



# BANGLADESH NATIONAL CONSERVATION STRATEGY



## BIODIVERSITY: FLORA

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# INTRODUCTION

## 1.1 GENERAL

Biological diversity – or Biodiversity is the term given to the variety of life on Earth and the natural patterns it forms (CBD 2000). It encompasses the variety of life, at all levels of organization, classified both by evolutionary (phylogenetic) and ecological (functional) criteria. Biodiversity is the result of billions of years of evolution, shaped by natural processes and increasingly by the influence of humans. The diversity includes the wide variety of plants, animals and microorganisms. Scientists estimate that there are actually about 13 million species, though estimates range from 3 to 100 million (CBD 2000). However, biodiversity is not just the number of species in a particular area. It is the total variety of genetic strains, species and ecosystems that are found in nature. In principle, biodiversity is sub-divided into three major hierarchical categories, e.g. variation at the genetic level within a particular species; species diversity or the number and proportion of different species in a particular area; and ecosystem diversity that describes the variation in the assemblages of species and their habitats (ITTO 1993).

Species diversity is a measure of the number of species of all or various taxa per unit area. Species come in all shapes and sizes, from the tiny organisms that we can see only through a microscope to large Boilam trees in natural forests or whales found in the oceans. An individual of a species can reproduce successfully, creating viable offspring only with another member of the same species. Biodiversity is much more than the variety of species. It also includes the genes that every individual inherits from its parents and passes on to the next generation. Genetic diversity is everywhere, from the variety of many mangoes to a family where differences are found in eye, hair colour, body shapes and heights etc. (MEA 2005). Genetic variability, responsible for different traits, interacts with local environmental conditions to determine the extent to which populations can adapt to environmental changes and survive to new pest and diseases. Plant breeders are looking for more and more to the wild species to introduce it into the cultivated forms with desired qualities of resistance to pest and diseases and the ability to withstand adverse soil and weather conditions, e.g. climate changes. Genes determine the traits of the individuals that form populations of a species. Populations and the non-living environmental components- such as water or minerals – surrounding them interact dynamically to form an ecosystem. Species are not evenly distributed all around the world. Some ecosystems, e.g. tropical forests and coral reefs are very complex and host a large number of species. Whereas, some other ecosystems such as deserts and arctic regions have less biodiversity but all sorts of biodiversity are equally important to the human being (MEA 2005).

Bangladesh is situated between the Indo-Himalayas and Indo-Chinese sub-regions with distinct physiographic characteristics, variations in hydrological and climatological conditions, and differences in the soil properties contribute in developing diverse forms of ecosystems with rich flora and fauna (DoE 2010). The country acts as an important merging and sharing habitat, land making bridge and biological corridors of the flora and fauna

between the Indo-Himalayan and Indo-Chinese regions (DoE 2015). Though small in size, Bangladesh is a biodiversity rich country. The people of the country have traditionally been using and conserving biodiversity generation after generations. Maintaining the sustainable use of these rich biodiversity is very important for a huge population of the country. However, the current status of biodiversity in Bangladesh is under stress. Population pressure, reckless pollution, monoculture, habitat destruction through land use change, introduction and rapid spread of invasive alien species along with the recent climate change is becoming a serious threat on our biodiversity (NBSAP 2006).

## 1.2 IMPORTANCE OF BIODIVERSITY

Biodiversity benefits people through more than just its contribution to material welfare and livelihoods. Biodiversity is essential to sustainable socio-economic development. Through agriculture, forestry, livestock and fisheries- biodiversity provides food, fiber, medicine, timber and contributes significantly to national economy and employment (NBSAP 2006). It also produces goods and services for the most fundamental of our needs – clear air, fresh water, and shelter. It also provides people with recreational, psychological, emotional and spiritual enjoyment. Our food comes directly or indirectly from plants. More than 90% of the calories consumed by people worldwide come from 80 plant species. Fruits, nuts, mushrooms, honey, spices and other foods that humans and wildlife consume originate from natural ecosystems. Most houses, furniture and even many clothes are made from natural products, including wood, oils, resins, waxes, gums, and fibers. The cocoons of silk worms are the basis of the valuable silk-making industry. Biodiversity contributes to security, resiliency, social relations, health and freedom of choices and actions (MEA 2005).



Globally 4.5 billion people still use plants as their primary source of medicine. Close to 30% of all pharmaceuticals on the market today were developed from plants and animals. Antibiotics such as penicillin are extracted from fungi. Wild yams have chemicals with anti-inflammatory properties. Ovarian and breast cancer treatments have been developed from the bark of the Pacific yew tree. Many plant species contain chemicals that are used to make painkillers, blood pressure boosters, anti-malarial drugs and anti-leukemia drugs (Alonso et al. 2001). Most plants have yet to be tested for their potential medicinal properties. Natural marine products have potential as pharmaceuticals, nutritional supplements, agricultural chemicals, and biomedical research.

The ethical and religious beliefs of cultures around the world include respect for and protection of nature. Some species, e.g. the bald eagle are part of cultural heritages, turtles



and bison – are integral to religious and spiritual beliefs. Species inspire songs, stories, dances, poetry, myths, crafts, regional cuisines, decorations, rituals, festivals, holidays and even names for sports teams (Alonso et al. 2001). For many of us, nature is an unsurpassed source of relaxation, wonderment, rejuvenation, beauty and peace.

Biodiversity provides us with life-sustaining services. Many flowering plants rely on animals such as bees, butterflies, moths, wasps, beetles, birds, and bats for pollination to produce fruit. Forests with rich biodiversity purify our air and water by taking in carbon dioxide, regulating water vapour, releasing oxygen, and cycling nutrients. Through photosynthesis, trees and other plants give off oxygen that helps in maintaining a breathable atmosphere. As plants in forests release oxygen and take up carbon dioxide – the most prevalent greenhouse gas – the forests act to store carbon and help in reducing global warming.

Biodiversity serves as an income-generating activity for countries around the world. Many people visit forests, beaches, mountains, grasslands, lakes, estuaries and streams for extended vacations or shorter periods of relaxation. Around the world the number of eco-tourists, people travelling to enjoy nature and various cultures is increasing. The people of Bangladesh depend on biodiversity for their day-to-day sustenance as well as overall livelihood security (NBSAP 2006). Through agriculture, forestry, livestock and fisheries-biodiversity provides food, fibre, medicine, timber and also contributes significantly to national economies and employment of the huge population. Considering the values of the goods and services that biodiversity directly or indirectly provides is increasing the relationship between the role of biodiversity in environmental sustainability, poverty reduction and sustainable development (MoEF 2007).

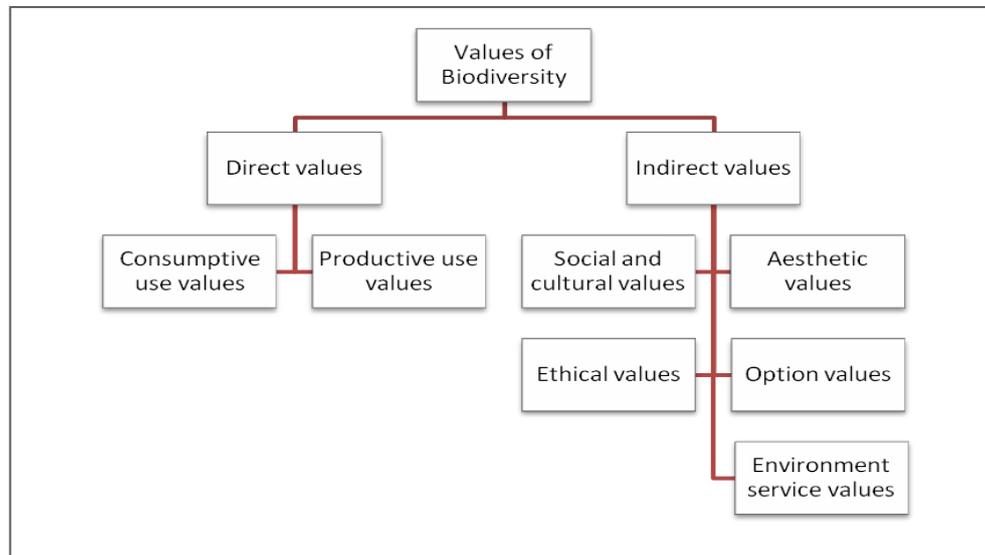
### 1.3 MAIN VALUES OF BIODIVERSITY

The world community is now conscious about the intrinsic value of biodiversity and of the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biodiversity and its components (MoEF 2007). Some of the major values of biodiversity are i) Environmental value, ii) Social value, iii) Ecosystem services, iv) Economic value, v) Consumptive use value, vi) Productive use value, vii) Ethical and moral value, and viii) Aesthetic value. Biodiversity is the most precious gift of nature and mankind is blessed with it. As all the organisms in an ecosystem are interlinked and interdependent, the value of biodiversity in the life of all the organisms including humans is enormous (**Fig. 1**). Direct use values (goods) are food, medicine, building material, fiber, fuel etc. Indirect use values (services) are atmospheric and climate regulation, pollination, nutrient recycling, cultural, spiritual and aesthetic etc. Non-use values include potential or option value (future value either as a good or service), existence value (value of knowing something exists), and bequest value, i.e. value of knowing that something will be there for future generations.

In fact, most of the environmental or ecological services are non marketed and hence does not have a market price. Even if a market price for a resource exists, market complexity structure often do not reflect the true 'opportunity cost' of resources (Haque and Aich 2014). MEA (2005) defined the ecosystem services conceptually based on four pillars, e.g. support, regulatory, provisional and cultural services. The ecological services of Bangladesh Sundarbans including 9 support, 7 regulatory, 5 provisional, 3 cultural plus waste treatment

etc value ranges from US\$ 105.07-840.59 per ha per year (Haque and Aich 2014). Similar valuation of ecosystems including the biodiversity is getting preferences in a number of ecosystems of the world. The conservation priority may be given to the ecosystems, if the proper valuations of the natural resources are done.

**Fig.1. Major values of biodiversity**



## 1.4 RELATIONSHIP OF THIS SECTOR WITH OTHERS

Biodiversity are the pillars upon which the human being builds civilizations. Biological resources support diverse industries as agriculture, cosmetics, pharmaceuticals, pulp and paper, horticulture, construction and waste treatment. Considering the importance of protection and improvement of the country's environment and biodiversity, the GoB in 2011 inserted the section 18A in the constitution as "the state shall endeavour to protect and improve the environments preserve and safeguard the natural resources, biodiversity, wetlands, forests and wildlife for the present and future citizens".

## 1.5 ANALYTICAL CONTEXT WITHIN THE FRAMEWORK OF SDGs

The year 2015 was the last year of implementing the MDGs. Apart from several constraints; Bangladesh is considered as a role model in attaining the Millennium Development Goals (MDGs) in most of the areas. The progress against the MDG 7 (Ensure Environmental Sustainability), was came out recently in a Government assessment. Bangladesh recently has updated her NBSAP and the revised NBSAP has given Bangladesh the opportunity to give a momentum in biodiversity conservation. Globally a new set of 17 goals has recently been approved as the Sustainable Development Goals (SDGs) to guide global development until 2030. Bangladesh has been exclusively upheld in the goals 14 and 15, focusing on marine and terrestrial ecosystems separately. The sector biodiversity is believed to coherence between the MDG and Aichi Biodiversity Targets 2020 that will continue in the SDG era till 2030.



