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A Review on Plant Biodiversity and Conservation in Bangladesh: Drawbacks and Prospects

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ABSTRACT

Biodiversity has become the talk of topic for so many years of its rapid decrease world-wide. Due to the geographical position and soil fertility Bangladesh is exceptionally endowed with a huge variety of plant species. In Bangladesh, the destruction of plant species in the forests and protected areas is a continuous process due to increasing population pressure, rural poverty, joblessness, lack of knowledge, absence of public awareness and other natural calamities etc. which pose a serious threat to the plant biodiversity. The Government and researchers of Bangladesh have undertaken several surveys, scientific researches, and monitoring, which helps to document related databases, to protect and restore ecosystems and biodiversity. This paper is based on the literature survey of some renowned researchers' studies and applications in biodiversity conservation in Bangladesh. Thus, this study attempts to review the present scenario of plant diversity, causes of loss or depletion of plant diversity, initiatives taken for the conservation by the government and last but not least the prospects of plant biodiversity in Bangladesh.

INTRODUCTION

Biodiversity or biological diversity refers to the variety and variability of life on Earth. A variety of life forms on earth, with variability of genes, species, ecosystems, and ecological processes covered by biodiversity (Rathoure & Patel 2020). Biodiversity may be defined as the variation that exists in all plants and animal species, starting from their genetic material, within and between the species and the ecosystems in which they occur. The role of biodiversity for a human being cannot be described in a word. Human depends on biodiversity directly or indirectly to meet up their basic demands (food, shelter, clothes and medicines) and aesthetic requirements (Seymour, 2016). Biodiversity is also essential for the sustainable development of various human activities. In this regard in June 1992, the Convention on Biological Diversity (CBD) has been established and signed by more than 150 countries with a common purpose of conservation and sustainable use of biodiversity (Wang *et al.*, 2020). The Convention of Biological Diversity (CBD) defined biodiversity as; 'the variability among living organisms from all sources including; inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part, this includes diversity within species, between species and of ecosystems.

Ecologists classified biodiversity into three levels: genetic diversity (variation in genes and genotypes present in all individual animals, plants, fungi, and microorganisms), species diversity i.e the differences within and between populations of species and among different species or species richness and ecosystem diversity (relationship of species in a community and their environment).

Plants are the most important resources of biodiversity which support the life system on earth. Plant diversity

expresses the number of plant species found in a particular habitat. Plant biodiversity is the genetic treasure of a country. Bangladesh, is a subtropical country, having a wide range of species of plants with vast genetic diversity. Bangladesh is the world's largest delta having a total area of 148,460 square km. Bangladesh lies in the northeastern part of South Asia, between 20° 34' and 26° 38' north latitude and 88° 01' and 92° 41' east longitude. The land of Bangladesh consists of 80% floodplains and 12% hilly areas. The maximum land was formed by the river alluvium of the Ganges and the Brahmaputra and their tributaries (Sarwar, 2019). Though a small country, with great physiographic traits, and different hydrological and climatological conditions Bangladesh harbour a vast variety of flora and fauna and makes contributions to the world's plant biodiversity. With productive soils and seasonal diversity, Bangladesh consists of around 6500 plants species including 5,700 species of angiosperms are estimated, having woody legumes (68), fibre plants (130), medicinal plants (500), orchids (29), gymnosperms (3) and pteridophytes (1,700) (Islam, 2003). These plants are scattered and grown in natural forests, wetlands, homestead forests, gardens, jungles and even on the roadside with natural occurrences or cultivated. (Hossain *et al.*, 2009).

Like other countries of the world, the plant diversity of Bangladesh is also facing a complicated situation of degradation. The tropical forest was rich in Plant biodiversity. It was 11.08% in 2010, which is below the international standard, of 25% (Mannan *et al.*, 2014). (Being an overpopulated country with inadequate area and resources (about 0.06 ha/person) (Ali, 1995 and UNDP, 1995). the issue is getting worse in Bangladesh.

