. It is subdivided into 3 beats viz Baralekha, Madhabchara, Samanbagh. The total area of reserved forest (These areas are finally notified under section 20 of the Forest Act, 1927 Bangladesh.. Everything is strictly prohibited unless permitted) in this range is 7,919.55 acre and acquired forest (These forest were acquired from different owners under State Acquisition and Tenancy Act of Bangladesh, 1950) is 1,488.9 acre. In the study area, among the total area of range, 6,411 acre area is under forest cover. In Samanbagh beat total area (1,800 acre) is a reserved forest. But in Barlekha and Madhabchara beat, total 253.7 acre area is under acquired forest. Encroached area (The area which is encroached) in this range is 1,661.95 acre. But in Samanbagh beat there is no encroached area. Vacant area in this range is 1,335.5 acre.

Table 1. Scenario of forest cover, encroached land, plantation area and vacant area in Juri Forest Range-2

Name of the beat	Forest cover (acre)		Encroached area (acre)		Plantation (acre)		Vacant area (acre)
	Reserved forest	Acquired forest	Reserved forest	Acquired forest	Reserved forest	Acquired forest	
Barlekha	1,969.05	150	400.00	1,119.60	290.00	150.00	850.5
Madhabchara	2,388.25	103.7	26.75	115.60	118.00	37.00	485.0
Samanbagh	1,800.00	-	-	-	535.00	-	-
Total	6,157.3	253.7	426.75	1,235.2	943	187	1,335.5
	6,411		1,661.95		1,130		

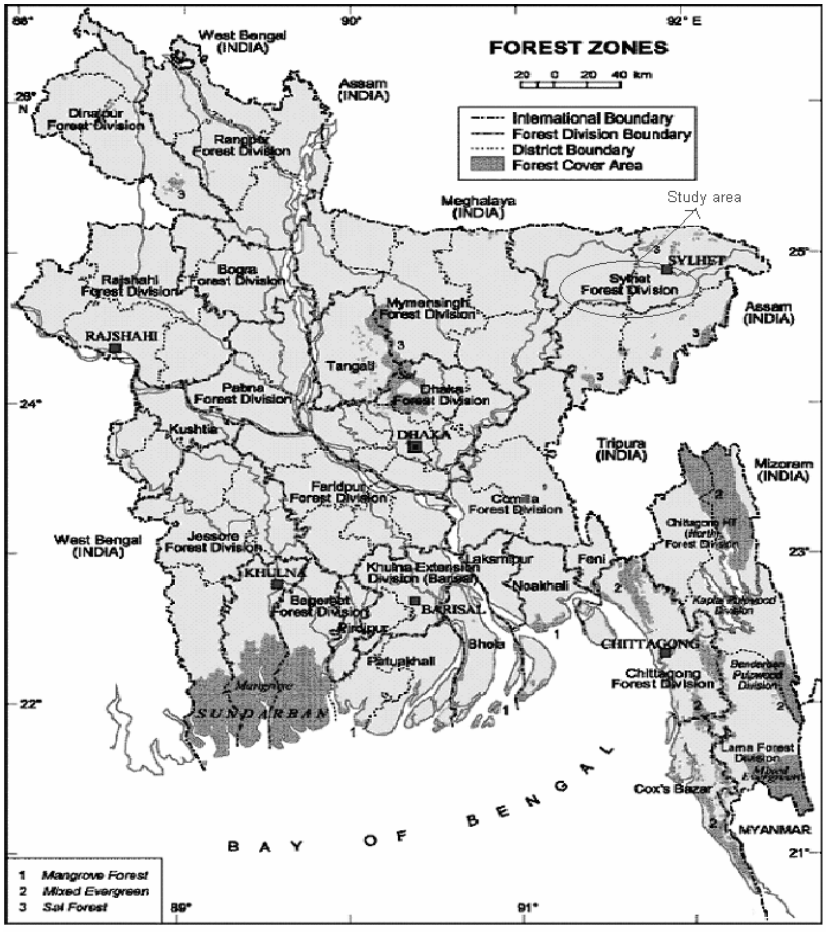

Figure. 1. Location map of the study area.