## 1.6 SCOPE OF THE REPORT

The MDGs program has brought about some improvement in people's lives and hence need to be continued in the follow up program called SDGs. The upcoming SDGs program will have to focus on the sustainable management of planet's natural resources. SDGs appeal to conserve and sustainably use of oceans and seas, freshwater resources, as well as forests, mountains and dry lands and to protect biodiversity, ecosystems and wildlife. The report have the momentum for taking up stronger efforts in the country towards conservation of biological diversity, ensuring the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of biodiversity.

The report has the opportunity for sustainable development and conservation of biodiversity in Bangladesh aspects as in **Box 1**.



**Box 1:**  
**Sustainable Development and Conservation of Biodiversity**

**Sustainability:** Usually the more diverse the species, the forest will be more sustainable with respect to the production of both goods and services. More biodiversity means diversified production of goods and services all the year round.

**Soil conservation/ improvement:** Biodiversity reduces soil erosion, increases water holding capacity, infiltration and microbial activity ensures stability of nutrient cycle and ultimately the improvement of soil condition.

**Gene - pool conservation:** More diversification of species results in more gene conservation. The species which survive in more diversified area, they pass through more interactions hence better varieties are conserved.

**Deduction of pest and disease:** Biological control is more effective in more diversified area. Predators of pest are more in such area. Thus, the chances of destruction of the whole area are less.

**Regeneration capacity increases:** More biodiversity means more production of seeds and other planting materials that enhances more regeneration. Diversified species produce more fertile regenerating materials due to cross breeding, hence more success in regeneration processes.

**Aesthetic value of the forest increases/ provides tourist facilities:** Biodiversity increases the aesthetic values that provide the recreational facilities for tourist and local people. This is also a source of earning both for the surrounding people of the forest.

**Conservation of environmental conditions:** Food chain is stable, production is multiple and environment is balanced, in the presence of diverse flora and fauna.

**Reduction of natural calamities:** More biodiversity helps in controlling the natural calamities like flood, cyclone, soil erosion, landslide etc.

**Employment opportunity:** Increase employment opportunity through nature based industries such as saw mills, forest based industries, cottage industries, herbal medicinal industries etc.

## 1.7 LIMITATIONS OF THE REPORT

The important thing is to have a real concept on the issues that is agreed to be implemented as an international community agenda. It is also necessary to conduct SDGs international campaign to promote the agenda and at the same time try to convince donor countries as well as business forums to contribute and support the initiatives. Bangladesh don't have complete database of biodiversity for different locations or sites, so analysis of the issues is based on very poor information.

## 2.1. CURRENT STATUS OF BIODIVERSITY (FLORA)

The floral diversity of Bangladesh is extraordinary. Khan (1991) reported that the country possessed more than 5,000 species of angiosperms and many of which have several sub-species. Of these, only some 160 species are used as crops (Mondal 1990). The major crops are rice, wheat, jute, pulses, oilseed plants, minor cereals, sugar crops, fruits, vegetables root tubers, spices, beverage crops, flowers, medicinal and aromatic plants, forest tree species and other wild plants. The natural forests of Bangladesh consist of three major vegetation types occurring on the three distinctly different land types (Hassan 1994). The natural forests are richest in floristic composition and some 2,260 plant species are reported from the Chittagong region which falls between two major floristic regions of Asia (DoE 2015). The geographical location and the climate of the country support a rich biodiversity but, unfortunately the total flora of the country is not yet fully investigated. A checklist developed by Basak and Alam (2015) enlisted 1,048 tree species (gymnosperm, dicot and monocot) under 432 genera in 99 families that will give information of the tree species in Bangladesh. Recent publication of 'Encyclopedia of Flora and Fauna of Bangladesh' by Asiatic Society provides an enumeration of the plant and animal resources of the country (Ahmed et al. 2008, 2009). It recorded 3,611 taxa of angiosperms from the country. Exploration, identification and description of new species are being published by the Bangladesh National Herbarium (BNH). Another 64 angiosperms were added to the flora during June 2009 to June 2013 of which 8 species were described as new to science (Irfanullah 2013) and BNH has reported 40 angiosperm species very recently (Ara and Khan 2015). A comparison of both the recorded and estimated number of flora of Bangladesh and the world is shown in **Table 1**.

**Table 1:**  
**Recorded and estimated number of flora of Bangladesh and worldwide.**

Categories	Recorded in Bangladesh	Estimated in Bangladesh	World described	World estimated
Algae	3600	6,000	40,000	200-350,000
Fungi	275		90,000	??
Lichens	51	--	13,500	20,000
Bryophytes	290	400	14,000	23,000
Pteridophytes	200	250	12,000	13,500
Gymnosperms	7	7	650	650
Angiosperms	3,723*	>5,700	250,000	300,000

## 2.2. MAJOR ECOSYSTEM OF BANGLADESH WITH RICH BIODIVERSITY

Based on the country's geographic and bio-geographic features, Bangladesh has notable diversity in its ecosystems. Considering the main biophysical characteristics, the ecosystems of Bangladesh are broadly categorized as terrestrial, inland water, and marine and coastal ecosystems. The status and trends of biodiversity of the ecosystems are as follows:

### 2.2.1 MAJOR FOREST ECOSYSTEMS

Forests are one of the major biodiversity rich areas in Bangladesh. Ecologically there are mainly four types of forests in Bangladesh.

#### **Sundarbans Mangrove Forest**

The Bangladesh portion of the Sundarbans (approximately 60% of the entire forest) is the largest productive and contiguous mangrove forest in the world (Siddiqi 2001, Hussain 2014). This was declared as 'Reserved Forest' during 1875-76, and The Sundarban Reserved Forest is internationally recognized as an important mangrove ecosystem of high biodiversity value. About 1,400 square kilometres of the forest was declared as a World Heritage Site by the UNESCO in 1997, of which 490 square kilometers is water. A part of Sundarbans has also been recognized as wetlands of international importance (Ramsar Site) under Ramsar Convention in 1992. Prain (1903a) recorded 334 species of plants for the Sundarbans and adjoining areas. Heinig (1892) reported 70 species from the entire Sundarbans. Chaffey and Sandom (1985) recorded 66 plant species from Bangladesh Sundarbans. However, Hussain and Acharya (1994) reported about 123 species of flora from the Bangladesh's portion of Sundarbans. Different assessments since 1903 reported as high as 122 angiosperms from the Sundarban along with 21 fern species, and many species of lower plant groups like mosses, lichens, cyano-bacteria, algae and fungi (Hussain, 2014).

#### **Chittagong Hill Tracts (CHT)**

The CHT is situated in the south-eastern corner of Bangladesh bordering Myanmar in the south-east, the state of Tripura on the north and Mizoram on the east, and the district of Chittagong on the west. Area of CHT is 13,294 sq. km, which is about one-tenth of the country. Among the total area of the CHT, more than 75% is considered as forest area and the forests of CHT are ecologically classified as Tropical wet-evergreen, Tropical semi-evergreen, Tropical moist-deciduous, Tropical open deciduous and Savannah forests (Das 1990). The important reserve forests of CHT are Kassalong reserve forests (159,449.7 ha), Raingkheong reserve forests (76,331.0 ha),



Sitapahar reserve forests (5,876.5 ha), 235.79 ha of Barkal reserve forests; and Sangu and Matamuhury reserve comprises about 74,500 ha (Chowdhury 2006). There are three protected areas, e.g. Pablakhali Wildlife Sanctuary, Kaptai National Park, and Sangu Valley Wildlife Sanctuary. The CHT in Bangladesh supports almost 80% of the country's total biodiversity (Nishat & Biswas 2005, in Jashimuddin and Inoue 2012). The evergreen and mixed evergreen forests of CHT are the habitat of 1560 species of flowering plants (Heinig 1925). Rampahar along with Sitapahar were declared as the first reserve forest in the Chittagong Hill Tracts region in 1875 (Anonymous, 1960). Presence of 85 different tree species having dbh  $\geq 10$  cm were reported from the Sitapahar reserve forest is comparable to other rich tropical forests (Nath et al. 2000). Since much of the biodiversity in tropical forests resides in herbs, shrubs and small trees, Uddin et al. (1998) recorded 332 species (248 dicots and 84 monocots) from this area. Harun-Ur-Rashid and Chowdhury (2013) later on added 43 taxa (38 dicots and 5 monocots) from this forest. A survey from 2001 to 2008 revealed 89 monocots (Uddin and Hassan, 2012a) and 500 dicot species from Rampahar area (648 ha) under Kaptai Forest Range. Uddin and Hassan (2012b) also reported 41 pteridophyte species belonging to 26 genera from Rampahar and Sitapahar area, which constitutes 21% of total fern flora of the country. Similarly, the status and distribution pattern of natural regeneration of Sitapahar reserve forest reported 62 identified tree species and another 20 unidentified tree species with an average density of 15,618 seedlings/saplings per ha indicating the rich soil seed bank of the native tree species (Hossain et al. 1999).

Unfortunately, the total enumeration of the flora in the inaccessible forest reserves of CHT is not yet completed. Bangladesh National Herbarium (BNH) has taken a project for enumerating the total flora of Cox's Bazar, Chittagong, Bandarban, Rangamati and Khagrachari districts recently. The mouza forest or village Common Forest (VCF) is a traditional forest conservation practice in the CHT (Baten et al. 2010, Sing 2013). It is estimated that there are still over 300 VCFs exist in the three hill districts which provide livelihood support to the communities and work as micro-watersheds in the area. The VCFs are supposed to harbor a number of unexplored plant species in this region (AF 2010).

### Sal Forests

The moist deciduous Sal (also known as Gazari) forests are located in the greater Dhaka, Tangail and Mymensingh districts in the central region and in the greater Dinajpur, Rangpur, and Rajshahi districts in the northern region. The Sal forests originally comprise an area of 120,255 ha of which 104,616 ha (87%) are located in the central region and 15,639 ha (13%) in the northern region. Most of the sal forests are now severely degraded and poorly stocked and the area is now becoming to only 34,000 ha (Altrell et al. 2007). Madhupur National Park is one of the last remaining patches of old-growth Sal forest left in the country. Sal (*Shorea robusta*) is the dominant species with associates of *Mallotus philippensis*, *Schleichera oleosa*, *Protium serratum*, *Dillenia pentagyna* etc. Alam (1995) recorded 260 woody plant species from sal forests of Bangladesh, whereas, Malaker et al. (2010) reported 174 plant species from Madhupur sal forests. Hossain et al. (2015) recorded 385 plant species from Madhupur National Park. At present, most of the forest areas in Madhupur has been denuded, degraded or encroached upon or taken over for the commercial production of pineapples, bananas, the industrial plantation of rubber and exotic fuel-wood species (Hossain et al. 2013, 2015).

