The Biodiversity Status and Conservation Activities of Singra National Park (SNP) in the Link of Co-Management Strategy

M. M. Ali[1*], N. Akter[2], M. R. Kabir[1], M. M. Hasan[1], M. M. Rahman[3] and M. S. Bari[1]

[1]Department of Agroforestry and Environment, Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, Bangladesh.
[2]Department of Horticulture, HSTU, Dinajpur, Bangladesh.
[3]Department of Agriculture Extension, People's Republic of Bangladesh, Nilphamari Sadar, Nilphamari, Bangladesh.

Authors' contributions

This work was carried out in collaboration among all authors. Authors MMA and MSB designed the study. Authors MMA, MRK and MMH collected the field data, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors NA and MMR managed the analyses of the study and literature searches. All authors read and approved the final manuscript.

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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 including 19 tree species, 5 herbs, 4 shrubs and four climbers. Inventory of fauna species was conducted using a combination of transect walk/ opportunistic and ethno zoological interview methods. Total 28 animal species were recorded of which 13 were birds, 3 were

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*Corresponding author: E-mail: manikhstu49@gmail.com;

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 problems with management of wildlife. Data were collected from the SNPauthority 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 domains. Forest authorities are trying to involve the people in and around the forest to co-management for conservation and restoration of the forest.

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 [1]. 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 valuable timber and wood tree species, the forests and the village groves have been important sources of numerous wild resource species, like fruit and nuts, fuel and fodder, vegetables, medicinal plants, bamboo and many other non-wood forest species. 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 balanced ecosystem. The forested areas, however, are decreasing day by day all over the world as a result of human activities. Asia is losing almost 1% of tropical forest per year. 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 [2]. 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 [3]. However, the Sal forest covers about 0.12 million hectares of land comprising about 4.7% of the total forest area of the country [4]. About 86% of Sal forest land is situated in this central region and the remaining 14% of Sal forest belongs to the northern part of the country [5].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 [6]. It has been reported that Sal forests are the most threatened ecosystem of Bangladesh [7]. 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 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 promulgated the forest as national park in 2010. During the 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 Birganj Upazila at approximately between the latitudes of 25º90'N and 26º30'N and longitudes 88º20'E and 88º50'E in the district of Dinajpur. It is located 45 km southwest corner from Dinajpur town besides the Dinajpur – Panchagarh highway with Dalagram, Chaulia, Singra, Nortodangi, Gandari, Singhojani, Sator, Ganpoito, Rathinthpur and Laskarpur Mouza. The Singrasal forest had an area of 305.69 hectare.
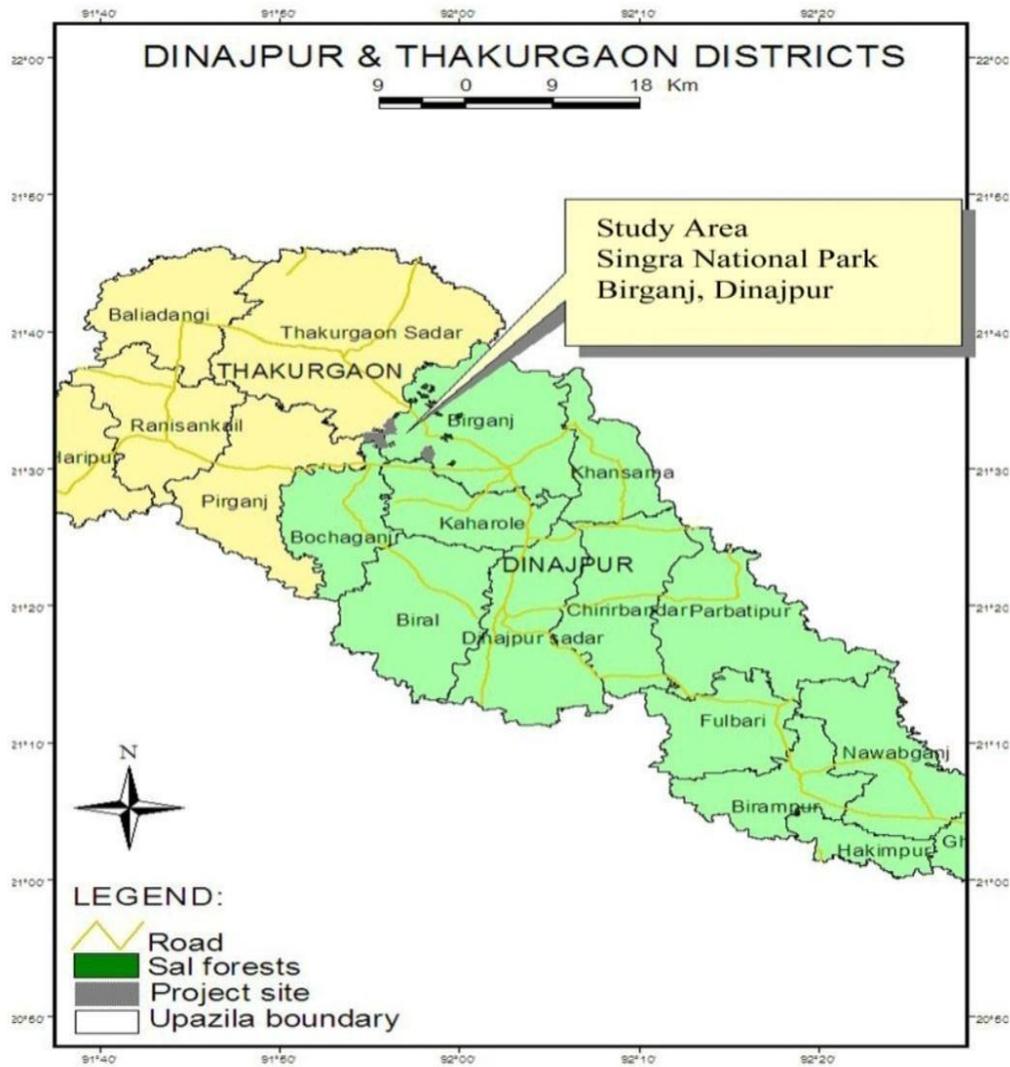