Methods

Multistage random sampling method was used to determine the floristic composition, quantitative structure and distribution of trees of the Juri forest range-2. Initially sampling points were located in the map proportionally and finally identified in the field. There were 60 plots of (10 m× 10 m) for tree stock, (2 m×2 m) for regeneration survey, (20 m×20 m) for NTFPs survey were taken in the study area respectively. The optimum quadrate size was determined by applying species area curve using Gareth's (1991), Sharma (1979) and Ambasht (1978) method. All the trees which, crossed 1.3m in height were measured and recorded. Different tree species in the area have been gathered and representative samples have been collected for herbarium preparations. The collected specimens were identified following Prain (1903) and Day (2006).

The Basal area per tree was calculated by the formula given by the Chaturvedi and Khanna (1982):

$$\text{Basal area per tree} = \Pi \times D^2/4$$

Where,

D = Diameter at breast height in centimetre.

Π = Constant = 3.142

Density of a species was calculated by the formula given by the Moore and Chapman (1986), Shukla and Chandal (1980), Ambast (1978), Dallmeier et al., (1992) and Sharma (1979):

$$\text{Density of a species} = \frac{\text{Total number of individuals of a species in all the quadrates}}{\text{Total number of quadrates studied.}}$$

RESULTS AND DISCUSSION

Present status of trees in Juri forest range-2

Study reveals that 14 species under eight families were found where the dominant family was Leguminasae containing four species followed by Euphorbiaceae, Meliaceae, Verbenaceae (two species each) and rest of the family contain one species each. *Syzygium grandis* and *Artocarpus chaplasha* were naturally available in the study area. Considering the planted area, *Tectona grandis, Acacia auriculiformis, Albizia procera, Acacia mangium* were available in the study area (Table 2). Similar study was done by Alamgir and Al-Amin (2005) found 32 tree species within 15 families at biodiversity conservation area, Banskhali, Bangladesh. The study also reveals that *Tectona grandis*

Table 2. Species composition in Juri Forest Range-2

Sl. No.	Family	Local name	Scientific name
1	Acanthaceae	1. Bashok	*Adhatoda vasica* Nees.
2	Combretaceae	2. Arjun	*Terminalia arjuna* Bedd.
3	Euphorbiaceae	3. Jhau	*Casuarina equisetifolia* L.
		4. Amloki	*Emblica officinalis* L.
4	Leguminosae	5. Akashmoni	*Acacia auriculiformis* A.Cunn.ex Benth.
		6. Krishnachura	*Delonix regia* (Boj.) Raf.
		7. Sada koroi	*Albizia procera* (Roxb.)Benth.
		8. Mangium	*Acacia mangium* willd.
5	Meliaceae	9. Neem	*Azadirachta indica* A Juss.
		10. Chickrassi	*Chickrassia tabularis* A. Juss.
6	Moraceae	11. Chapalish	*Artocarpus chaplasha* Roxb.
7	Myrtaceae	12. Dhakijam	*Syzygium grandis* (Wt.) Wall.
8	Verbenaceae	13. Teak	*Tectona grandis* L.
		14. Gamar	*Gmelina arborea* Roxb.