## 2.2.2 AGRO ECOSYSTEMS

Bangladesh has been divided into thirty agro-ecological zones and 88 subzones on the basis of physiographic, soil properties, soil salinity, depth, duration of flooding etc. The general agro-ecological variations of Bangladesh range from below sea level-basins to small hills. People over the centuries have been cultivating, preserving, and using more than 1,364 plant species from both the native and exotic origins for more than 85 different uses (DoE 2015). Many varieties of rice, jute, sugarcane, cotton, oilseed, mustard, cucumber, beans, and gourds have also been selected and raised by the people from time immemorial. Farming practices in Bangladesh are complex and diverse and are largely controlled by physical, biological, climatologically and socioeconomic factors. In Bangladesh more than 300 different crops are presently cultivated of which many of them are endemic. However, the diversity of landraces for almost all the crops is decreasing with the increased priority of high yielding varieties.

## 2.2.3. HOMESTEAD ECOSYSTEM

Homestead ecosystems, which in together is the largest manmade ecosystem in Bangladesh, act as the last refuge of wild flora and fauna of open woodland ecosystem. Most of the homestead ecosystems in the floodplains consist of a small pond, backyard jungles, bushes and kitchen gardens. Homesteads in the hilly terrain are usually tiny hillocks with its valley and hilly streams. Homesteads in the coastal zones have backyard mangroves with inter-tidal canals and ditches. Despite the conversion of natural bushes in the homestead ecosystems, a wide range of wild flora and fauna are still occurring in the homesteads with remarkable abundance (Islam et al. 2015, Nath et al. 2015).

Homesteads of Bangladesh have a long heritage of growing timber and fruit trees, along with other perennial shrubs and herbs. Species composition and number of species in the homesteads of Bangladesh are variable and sporadic. Abedin and Quddus (1990) reported that the number of plant species (excluding vegetable species) in the coastal areas was higher (70 species) than those found in the homesteads of Tangail (52 species), Ishurdi (34 species), Jessore (28 species), Patuakhali (20 species), Rajshahi (28 species) and Rangpur (21 species) districts. Homestead gardens are significant sources of fruits, timber, fuelwood, lumber, veneer logs and bamboo of Bangladesh. In this way, the homesteads of the country are vital sources of livelihood for many farmers and serve as the safety net during the time of hardship and natural disasters.

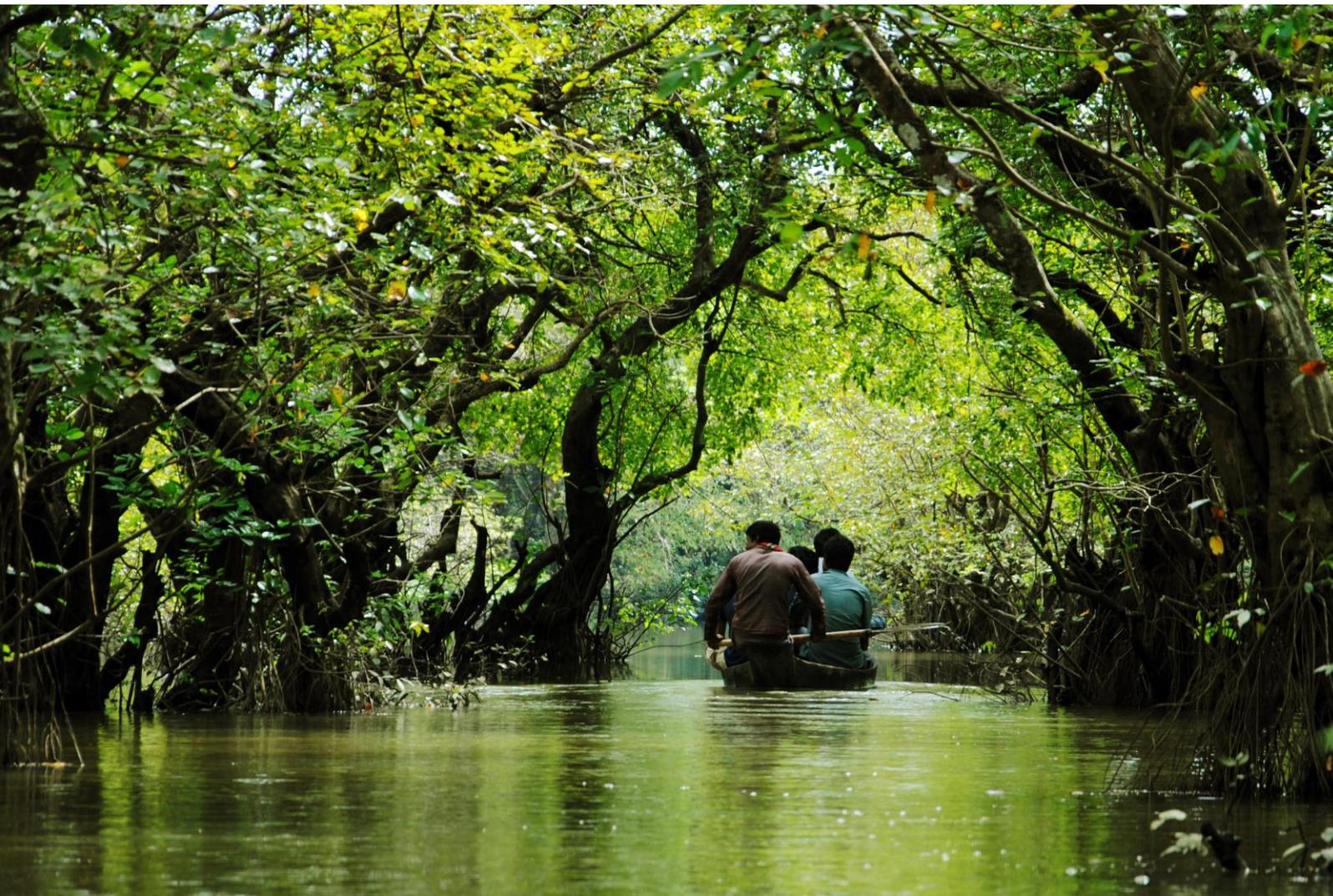
## 2.2.4. INLAND WATER ECOSYSTEM

Bangladesh is a land of water and wetlands. Wetlands constitute more than 50% territory of the country and play significant role in social and economic livelihood of the population. The wetlands in Bangladesh encompass a wide variety of ecosystems including the main rivers (the Ganges, the Brahmaputra and the Meghna) and their 700-plus tributaries and distributaries; about 6,300 *beels* (permanent and seasonal shallow lakes in floodplain depressions); at least 47 major *haors* (deeply flooded depressions in the north-east), *baors* (oxbow lakes); vast areas of seasonally flooded land; and fish ponds and tanks (Nishat 1993, Khan 2001).

Floodplain in Bangladesh occupies a greater part of the landscape and offers important habitats of wide variety of wild flora and fauna. A total of 200-300 plant species in Bangladesh are considered to be wetland species for all or part of their life spans (Nishat 1993). The country has a praiseworthy achievement in conservation and sustainable uses of floodplain biodiversity and most of these have been through the activities of various projects of Government and the development partners. The 'community-based wetlands conservation model' was replicated creatively and it succeeded in cases of conservation and wise-use of wetlands biodiversity. The threatened species of flora and fauna were conserved successfully and the common species having economic value were used sustainably with a significant improvement of livelihoods of the local communities (DoE 2015).

### **Ratargul Swamp Forest**

Ratargul is a small freshwater swamp in the *haor* basin of north-east region of Bangladesh. The ecosystem is a typical freshwater wetland forest rich with 73 species of flora and 230 species of fauna from Ratargul (Choudhury et al. 2004). Species diversity is very rich in this swamp. Mention worthy flora of the swamp are *Barringtonia*, *Pongamia*, *Crataeva*, *Salix*, *Clinogyne*, *Phragmites*, *Rosa*, *Saccharam*, *Phyllantus*, *Calamus*, *Ficus*, *Asclepias*, *Oryza*, *Cyperus*, *Nymphaea*, *Trapa*, *Vallesnaria*, *Echinochloa* and *Polygonum* species. This forest also harbors a number of medicinal plants such as *Asparagus racemosus*, *Centella asiatica*, *Crataeva magna*, *Hemidesmus indicus*, *Ipomoea fistulosa* and *Mimosa pudica*. *Calamus guruba* (Rattan) plantations have been raised at suitable locations of this forest.



### Tangua Haor

A natural fresh water wetland in the north-eastern region. It has become the 2nd Ramsar site of the country. This wetland is an important fish habitat comprising about 140 species and seasonally harbouring more than 60,000 individuals of migratory water birds belonging to 60 species. Biodiversity of Tangua Haor elaborately discussed in Gieson and Rashid (1997), Nurazzaman (1997), Khan (2001) and Sobhan et al. (2012).



### Hakkaluki Haor

Hakkaluki Haor is one of the major wetlands with a land area of 18,386 ha. It supports a rich biodiversity and provides direct and indirect livelihood benefits to nearly 190,000 people. Miah (2010) observed that the 83% of *beels*, 94.45% of rivers and 97% of canals of Hakkaluki haor became degraded at different levels. A total of 115 fish were documented (107 indigenous and eight exotics) that can be categorized as Critically Endangered (8 species), Endangered (21), Vulnerable (13), Not Threatened (50), Data Deficient (13), and Not Evaluated species were 10.

### Kaptai Lake

The largest man-made lake in South Asia is Kaptai Lake covering 68,800 ha (surface area– 58,300 ha). The lake was created from the construction of dam across the river Karnafuli near Kaptai sadar in 1961. It has drowned almost the whole of the middle-Karnafuli valley and the lower reaches of the Chengi, the Kasalong and the Rinkhyong Rivers. The lake is substantially contributes to the national economy through freshwater fish production, navigation, flood control and agriculture. The lake is confined within the hill district of Rangamati and embraces sub-districts of Rangamati Sadar, Kaptai, Nannerchar, Langadu, Baghaichhari, Barkal, Juraichhari and Belaichhari. Significant number of flora and fauna are found in the lake and surrounding hilly forest areas. Halder *et al.* (2002) recorded 66 species of indigenous fish in the lake.

### 2.2.5. COASTAL AND MARINE ECOSYSTEM

Bangladesh coastline extends 710 km starting from St. Martin's Island in the south-east to the Sundarban mangroves in the south-west. The coastline consists of three major regions – the eastern, central and western. The eastern coast is comparatively stable whereas the central coast is very dynamic with highest rate of accretion and erosion. The western coast is dominated by mangrove forest ecosystems. The biodiversity of coastal and marine ecosystems are very rich. Moreover, coastal system of Bangladesh has a significant relationship with the Sundarban mangrove forest. Bangladesh coast supports more than 10 globally threatened migratory shorebirds, including Spoon-billed Sandpiper, Asian dowitcher, Spotted Redshank, Nordman's Greenshank, Goliath Heron and Indian Skimmers (Khan 2014).