Fig. 1. Showing Study Area Singra National Park (SNP)

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 value5.79, total nitrogen % 0.072, organic carbon % 0.729, organic matter 1.26%, phosphorus 8ppm, sulphur l0ppm, and exchangeable potassium 38ppm under agro-ecological zone (AEZ-1) Old Himalayan piedmont [8]. The studied area enjoys a 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 November to February.Average highest temperature was 34.6°C andlowest 9.7°CAverage annual rainfall was 181mm [9]. The cool dry season records lowest temperature and relative humidity of the year. Of course this value fluctuates from year to year.

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) quadrate plots were established for the identification of tree species, shrubs and herbs. 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 [10].Analysis and identification of tree species were based on the standard taxonomic classification [11].Some key informant interview was conducted with various stakeholders which people were expert 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 the Assistant conservator of forest (ACF) and Bit Ranger to assess what exactly happens at local level, what are causes of deforestation and what steps are taken to recover degradation. Some group

discussion was done, the group discussions will be conducted in each of the study areas, 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 [12].

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, Haritaki, (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) preceded by Kumarilata (mean, 1.00) . In case of fauna, 13 species of birds, 3 species of amphibians, 6 species of mammals were and6 species of reptiles were found. Among them the highest number of birds was Magpie Robin and Tuntuni,(mean, 6.00) followed by Woodpecker, Shalik and Machranga (mean, 4.0). The lowest number of birds was found in the Cuckoo Rose Ringed 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

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 (Jackfruit)	2g			Doel(Magpie Robin)	6a	
	Amloki (Aonla)	4c			Shama	2d	
	Tal(palm)	1h			Kath hokra(Woodpecker)	4b	
	Bohera	3f			Tia (Rose Ringed parakeet)	1e	
	Eucalyptus	11b			Ghugu (Dove)	3c	
	Jarul	1h			Lokkhi Pecha	1e	
	Mohua	2g			Bon Morog	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 bullfrog)	4a	
	Haritaki	2g		Reptiles	GuiShap(Bengle monitor lizard)	1c	13c
	Minjiri	1h			Khatash	5a	
	Neem	2g			Rokto Chosa	2b	
Shrubs	Bashok	1c	9e		Gechosap	1c	
	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	

