

THE BIODIVERSITY STATUS AND COSERVATION ACTIVITIES OF SINGRA NATIONAL PARK (SNP) IN THE LINK OF CO-MANAGEMENT STRATEGY

Abstract

This paper emphasizes the trend of biodiversity and their conservation strategy of Singra National Park (SNP), which is very well known for its characteristics as deciduous forest. Two types of studies were conducted: (i) Study of the vegetation composition and structure and (ii) conservation strategy of the Forest. In the first study, the diversity of plant (trees, shrubs, herbs and climbers) and animal (birds, amphibians, reptiles and mammals) species were measured. A stratified random quadrat method was employed to determine the floral diversity. A total of 32 plant species were recorded of which 19 were tree species, 5 were herbs, 4 were shrubs and 4 were climbers. Inventory of fauna species was conducted using a combination of transect walk/opportunistic and ethno zoological interview methods. A Total of 28 animal species were recorded of which 13 were birds, 3 were amphibians, 6 were reptiles and 6 were mammals. With regard to the quantitative attributes of total flora and fauna species, the highest number was found in trees (mean, 126.00) and the lowest number was found in mammals (mean, 7.00). The result showed very high significant variation among them. The second study examined the management of the forest, causes of biodiversity loss, administrative problem with management of wildlife. Data were collected from the SNP authority and questionnaire survey among local people in the study area. It was evident from the study that the people around the forest collect forest flora and fauna illegally. The people are not aware of the importance of forest in various aspects like social, economic, ecological and environmental aspects. Forest authorities are trying to involve the people in and around the forest to co-management for conservation and restoration of the forest.

Keywords: Biodiversity, Conservation, Species Composition, Management, Singra National park (SNP)

1. Introduction

Bangladesh is a small South Asian developing country with high population pressure. The total geographic area of Bangladesh is approximately 14.40 million hectares of which 13.46 million hectares are land surface and 0.94 million hectares are rivers and other inland water bodies (Islam, 2005). It is unique in having a wide variety of plant species with enormous genetic diversity that are scattered in forests, village groves and homesteads. In addition to many

Comment [a1]: Just write as "A of 32 plant species were recorded including 19 tree species, 5 herbs, 4 shrubs and four climbers

Comment [a2]: Remove of which and replace with including 13 birds, 3 amphibians etc. remove all the "were" highlighted in red.

Comment [a3]: Check your English here

Comment [a4]: Replace with domain

Comment [a5]: Please, rephrase your abstract to be more scientific. A good abstract starts with a brief introduction, objectives of the study, summary of method use, results and a concluding statement. Do not separate your views for the different studies since it is just one article.

Comment [a6]: Source

valuable timbers and wood tree species, the forests and the village groves have been important source of numerous wild resource species, like fruit and nuts, fuel and fodder, vegetables, medicinal plants, bamboo and many other non-wood forest species (Sultana, 2005). The forest is an important natural resource that plays several important roles in nature. It is a store house of biological diversity. It is generally recognized that a minimum of 25 to 33 percent of the land in any country should be covered by forest in order to maintain a balance ecosystem (Source). The forested areas, however, are decreasing day by day all over the world as a result of human activities (source). Asia is losing almost 1% of tropical forest per year (Source). In Asia, some 67% of wildlife habitat has been converted to other uses (McNeely, 1991). According to a recent estimate of the Bangladesh Forest Department, the country has only 17.5% (2.52 million hectare) of forest coverage which is unevenly distributed throughout the country (Motiur, 2006). One of the peculiarities of forest resource distribution in Bangladesh is that the resources are very eccentrically distributed. More than 90% of the government forests are concentrated within 12 districts in the eastern and southeastern regions of the country (GOB. 1992). However, the Sal forest covers about 0.12 million hectares of land comprising about 4.7% of the total forest area of the country (Motiur, 2006). About 86% of Sal forest land is situated in this central region and the remaining 14% of Sal forest belongs to northern part of the country (Alamet. al 2008). The Food and Agricultural Organization (FAO) estimated that about 36% of the Sal forest cover existed in 1985; while in 1990 only about 10% of the forest cover remained (Haque, 2007). It has been reported that Sal forests are the most threatened ecosystem of Bangladesh (Alam *et al.*, 2008). Where the important ecosystems are deteriorating due to several anthropological and natural threats like over-exploitation, deforestation, habitat change to agriculture, pollution, and invasive species are being considered the most. A wide range of plants, mammals, birds, amphibians, reptiles, face extinction in this area. It is, therefore, essential to conserve this threatened biodiversity of these areas for the well-being of the people. To date, various programs and strategies have been undertaken to tackle this problem at both national and regional levels. The governments throughout the world have been strengthening their conservation capacity by developing and adopting various policies, legislations and innovative approaches. Declaring and maintaining protected areas has long been the most effective and widespread measure for conserving nature and natural resources around the world. However, the declaration of Protected Areas (PA) for biodiversity conservation is rather a new concept in Bangladesh. In 1974, the

Comment [a7]: 12 out of how many districts

Comment [a8]: Alamet *et al.* this should be in italic. After the fullstop is a comma before the year.