To meet up the demand of the increasing population

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forest resources are used cautiously or incautiously being exploited due to poverty, illiteracy, ignorance, unemployment, greediness and so on. The key reason for the reduction of plant biodiversity can be accredited to the anthropogenic activities on biodiversity. Such as rapid industrialization, urbanization, deforestation takes place, which resulting habitat loss of plant species, environmental pollution, exploitation of wildlife happens, degradation and fragmentation of land, illegal collection and cutting of trees, changes in land use patterns and changes in a hydrological regime that are extremely degrading the diversity of plant., Some other causes are natural calamities such as for instances floods, cyclones, increasing soil salinity, intrusion of invasive alien species etc. are responsible for biodiversity depletion in Bangladesh. Thus, the loss of forests contributes to the increasing temperature of the world, and climate change, resulting in sea level rise, melting of snow as whole global warming.

The balanced use and judicial management of resources of biodiversity, are important to ensure the sustainable improvement of biodiversity. The knowledge of genetic resources and species in an ecosystem is a must for the sustainable development of biodiversity. It is essential to reduce the loss of plant resources by implementing suitable conservation policies for conserving and protecting plant biodiversity.

In this article, we reviewed some studies and applications in the conservation of biodiversity in Bangladesh. This study provides an overall idea of the activities carried out by the scientists, policymakers and Government of Bangladesh such as the planning, execution, and monitoring of conservation schemes, in-situ and ex-situ conservation, natural restoration, applying laws and regulations, knowledge and education and public consciousness. This review study aims to discuss the present status of plant biodiversity in Bangladesh and the strategies followed for their conservation. We also emphasize the limitations and prospects of plant biodiversity conservation in Bangladesh.

METHODS

In this review paper, the present condition of plant biodiversity and conservation in Bangladesh was stated. We also discussed the activities, strategic planning, implementation and monitoring taken by the policymakers and legislators. The challenges in diversity, limitations in execution and prospects are also constructively summarized here. A wide range of research has been published regarding biodiversity loss and conservation. This review article is based on different observations published in research articles and available in online and offline journals. We searched through PubMed and Google Scholar using the terms 'plant' 'Biodiversity', 'conservation', 'Bangladesh', 'prospects', 'challenges', 'limitations', and 'drawbacks' as a basis for reviewing. Research data from national and international journals, magazines, books and documentaries etc. have been

used for the article. Booklets, brochures, project results, programs, videos etc. have been used as the secondary source of information. Browsing, collecting, observing, scanning and sorting out data were done to make the article complete and comprehensive.

RESULTS AND DISCUSSION

Present scenario of plant diversity in Bangladesh

Being a part of the Indo-Burma region Bangladesh belongs to one of the ten global hotspot areas for biodiversity. The geographical position of this country made it very rich in biodiversity (Mukul, 2007) and 7000 endemic plant species are supposed to belong to the country (Mittermeier *et al.* 1998).

So far, 5,700 species of angiosperms are estimated, having woody legumes (68), fibre plants (130), medicinal plants (500), orchids (29), gymnosperms (3) and pteridophytes (1,700) have been documented in Bangladesh (Firoz *et al.*, 2004). Bangladesh is very rich in agro-biodiversity having more than 8,000 rice varieties along with 3,000 crop varieties. Bangladesh Agricultural Research Council have also recorded pulses (3000 varieties), oilseed (781 varieties), vegetables (3516-both species and cultivar), spices (156) and fruits (89) Other than these Biodiversity (Chowdhury, 2012). More than 5000 varieties (both species and cultivar) of jute and 475 varieties of tea have also been documented in the country. However, many of the species and varieties are at risk due to the massive population pressure, overexploitation and extreme utilization of hazardous chemicals in crop fields etc. It is been predicted that already 10% flora of the country has gone extinct (Mukul, 2007a). Reza, 2004 reported that according to Bangladesh National Herbarium, 106 vascular plant species are facing risks of extinction. 167 plant species are documented as vulnerable or endangered in Bangladesh (Dey, 2006).