Plants biodiversity				Animal biodiversity			
Group	Species	Mean No. found	Total	Group	Species (Animals)	Mean No. found	Total
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 2(a). Identification of floral composition at SNP

Sl. No.	Local/English Name	Scientific Name	Family Name
Tree Species			
1	Am (Mango)	*Mangifera indica L*	Anacardiaceae
2	Amra(Hog plum)	*Spondiaspinnata (L.f.) Kerz*	Anacardiaceae
3	Bohera	*TerminaliabelericaRoxb*	Combretaceae
4	Amloki(Aonla)	*Phyllanthus emblica L.*	Euphorbiaceae
5	Haritaki	*Terminaliachebula*	Combretaceae
6	Shegun	*Tectona grandis*	Verbenaceae
7	Mohua	*Madhuca longifolia*	Sapotaceae
8	Akashmoni	*Acacia auriculiformis*	Mimosaceae
9	Jarul	*Lagerstroemia speciosa (L.) Pers*	Lythraceae
10	Mehogoni	*Swietenia Macrophylla*	Meliaceae
11	Tetul(Tamarind)	*Tamarindus Indica*	Caesalpiniaceae
12	Bel(Bael)	*Aeolemar melos*	Rutaceae
13	Tal (palm)	*Borassus Flabellifer*	Palmae
14	Kathal(Jackfruit)	*Artocarpus heterophyllus*	Moraceae
15	Minjiri	*Acacia mangium*	Mimosaceae
16	Jam(Black berry)	*Syzygiumgrandis (Wt.) Wall.*	Meliaceae
17	Sal (Gajari)	*ShorearobustaGaertn*	Dipterocarpaceae
18	Eucalyptus	*Eucalyptus camaldulensis*	Myrtaceae
19	Neem	*Azadiractaindica*	Meliaceae
Herb Species			
1	Thankuni	*Centella asiatica (L.) Urban*	Umbellifera

Sl. No.	Local/English Name	Scientific Name	Family Name
2	Bhant	*Clerodendrum Viscosum Vent*	Verbenaceae
3	Kalomegh	*Andrographis paniculata Nees*	Acanthaceae
4	Kukursinga	*Blumea Lacera (Burm. F.) DC.*	Compositae
5	Patka	*Grewiamicrocos L.*	Liliaceae
Shrub Species			
1	Bashok	*AdhatodavasicaNees*	Acanthaceae
2	Akanda	*Calotropis Gigantea Br.*	Asclepiadaceae
3	Arhar	*Cajanus Cajan (L.) Millsp.*	Leguminosae
4	Kutushkanta	*Lantana camara L Var.*	Verbenaceae
Climber Species			
1	Assam lata	*Mikaniascandens*	Compositae
2	Kumari Lata	*Smilax zeylanica L.*	Smilacaceae
3	Harjora	*Vitis Quadrangularis Wall.*	Vitaceae
4	Bet	*Calamus rotang Wild.*	Palmae

Table 2(b). Identification of faunal composition at SNP

Sl. No.	Local/English Name	Scientific Name	Family Name
Birds Species			
1	Salik(Martin)	*Acridotheres tristis*	Sturnidae
2	Bulbuli(Red-vented bulbul)	*Pycnonotus cafer*	Pycnonotidae
3	Kakil(Cuckoo)	*Eudynamys scolopaceus*	Cuculidae
4	Tuntuni(Tailor bird)	*Orthotomussutorius*	Muscicapidae
5	Doel(Magpie-robin)	*Copsychus saularis*	Muscicapidae
6	Shama	*Copsychus malabaricus*	Muscicapidae
7	Kath thokra(Woodpecker)	*Micropterus brachyurus*	Picidae
8	Tia(Rose Ringed parakeet)	*Psittacula krameri*	Psittaddae
9	Ghugu (Dove)	*Streptopelia chinensis*	Columbidae
10	Bon Morog	*Gallus gallus*	Phasianidae
11	Lokkhi Pecha	*Tyto alba*	Tytonidae
12	Machranga	*Alcedo atthis*	Alcedinidae
13	Bok	*Ardeola grayii*	Ardeidae
Amphibian Species			