Comment [a9]: Remove comma and put and

Bangladesh Wildlife Preservation Act defined three types of PA under different IUCN protected area management categories in the country. The Singra National Park (SNP) is a protected area, situated in Dinajpur district of the northern part of the country. The main forest tree species in SNP is Sal (*Shorea robusta*). Formerly the area was very rich in flora and fauna and had populations of fox and different sub species of bears, and birds. Most of these mammals are now locally extinct. Remaining fauna species include fox and Lizard. Floral species include Gajari, shegun, Akashmoni, Eucalyptus, etc. To protect the biodiversity of SNP Bangladesh government had been promulgated the forest as national park in 2010. During last two and half years RDRS Bangladesh has been implementing a project (co-management program) for conserving and restoring the biodiversity of SNP with a donation from Arannayk Foundation for the conservation and restoration of biodiversity. Hence, the study was conducted to find out the biodiversity status of the forest after conservation activities in the linked with co-management strategies.

2. Methodology

2.1 Geographical location of the study area

The study area is located within the Birgang Upazila at approximately between the latitudes of 25°90'N and 26°30'N and longitudes 88°20'E and 88°50'E in the district of Dinajpur. It is located 45 km southwest corner from Dinajpur town besides the Dinajpur – Panchagarh high way with Dalagram, Chaulia, Singra, Nortodangi, Gandari, Singhojani, Sator, Ganpoito, Rathinthpur and Laskarpur mouza. The Singrasal forest had with an area of 305.69 hectate.

Comment [a10]: Source

Comment [a11]: Give source and start with The remaining

Comment [a12]: Remove this

Comment [a13]: Not appropriate here. Remove it.

Comment [a14]: Is beside, not besides. Besides means in addition

Comment [a15]: Delete this

Comment [a16]: Hectares

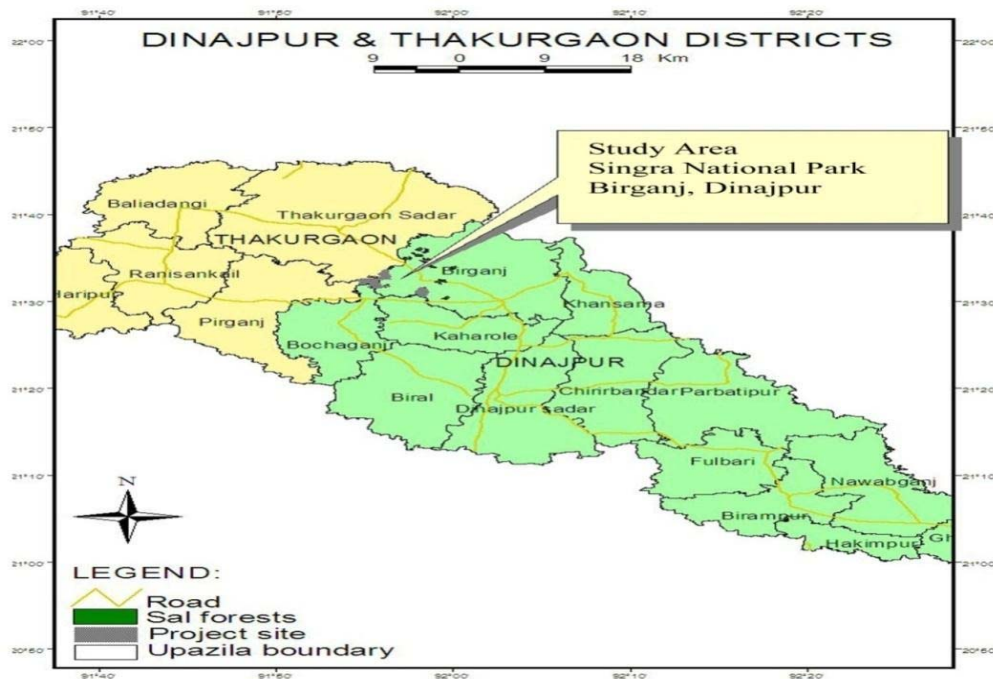


Fig. Showing Study Area Singra National Park (SNP)