Major vegetation exists in the forest area of Bangladesh: Three major vegetation types are found in three different ecosystems of Bangladesh i.e. hill forests (evergreen to semi-evergreen); plain land Sal (*Shorea robusta*) forests and mangrove forests. The forest covers 12.8% of the total country area, when only land area is considered, forest cover is 14.1% (Forest Department, 2014).

1. Hill forests (evergreen to semi-evergreen): located in the Eastern part of the country (Chittagong, Chittagong Hill Tracts and Sylhet), covering an area of 0.67 million ha. There are some Unclassed State Forest (USF) situated in the Chittagong Hill Tracts with an area of 0.73 million ha.

2. Plain land Sal (*Shorea robusta*) forests; Generally tropical moist deciduous forest positioned Central and north-western region (Dhaka, Mymensingh, Tangail etc.) and the area is 0.12 million ha.

3. Mangrove forests; Mangrove forests Sundarbans in the Southwest part (Khulna, Satkhira) of the country cover an area of 0.57 million ha. There are also Coastal plantations Along the shoreline of twelve districts which is approximate 0.10 million ha.

4. Village forests; usually homestead forests are spread all over the country with an estimated area of 0.27 million ha.

5. Tea gardens and rubber plantations are positioned in the Chittagong Hill Tracts and Sylhet covering an area of 0.07 million ha.

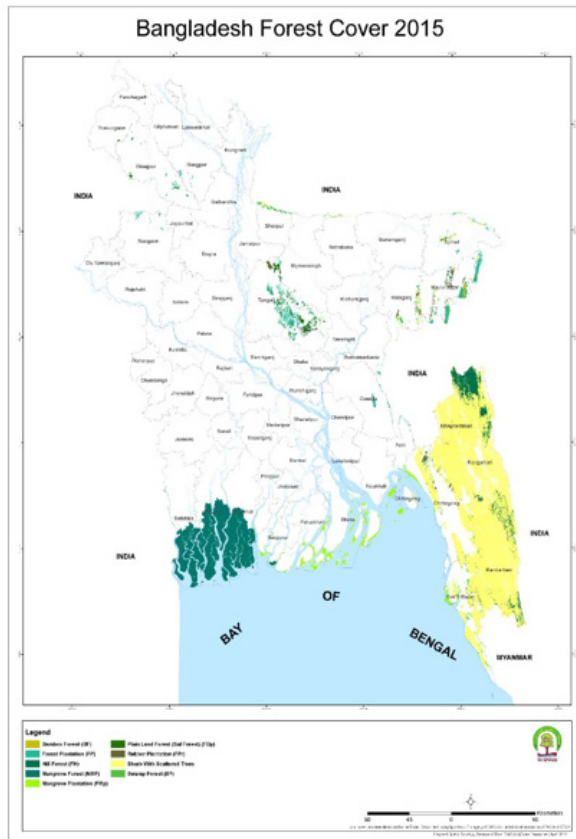


Figure 1 : Map showing forest types of Bangladesh
Source: (Forest department, 2021)

Plant biodiversity loss and Constraints on their conservation

Loss of plant diversity and weak management is a great threat to humankind as directly and indirectly they are dependent on natural resources. Following are some key issues regarding the loss of plant diversity in Bangladesh and some challenges to deal with conservation.

1. Bangladesh is a highly populated country; a large number of people are underlying below the poverty level. Most of the poor people living in rural areas or close to forest areas are dependent on natural resources i.e, plants for food, firewood, fuel, materials for housing construction etc. Intentionally or unintentionally, they are extracting plant species for their livelihood. The rate of extraction or damaging trees for the survival of rural people is more than the natural vegetation and manmade plantation. Thus, the loss of plant species deteriorates the plant diversity and creates problems for the wild animals which are dependent on them for their shelter or food.