The east coast is an important breeding ground of four species of marine turtles. The only coral community is located on the east coast in association with high diversity and moderate density of marine algae and mollusks. The west coast, on the other hand, supports nesting ground for Batagur Baska, Masked finfoot, the Bengal Tiger, Saltwater Crocodile, King Cobra, White Bellied Sea Eagle, and Ganges River Dolphin. The main ecosystems of the coastal zone of Bangladesh are Coral-associated Island, Sandy beach, Small islets, Sand dunes, Inter-tidal mudflats, Grasslands, Reed lands, and Mangrove forest.

The Department of Fisheries declared a marine reserve in the year 2000 under section 28 of the *Marine Fisheries Ordinance, 1983* (Ordinance No. 35 of 1983). The area of the reserve is estimated to be 69,800 ha (698 square km). The marine biome in the Bay of Bengal bordering maritime boundary with Myanmar, Sri Lanka and India is an important biodiversity area as far as the cetaceans and shore birds are concerned. Whale, dolphin and porpoises species are recorded recently from the Swatch of no-Ground numbering over 15,000 individuals. Very recently the Government of Bangladesh has declared the Swatch of no-Ground as its first marine protected area (DoE 2015). CWBMP of DoE has prepared a comprehensive checklist of the flora and fauna of St. Martin's and Sonadia islands of the Bay of Bengal in 2014.

**Seaweeds:** According to *Encyclopedia of Flora and Fauna of Bangladesh*, there are 50 species of brown algae, 82 species of red algae and 26 species of green algae. Almost all seaweeds species are found on St. Martin's Island.

**Seagrasses:** In Bangladesh, five species have been reported from Bangladesh coast, e.g. *Halodule uninervis*, *H. beccarii*, *H. decipiens*, *H. pinifolia* and *Ruppia maritima* (Kamal and Short 2009 in DoE 2015). Seagrass beds are unique ecosystem harbouring marine biodiversity, providing significant ecosystem services.

### 2.2.6 PROTECTED AREAS AND STATUS OF BIODIVERSITY

Protected Areas (PAs) are "Areas especially dedicated to the protection and maintenance of biological diversity and associated cultural resources, which are managed through legal or other effective means". Bangladesh currently has 38 protected areas (Table 2). Seven National Parks, 12 Wildlife Sanctuaries, one Safari Park and one Marine Protected Area (MPA) have been declared by the government to conserve wildlife and their habitats since 2010, after the submission of the Fourth National Report to the CBD (MoEF, 2010). The total

area of 19 new PAs (National Parks and Wildlife Sanctuaries) is 33,711.06 hectares. Protected Areas now covers 10.72% of total forest area which is 1.8% of the total land area of Bangladesh. As per the Bangladesh Wildlife (Conservation and Security) acts, 2012 the marine protected area is 1,738 square kilometers constituting 1.63% of total marine area (106,613 square kilometers) of Bangladesh. Bangladesh has increased the PAs including several wetland ecosystems. In practice, these areas remain unprotected and both legal and illegal activities are continuing to diminish the quality of biodiversity of the PAs (Kabir and Muzaffar 2002, Muzaffar et al. 2007). Functionally, most of the PAs are not really protected from illegal activities.

**Table 2:**  
**Protected areas of Bangladesh (BFD web)**

**A) National Parks**

Sl. No.	National Parks	Location	Area (ha)	Established
1	Bhawal National Park	Gazipur	5022.00	11-5-1982
2	Madhupur National Park	Tangail/ Mymensingh	8436.00	24-2-1982
3	Ramsagar National Park	Dinajpur	27.75	30-4-2001
4	Himchari National Park	Cox's Bazar	1729.00	15-2-1980
5	Lawachara National Park	Moulavibazar	1250.00	7-7-1996
6	Kaptai National Park	CHT	5464.00	9-9-1999
7	Nijhum Dweep National Park	Noakhali	16352.23	8-4-2001
8	Medhakachhapia National Park	Cox's Bazar	395.92	8-8-2008
9	Satchari National Park	Habigonj	242.91	15-10-2005
10	Khadimnagar National Park	Sylhet	678.80	13-04-2006
11	Baroiyadhala National Park	Chittagong	2933.61	06-04-2010
12	Kuakata National Park	Patuakhali	1613.00	24-10-2010
13	Nababgonj National Park	Dinajpur	517.61	24-10-2010
14	Singra National Park	Dinajpur	305.69	24-10-2010
15	Kadigarh National Park	Mymensingh	344.13	24-10-2010
16	Altadighi National Park	Naogaon	264.12	24-12-2011
17	Birgonj National Park	Dinajpur	168.56	24-12-2011

**B) Wildlife Sanctuaries**

Sl. No.	Wildlife Sanctuaries	Location	Area (ha.)	Established
18	Rema-Kalenga	Hobigonj	1795.54	7-7-1996
19	Char Kukri-Mukri	Bhola	40.00	19-12-1981
20	Sundarban (East)	Bagerhat	31226.94	6-4-1996
21	Sundarban (West)	Satkhira	71502.10	6-4-1996
22	Sundarban (South)	Khulna	36970.45	6-4-1996
23	Pablakhali	Chittagong Hill Tracts	42087.00	20-9-1983
24	Chunati	Chittagong	7763.97	18-3-1986
25	Fashiakhali	Cox's Bazar	1302.43	11-4-2007
26	Dudpukuria-Dhopachari	Chittagong	4716.57	6-4-2010
27	Hajarikhil	Chittagong	1177.53	6-4-2010
28	Sangu	Bandarban	2331.98	6-4-2010

29	Teknaf	Cox's Bazar	11615.00	24-03-2010
30	Tengragiri	Barguna	4048.58	24-10-2010
31	Dudhmukhi	Bagerhat	170.00	29-01-2012
32	Chadpai	Bagerhat	560.00	29-01-2012
33	Dhangmari	Bagerhat	340.00	29-01-2012
34	Sonarchar	Patuakhali	2026.48	24-12-2011
35	Nazirganj (Dolphin) Sanctuary	Pabna	146.00	01-12-2013
36	Shilanda-Nagdemra	Pabna	24.17	01-12-2013
37	Nagarbari-Mohanganj Dolphin Sanctuary	Pabna	408.11	01-12-2013

### C) Marine Protected Area

No.	MPA	Location	Area (sq km)	Established
38	Swatch of No-Ground	Bay of Bengal	1,738	27-10-2014

Moreover, there is another 582 sq kilometer marine area declared as protected under Marine Fishery Act. Therefore, the total marine protected area is about 2,320 sq kilometer which is about 2.17% of the marine area of Bangladesh. However, it is to be mentioned here that more than 10% of the country's reserved forests has been maintaining the status of IUCN VI categories of Protected Areas because no extraction of trees are allowed from the reserved forests of Bangladesh. The inland water constitutes about 7% in which seasonal ban for fishing is in practice for the conservation of fish species.



**Table 3.**  
**Number of flora recorded from some Protected Areas (PAs) of Bangladesh**

PAs	Trees	Shrubs	Herbs	Climbers	Epiphytes	Parasites	Ferns	Total	References
Rema-Kalenga WS	142	163	190	102	16	7	-	620	Feeroz et al. 2011
Dudhpukuria-Dopachari WS	182	125	200	71	7	6	17	608	Feeroz et al. 2012
Fasiakhali WS	82	66	88	41	8	-	-	285	Uddin et al. 2011
Chunati WS	240	102	211	106	19	7	6	691	Hossain & Hossain 2014
Teknaf WS	142	112	184	87	10	1	-	536	Feeroz 2013
Sitakunda Eco-park	140	79	54	28	2	-	9	312	Sourav et al. 2014
Madhupur NP	139	48	136	46	5	2	9	385	Hossain et al. 2015
Satchari NP	73	46	86	37	3	-	-	245	Arefin et al. 2011
Nijhum Dweep National Park	66	15	58	13	-	-	-	152	Feeroz and Uddin 2015
Inani Protected Forest	151	85	140	60	7	-	-	443	Feeroz 2016

In addition, we do not have regular monitoring mechanisms or programs for biodiversity assessment that will show the trend of changes in biodiversity status. To achieve the functions of Protected Areas (PAs), it is essential to take stock of what biodiversity we have at PAs; what we are doing to conserve them; what can be done better to reach the targets of sustainable conservation practice and how to implement actions. That's why measuring and monitoring is an initiative to explore and quantify the flora and fauna of Protected Areas (PAs) of Bangladesh (Table 3).

### 2.2.7 BOTANICAL GARDENS

The Bangladesh Forest Department also administered some Botanical Gardens, Safari Parks and several Eco-parks in different parts of the country (Table 4). Although these sites are mostly used for recreational purposes, they also harbour a diverse community of flora and fauna. A numbers of captive breeding programs is being implementing in the Safari Parks, including threatened species like Crocodiles, Gharials, Batagur turtles, Vultures, Hog deer,

Sambar, Goat antelope and Clouded leopard. The total area coverage of Botanical gardens and eco-parks is 9,434.18 hectares which is 0.06% of the total country (DoE 2015).

**Table 4:  
Botanical Gardens and Eco-parks**

No.	Protected Areas	Ecosystem	Conservation Focus	Location	Area (ha.)	Date
1	Balda Garden	Man made	Education, PGR	Dhaka	1.37	1909
2	National Botanical Garden	Man made	Plant species	Dhaka	84.21	1961
3	Bangabandhu Safari Park at Dulahazara, Cox's Bazar	Mixed Evergreen	Wildlife species	Cox's Bazar	600.00	1999
4	Sitakunda Botanical Garden & Eco-Park	Mixed Evergreen	Plant species	Chittagong	808.00	2000
5	Madhabkunda Eco Park	Mixed Evergreen	Natural	Moulvibazaar	265.68	2001
6	Madhutila Eco Park	Deciduous Forest	Natural	Sherpur	100.00	2001
7	Banshkhali Eco-Park	Mixed Evergreen	Natural	Chittagong	1,200.00	2003
8	Kuakata Eco-Park	Coastal beach		Patuakhali	5,661.00	2005
9	Tilagar Eco-Park	Mixed Evergreen	Natural	Sylhet	45.34	2006
10	Borshijora Eco-Park	Mixed Evergreen	Natural	Moulavibazar	326.07	2006
11	Bangabandhu Sheikh Mujib Safari Park	Deciduous Forest	Education, recreation, wildlife	Gazipur	1,542.51	2014
<b>Total</b>					<b>9,434.18</b>	

## 2.2.8 ECOLOGICALLY CRITICALLY AREAS

ECAs are ecologically defined areas or ecosystems affected adversely by the changes brought through human activities. Department of Environment has declared 13 sites as Ecologically Critical Areas (ECAs) under the section 5 of *the Bangladesh Environment Conservation Act, 1995* (Table 5). The total area coverage of ECAs is 384,529 hectares or 2.60% of the total country.