Table 3. Present stock of trees in Juri Forest Range-2

Species/Origin	Year of plantation	Plantation area (ha)	Average DBH. (cm)(mean±SD)	Average height (m) (mean±SD)	Average basal area (m^2/ha) (mean±SD)	Stems /ha
Tectona grandis/ Planted	1961-62	14.75	49.95(±6.051)	21.1(±0.430)	0.194(±0.049)	500
	1966-67	5	57.17(±8.561)	20.37(±1.331)	0.262(±0.078)	450
	1994-95	6.5	18.85(±2.023)	15.95(±1.498)	0.028(±0.006)	520
	1995-96	17.67	18.15(±2.737)	13.25(±2.562)	0.026(±0.008)	800
Gmelina arborea	2001-02	10	9.81(±1.034)	10.20(±1.364)	0.008(±0.002)	850
	2004-05	20	5.53(±0.709)	5.43(±0.757)	0.002(±0.001)	400
	2005-06	5	4.75(±1.160)	4.25(±0.563)	0.002(±0.001)	1100
Acacia auriculiformis	2005-06	50	6.10(±1.311)	5.80(±0.889)	0.003(±0.001)	300
	2004-05	20	6.15(±1.159)	5.57(±1.060)	0.003(±0.001)	600
	2005-06	50	5.29(±1.257)	4.71(±0.988)	0.002(±0.001)	600
	2005-06	50	5.83(±0.520)	5.36(±0.572)	0.003(±0.001)	600
	2006-07	20	3.02(±0.611)	3.06(±0.618)	0.001(±0.001)	750
Acacia mangium	2004-05	20	5.90(±1.141)	5.37(±0.750)	0.003(±0.001)	300
	2005-06	50	4.24(±0.813)	4.72(±1.103)	0.001(±0.001)	300
	2006-07	20	2.80(±1.071)	3.55(±0.771)	0.001(±0.001)	250
Casuarina quisetifolia	2001-02	2	7.22(±1.780)	9.19(±1.795)	0.004(±0.002)	500
Delonix regia	2001-02	2	10.50(±1.615)	11.70(±1.352)	0.009(±0.003)	400
Albizia procera	2001-02	2	8.96(±0.702)	10.33(±1.320)	0.006(±0.001)	300
	2004-05	20	5.30(±1.217)	4.36(±0.551)	0.002(±0.001)	350
	2006-07	20	3.80(±0.294)	4.47(±0.506)	0.001(±0.001)	400
Emblica officinalis	2002-03	3.32	7.65(±2.051)	4.00(±0.141)	0.005(±0.002)	350
Adhatoda vasica	2002-03	3.32	5.05(±0.212)	3.90(±0.707)	0.002(±0.001)	400
Terminalia arjuna	2002-03	3.32	6.03(±0.379)	4.20(±0.557)	0.003(±0.001)	300
Chickrassia tabularis	2004-05	20	3.63(±0.643)	3.13(±0.321)	0.001(±0.001)	400
	2006-07	20	2.87(±0.287)	3.72(±0.435)	0.001(±0.001)	450
Azadirachta indica	2006-07	20	3.00(±0.141)	3.19(±0.997)	0.001(±0.001)	250
Syzygium grandis/Natural	-	43	16.20(±2.519)	9.320(±0.680)	0.021(±0.006)	267
Artocarpus chaplasha	-	25	10.060(±0.891)	8.820(±1.417)	0.008(±0.001)	167

shows average number of stem/ha was 624 and basal area/ha was (10.36 m^2/ha) followed by *Acacia auriculiformis* (0.2 m^2/ha and 637 stem/ha), *Gmelina arborea* (0.2 m^2/ha and 600 stem/ha), *Acacia mangium* (0.0016 m^2/ha and 283 stem/ha), *Casuarina equisetifolia* (0.004 m^2/ha and 500 stem/ha), *Delonix regia* (0.009 m^2/ha and 400 stem/ha), *Albizia procera* (0.003 m^2/ha and 350 stem/ha), *Emblica officinalis* (0.005 m^2/ha and 350 stem/ha) respectively. There were some old plantations of *Tectona grandis* available in the study area. The following table shows present status of stock of different trees in the study area (Table 3).

Present status of regeneration in Juri forest range-2

In the study area, 14 species were found belonging to 9 families. The family Meliaceae was dominant with 3 species followed by Leguminaceae, Myrtaceae and Verbenaceae containing 2 species (Table 4). The remaining family containing one species each. Similar study was done by Alamgir and Al-Amin (2007) found 39 species under 18

families in a proposed biodiversity conservation area (Bamerchara and Danerchara) in Chittagong, Bangladesh. Hossain (1994) in the Sitapahar natural forest of Chittagong Hill tracts (South) forest division, found 52 species of 32 families. Ahmed and Bhuyian (1994) found 42 known and few unknown regenerating species in the natural forest of Cox's Bazar Forest Division, Bangladesh. In comparison to these studies, the number of regenerating species in the study area is less because most of the area in this range under new plantation and degraded condition of the natural forests. The quantitative structure of regeneration shows in Table 5. Highest density was estimated in Alstonia scholaris (3,750 seedling/ha) followed by *Syzygium fruticosum* (3,375 seedling/ha), *Aphanamixis polystachya* (3,125 seedling/ha), *Albizia procera* (2,750 seedling/ha) and *Anthocephalus chinensis* (2,500 seedling/ha).