2.2 Soil and climate of the study area

The soil of the study area was a high land and soil was silt loam texture with pH value 5.79, total nitrogen % 0.072, organic carbon % 0.729, organic matter 1.26%, phosphorus 8ppm, sulphur 10ppm, and exchangeable potassium 38ppm under agro-ecological zone (AEZ-1) Old Himalayan piedmont (BBS, 2004). The studied area enjoys tropical monsoon climate characterized by a hot summer season warm humid rainy season and a cool dry winter season. The rainy season also called wet monsoon season is very short and late in some years, but favorable for plant growth. It extends from July to October receiving average monthly rainfall of 333 mm. The dry winter season is a dry season, rainfall mostly as an occasional drizzles between Novembers to February. Average highest temperature was 34.6°C and lowest 9.7°C Average annual rainfall was 181mm

Comment [a17]: Rephrase this. It is not clear. Since you are describing soils which is a resource in-situ, use is ie the soil of the areas is

Comment [a18]: Delete and start with a new sentence as " This soil of this area falls under the agro-ecological zone (AEZ 1) of the Old Himalayan....."

Comment [a19]: The study area not the studied

(BBS, 2010). The cool dry season records lowest temperature and relative humidity of the year.

Of course this value fluctuates from year to year.

Comment [a20]: Remove this and start with..This value....

2.3 Data collection

For biodiversity measurement Nested Plot and habitat sampling methods were used during the inventory of flora. A total of 30 (20m x 20 m) quadrat plot were established for the identification of tree species, shrubs and herbs. For To ensure maximum listing of wildlife resources, a two (2) kilometer transect line was established. Ethno zoological survey was conducted through interviews of people residing in the area particularly the persons who served as guides in the study sites. Survey of birds, mammals, reptiles and amphibians was also done in the area and identified to species level (Nuneza et al, 2006). Analysis and identification of tree species were based on the standard taxonomic classification (Pelsers et al, 2011). Some key informant interview was conducted with various stake holders which people were experts and associated with forest conservation and management. For study purposes interview was carried out with Divisional Forest Officer (DFO) about some important logistic support, present management strategy, biodiversity status, causes of decrease biodiversity, forest degradation and their plan to conserve it. Interview was also carried out with Assistant conservator of forest (ACF) and Bit Ranger to assess what exactly happen in local level, what are causes of deforestation and what taken steps to recover degradation. Some group discussion was done, the group discussions will conduct in each of the study area, with 8–10 people in each group. Some secondary information also obtained from forest department reports, statistical year-books and other sources. All the data both collected from different sources has been tabulated and analyzed by using statistical computer software MSTAT-C (Gomez and Gomez, 1984).

Comment [a21]: remove

Comment [a22]: remove this

Comment [a23]: who

Comment [a24]: the

Comment [a25]: what steps are taken

Comment [a26]: was conducted

Comment [a27]: was

Comment [a28]: Source

Comment [a29]: Please, you have not explained your methods very well. In the interview, you have to give the type of interview conducted; random, stratify etc and the reason why you chose a particular interview over the rest.

State those who were involved and their age groups

Comment [a30]: Replace by starting as " Result revealed that.....

3. Results and Discussion

3.1 Biodiversity status of SNP

During the study period, 19 tree species, 5 herbs species, 4 shrubs species and 4 species of climbers were found, the highest number of tree was Shal (mean, 76.00) followed by Eucalyptus (mean, 11.00). The lowest number of tree found was Jarul. Minjhiri, Bohera, Am, Tal and bal (mean, 1.00) preceded by Black berry, Jackfruit, Palm, Mohua, Hogplum, Horitoki, (mean, 2.00). Among the shrubs, the highest number of shrub was Akanda (mean, 4.00) followed by kutushkanta and Arhar (mean, 2.00). The lowest

number of Shrub was Bashok (mean, 1.00). In the shrubs species, there was statistically significant variation among Bashok, Akanda, Kutushkanta, but Arhar and Kuuskata are statistically similar. There was highly significant variation among the number of herbs. Among them the highest number of herb was Bhat (mean, 7.00) followed by Kalomegh (mean, 4.00) and Kukursingha (mean, 4.00). The lowest number of herb was Patka (mean, 2.00) and Thankuni (mean, 2.00). Among the climber species, the highest number of climbers was Bet (mean, 11.00) followed by Harjora (mean, 4.00). The lowest number of climbers was found Ashamilata (mean, 2.00) proceeded by Kumarilata (mean, 1.00). In case of fauna, 13 species of birds, 3 species of amphibians, 6 species of mammals were and 6 species of reptiles were found. Among them the highest number of birds was Magpie Robin and Tuntuni,(mean, 6.00) followed by Wood peacker, Shalik and Machranga (mean, 4.0). The lowest number of birds was found Cuckoo Roseringed parakeet, Shama, (mean, 1.00). Among the faunal species the highest number of amphibians was Kulabang (mean, 4.00) followed by Kuno bang (mean, 2.00) whereas, the lowest number of amphibians was Gecho bang (mean, 1.00). There was no significant variation among amphibian's species. In case of mammals the highest number of mammals was Indur and Chika (mean, 3.00). The lowest number of mammals was found Fox and Bon Biral (mean, 1.00). The highest number of reptiles was Lizard/Khatash (mean, 5.00) followed by Dhora Sap and Ghokra sap (mean, 2.00) and the lowest number of reptiles was GuiShap and Gechoshap (mean, 1.00). Finally the highest number of species was trees (mean, 126.0) followed by birds (mean, 35.00). The lowest number of species was Mammals (mean, 7.00) preceded by Amphibians (mean, 8.00).