**Table 5:**

## Ecologically Critical Areas (ECAs) of Bangladesh (DoE, 2015)

Sl. No.	Name of the ECA	Type of Ecosystem	Location	Areas (ha)	Year of Declaration
1	Cox's Bazar-Teknaf Peninsula	Coastal-Marine	Cox's Bazaar	20,373	1999
2	Sundarbans (10 km landward periphery)	Coastal-Marine	Bagerhat, Khulna & Satkhira	292,926	1999
3	St. Martin's Island	Marine Island with coral reefs	Teknaf upazila, Cox's Bazaar	1,214	1999
4	Hakaluki Haor	Inland Freshwater Wetland	Sylhet and Moulvi Bazar	40,466	1999
5	Sonadia Island	Marine Island	Moheshkhali upazila, Cox's Bazar	10,298	1999
6	Tanguar Haor	Inland, Fresh water Wetland	Moulvi Bazar	9,727	1999
7	Marjat Baor	Oxbow Lake	Kaliganj, Jhenaidah & Chaugacha upazila of Jessore	325	1999
8	Gulshan-Baridhara Lake	Urban Wetland	Dhaka city	101	2001
9	Buriganga	River	Around Dhaka	1336	2009
10	Turag	River	Around Dhaka	1184	
11	Sitalakhya (around Dhaka city)	River	Around Dhaka	3771	
12	Balu including Tongi canal	River	Around Dhaka	1315	
13	Jaflong-Dawki	River	Jaflong, Sylhet	1493	2015

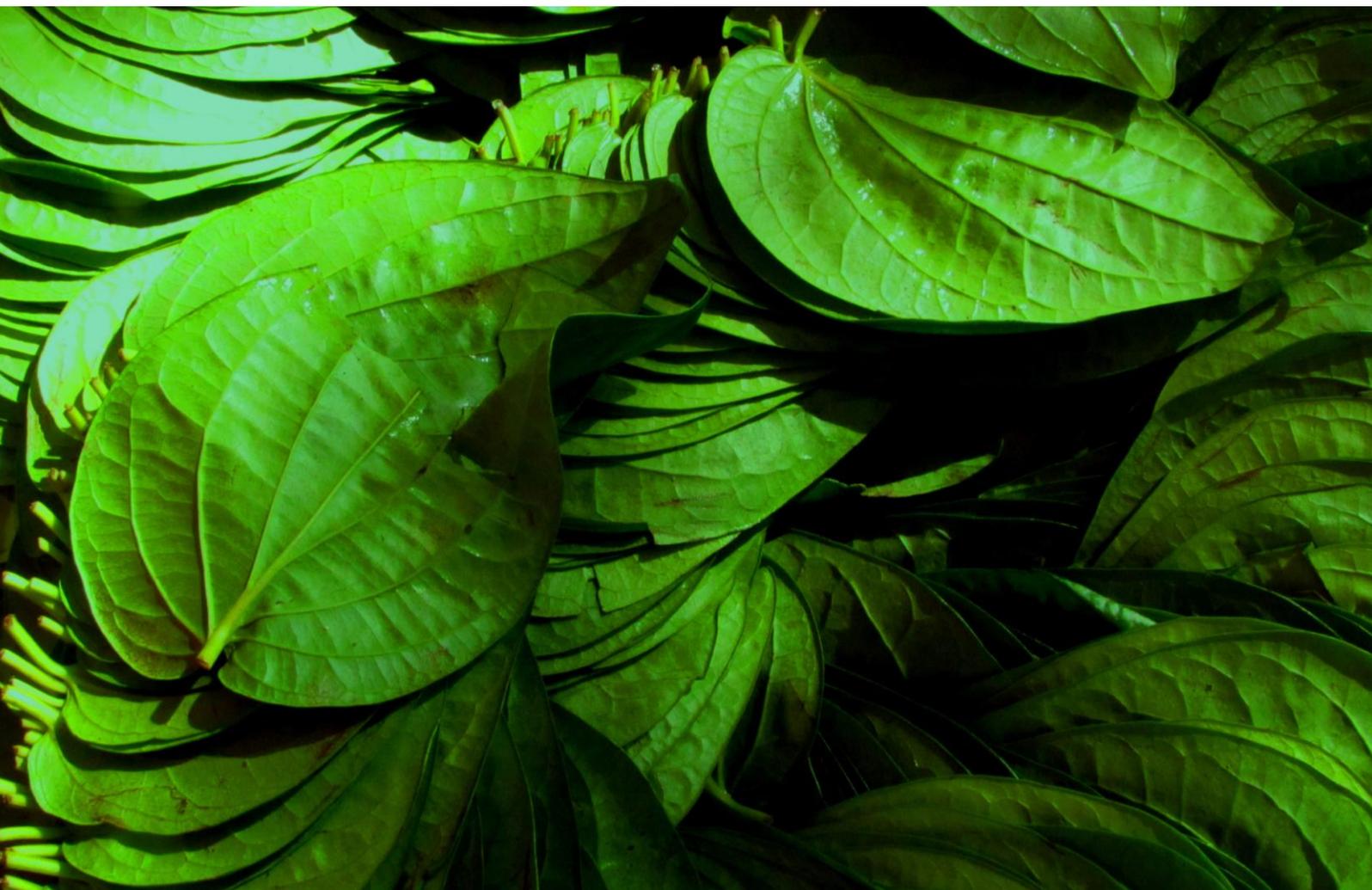
### 2.2.9 RESOURCE DEPLETION STATUS

Biodiversity is depleting from all natural habitats of Bangladesh. Biodiversity loss continues because current policies and economic systems do not incorporate the values of biodiversity effectively in either the political or the market systems, and many current policies are not fully implemented in the country. The depletion of biodiversity in Bangladesh is the result of over-extraction and exploitation. Though Bangladesh supports a rich forest biodiversity but the quantitative data is absent except for a few sites, e.g. Bamu forest (Hossain et al. 1997), Sitapahar Forest Reserve (Nath et al. 2000), Chunati Wildlife Sanctuary (Rahman and Hossain 2000, Hossain and Hossain 2014). Biodiversity conservation is of immense importance, under present state of habitat destruction and species depletion. Moreover, the database, so far we have, are very poor or inadequate. The quality of some of these databases is also under question! Moreover, wide variation shows among different reports, e.g., Huq and Banik (1992) and Khan (1991) reported the endangered forest species of Bangladesh, where both reports mentioned only one species in common to have the status of endangered species. Khan et al. (2001) published Red Data Book of Vascular Plants of Bangladesh (Vol. 1) listing 106 species of threatened plant species of various categories. Similarly, the second volume of Red Data Book of Vascular Plants of Bangladesh describes

120 species in different categories (Ara 2013). A complete inventory of 13 angiosperm families by Rahman (2013) reported 520 species, of which 235 plant species were categorized as threatened in different categories (69 were assessed as extinct, 128 endangered, 20 vulnerable and 13 as others), but the categorization is not based on any acceptable methodologies. However, according to the *Encyclopedia of Flora and Fauna of Bangladesh* (2007-2009; Volumes 5-12), Irfanullah (2011) considered 486 vascular plants as threatened in Bangladesh (Table 6).

**Table 6:**  
**Threatened plant species of Bangladesh**

Vascular plant groups	Total no. of species	Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)	Total no. of threatened species (% of total species in a group)
Pteridophytes	195	0	0	36	36 (18.46)
Gymnosperms	7	0	1	0	1 (14.29)
Angiosperms	3,611	30	126	293	449 (12.43)
Dicotyledons	2623	8	80	179	267 (10.18)
Monocotyledons	988	22	46	114	182 (18.42)
<b>Total</b>	<b>3,813</b>	<b>30</b>	<b>127</b>	<b>329</b>	<b>486 (12.75)</b>



### 3.1 GENERAL

The main issues in the loss of biodiversity in Bangladesh are degradation of habitat, e.g. change in land use, conversion of agricultural lands, haphazard introduction of HYV, priority of alien invasive species, urbanization, expansion of road networks, unplanned embankment and other anthropogenic activities that have damaged most of the ecosystems. Over exploitation of resources, e.g. unregulated fishing, illicit felling, encroachment, indiscriminate harvesting of medicinal plants and Non-Timber Forest products, hunting and trafficking along with the environmental pollution exerts a significant negative impact on the biodiversity of the country.

### 3.2 HABITAT DEGRADATION

Degradation and destruction of habitat by human settlement, agricultural expansion, road networks and shifting cultivation are the major issues for the conservation of biodiversity in Bangladesh (Hossain et al. 2008a, 2008b).

#### **Population Pressure**

Population of Bangladesh has been increased to more than 2 times after Independence. More population means more consumption of natural resources leading to degradation of flora and fauna habitat. Habitat degradation due to a growing population is much sharper in Bangladesh because of the improvement in the standard of living and quality of life of the people, exerts greater pressure on environmental resources.

#### **Jhoom (Shifting Cultivation)**

Shifting cultivation goes with primitive economies and isolated cultural communities in the hilly areas of Bangladesh. Shifting cultivation is characterized by a rotation of fields rather than by crops, accompanied by slash and burning (Khisa and Mohiuddin 2015). In a situation of little or no population or market pressure, shifting cultivation is environmentally acceptable. But, with a developing market economy and the inevitable population pressure on land, the shifting cultivation collapsed into degradation and retrogression, influenced by factors both internal and external to the system. About 40,000 families are engaged in shifting cultivation covering an area of about 40,000 ha (Khisa and Mohiuddin 2015) of the hill forests reserves of Bangladesh. Different ethnic groups of CHT were traditionally used to live in harmony with forests through protecting and consuming them. Unfortunately, such traditional practices have been lost and a more commercial approach to forest exploitation has led to large-scale deforestation in Bangladesh over the last few decades. Clearing of natural vegetation for cultivation of banana, pineapple, ginger and turmeric along the slopes has a negative effect, which increases soil erosion in the hilly areas.

### **Extensive Cultivation**

Increased demand of food supply for large population is causing conversion of natural ecosystems into other land covers. Intensive cultivation for meeting the additional requirements leads to soil erosion and loss of fertility, encroachment and degradation of forest, siltation and flooding in river basins, changes in microclimate and loss of habitat. On the other hand, cultivation in the low-lying areas severely disturbs traditional habitat of fish and other aquatic fauna. In CHT, horticulture is gaining popularity in forestlands with intensive cultivation of few crops, e.g. mango, litchi, orange etc.

### **Wrong Management Practices**

Clear felling followed by artificial regeneration is a long practiced silvicultural system in the hill forests by Bangladesh Forest Department. It is very much detrimental to the existing biodiversity predominantly floral diversity as it involves slash and burn of the natural vegetation, clearing of the forest floor, increase surface runoff of water and soil erosion, introduction of single or few species instead of diverse plant species.

### **Tobacco Cultivation**

Extension of tobacco cultivation in Lama, Ali Kadam and Naikhongchhari upazila of Bandarban district, and recently in Khagrachari and Rangamati has also contributed towards deforestation in two ways: through bringing fringe forest lands under tobacco cultivation and, supplying fuel wood for tobacco curing from adjacent forests. Tobacco is also responsible for the erosion of agro-biodiversity in their cultivation areas (Motaleb and Irfanullah 2011).

### **Brick Fields**

Brick fields in and around the vicinity of forests have been identified as one of the notorious causes of deforestation and biodiversity loss. Brick field owners who are the elites and patrons within existing power structures, have good liaison with political and government officials. Brick fields in the vicinity of forests have caused not only deforestation, but it has also caused environmental degradation of the biological production systems. Farmers of many areas reported that their fruit production in the areas had declined because of smoke originating from the brick fields. Moreover, the energy used for burning bricks comes mostly from woody biomass of the forests.