Table 4. Species composition in Juri Forest Range-2

Sl. No.	Family	Local name	Scientific name
1.	Apocynaceae	1. Chatian	*Alstonia scholaris* (L) R. Br.
2.	Leguminosae	2. Sada koroi	*Albizia procera* (Roxb.) Benth.
		3. Krishnachura	*Delonix regia* (Boj.) Raf.
		4. Pitraj	*Aphanamixis polystachya* (Wall.) Par.
3.	Meliaceae	5.Toon	*Toona ciliate* J.Roem
		6. Neem	*Azadirachta Indica* A Juss
4.	Moraceae	7. Chapalish	*Artocarpus chaplasha* Roxb.
5.	Myrtaceae	8. Ban jam	*Syzygium fruticosum* (Roxb.) DC
		9. kalojam	*Syzygium cuminii* (L) skeel.
6.	Rubiaceae	10. Kadam	*Anthocephalus chinensis* (Lam) Rich
7.	Rutiaceae	11. Jambura	*Citrus grandis* (L.) Osbeck
8	Thymalaceae	12. Agor	*Acquilaria agallocha* Roxb
9.	Verbenaceae	13. Teak	*Tectona grandis* L.
		14. Gamar	*Gmelina arborea* Roxb.

Table 5. Quantitative structure of regeneration in Juri Forest Range-2

Sl. No.	Scientific name	Density/ha	Average collar dia (cm) (mean±SD)	Average height (m) (mean±SD)
1.	*Acquilaria agallocha*	1250	0.475(±0.096)	0.598(±0.241)
2.	*Albizia procera*	2750	0.440(±0.141)	0.645(±0.283)
3.	*Alstonia scholaris*	3750	0.620(±0.239)	0.790(±0.190)
4.	*Anthocephalus chinensis*	2500	0.320(±0.045)	0.558(±0.327)
5.	*Aphanamixis polystachya*	3125	0.400(±0.096)	0.698(±0.188)
6.	*Artocarpus chaplasha*	1250	0.563(±0.245)	0.633(±0.094)
7.	*Azadirachta Indica*	975	0.467(±0.153)	0.703(±0.111)
8.	*Citrus grandis*	1125	0.453(±0.050)	0.593(±0..090)
9.	*Delonix regia*	625	0.488(±0.144)	0.673(±0.260)
10.	*Gmelina arborea*	1000	0.450(±0.129)	0.675(±0.096)
11.	*Syzygium cuminii*	1125	0.493(±0.224)	0.563(±0.186)
12.	*Syzygium fruticosum*	3375	0.501(±0.210)	0.716(±0.209)
13.	*Tectonal grandis*	1125	0.440(±0.114)	0.686(±0.274)
14.	*Toona ciliata*	1875	0.433(±0.058)	0.747(±0.150)

Present status of NTFPs in Juri forest range-2

In the study area, bamboo and cane were the major NTFP's. There are three types of bamboo available in this range. Among them, *Melocanna baccifera* is the most common in the study area. *Calamus guruba* is the only one type of cane available in this range (Table 6). Similar study was done by Anon (2008) in Ukhia range of Cox's Bazar South Forest Division, which shows cane, bamboo, sungrass were the major NTFPs. Another study was done by Miah et al., (2002) in floodplain areas of Bangladesh, which found four species of bamboo-*Bambusa balcooa, B. tulda, B. arundinaceae* and *M. baccifera*. The study also revealed that *M. baccifera* shows highest no of culm per hectare (9,000 culm/ha) followed by *Bambusa vulgaris* and *Neohouzeaua dulloa* show (7,500 culm/ha) and (3,150 culm/ha) respectively. *M. baccifera* does not show any clump (Table 7). In the study area, *Calamus guruba* shows 4,950 stems per hectare and 225 clumps per hectare. The average no of stem per clump is 25 and average circumference of each clump is 3.02 m (Table 8).