Comment [a31]: Put the test results

Comment [a32]: Remove this

Comment [a33]: Put test results in all such statements

Table -1: Species Composition and Biodiversity Status of SNP (ANOVA)

Plants biodiversity				Animal biodiversity			
Group	Species	Mean No. found	Total	Group	Species (Animals)	Mean No. found	Total
Trees	Shal	76a	126 a	Birds	Shalik (Martin)	4b	35b
	Shegun(teak)	7c			Bulbuli (Red- vented bulbul)	2d	
	Am (Mango)	1h			Kakil (Cuckoo)	1e	
	Jam (Black berry)	2g			Tuntuni	6a	
	Kanthal (Jacfruit)	2g			Doel (Magpie Robin)	6a	
	Amloki (Aonla)	4c			Shama	2d	
	Tal (palm)	1h			Kath hokra (Wood peacker)	4b	
	Bohera	3f			Tia (Rose ringed parakeet)	1e	

	Eucalyptus	11b			Ghugu (Dove)	3c			
	Jarul	1h			Lokhipecha	1e			
	Mohua	2g			Bonmorog	1e			
	Amra (plum)	1h			Machranga	2d			
	Akashmoni	5d			Bok	2d			
	Mehogoni	1h			Amphibians	Kuno bang		3b	8e
	Tetul (Tamarind)	3f				Gecho bang		1c	
	Bel (Bael)	1h				Kula bang (Indian bull frog)		4a	
	Horitoki	2g			Reptiles	GuiShap (Bengle monitor lizard)		1c	13c
	Minjiri	1h				Khatash		5a	
	Neem	2g				Roktochosa		2b	
	Shrubs	Bashok				1c		Gechosap	
Akanda		4a	Dhorasap	2b					
Arhar		2b	Ghokrasap	2b					
Kutushkanta		2b	Mammals	Bon Biral	1b	7e			
KukurSingha		4b		Shiyal (Fox)	1b				
Herbs	Thankuni	2c	19c	Badur	2a				
	Kalomegh	4b		Khorgosh	1b				
	Patka	2c		Indur	1b				
	Bhant	7a		Chika	1b				
Climbers	Bet	11a	18c						
	Kumarilata	2c							
	Ashamilata	1d							
	Harjora	4d							

* Figures followed by similar letters in the same column are not statistically significant at 0.05 Level of DMRT

Table-2a: Identification of floral composition at SNP

SINo	Local/ English Name	Scientific Name	Family Name
Tree Species			
1	Am (Mango)	<i>Mangifera indica L</i>	Anacardiaceae
2	Amra (Hog pulm)	<i>Spondia spinnata (L.f.) Kerz</i>	Anacardiaceae
3	Bohera	<i>Terminalia belerica Roxb</i>	Combretaceae
4	Amloki(Aonla)	<i>Phyllanthus embelica L.</i>	Euphorbiaceae
5	Horitoki	<i>Terminalia chebula</i>	Combretaceae
6	Shegun	<i>Tectona grandis</i>	Verbenaceae
7	Mohua	<i>Madhuca longiolia</i>	Sapotaceae
8	Akashmoni	<i>Acacia auriculiformis</i>	Mimosaceae
9	Jarul	<i>Lagerstroemia speciosa (L.) Pers</i>	Lythraceae