2. There are also some natural causes of vegetation losses such as land slide, drought, flood, storm or hail, earthquake, plant disease, forest fire, salinity intrusion and invasion of aggressive and exotic weeds etc.

Clearing of forest land or conversion of forest land for agriculture, roads and human settlement, jhum cultivation practiced of by the tribal people in the Chittagong Hill Tracts, cattle and goat grazing during regeneration phase, rapid urbanization and industrialization, mining and underground resources collection, destruction of the mangrove forests of Chakoria and Teknaf for raising shrimp farms are the anthropogenic causes responsible for the degradation of diversity. Moreover, Greedy people with business interests are associated with unregulated logging, illicit felling of trees, harvesting of medicinal plants, bamboo, cane and Non-Timber Forest Products (NTFPs) indiscriminately (Khan *et al.*, 2009). The overexploitation of plant resources is also making the wild animals shelter less as well as the extinction of both plant and animal species resulting in the loss of total biodiversity.

3. Habitat loss, degradation and fragmentation in all ecosystems due to changes in cropping patterns, conversions of land use patterns, an extension of agricultural land, expansion of road networks, unplanned embankments, urbanization and other factors.

4. Invasion of non-native/alien plant species in Agriculture, and horticulture reasons major damage to the biological community. The effective alien species eradicate the native species towards the point of extinction. So, they are harmful to native species in the ecosystem globally resulting the loss and habitat degradation. This cost is the ir retrievable loss of native species in an ecosystem.

5. Environmental pollution is one of the major concerns nowadays to deteriorate plant diversity. Pollution of air, soil and water due to road runoff from rain and stormwater chemical fertilizers, insecticides, and industrial effluents mixing with soil and water causes damage to crops, aquatic resources and riparian natural resources.

6. The less educational quality or with very little knowledge of the structure and function of the ecosystem is a barrier to understanding the structure of the population, status and value of species in an ecosystem, ecological services on humankind, the rate of depletion of biodiversity and their consequences interrupting the food web of ecosystems.

7. The total species inventory in Bangladesh is incomplete, still, there are so many small to medium landmasses that remain unexplored. There is no central publicly accessible database, no perfect body to preserve and maintain the database, and People do not have any idea where to collect information and pursue assistance in dealing with the issues of biodiversity. To enrich the species data bank of Bangladesh it is essential to discover the unexplored area with the different categories of species such as extinct, vulnerable, endangered etc.

8. Lack of updated information and knowledge gaps leads to in aware lessness and reluctance among people. People are unaware of laws that protect certain plant species and ecosystems, ban the trading of species, controlling of environmental pollution, they are even

unaware of Protected Areas of the country.

9. Bangladesh, there are poor institutional capacities and an absence of trained manpower regarding biodiversity, a deficiency of taxonomic skills, and less efficient personnel to evaluate the conservation of biodiversity. Lack of national body or institution to integrate, cooperate, report, implement and create consciousness regarding biodiversity conservation issues and other processes.

10. There is an absence of proper national biodiversity policy and laws for the conservation of biodiversity. In Bangladesh, current laws are not enough to deal with conservation, sustainable use and equitable sharing of benefits.

11. Poor coordination in management and planning, frequent monitoring, and cross-checking prevail in the system. Less participation of local people in the conservation program rather than exploiting resources influence more depletion of biodiversity in Bangladesh. No political parties are interested in campaigning for the conservation of biodiversity, even during the election while asking for support and voting. Moreover, they are associated in some cases with the deterioration of biodiversity by exercising their power (Mukul,2007). Lack of synergies among different sectors, agencies and actions are the chief weaknesses to attain sustainable goals of biodiversity conservation. Lack of a National Biodiversity Strategy and Action Plan (NBSAP) to report the issues of synergies among nature, biodiversity and sustainable development.