Table 6. Species composition in Juri Forest Range-2

NTFP's	Local name	Scientific name	Family
Bamboo	Dulu	*Neohouzeaua dulloa* (Gam.)Camp.	Graminae
	Jai	*Bambusa vulgaris* Schrad.	
	Muli	*Melocanna baccifera* (Roxb.) Kurz	
Cane	Jali	*Calamus guruba* Ham.	Palmae

Table 7. Present status of bamboo in Juri Forest Range-2

Scientific name	**No of culm/ha**	**No of clump/ha**	**Average no of culm/clump** (mean±SD)	**Circumference of each clump (average) (m)** (mean±SD)
Bambusa vulgaris	7,500	375	22(±9.409)	4.25(±1.233)
Melocanna baccifera	9,000	-	-	-
Neohouzeaua dulloa	3,150	150	27(±5.422)	7.13(±1.923)

Table 8. Present status of cane in Juri Forest Range-2

Scientific name	**No of stem/ha**	**No of clump/ha**	**Average no of stem/clump** (mean±SD)	**Circumference of each clump (average)(m)** (mean±SD)
Calamus guruba	4,950	225	25(±6.016)	3.02(±0.884)

Table 9. Last ten years output of Juri Forest Range-2

Year	**Timber (cft)**	**Fuel wood (cft)**	**Bamboo no.**	**Pole (length in ft)**
1997-98	20,761.49	9,298.00	-	6,189
1998-99	-	11,245.00	62,32,323	7,692
1999-00	14,256.32	7,828.00	-	3,691
2000-01	11,246.23	6,391.10	-	4,581
2001-02	9,458.56	18,245.32	87,16,450	4,120
2002-03	30,873.68	11,400.00	-	3,121
2003-04	-	8,962.35	72,56,682	2,301
2004-05	14,564.23	-	-	4,852
2005-06	15,846.12	-	-	4,562
2006-07	11,589.51	4,256.00	-	1,684
Total	1,28,596.14	77,625.77	2,22,05,455	42,793

Potentiality of Juri forest range-2

Last ten years timber output and revenue earnings

The total output of timber in last ten years was 1,28,596.14 Cubic feet (cft). In 2002-03, highest amount of timber (30,873.68 cft) was obtained. There was no output of timber in 1998-99 and 2003-04 (Table 9). In the study area, it was found that total amount of revenue in last ten years was (4,64,434 US$). In 2002-03, highest amount of revenue (1,15,561 US$) was earned. In 2000-01, lowest amount of revenue (9,144 US$) was earned (Table 10).

Status of vacant area in Juri forest range-2

In the study area, total area of forest cover is 6,411 acre which is the 68% of total area. The area under vacant is 1,335.5 acre and it contains 14% of total area.

Table 10. Last ten years revenue earnings in Juri Forest Range-2

Year	US$
1997-1998	53,025.81
1998-1999	35,455.38
1999-2000	16,538.29
2000-2001	9,143.652
2001-2002	94,939.13
2002-2003	1,15,561.1
2003-2004	31,219.99
2004-2005	20,893.04
2005-2006	45,262.72
2006-2007	42,394.64
Total	4,64,434

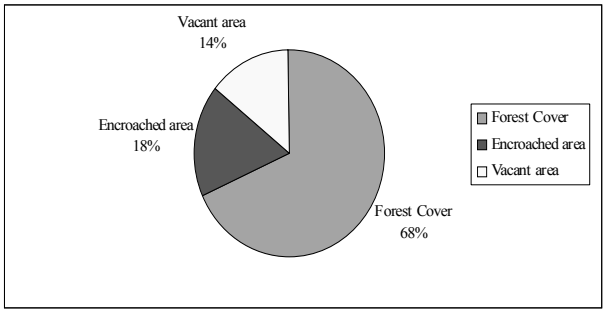

Figure. 2. Status of vacant area in Juri Forest Range-2.

If this vacant area is planted with suitable species and take proper steps for appropriate management of this species it will be a great potentiality which ultimately conserves the biodiversity or ecological balance in the study area.

CONCLUSION

The forests of Bangladesh are physiographically divided into hill forest (tropical moist evergreen and semi-evergreen); inter-tidal mangrove forests (tropical evergreen) and plain land Sal (*Shorea robusta*) forest (tropical moist deciduous). Among them, hill forest (Sylhet Forest division, Chittagong, Chittagong Hill Tracts, Cox's Bazar) constitutes 67% which supply 66% of the growing stock of the country (Khan et al., 2004). This article has shown the present status of tree stock, quantitative structure of regeneration, status of NTFP's and potentiality of this range. If properly conserve the naturally regenerated seedling in the study area, it has good potentials and cultivation of the vacant area in the near future will make this area as a biologically or environmentally rich one.

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