10	Mehogoni	<i>Swe-ietenia macrophylla</i>	Miliaceae
11	Tetul(Tamarind)	<i>Tamarindus indica</i>	Caesalpinieae
12	Bel (Bael)	<i>Aeole marmelos</i>	Rutaceae
13	Tal (palm)	<i>Borassus abellifer</i>	Palmae
14	Kathal(Jackfruit)	<i>Artocarpus heterophyllus</i>	Moraceae
15	Minjiri	<i>Acacia mangium</i>	Mimosaceae
16	Jam(Black berry)	<i>Syzygium grandis (Wt.) Wall.</i>	Meliaceae
17	Sal (Gajari)	<i>Shorea robusta Gaertn</i>	Dipterocarpaceae
18	Eucalyptus	<i>Eucalyptus comaldulensis</i>	Myrtaceae
19	Neem	<i>Azadiracta indica</i>	Meliaceae
Herb Species			
1	Thankuni	<i>Centella asiatico (L.) Urban</i>	Umbellifera
2	Bhant	<i>Clerodendrum viscosumvent</i>	Verbinaceae
3	Kalomegh	<i>Androgrophis paniculata Nees</i>	Acanthaceae
4	Kukursinga	<i>Blumeala cera (Burm. F.) DC.</i>	Compositae
5	Patka	<i>Grewia microcos L.</i>	Teliaceae
Shrub Species			
1	Bashok	<i>Adhatoda vasicaNees</i>	Acanthaceae
2	Akanda	<i>Calotropisgigontea Br.</i>	Asclepiadaceae
3	Arhar	<i>Cajanus cajan (L.) Millsp.</i>	Leguminosae
4	Kutushkanta	<i>Lantana camara L Var.</i>	Verbinaceae
Climber Species			
1	Assam lata	<i>Mikania candens</i>	Compositae
2	Kumarilata	<i>Smilax zeylanica L.</i>	Smilacaceae
3	Harjora	<i>Vitisquadrans gularis Wall.</i>	Vitaceae
4	Bet	<i>Calamus rotung Willd.</i>	Palmae

Table - 2b: Identification of faunal composition at SNP

Sl. No.	Local/English Name	Scientific Name	Family Name
Birds Species			
1	Salik (Martin)	<i>Acridothe restritis</i>	Sturnidae
2	Bulbuli (Red-vented bulbul)	<i>Pycnonotus cafer</i>	Pycnonotidae
3	Kakil (Cuckoo)	<i>Eudynamys scolopacea</i>	Cuculidae
4	Tuntuni (Tailor bird)	<i>Orthotomus sutorius</i>	Muscicapidae
5	Doel (Magpie-robin)	<i>Copsychussaularis</i>	Muscicapidae
6	Shama	<i>Copsychus malabaricus</i>	Muscicapidae
7	Kath thokra (Woodpecker)	<i>Microptermus brachyurus</i>	Picidae

8	Tia (Rose ringed parakeet)	<i>Psittacula krameri</i>	Psittacidae
9	Ghugu (Dove)	<i>Streptopelia chinensis</i>	Columbidae
10	Bonmorog	<i>Gallus gallus</i>	Phasianidae
11	Lokhipocha	<i>Tyto alba</i>	Tytonidae
12	Machranga	<i>Alcedo atthis</i>	Alcedinidae
13	Bok	<i>Ardeola grayii</i>	Ardeidae
Amphibian Species			
1	Kuno bang	<i>Bufo melanostictus</i>	Bufonidae
2	Gecho bang	<i>Rhacophorus leocomystax</i>	Rhacophoridae
3	Kula bang	<i>Rana tigrina</i>	Ranidae
Reptile Species			
1	Guishap	<i>Varanus bengalensis</i>	Varanidae
2	Khatus (Lizard)	<i>Calotes versicolor</i>	Agamidae
3	Roktochosa	<i>Calotes rouxii</i>	Agamidae
4	Gechosap	<i>Dendrela phispictus</i>	Colubridae
5	Dhorasap	<i>Xenochrophis piscator</i>	Colubridae
6	Ghokrasap	<i>Naja naja</i>	Elapidae
Mammal Species			
1	Sheal (Jackle)	<i>Trachypithecus pileatus</i>	Cercopithecidae
2	Bon Biral	<i>Felis chaus</i>	Felidae
3	Khorgosh (Hare)	<i>Axis axis</i>	Cervidae
4	Badur	<i>Pteropus giganteus</i>	Pteropodidae
5	Indur	<i>Bandicota bengalensis</i>	Muridae
6	Chika	<i>Suncus murinus</i>	Soricidae

3.2 Forest management and conservation Activity

Forest management today is almost totally different from the past in respect of its objectives and philosophy. Present-day forest management objectives are not only to produce timber but also to provide clean air, clean water, and a healthy habitat for wildlife and to act as a major harbor of biodiversity and nature based tourism. The present philosophy is to involve people in the management of forest resources and create an environment so that people can feel that they have also a share on trees growing on forestland as well as to improve the living standard of people residing in the vicinity of the forest.

Present-day forest management in Bangladesh is primarily guided by the Forestry Master Plan (FMP) completed in 1993 with the assistance of ADB, UNDP and FAO.