### **Land Use Change**

Land transfers have taken place where forested land get diverted for human settlement, development of industry, fishery, irrigation, energy and power, mining, tourism, educational institutions and Bangladesh army, navy and air force. The extent of such transfers of forest lands was about 20,016 ha (Rahman 2011).

### **Roads and Rail Lines Through Forests**

Communication networks through forests fragmented the natural habitats of both flora and fauna in Sylhet, Chittagong, Cox's Bazar, Mymensingh, Tangail and CHTs. Road construction or development of communication systems through forests or protected areas facilitates encroachment and extraction of resources from the forests. Such networks also restrict wildlife into limited area and often killing of those during crossing the roads.

### 3.3 ECOLOGICAL IMPACTS

#### **Pollution**

Aquatic ecosystem is polluted by discharges of untreated industrial effluents, domestic organic and inorganic wastes and agro-chemicals, i.e pesticides, insecticides, herbicides and organic fertilizers. Motorized vehicles also release oil and other wastes into the rivers causing pollution. Indiscriminate dumping of all forms of waste, both solid and liquid, is also the threat to aquatic and terrestrial habitats and biodiversity. The direct impact of oil spills on aquatic and marine ecosystems are widely reported. Oil spills from sea vessels during plying through river or other water ways degrades the water quality of the aquatic ecosystems. Discharge of wastes from ship breaking industries, tanneries, and paper mill industries severely pollutes the water by changing the standards of water quality parameters. Aquatic fauna including fishes both in variety and quantity is greatly reduced mainly due to such pollution. A recent accident of oil tanker in the Sundarbans caused severe damage to marine biodiversity predominantly reduction of phytoplankton, zooplankton etc.

#### **Changing the Ecology of Sundarbans**

Reduction of fresh water flow in the trans-boundary rivers in the upstream caused intrusion of salinity in the fresh water zones of the Sundarbans. Moreover, new areas are arising in the coastal regions through continuous siltation. Such changes in the ecology of the Sundarbans are changing the distribution and abundance of biological organisms especially which are sensitive to increased salinity. Land use change and installation of numerous flood management infrastructures in the coastal and floodplain areas have also changed the hydrological cycle (Hussain 2014).

#### **Climate Change**

Biodiversity and ecosystems are already more stressed than at any comparable period of human history. Climate change is causing many species to shift their geographical ranges, distributions, regeneration and phenologies at faster rates than previously thought. Climate change induced modifications in forestry increased the frequency and intensity of forest fire, outbreaks of insects and pathogens, and extreme events, as high wind etc. However, climate change can also accelerate vegetation growth caused by a warmer climate, longer growth seasons and elevated atmospheric CO<sub>2</sub> concentrations.

#### **Natural Calamities**

Bangladesh is the landing station of tropical cyclones. In addition, flood, tidal surges, intrusion of salinity, land slide, erosion and accretion in river bank and coastal areas also responsible for the loss of biodiversity in Bangladesh.

### 3.4 UNSUSTAINABLE USE OF FOREST RESOURCES

#### **Over Exploitation**

Over-exploitation of biodiversity components, e.g. medicinal plants, non-wood forest products, freshwater mollusks, corals, turtles, frogs, snakes and birds is also a threat to biodiversity.

### **Uncontrolled Tourism**

Unplanned and uncontrolled tourism is becoming a major threat for the degradation of biodiversity hot spots. The biodiversity of St. Martin's Island, Lawachara National Park, Madhabkundu Ecopark, and Sunderbans for examples, have been facing continuous threat from unmanaged or poorly managed tourism industry. The authorities don't bother about the carrying capacity of the tourist spots.

## **3.5 ALIEN INVASIVE SPECIES**

### **Introduction and Prioritizing the Alien Invasive Species**

One of the major threats to native biological diversity is now acknowledged by scientists and governments to be biological invasions caused by alien invasive species (Shine et al. 2000). "Alien invasive species" means an alien species which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity (IUCN 2000). In Bangladesh introduction of alien invasive species of flora and fauna were deliberate primarily in order to increase productivity to support the needs of a huge population. There are no records of introduction of a number of species. But, the deliberate preferences of fast growing high yielding cultivars eroded some of the native species and the genetic resources abruptly. Very scarce information is available about the alien species in Bangladesh and their impacts on the ecosystem and the native species (Barua et al. 2001, Hossain and Pasha 2001). More than 300 exotic plant species are supposed to either wildly growing or cultivated as an economic crop in Bangladesh (Hossain and Pasha 2001). Of them, the herbaceous and lianas are the dominant exotics followed by trees and shrubs.

### **Erosion in Genetic Diversity**

Genetic erosion in agricultural biodiversity is the result of introduction of High Yielding Varieties (HYV). Out of more than 10,000 local rice varieties used to be cultivated in Bangladesh, only 22 are now mostly used. Monoculture of few fast-growing exotics has accelerated the loss of native forest genetic resources (Hossain 2015). Akashmoni (*Acacia auriculiformis*) is getting priority in forests plantations (~75%) that accelerate the loss of native forest plant diversity in an alarming rate (Hossain, 2014).

## **3.6 RESEARCH, EDUCATION AND AWARENESS**

### **Knowledge and Awareness**

Gaps in knowledge and awareness at various levels have been identified in implementing biodiversity conservation programs. Many people do not know that there are so many species of plants and animals in Bangladesh keeping the natural system healthy. Different types of Protected Areas exist in the country; but relevant stakeholders are not aware of the management systems of those Protected Areas.

A comprehensive survey of flora and fauna of the PAs need to be documented and monitoring shall be done to assess the trends of changes in biodiversity. Relevant skilled manpower in the field of flora and fauna are very scant. Emphasis may be given to develop skilled taxonomists, ecologists and biodiversity specialists in managing, survey and doing research in the field of biodiversity.

## 4.1 PRIORITY THE SECTOR BIODIVERSITY

The Article 18A of the Bangladesh Constitution ensures “protection and improvement of environment and biodiversity”. The state shall endeavor to protect and improve the environment and to preserve and safeguard the natural resources, biodiversity, wetlands, forests and wildlife for the present and the future generations. In addition Bangladesh has obligations to fulfill the commitments of the international agreements for the conservation of the natural resources. The government of Bangladesh is committed to conserve its natural resources through a series of international treaties, conventions and also by its constitution. These have been reflected through the documents approved by the government and the Parliament, and the commitments made by the Prime Minister in various international forums.

Bangladesh has signed the five major conventions and agreements related to biodiversity conservation (i.e. CBD, CITES, CMS, RAMSAR, WHC). As a signatory party of these conventions the government has undertaken various initiatives to conserve the biodiversity in both ecosystem and species level (Chowdhury 2008). Again as a CBD-COP the country is bound to adopt the Ecosystem Approach to conserve biodiversity.

**Table 7:**  
**Major efforts and interventions towards biodiversity, environment conservation and sustainable development in Bangladesh**

Major efforts and interventions	Brief description
Ramsar Convention, 1971	Convention on wetlands of International importance, especially as waterfowl habitat, 1971; Bangladesh ratified the convention in 1992.
CITES, 1973	Convention on International trade in endangered species of wild fauna and flora (CITES); Bangladesh signed and ratified the convention in 1981 and 1982 respectively.
UNFCCC	Framework convention on climate change; Bangladesh accessed the convention in 1992.
UNCBD, 1992	Convention on Biological Diversity (CBD); signed in 1992 in Rio and ratified by the Government in 1994. NBSAP was prepared under CBD in 2006.
UNCCD, 1994	International convention to combat desertification; signed in Paris in 1994. In Bangladesh, an Action Plan is yet to be drawn up.

Some significant initiatives have been taken by the Government agencies, e.g. Forest Department, Department of Environment, public institutions, Universities, Development partners, and national and international NGOs in an aim to conservation of the natural resources.

## 4.2 LIST OF POLICIES/PROGRAMS/PROJECTS FOR BIODIVERSITY CONSERVATION

### **National Forest policy, 1994**

The National Forest Policy of 1994 is the amended and revised version of the National Forest Policy of 1977 in the light of the Forestry Master Plan. The major target of the policy is to conserve the existing forest areas and bring about 20% of the country's land area under the Forestation Program and increase the protected areas by 10% of the reserve forest land by the year 2015, through coordinated efforts of GO-NGOs and active participation of the people. It had designed as the priority protection area that encompass representative sample of flora and fauna in the core area of National parks, Wildlife sanctuaries etc.

### **Forestry Master Plan, 1993-2012**

It incorporates various programs for enhancing the involvement of rural population in forestry sector activities. Its objectives include preserving existing values, conserving plants and animals, and ensuring maximum benefits to local people.

### **Wetland Policy, 1996**

The Policy is relevant to biodiversity because it seeks to conserve wetlands to sustain their ecological and socio-economic functions and further sustainable development; establish key principles for wetland sustainability and unsustainable practices; maintain existing levels of biodiversity; maintain wetland functions and values; and actively promote integration of wetland functions in resources management and economic development.

### **National Fisheries Policy, 1998**

The National Fisheries Policy provides the framework for the conservation and management of fisheries resources to ensure supply and enhance production. All the water bodies suitable for fisheries production and their fisheries resources conservation, development and management are addressed under this policy. These include rivers and canals, haor and baor, floodplains, open and coastal water systems.

### **Tourism Policy**

The National Tourism Policy of Bangladesh was declared in 1992.

### **Land Use Policy, 2001**

The National Land Use Policy 2001 of the Ministry of Land highlights the need, importance and modalities of land zoning for integrated planning and management of land resources of the country. The National Land Use Policy mentioned the need of formulating a Zoning Law and Village Improvement Act for materializing the identified land zoning area.

### **National Water Policy, 2012**

The National Water Policy of 1999 was passed to ensure efficient and equitable management of water resources, proper harnessing and development of surface and ground water, availability of water to all concerned, and institutional capacity building for water resource management.

### **Coastal Zone Policy, 2005**

The Coastal Zone Policy (CZP) 2005 aims to ensure a participatory and integrated approach in the management and development of the coastal zone, to reduce conflicts in the utilization of coastal resources and to optimize exploitation of opportunities. This is in view of the complexity of the coastal zone, which encompasses both the terrestrial and aquatic environment and transcends a wide variety of human activities.

### **Industrial Policy, 2010**

The Industrial Policy, 2010 presents an integrated strategy for achieving high economic growth in the country through rapid industrialization. It has been prepared taking into consideration the government's determination to achieve the Millennium Development Goals (MDGs) by 2015, and halve the number of the unemployed and hunger- and poverty-stricken people by 2017.

### **National Energy Policy, 1995**

One of the seven 'objectives' addresses the environment and says "to ensure environmentally sound sustainable energy development programs causing minimum damage to environment".

### **National Agriculture Policy, 1999**

The overall objective of the National Agriculture Policy is to make the nation self-sufficient in food through increasing production of all crops including cereals and ensure a dependable food security system for all. The aims are also to ensure sustainable agricultural production system, preservation and development of land productivity and preservation of crop biodiversity. However, there are some gaps found in the biodiversity elements in major national policies (Table 8).