Conservation initiatives are taken by Government

So far, the Bangladesh government has signed several local and international conventions and agreements related to biodiversity conservation (i.e. Convention on Biological Diversity, Convention on International Trade in Endangered Species, Convention on the Conservation of Migratory Species, Ramsar Convention, and World Heritage Convention) (Brown and Durst, 2003).

Henceforth many legislative policies and approaches are taken by the government to deal with the conservation of biodiversity such as 1) National Biodiversity Strategy and Action Plan (NBSAP); 2) National Conservation Strategy (NCS); 3) Bangladesh Wildlife (Preservation) (Amendment) Act, 1974; 4) Bangladesh Forest Act, 1978 and subsequent amendments; 5) National Environment Management Action Plan (NEMAP); 6) The Bangladesh Environment Conservation Act, 1995 and Environment Conservation Rules 1997; 7) Sustainable Environment

Management Program SEMP); and the 8) Nishorgo Support Project (NSP) for the co-management of PAs (Mukul, 2007b)

Bangladesh has also taken various in situ and ex situ conservation actions to preserve its rich biological diversity. The country has declared protected areas, ecologically critical areas, World Heritage Sites, and Ramsar Sites as part of in situ conservation (Mukul *et al.*, 2008). A total of 44 protected areas where there are national parks (24), wildlife sanctuaries (24) and game reserves scattered along the country (Forest Department,2014). on the other hand, botanical gardens, arboretums, preservation plots and gene banks are included under ex situ conservation.

In situ conservation

Ecologically Critical Area (ECA)

The ecosystems which are affected badly by the changes of anthropogenic activities belong to the Ecologically Critical Area (ECA). Where ecologically defined areas are vulnerable to being threatened by a critical state Department of Environment declared those areas as ECA. There are some ECA's declared by the Department of Environment (DoE), so far; Cox's Bazar-Teknaf Sea Beach, St Martin's Island, Sonadia Island, Hakaluki Haor, Tanguar Haor, Marjat Baor, Gulshan Lake Strip of 10 km. outside the Sundarbans Reserved Forest, Buriganga River, Turag River, Sitalakhya River, Balu including Tongi canal River and Jaflong-Dawki.

Protected Areas of Bangladesh

The purpose of protected areas is to conserve biodiversity and the natural environment within the forest vegetation. There are three types of protected areas in the IUCN protected area management category.

Wildlife Sanctuary; The habitat of this area is protected and maintained as an uninterrupted breeding ground for wild fauna. National Park is a relatively big area consisting of a profound amount of plants and wild animals which is open to all for education, research and aesthetic gratification. Game Reserve consists of a moderately isolated area for the protection and increase of wildlife species.

The PAs of Bangladesh consists of 456,086 hectares (without the Marine PA) land, which covers around 18% of the total forest areas of the country (Sarwar, 2019) and 1.8% of the country's total land area (Mukul *et al.*, 2017; Mukul *et al.*, 2008). Table 1 shows the protected areas of Bangladesh according to IUCN.

Table 1: List of protected areas of Bangladesh according to IUCN. (Forest department, 2014)

Wildlife Sanctuaries:			
SI NO.	Protected Areas	Location	Area (ha)
1	Char Kukri-Mukri Wildlife Sanctuary	Bhola	40.00
2	Pablakhali Wildlife Sanctuary	Chittagong Hill Tracts	42,087.00
3	Chunati Wildlife Sanctuary	Chittagong	7,763.97
4	Rema-Kalenga Wildlife Sanctuary	Hobigonj	1,795.54
5	Sundarban (East) Wildlife Sanctuary	Bagerhat	122,920.90
6	Sundarban (West) Wildlife Sanctuary	Satkhira	119,718.88
7	Sundarban (South) Wildlife Sanctuary	Khulna	75,310.30