Sl. No.	Local/English Name	Scientific Name	Family Name
1	Kuno bang	*Bufo melanostictus*	Bufonidae
2	Gecho bang	*Rhacophorusleocomystax*	Rhacophoridae
3	Kula bang	*Rana tigrina*	Ranidae
Reptile Species			
1	Guishap	*Varanusbengalensis*	Varanidae
2	Khatus (Lizard)	*Calotes versicolor*	Agamidae
3	Rokto Chosa	*Calotes rouxii*	Agamidae
4	Gechosap	*Dendrelaphis pictus*	Colubridae
5	Dhorasap	*Xenochrophispiscator*	Colubridae
6	Ghokrasap	*Naja naja*	Elapidae
Mammal Species			
1	Sheal(Jackal)	*Trachypithecus pileatus*	Cercopithecidae
2	Bon Biral	*Felischaus*	Felidae
3	Khorgosh(Hare)	*Axis axis*	Cervidae
4	Badur	*Pteropus Giganteus*	Pteropodidae
5	Indur	*Bandicota Bengalensis*	Muridae
6	Chika	*Suncus Murinus*	Soricidae

Table 3. Afforestation and reforestation activities

Area	Types of Species	No of species /plants	Name of Species	Age of Trees	Average height(m)	Remarks
225	Timber trees	70000 plants of 12 species	1. Según (*Tectonagrandis*)	2.5 years	4.5	Forest
			2. Sal (*Shorea robusta*)	”	”	”
			3. Jarul (*Lagerstroemia speciosa*)	”	3.5	”
			4. Minjiri (*Cassia siamea*)	”	”	Forest & Homestead
			5. Gamar (*Gmelina arborea*)	”	”	Forest
			6. Acacia (*Acacia auriculiformis*)	”	4.5	Forest, Homestead road side
			7. Eucalyptus (*Eucalyptus globulus*)	”	”	”
			8. Jhau (*Casuarina Equisetifolia*)	”	”	Forest
			9. Mahogany (*Swietenia Macrophylla*)	”	3.0	Forest, Homestead & road side

Area	Types of Species	No of species /plants	Name of Species	Age of Trees	Average height(m)	Remarks
			10. Koroi (*Albizia sp.*)	"	4.5	"
			11.Simul (*Bombaxceiba*),	"	"	"
			12.Ipil-ipil (*Leucaena leucocephala*)	2 years	"	"
			13.Mangium (*Acacia mangium*)	"	"	"
			14. Kadam (*Anthocephalus Chinensis*)	"	"	"
	Fruits Species	18000 plants of 7 species	1. Bohera (*Terminaliabellerica*)	2.5 years	3.5	Forest
			2. Haritaki(*Terminaliachebula*)	"	"	"
			3. Bot (*Ficus sp.*)	"	"	"
			4. Jalpai (*Elaeocarpus Floribundus*)	"	"	"
			5. Jam (*Syzygium sp.*)	"	"	"
			6. Amloki(*Phyllanthusemblica*)	"	"	"
			7. Mango (*Mangifera Indica*)	2 years	"	Homestead
	Medicinal specis	22000 plants of 6 species	1. Neem (*Azadirachta Indica*)	"	"	Homestead & road side
			2. Gora neem (*Melia Azadirachta*)	"	"	"
			3. Arjun (*Terminaliaarjuna*)	2.5 years	"	"
			4. Khair (*Acacia catechu*)	"	"	Forest
			5. Nageswer (*Mesuaferrea*)	"	"	"
			6. Petali (*Treia Nudiflora*)	"	"	"
			7. Agar (*Aquilaria Agallocha*)	"	"	"

mammals was found Fox and Bon Biral (mean, 1.00).The highest number of reptiles was Lizard/Khatash(mean, 5.00) followed by DhoraSap and Ghokra sap (mean, 2.00) and the lowest number of reptiles was GuiShapand 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).

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 of 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 the protected area a new approach co-management practice is initiated in this regarding areas. The co-management practice in this regard enables local park managers to manage the park effectively by ensuring the equity of local people in decision making and benefit sharing. In SingraNational Park a FD project financed by USAID tries to develop a co-management structure in the area. Additionally they formed some co-management committees to involve local community members in decision-making by taking representatives 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 staff from upazila 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 [13]

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)

3.2.3 People response towards co-management

Although, people under various beneficial schemes in the 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 NGOs have been working 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.

4. 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.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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