**Table 8:  
Gaps found in the biodiversity elements in major national policies**

<b>Sector/ Ministry</b>	<b>Name of the policy</b>	<b>Biodiversity elements and gaps</b>
MoEF	Environment Policy 1992	Section 3 of this policy has a clear mention of biodiversity and its conservation but as a cross cutting issue. Section 4 of this policy has suggested to follow the ICTPs and thereby incorporated the CBD briefly. It has no explicit
MoEF	Forest Policy 1994	Biodiversity has been mentioned in this policy in a very sketchy manner. None of the 29 statements of this policy
Agriculture	National Agriculture Policy 2013	Biodiversity conservation, sustainable use of land and water resources, IPM, integrated crop cultivation and collection, conservation and use of genetic resources are emphasized. Emphasis has been given to balanced use of fertilizer and popularizes organic fertilizer.
Fisheries	National Fisheries Policy 1998	The 5th objective has mentioned about the maintenance of ecological balance and conservation of biodiversity. This is enough to induce 'biodiversity' in the fisheries sector.

Fisheries	National Shrimp Policy 2014	While emphasizing on shrimp farming, it has some mention of -Environment Friendly to be fool the environmentalists. Under item 2d of the policy it has stated to conserve biodiversity in shrimp cultivation area,
Land	Jalmohal (water-body) Management Policy 2009, amended in	This policy has mostly dealt with the leasing authorities of government and control on water bodies depending on its size. It has a mention of declare some of the government owned water bodies as fish —reserve. Section 35 of this policy has given an absolute authority to
Land	Land Use Policy 2001	It has mentioned that the agricultural land was 22.6 million acres which declined to 20.2 million acres in 1997. It has expressed concern on the conversion of agricultural lands to other uses. It has mentioned about the conservation of forest land. It has suggested for land zoning and promulgation of a 'zoning law'. It stated that proper implementation of environment policy 1992 and forest
Land	Khas Land Settlement Policy 1995 & 1997	There are two sets of policies (used as rules) namely Agriculture Khas land management and settlement policy, 1997 and Non-Agriculture Khas land management and settlement policy 1995. None of these has any
Land	Khas Land Settlement Policy for Hotel Motel 1998	It has no mention of biodiversity.
Land	Salt Mohal Management Policy	It has no mention of biodiversity
MoWR	National Water Policy 1999	It has indication on minimum stream flow and mention of preservation of the environment. But it has no mention of biodiversity conservation.
MoWR	Coastal Zone Policy 2005	It has incorporated the biodiversity aspects but under a complex umbrella of many sectors. Thus it is completely ineffective. It has incorporated too many diverse issues as policy and

### 4.3 THE ACTS AND RULES HAVE ALSO BEEN DRAFTED

- Integrated Coastal Zone Management Plan, 2005
- Deer Rearing Rules, 2008
- Biomedical Waste Management Rules, 2008
- Bangladesh Climate Change Strategy & Action Plan (BCCSAP 2009)
- Bangladesh Climate Change Trust Fund Act, 2010
- Revised National Conservation Act, 2010
- National 3-R Strategy, 2010
- Environmental Courts (in all district) Act, 2010
- Bangladesh Environment Conservation Act, 1995 (Amendment 2010)

- Environment Court Act 2010
- Bangladesh Climate Change Resilience Fund, 2011
- Forest Transit Rule, 2011
- Social Forestry Rule, 2004 (amended in 2010 & 2011)
- Hazardous Waste and Ship Breaking Waste Management Rules, 2011
- Bangladesh Bio-safety Rules, 2012
- Bangladesh Wildlife Conservation and Security Act, 2012
- Draft Tree Conservation Act, 2012
- Bangladesh REDD+ Readiness Roadmap, 2012
- The Brick Manufacture and Brick Kiln Installation (Control) Act, 2013
- Bangladesh Biological Diversity Act, 2013
- Solid Waste Management Rules, 2013
- Ecologically Critical Area Management Rules, 2013
- E-waste Rules, 2013

#### 4.4 MULTILATERAL ENVIRONMENTAL AGREEMENTS (MEAs)

Bangladesh has so far signed, ratified and or accessed 35 International Conventions, Treaties and Protocols (ICTPs). Among them the following ICTP's received attention of the government for follow up implementation.

- Stockholm Convention On Persistent Organic Pollutants
- Vienna Convention For The Protection Of Ozone Layer
- Montreal Protocol On Substances That Deplete The Ozone Layer (1987)
- Un Framework Convention On Climate Change (UNFCCC) 1992
- Kyoto Protocol To The Un Framework Convention Climate Change (1997)
- United Nations Convention On Biological Diversity (CBD)
- Cartagena Protocol On Bio safety
- Convention On Wetland Of International Importance Especially As Waterfowl Habitat (Ramsar Convention)
- Convention On International Trade In Endangered Species Of Wild Fauna And Flora (Generally Known As CITES)
- United Nations Convention To Combat Desertification
- Basel Convention On The Control Of Transboundary Movements Of Hazardous Wastes And Their Disposal
- The United Nations Convention On The Law Of The Sea
- The International Convention For The Prevention Of Pollution From Ships, 1973, As Modified By The Protocol Of 1978 Relating Thereto (Marpol 73/78)
- Minamata Convention on Mercury
- Nagoya Protocol on Access and Benefit sharing

#### 4.5 BIODIVERSITY PROJECTS

- Community Based Adaptation in the Ecologically Critical Areas through Biodiversity Conservation and Social Protection,
- Bangladesh Coastal and Wetland Biodiversity Management Project,

- Updating and Mainstreaming of National Biodiversity Strategy and Action Plan (NBSAP) for Bangladesh,
- Implementation of the National Biosafety Framework of Bangladesh (INBF),
- Clean Air and Sustainable Environment (CASE) Project (Environment Component),
- Bangladesh Environment and Climate Change Outlook (ECCO),
- Environment Friendly Management of Poly-Packaging Waste to reduce water logging and adverse impact of Climate Change,
- Climate Resilient Participatory Afforestation and Reforestation Project (CRPARP)

The above policies, plans and instruments are contributing to environmental advancement and biodiversity conservation. As for example, in the area of biodiversity conservation and protection, enactment of Deer Rearing Rule 2008, compensation for Wildlife Affected People Rule 2011, and Compensation for Wildlife Affected Forest Staff Rule 2011, are playing a positive role in protecting endangered wildlife like deers, tigers and elephants as the Rule provide an incentive to people to play a role in ensuring necessary protection (MoEF 2012).

## 4.6 OBJECTIVES, NATIONAL TARGETS AND WORK PLAN FOR BIODIVERSITY CONSERVATION

The 10th meeting of the Conference of the Parties (COP) of the CBD in 2010 adopted a revised and updated 'Strategic Plan for Biodiversity 2011-2020. This plan provides an overarching global framework on biodiversity conservation. This Strategic Plan includes Aichi Biodiversity Targets 2020 – a total of 20 targets under five Strategic Goals (A-E). In the light of the Strategic Plan and its Targets, Bangladesh has started updating its NBSAP (MoEF 2006) in 2014. Implementation of NBSAP was assessed and shared with the CBD through Fourth National Report (MoEF, 2010). In accordance to the spirit of the Aichi Targets and MDGs, Bangladesh is formulating its national Targets through evidence-based approach. The Department of Environment under the Ministry of Environment and Forests along with other government agencies is attempting to integrate these learnings into the Seventh Five Year Plan of Bangladesh currently under formulation by the Government of Bangladesh (DoE 2015).

### **Achievements of the Aichi Biodiversity Targets:**

The Aichi Biodiversity Targets came into effect since 2011 and sets 20 targets to be achieved by 2020 (Table 9). Bangladesh is in the process of developing its national Biodiversity Targets 2020.



**Table 9:**  
**Targets and achievements under Strategic Goals of Aichi Biodiversity Targets in Bangladesh (Adapted from DoE 2015)**

Targets	Target Statement	Achievement till to date (2015)
<b>Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society ( Aichi Biodiversity Targets 1 to 4).</b>		
01	By 2020, at the latest, people shall aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.	<p>Evidence showed that awareness level of the general mass has increased, especially around biodiversity-rich ecosystems, e.g. protected areas, Ramsar sites etc.</p> <p>University level students and academia are aware of values of biodiversity through education and research programs.</p> <p>People are oriented through celebrating the World Environment Day, the World Wetlands Day, the World Migratory Birds Day, the Earth Day, the World Wildlife Day, the international Tiger Day, the Vulture</p>
02	By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning	<ul style="list-style-type: none"> <li>▪ Importance of biodiversity has already been incorporated to some extent (e.g. Constitutional endorsement, Poverty Reduction Strategy Paper &amp; National Strategy for Accelerated Poverty Reduction).</li> <li>▪ Economic valuation of biodiversity and other ecosystem services are yet to be incorporated in national accounting and reporting system.</li> </ul>
03	By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and	<ul style="list-style-type: none"> <li>▪ Positive incentive in terms of price reduced of non-urea fertilizer in order to discourage over-use of nitrogen or fertilizer.</li> <li>▪ The Government of Bangladesh is encouraging integrated pest management in order to minimize excess use of fertilizer, pesticides and insecticides.</li> <li>▪ Reduced subsidies in chemical fertilizer are in place. Initiatives has been taken to conserve biodiversity by introducing financial systems, e.g. micro- capital grant, endowment fund (both under the CBA-ECA project) and alternative income generation activities (in numerous projects).</li> <li>▪ Diclofenac has been banned and Ketoprofen is in the process of banning to save critically endangered vulture population. Two Vulture Safe Zones were declared in December 2014 (IUCN Bangladesh, 2015).</li> </ul>

04	By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and	<ul style="list-style-type: none"> <li>▪ Bangladesh Bank has established green banking program to support financing for energy efficient and environment friendly industrial activities.</li> <li>▪ Corporate social responsibility is coming into the scene to meet the environmental standards.</li> </ul>
<b>Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use (Aichi Biodiversity Targets 5 to 10)</b>		
05	By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.	<ul style="list-style-type: none"> <li>▪ No updated information on the rate of degradation and loss of natural habitat.</li> <li>▪ The rate of degradation of forests has been addressed through expansion of Protected Areas</li> <li>▪ Protected Areas, Ecologically Critical Areas and fish and wildlife sanctuaries have been established,</li> <li>▪ The drivers of degradation have not been addressed fully at its full range.</li> <li>▪ Ministry of Land is implementing land zoning at local level (upazila or sub-district level).</li> <li>▪ Biological zoning approach has been adopted in PA to ensure the protection of wildlife species and floral habitats.</li> </ul>
06	By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse	<ul style="list-style-type: none"> <li>▪ Department of Fisheries has introduced fishing area restriction, seasonal fishing ban and banned bottom trawling.</li> <li>▪ Sustainable management of aquatic resources has been practiced in a limited scale at important ecosystems, e.g. in the Sundarban and Tanguar Haor.</li> <li>▪ Fisheries stock survey is regularly going on in certain habitats.</li> <li>▪ For marine fisheries stock survey is under planning.</li> <li>▪ A large area has been brought under sanctuary management and operationalized by the local fisher communities.</li> <li>▪ Hilsa management plan is in place (2000, 2006).</li> </ul>