8	Fashiakhali Wildlife Sanctuary	Cox's Bazar	1,302.43
9	Dudpukuria-Dhopachari Wildlife Sanctuary	Chittagong	4,716.57
10	Hajarikhil Wildlife Sanctuary	Chittagong	1,177.53
11	Sangu Wildlife Sanctuary	Bandarban	2,331.98
12	Teknaf Wildlife Sanctuary	Cox's Bazar	11,615.00
13	Tengragiri Wildlife Sanctuary	Barguna	4,048.58
14	Sonarchar Wildlife Sanctuary	Patuakhali	2,026.48
15	Dudhmukhi Wildlife Sanctuary	Bagerhat	170.00
16	Chadpai Wildlife Sanctuary	Bagerhat	560.00
17	Dhangmari Wildlife Sanctuary	Bagerhat	340.00
18	Nazirganj Wildlife (Dolphin) Sanctuary	Pabna	146.00
19	Shilanda-Nagdemra Wildlife (Dolphin) Sanctuary	Pabna	24.17
20	Nagarbari-Mohanganj Dolphin Sanctuary	Pabna	408.11
21	Pankhali Wildlife (Dolphin) Sanctuary	Khulna	404.00
22	Shibsha Wildlife (Dolphin) Sanctuary	Khulna	2155.00
23	Vadra Wildlife (Dolphin) Sanctuary	Khulna	868.00
24	Padma Setu Wildlife Sanctuary	Madaripur, Shariotpur, Munshiganj, Faridpur	1772.605

National Parks			
SI NO.	Protected Areas	Location	Area (ha)
1	Himchari National Park	Cox's Bazar	1,729.00
2	Bhawal National Park	Gazipur	5,022.00
3	Madhupur National Park	Tangail/ Mymensingh	8,436.00
4	Lawachara National Park	Moulvibazar	1,250.00
5	Kaptai National Park	Chittagong Hill Tracts	5,464.00
6	Nijhum Dweep National Park	Noakhali	16,352.23
7	Ramsagar National Park	Dinajpur	27.75
8	Satchari National Park	Habigonj	242.91
9	Khadimnagar National Park	Sylhet	678.80
10	Medhakachhapia National Park	Cox's Bazar	395.92
11	Baroiyadhala National Park	Chittagong	2,933.61
12	Kuakata National Park	Patuakhali	1,613.00
13	Nababgonj National Park	Dinajpur	517.61
14	Singra National Park	Dinajpur	305.69
15	Kadigarh National Park	Mymensingh	344.13
16	Altadighi National Park	Naogaon	264.12
17	Birgonj National Park	Dinajpur	168.56
18	Sheikh Jamal Inani National Park	Cox's Bazar	7085.16
19	National Botanical Garden	Dhaka	87.10
20	Dharmapur National Park	Dinajpur	704.41
Game Reserve			
1	Teknaf GR	Cox's Bazar	11,615.00

Ex-situ conservation

The practice of conserving biodiversity (or genetic materials) in a place without its natural habitat is known as ex-situ conservation such as botanical garden, arboretum, field gene bank/preservation plot, and gene/seed bank. The National Botanical Garden, Mirpur consists of 84.2 ha area, having 306 tree species (No. of total plant is 33,413), 441 shrub species (plants;20,746), 201 herb species (plants:13,092) and 62 vine/climber species (plants:1,190) (Mukul,2007 and Sarwar, 2019). The Boldha garden which is also managed by DoF along with Mirpur Botanical garden, constitutes 1.15 ha of land having total no. 18,000 herbs, shrubs and trees, belonging to the 820 species and 92 families. Some other botanical gardens are maintained by different public Universities

in Bangladesh as a part of their teaching and research facilities. Bangladesh Agricultural University (BAU) possess a botanical garden covering an area of 9.8 ha. This Botanical garden serves the facilities for teaching, research and extension activities additionally collecting, conserving, and multiplying rare and endangered plant species of Bangladesh.