3.2.1 Co- management as forest management and conservation

To conserve the biodiversity of protected area a new approach co-management practice is initiated in this regarding areas. The co-management practice in this regard enables local park manager to manage the park effectively by ensuring the equity of local people in decision making and benefit sharing. In Singra National Park a FD project financed by USAID tries to develop a co-management structure in the area. Already they formed some co-management committee to involve local community members in decision-making process by taking representative from each social class and forest stakeholders. Members have been taken from local political elites (who sometimes were supposed to be the godfather of the illegal loggers), former illegal loggers, local influential persons, and administrative staffs from upozilla headquarters, FD officials etc. Some formal meetings are now held regularly to approve new decisions and evaluating effectiveness of the present management regimes. One of the very important aspects of the management approach is to provide economic incentives to the local people. Though the support was very limited, it has built the trust between the government and local stakeholders (Rashid et al. 2013a).

3.2.2 Afforestation and reforestation activities

In order to restore degraded forest lands of SNP, people-oriented forestry was introduced as an alternative to traditional forest management. Active participation in the management of forest resources was encouraged through these programs. Participation was successfully created in different degraded forest zones. A total 110000 number of plants of different forest fruit and medicinal species were planted in the degraded area of the forest. (Table -3)

Table 3 Afforestation and reforestation activities

Area	Types of Species	No of species / plants	Name of Species	Age of Trees	Average height(m)	Remarks
	Timber trees	70000 plants of 12 species	1. Segun (<i>Tectona grandis</i>)	2.5 years	4.5	Forest
			2. Sal (<i>Shorea robusta</i>)	”	”	”
			3. Jarul (<i>Lagerstroemia speciosa</i>)	”	3.5	”
			4. Minjiri (<i>Cassia siamea</i>)	”	”	Forest & Homestead

225			5. Gamar (<i>Gmelina arborea</i>)	”	”	Forest	
			6. Acacia (<i>Acacia auriculiformis</i>)	”	4.5	Forest, Homestead & road side	
			7. Eucalyptus (<i>Eucalyptus globulus</i>)	”	”	”	
			8. Jhau (<i>Casuarina equisetifolia</i>)	”	”	Forest	
			9. Mahagony (<i>Swietenia macrophylla</i>)	”	3.0	Forest, Homestead & road side	
			10. Koroï (<i>Albizia sp.</i>)	”	4.5	”	
			11. Simul (<i>Bombax ceiba</i>),	”	”	”	
			12. Ipil-ipil (<i>Leucaena leucocephala</i>)	2 years	”	”	
			13. Mangium (<i>Acacia mangium</i>)	”	”	”	
			14. Kadam (<i>Anthocephallus chinensis</i>)	”	”	”	
		Fruits Species	18000 plants of 7 species	1. Bohera (<i>Terminalia bellerica</i>)	2.5 years	3.5	Forest
				2. Horitoki (<i>Terminalia chebula</i>)	”	”	”
				3. Bot (<i>Ficus sp.</i>)	”	”	”
				4. Jalpai (<i>Elaeocarpus floribundus</i>)	”	”	”
				5. Jam (<i>Syzigium sp.</i>)	”	”	”
				6. Amloki (<i>Phyllanthus emblica</i>)	”	”	”
				7. Mango (<i>Mangifera indica</i>)	2 years	”	Homestead
		Medicinal species	22000 plants of 6 species	1. Neem (<i>Azadirachta indica</i>)	”	”	Homestead & road side
				2. Gora neem (<i>Melia azadirachta</i>)	”	”	”
				3. Arjun (<i>Terminalia arjuna</i>)	2.5 years	”	”
				4. Khair (<i>Acacia catechu</i>)	”	”	Forest
				5. Nageswer (<i>Mesua ferrea</i>)	”	”	”
	6. Petali (<i>Trewia nudiflora</i>)			”	”	”	
	7. Agar (<i>Aquilaria agallocha</i>)			”	”	”	

3.2.3 People response towards co- management

Although, peoples under various beneficial schemes in SNP area are still very limited but the preliminary results of these efforts were found to be encouraging. According to local peoples, “people’s involvement in various forest practices like illegal logging, fuel wood collection, NTFP harvesting etc. in the studied villages are significantly reduced compared to earlier”. Again since some other NGO’s have been worked

to create some alternative income generating (AIG) opportunities among the primary forest stakeholders in SNP, their dependency on forest for livelihood income has found to be compacted. Again as the people came to an understanding about the necessity of conserving forest for their survival and to secure their future generations, now they change their mind, earn money in clear and authorized ways. During the study several former illegal poachers were found to contribute to the betterment of their society by involving in various environmental regeneration activities like tree planting.