07	By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.	<ul style="list-style-type: none"> <li>▪ Policies and programs are in place for fisheries and aquaculture; but not adequately implemented as of now. No specific policy and strong programs are available for agriculture and aquaculture in terms of biodiversity conservation.</li> <li>▪ Forests are now managed sustainably, no extraction of trees from natural forests, only sustainable extraction is allowed from plantations of the reserved forests</li> <li>▪ Some Protected Areas and wetland have</li> </ul>
08	By 2020, pollution, including from excess nutrients, has been brought to levels that are not	<ul style="list-style-type: none"> <li>▪ Activities like, Environment Impact Assessments, installation of effluent treatment plants, monitoring and enforcement, damage assessment, and integrated pest management have been undertaken widely.</li> </ul>
09	By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in	<ul style="list-style-type: none"> <li>▪ Quarantine system has been established at the ports of entry. However, there is space to enhance the capacity of manpower and logistics, in order to increase functionality of the system.</li> </ul>
10	By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as	<ul style="list-style-type: none"> <li>▪ Some initiatives to reduce anthropogenic pressures on mangrove ecosystem and inland wetlands have been taken. For example, CREL project is being implemented with the aim to improve the livelihoods of local communities dependent on vulnerable and critical ecosystems, like corals in the St. Martin's Island.</li> </ul>

**Strategic Goal C: To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity (Aichi Biodiversity Targets 11 to 13)**

11	By 2020, at least 17 per cent of terrestrial and inland water areas, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.	<ul style="list-style-type: none"> <li>▪ Till date, 10.72% forested area is under Protected Areas coverage (as National Parks and Wildlife Sanctuaries), which is around 1.8% of the whole country. The Marine Protected Area is 1.63% of the total marine area of Bangladesh.</li> <li>▪ The Department of Fisheries declared a marine reserve in the year 2000 under section 28 of the <i>Marine Fisheries Ordinance, 1983</i> (Ordinance No. 35 of 1983). The area of the reserve is estimated to be 69,800 hectares (or 698 square km)</li> <li>▪ In addition, more than 10% of the country's reserved forests has been maintaining the status of IUCN VI categories of Protected Areas.</li> <li>▪ The inland water constitutes about 7% in which seasonal ban for fishing is in practice for the conservation of fish species.</li> </ul>
12	By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.	<ul style="list-style-type: none"> <li>▪ Red List of animals prepared by IUCN Bangladesh is currently being updated by IUCN Bangladesh under the SRCWP project of Bangladesh Forest Department.</li> <li>▪ Implementation of Tiger Action Plan (2009-2017)</li> </ul>
13	By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio- economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing	<ul style="list-style-type: none"> <li>▪ A good number of germplasms of cultivated crops and commercially viable plant species are preserved in government research institutes (BRRI, BJRI) and Universities. Limited private sector involvement is present currently.</li> </ul>

**Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services (Aichi Biodiversity Targets 14 to16)**

14	By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.	<ul style="list-style-type: none"> <li>▪ Significant progress has been made, e.g. major ecosystems, like Tanguar Haor, Hakaluki Haor, Hail Haor, Sonadia Island, Lawachara Forest, Teknaf Forest, Chunati Wildlife Sanctuary, Modhupur National Park, and Community Conserved Areas in the Chittagong Hill Tracts are examples of steps taken to restore and safeguard focusing co-management and community-based natural resource management approaches.</li> <li>▪ Substantial portion (.....) of plain land forest ecosystems has already been restored through implementing social forestry system with the involvement of women, poor and vulnerable people of local communities as beneficiaries.</li> </ul>
15	By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15% of degraded ecosystems, thereby contributing to climate change	<ul style="list-style-type: none"> <li>▪ Carbon stock of 15 Protected Area including Sundarbans has been taken already.</li> <li>▪ More than 15% of the plain land forests have been restored.</li> <li>▪ Government has taken initiatives to restore the ecosystems of hill forests through massive enrichment plantation, natural regeneration and introduction of Social Forestry in the hilly districts of Bangladesh.</li> </ul>
16	By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force	<ul style="list-style-type: none"> <li>▪ In September 2011, Bangladesh signed the Nagoya Protocol to the CBD.</li> <li>▪ Bangladesh has drafted <i>Bangladesh Biological Diversity Act, 2012</i> in which addressed access benefit sharing issues.</li> </ul>
<b>Strategic Goal E: Enhance implementation through participatory planning, knowledge management and capacity building (Aichi Biodiversity Targets 17 to 20)</b>		
17	By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy	<ul style="list-style-type: none"> <li>▪ Updating of the NBSAP is finalized by Department of Environment December 2015.</li> </ul>

18	By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international	<ul style="list-style-type: none"> <li>▪ Traditional knowledge related to biodiversity has been documented, like the Ayurvedic practices, including an establishment of a University.</li> <li>▪ A book entitled 'Traditional use of ethnomedicinal plants of the Chittagong Hill Tracts' has been published by the Government of Bangladesh.</li> <li>▪ Hill communities' traditional medicinal knowledge and practices have been documented in many research papers and books.</li> </ul>
19	By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and	<ul style="list-style-type: none"> <li>▪ Research on commercially important crop genetic resources are being carried out by national agricultural research institutes on rice, jute, tea and many agricultural and horticultural crops.</li> <li>▪ DNA bar-coding initiated in taxonomic identification of species.</li> <li>▪ Study is being conducted on state of research and assessment of technological needs.</li> </ul>
20	By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization, should	<ul style="list-style-type: none"> <li>▪ NBSAP updating process included activity on developing resource mobilization strategy.</li> <li>▪ The Sixth Five Year Plan of Bangladesh had incorporated a lump sum budget on issues pertaining to wildlife and Protected Areas.</li> <li>▪ The Sixth Five Year Plan of Bangladesh had incorporated a lump sum budget on issues pertaining to Biodiversity</li> </ul>

## 4.7 INSTITUTIONS

A number of institutions, e.g. Forest Department, Department of Environment, Bangladesh Forest Research Institute, Bangladesh National herbarium, Universities along with the ministries (Ministry of Environment and Forest, Ministry of Agriculture, Ministry of Fisheries, Ministry of Industries etc.), NGOs and Community-based Organizations (CBOs) are collectively involved in forest biodiversity management and conservation programs. Major institutional constraints associated with biodiversity and forestry development in Bangladesh are inadequate and appropriate policy and planning, outdated and ineffective legislation, corrupt and inefficient administration, poor and not need based training, research and extension (Ahmed 2001). Moreover, the prevailing law and order in Bangladesh makes FD unable to implement the existing legislation and in providing protection the remaining natural forests.

Infrastructure and resource capacity of most of the organizations have improved considerably but the scientific knowledge base and understanding remain inadequate for protecting the biodiversity. Linkage between different governmental organizations and between government and non-government or autonomous organizations is very poor (Muzaffar et al. 2011). Initiatives are taken for co-management of the PAs but the progress is yet to be improved a lot. Most importantly, substantial changes are needed in the implementation of forestry and biodiversity plans and policies. Forest Department was not able to implement the Forestry Master Plan (1995-2015), but initiatives are also in action for the formulation and development of a new Forestry Master Plan.



<b>Issue(s)</b>	<b>Action</b>	<b>Implementing agency</b>
Review existing laws and policies	Review, update and strictly implement laws and policies related to environmental pollution	MoEF
		MoEF, MoA, MoF
Legislation	Implementation of the Biodiversity Act	MoEF, MoA, MoF, Legal experts
	Enhance the capacity of Environmental Court to handle issues of biodiversity conservation appropriately.	
Document and monitor biodiversity	Develop database of all known species based on published information	MoSICT, BNH and Universities
	Inventory marine biodiversity, micro organism, agro-biodiversity, lower plants etc.	
	Develop a National Policy on Genetic Resources	MoEF, MoA, Universities, AF, IUCN
	Updating of inventory on existing and endangered flora and fauna	
Evaluate status of Threatened Flora and Fauna	Detailed countrywide survey of the plants and animals that have been listed as threatened	MoEF, FD, BNH, BFRI and Universities
	Prepare a handbook that illustrate and describe the known species of plants and animals in Bangladesh	MoEF, MoSICT
Prepare the Management Plan for the PAs	Prepare management plan for all ecosystem of the country including the Wildlife Sanctuary, National Parks, Ecologically Critical Areas etc.	MoEF, MoSICT, FD, BFRI, BNH BCSIR, BFRI, BNH and universities
Ensure cross-sectoral integration of biodiversity	Integrate biodiversity information and communication protocol in all development projects.	MoSICT, MoF
	Network biodiversity information system so that they are accessible across sectors	
Local Participation	Build capacity in the local government to manage biodiversity locally	MoEF and NGOs
	Establish cooperatives and regulated markets locally exclusively for	

	biodiversity trade	
	Build capacity in women to run the local level institutions	
Replenishment of resources	Plant species bearing food and providing shelter to wild animals and bird should be included in tree planting programme in rural and forest area.	MoEF in collaboration with MoLGRDC, MoA, FD, DAE and NGOs
	Restoration and recolonization of native tree species with Assisted Natural Regeneration (ANR)	
	Blank in managed forest and unclassified state forest to be planned with indigenous species and bamboos.	
	Wildlife survey to be initiated with adequate qualified personnel and equipment in the protected areas. Survey will include study of population dynamics and listing of rare, endangered and threatened species.	
	Documentation and participatory management of the VCFs in CHT	Headmen/Karbari, CHT Development Board, NGOs
	Reclamation and restoration of degraded forest land through natural regeneration (soil seed bank, wildlings, stumps & roots and seed dispersal from outside)	FD, NGOs, Universities
	Conservation and restoration of mangroves, e.g. Chakaria Sundarbans Develop models for community participation AIGs for forest dependent groups, e.g. CRPARP	FD, NGOs
Research, Education & Public Awareness	Create widespread awareness amongst the general public	
	Sensitise the religious heads at all levels to address the issue of biodiversity conservation.	MoEF, DoE and FD
	Graduate courses on wildlife biology and management to be introduced in universities for production of professionals on the subject.	MoE in collaboration with MoEF and University Grants Commission
	School curricula to be incorporated with small projects on fields' visits of 'biodiversity hotspots'	MoE in collaboration with School Text Book Boards, Boards of Secondary and

	Establish Village Biodiversity Register for documenting the rural biodiversity resources	Higher Secondary Education
	Eco-tourism to be developed in protected areas for public awareness and generating income.	MoEF, FD
	Research for exploration the climate resilient species	BFRI, Universities
Resource inventory and protection	A National Committee for Plant and Animal Genetic Resources should be established. This may be constituted under the auspices of a National Institute, e.g BARC (apex body of the NARS)	MoEF and BARC
	Physical facilities and expertise of the Universities to conserve germplasm.	MoEF, UGC, Universities and NARS.



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