Bangladesh Forest Research Institute (BFRI) used to provide great effort to maintain the forest resources. Such as, five preservation plots have been established by BFRI at different hill forest areas and 27 at the Sundarbans (mangrove) forest. Two clone banks have also been established by BFRI at Hyako, Chittagong (4 ha) and another at Ukhia, Cox's Bazar (4 ha). Seven tree species are conserved in these two locations. One bambusetum covering an area of 1.5 ha has been established in the

BFRI premises containing 27 bamboo species with 6 exotic species (Mukul, 2007). One arboretum covering of 1.0 ha of land has been established on the BFRI campus containing 40 species of medicinal plants. BFRI also established one cane arboretum of 0.5 ha land including seven species and three more arboretums of tree species. There are also some eco-parks and two safari parks in

Bangladesh where both ex-situ and in situ conservation actions are being practiced to preserve biological diversity and genetic resources for exploration and other purposes. Table 2 and table 3 show the name and locations of the Eco-parks, safari parks and special biodiversity area of Bangladesh.

Table 2: List of Eco-parks and safari parks. (Forest department, 2014)

SI NO.	Eco-parks/Safari parks	Location	Area (ha)
1	Madhabkundu Eco-Park	Moulavibazar	265.68
2	Sitakunda Botanical Garden and Eco-park	Chittagong	808
3	Modhutila Eco-Park	Sherpur	100
4	Banshkhali Eco-Park	Chittagong	1200
5	Kuakata Eco-Park	Patuakhali	5661
6	Tilagar Eco-Park	Sylhet	45.34
7	Borshijora Eco-Park	Moulavibazar	326.07
8	Jamuna Bridge Eco-Park	Jamuna River Bank, Pabna	50.02
9	Pirojpur Riverview Eco-Park	Pirojpur	2.54
10	Char-muguriaEco-park	Madaripur	4.20
11	Bangabandhu Sheikh Mujib Safari Park	Gazipur	1493.93
12	Bangabandhu Sheikh Mujib Safari Park	Cox's Bazar	600

Table 3: List of Special Biodiversity Conservation Area (Forest Department, 2014)

Name	Location	Area (ha.)
Special Biodiversity Conservation Area (Ratargul)	Sylhet	204.25
Altadighi water based Special Biodiversity Conservation Area	Naogaon	17.34

Future prospects

Plants are the utmost precious elements of biodiversity which support life systems on earth. They represent the very basis for the survival of human beings. Still, there are so many small landmasses that remained unexplored which is a constraint for gaining knowledge on plant diversity and the policy for conservation to be taken. The inventory and documentation of plant species are lagging; therefore, a lot of prospects are there to deal with towards sustainable development and conservation of plant biodiversity in Bangladesh. They are as follows:

1. Unexplored area exploration, Identification, inventory for species bank data and documentation of the flora. Seeking of international association to accelerate the speed of exploration and documentation of the plant species of Bangladesh before its extinction.

2. With Protected Areas, some other special areas should be identified and defined with biodiversity interest like homestead areas, small wetlands, fallow meadows etc. Plants of threatened categories, extinct, or prone to extinction should be identified and documented. The changes or losses of plants in different ecosystems should be monitored consistently due to climate change vulnerabilities. Preparing databases regarding plant diversity, genetic history, in situ-ex situ conservation activities and sharing, and exchanging of information with a group of people of common interests related to biodiversity conservation.

3. Documentation of wild crop relatives, nonmajor crops introduced with food and medicinal values and/or of economic importance.

4. Cultivation of nonmajor and non-utilized food plants like aroids, vegetables (bathua, napha, dhemshe shak, helencha, dheki shak, thankuni, telakucha etc. and so on a large scale to meet up the food gap.

5. Encouraging the cultivation of more medicinal plants on a commercial scale, as herbal medicines are getting popularity day by day. In Bangladesh, more than 70% of rural people are dependent on medicinal plants for their primary treatments such as fever, cough etc. Bangladesh possesses more than 650 medicinal plant species (Uddin, 2013). So, the rearing of medicinal plants could be a profitable industry in near future.