Conclusion

Since people's involvement is one of the major criteria of co-management approaches, their involvement should be confirmed from decision making to the implementation process, and sharing of benefits should be exercised in a fair and honest approach. Most of the poor villagers have little or no idea about biodiversity conservation. So, steps should be taken by the managing body to make villagers aware of species conservation as well as the link of deforestation, global warming, climate change and their consequences. Considering local dependence on the forest resources, sustainable use of some resources like vegetables, honey, medicinal plants and other non-timber forest products may be allowed. Clear felling should be stopped by any means to conserve the forest biodiversity.

References

- Ahmad, A.I. 2008. Underlying causes of deforestation and forest degradation in Bangladesh. Institute of Cultural affairs (ICA), Bangladesh, pp. 6-21.
- Alam, M., Furukawa, Y., Sarker, S.K. and Ahmed, R. 2008. Sustainability of Sal (*Shorea robusta*) forest in Bangladesh: past, present, and future actions, *International Forestry Review* 10:29-37.
- Arunachalam, A. 2002. Species diversity in two different forest types of Western Ghats, India. *Ann. Forest.* 10(2): 204-213.
- Ashutosh, M., Laxini, M., Sharma, C.M., Sharma, S.D., Mishra, A. and Mishra, 2002. Community structure and growing stock variation on different aspects of Dry Semi-Evergreen *Shorea robusta* forest cover type of Garhwal Himalaya. *Ann. Forest.* 10(2): 233-242.
- Banglapedia. 2008. National encyclopedia of Bangladesh, Sal forest, Banglapedia. Retrieved February 10, 2009, from http://banglapedia.search.com.bd/HT/S_0035.htm
- Barry, M.J., Bowers, R. and Deszalay, F.A. 2004. -Effects of hydrology, herbivory and sediment disturbance on plant recruitment in a Lake Erie Coastal Wetland. *American Midland Naturalist*, Department of Biological Sciences, Kent State University, Ohio, USA. 151(2): 217-232.

Comment [a34]: Please, you have not discussed your work. After results, you are supposed to discuss your work in respects to similar works. From literature of similar works, you can be able to deduce if you are in agreement with past works or you have contrary views. This makes your work very Scientific

Comment [a35]: To create awareness among villagers on species conservation

- Barry, M.J., Bowers, R. and Deszalay, F.A. 2004. -Effects of hydrology, herbivory and sediment disturbance on plant recruitment in a Lake Erie Coastal Wetland. *American Midland Naturalist*, Department of Biological Sciences, Kent State University, Ohio, USA. 151(2): 217-232.
- Bauer, D.M., Cyr, N.E. and Swallow, S.K. 2004. Public preferences for compensatory mitigation of salt marsh losses: A contingent choice of alternatives. *Conservation Biol.* 18(2): 401-411.
- BBS (Bangladesh Bureau of Statistics). 2004. Statistical year book of Bangladesh Bureau Stat, Stat. Div. Ministry of Plan. Govt. of People's Rep. Bangladesh, Dhaka. pp. 26-30.
- BBS (Bangladesh Bureau of Statistics). 2010. Statistical year book of Bangladesh Bureau Stat, Stat. Div. Ministry of Plan. Govt. of People's Rep. Bangladesh, Dhaka. pp. 38-47.
- Begum, F. 1996. Country report on biodiversity conservation in Bangladesh People Republic of Bangladesh. Dhaka. pp. 96-111.
- Brose, U. 2003. Regional diversity of temporary wetland carabid beetle communities: a matter of landscape features or cultivation intensity. *Agric.* 98(1-3): 163-167.
- Brown, T. Edinger, E., and Hooper, R. 2006. Benthic biodiversity of two near-shore Arctic locations, and potential impacts of sea level change, coastal erosion, and climate change. 3rd Annual Arctic Net Scientific Meeting. Victoria, British Columbia. 4(2): 31.
- Findlay, Scott, C.J. and Bourdages, J. 2005. Response time of wetland biodiversity to road construction on adjacent lands. *Conservation Biol.* 14(1): 86-94.
- GAiA. 2008. The Relevance of Effective Protected Areas for Biological Conservation: An Introduction. 17(SI) pp 86-89.
- Gain, P., 2004. Modhupur Forest. Demise Is Imminent U, Society for Environment and Human Development (SEHD).
- GOB. 1992. Forestry Master Plan (Participatory Forestry), Ministry of Environment and Forests, Peoples Republic of Bangladesh, Dhaka.
- Gomez A. K. and Gomez A. A. 1984. Statistical Procedure for Agricultural Research. Intl. Rice Res. Inst., John Wiley and Sons. New York, Chichester, Brisbane, Toronto, Singapore. P. 680.
- Gomez, K.A. and Gomez, A.A. 1984. *Statistical procedures for agricultural research*. (2nd eds) John Wiley and Sons. Inc., New York. 680 p.
- Haque, N. 2007. Depletion of Tropical Forests with Particular Reference to Bangladesh. Retrieved February 10, 2009, from http://www.eb2000.org/short_note_10.htm