6. Balanced use and sustainable management of both timber and non-timber forest products. NTFPs comprise medicinal plants, fruits, spices, firewood, bamboo etc. other than commercial timber. Introducing more the use of NTFPs is environmentally feasible, and economically profitable due to its vast applications rather than timber harvesting. So, the expansion of NTFP-based small-scale industries possibly will lead to conservation on a broader scale.

7. Homestead gardens and forestry are old-style diversified agro-forestry-based exercises where vegetables, fruits, bamboo, timber species and other crops are grown with intensive care in and around the residence premises. The majority of the country's domestic needs (food, fuel, bamboo and timber) are fulfilled by homestead gardens and forests. Moreover, these enriched floral diversities could harbour several birds; reptiles; even a few mammals i.e. a great contribution to biodiversity conservation. With suitable models, based on both traditional and technical knowledge, homestead forestry may emerge as

an effective means for both economically and biodiversity conservation in Bangladesh (Muhammed *et al.*, 2011).

8. Numerous ecological services are being provided by the forest coverage of the world, for instance; watershed protection, acting as a guard shield for tidal surges and cyclones, purification of air, sequestration of carbon, control of soil erosion etc. Bangladesh is none of the exceptions. One example can be mentioned; the presence of Sundarban Mangrove Forest is such a blessing that protected us from the devastating effects of the storm, and cyclones in the past several times and reduced the damage or loss from Super Cyclonic Storm 'Sidr'. So, Government should enforce the practical application of payments (e.g, tax) for these ecological services (Mukul, 2007) and after collection, these can be expensed in favour of biodiversity conservation.

9. The forests of Bangladesh absorb carbon more than the total carbon produced in the country. According to 'Kyoto Protocol' we can ask the developed countries to compensate for the extra carbon absorbed by the forest of Bangladesh (Mukul, 2007).

10. Eco-tourism is nature-based tourism which is one of the advanced growing sectors in the world. Countries like Sri Lanka, Portugal and some other countries are dependent mostly on tourism utilizing and improvising their natural beauty. However, this sector is not promising or we can say poorly developed in Bangladesh. Government and policymakers should improve infrastructural and other conveniences to draw the attention of national and international travelers to several exciting destinations of Sylhet, Chittagong, Bandarban, Rangamati, Cox's Bazar and Sundarbans etc. especially as the southern part of Bangladesh.

CONCLUSION

Bangladesh is still initiating and making progress in the research, planning and execution of the conservation of biodiversity. As a result of global climate change, the melting of ice Bangladesh is very much susceptible among the countries to face the threat of consequential sea level rise. Massive population demand and overexploitation of plant resources such as illegal cutting down of trees, clearing of forest for establishing housing, and conversion of forest land for agricultural practices are responsible for the decline of the remarkable forest area of Bangladesh. Rural and poor people are more dependent on forest resources for their livelihood. Moreover, Bangladesh's forest is consuming more GHG's than they emit compared with the developed countries of the world. The government should instantly give proper attention and take important measures to deal with this unavoidable affair. The Government should create public consciousness more and involve much participation of root level people in favour of the nation's plant diversity conservation. The Government should make a conservation framework by providing knowledge on the usefulness of plants and the negative impacts of the loss of plant diversity, by giving the training to create

skilled personnel on biodiversity conservation, making collaboration and seeking cooperation with developed countries, continuous monitoring, and conservation strategy must be improved to address the threat of loss of plant diversity. So far, there are many small to medium landmasses, which are still unexplored, so species data bank is not rich enough, to conduct future studies. The insufficiency of the raw data to describe richness patterns due to sampling bias was one of the research's weaknesses. Other limitations of the research included a lack of survey effort assessment and inadequate coverage of the regional and environmental changes that influence organism dispersal. The authors suggest a more comprehensive strategy for biodiversity conservation activities that involves a wide range of stakeholders. Conservation literacy is still a missing tool for successful conservation planning in Bangladesh. Future researchers should fill this gap by contributing in conservation education in line with conservation research.

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