- Huang, W.D., Pohjonenn, V., Johansson, S., Nashanda, M., Katigula, M.LL.andLuukkanen, O. 2003.Species diversity, forest structure and species composition in Tanzanian tropical forests. *Forest Ecol. Manag.* 173(1-3): 11-24.
- Hylander, K., Nilson, C., Jonsson, B.G. and Goethner, T. 2005. Differences in habitat quality explain nestedness in a land snail meta-communities. *Ecology and Environmental Science Department, Umea University, Umea, Sweden.OIKOS.* 108(2): 351-361.
- Isa, L, Hamsawi, S. and Cheksum, T. 2002. Floristic Composition of Forest Formation at Mahua, Crocker Range National Park, Sabah.Asean Rev. Biodiver. Environ. Conserv.(ARBEC). 5(2): 67-80.
- Islam, N. 2005. Environmental Issues in Bangladesh: An Overview. *Pakistan Journal of Social Sciences* 3:671-679.
- IUCN. 1994. Guidelines for Protected Area Management Categories. The World Conservation Union (IUCN), Cambridge, UK.pp 259.
- Jeet-Ram, Arvind-kumar and Jutendra-Bhatt. 2004. Plant diversity in six forest types of Uttaranchal, Central Himalaya, India. *Department of Forestry, Kumaun University, India.* 87(7): 975-978.
- Kabir D.S. and Ahmed A.Z. 2005. Wildlife Biodiversity in Bhawal National Park: Management Techniques and Drawbacks of Wildlife Management and, Nature Conservation. *Our Nature* 3: pp 83-90.
- Khan, E. 2001.Water and environment. In: Bangladesh: State of environment report 2000. Forum of Environmental Journalists of Bangladesh (FEJB), SegunBagichha, Dhaka-1000. pp. 17-25.
- Koellner, T., Schmitz, O. J. 2006. Biodiversity, Ecosystem Function, and Investment Risk .*BioScience, American Inst. Biol. Sci.* 56(12): 977-985.
- Malaker JC, Rahman MM, Azad-Ud-Doula Prodhana AKM, Malaker SK, Khan MAH (2010) Floristic composition of Madhupursal forest in Bangladesh. *J. Soil Nature*4(1), pp 25-33.
- MEA (Millennium Ecosystem Assessment) 2005.Ecosystem and Human Wellbeing Synthesis. Washington. D. C., Island Press.
- Miller, J.R. 2005.Biodiversity conservation and the extinction of experience. *Trends in Ecology and Evolution, Elsevier Ltd.* 20(8): 430-434.
- Motiur, M.R. 2006.Management and economics of homestead forests in Bangladesh. PhD thesis submitted to United Graduate School of Agricultural Sciences, Ehime University, Matsuyama, Japan.
- Mulongoy, K.J. and Chape, S.P. (eds). 2004. Protected Areas and Biodiversity: An overview of key issues. CBD Secretariat, Montreal and UNEP-WCMC, Cambridge, UK.pp 52.
- Munesh, K., Sharma, C.M. and Rajwar, G.S. 2004.A study on community structure and diversity of a sub-tropical forest of GarhwalHimalayas.*Indian Forest.* 130(2): 207-214.

- O.M. Nuñez et al., A Photographic Guide to Vertebrate fauna of Mt. Malindang, The Philippine-Netherlands Biodiversity Research Program for Development in Mindanao, SEAMEO SEARCA, College Laguna, 2006.
- P.B. Pelser, J.F. Barcelona, D.L. Nickrent, onwards. Co's Digital Flora of the Philippines, 2011. Available: www.philippineplants.org
- Rahman, M.A., Mossa. J. S. and Al-Said, M. S. 2004. Medicinal plants diversity in the flora of Saudi Arabia a report on seven plant families. Dept. of pharmacognosy of pharmacy, King Saud Unilversity, Saudi-Arabia. 75(2): 149-161.
- Rashid, A.Z.M.M., Craig, D., Mukul, S.A., Khan, N.A. 2013a. A journey towards shared governance: status and prospects for collaborative management in the protected areas of Bangladesh. Journal of Forestry Research 24: 599–605.
- Rasid, M. 1990. Fulerchash Bangla Academy, Dhaka. Bangladesh. pp. 34-172.
- Tchouto-MGP. 2004. Plant diversity in a Central American Rainforest: implications of biodiversity conservation in Cameroon. Tropenbos Cameroon-series. 7: 208.

Comment [a36]: Your referencing is poor. Some starts with abbreviations and some do not. If you take a referencing style, follow it throughout