Thematic Article

Present Status of Biodiversity Conservation in Bangladesh

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1.0 Introduction

Biodiversity is that part of nature, which includes the differences in genes among the individuals of a species, the variety and richness of all the species in a region, as well as the various types of ecosystems within a defined area. The large variations found in nature influence the day-to-day lives of millions of people. A large number of people depend on biodiversity for their survival. The preservation of biodiversity is therefore an integral part to any strategy that aims at improving the quality of human life.

Over the past few decades, biodiversity has become the issue of global concern for its rapid reduction worldwide. The country is exceptionally endowed with a vast variety of flora and fauna, but due to country's tremendous population pressure, rural poverty and unemployment it has been decreased alarmingly. It is also widely supposed that it is the poorest people of most developing countries, who depend most immediately upon local ecosystems for their livelihoods, that will be most affected by the consequences of this biodiversity loss (CBD, 2006).It is, therefore, essential to conserve this threatened biodiversity for the wellbeing of these people.

The main tool of biodiversity conservation is the protection and conservation of ecosystems like forest ecosystems, mangrove ecosystem, grassland ecosystems, aquatic ecosystems, river ecosystem, wetland ecosystem, oceanic ecosystem or agro-ecosystems need to properly function. However, the fact is that most of the ecosystem services are currently under big threat because of uncontrolled exploitation of natural resources, population pressure, forest and wetland habitat destruction, linear expansion roads and railways, pollution and climate change etc.

Animal species diversity is the integral part of diversity of natural ecosystem. Bangladesh is rich in animal diversity due to the diversity of their habitats. Major habitats are forests, rivers, seas, wetlands (haor, baor, beel, lake, pond, canal etc.), agriculture lands, non-agriculture lands, villages, estuaries and urban areas etc. The forest ecosystems are the major habitats of wild animal like tropical evergreen, semi-evergreen, mangrove, mixed evergreen, Sal, swamp, coastal and village forests. These ecosystems are also in big threat because of encroachment, illegal tree felling, human settlement, roads and railway expansion, urbanization, over exploitation of forest produces and weakness of legal action etc.

2.0 Biological Diversity

It is estimated that the number of species of plants and animals on earth that may be present varies from 20 to 25 million. The current trends in the destruction of wilderness habitats are likely to eliminate approximately **12 to 15 million species** by the year 2050. The impact of highly affluent societies of the developed countries and the ever-increasing population in the developing world, are the chief factors leading to the current mass-extinction of species. Biodiversity has global, national, regional and local implications in relation to its economic value. Biological diversity can be classified into three kinds:

(i) Genetic diversity

(ii) Species diversity

(iii) Ecosystem diversity

1. **Genetic diversity:** This is variation among individuals of a species e.g. each human being differs widely from all other human beings. This diversity is due to the large number of combinations possible in our genes that give one individual a specific characteristics and identity. This genetic variability is essential for a healthy breeding population of a species. If the number of breeding individuals is reduced; in-breeding occurs, which is not good for the health of the species.
2. **Species diversity:** The number of species of plants and animals that are present in a region constitutes its species diversity. This diversity of species is found in natural systems and in agricultural systems. Natural tropical forests have much greater species diversity than most other regions. Modern intensive agricultural systems have a relatively lower diversity than traditional agro-pastoral farming systems. A natural forest has higher species diversity than a plantation, which is usually a mono-culture. In the natural system, there are a large number of non-wood products on which people depend such as timber fuel-wood, fruit, fodder, fiber, gum, resin, medicines and several other products.
3. **Ecosystem diversity:** Each area has a variety of ecosystems. These have their own distinctive interlinked species of plant and animals. Each of them varies functionally and structurally from other systems. The ecosystem in an area is referred to as natural when it is relatively undisturbed by human activities or modified when it is changed to other types of uses. Natural ecosystems are forests, grasslands, deserts and aquatic systems. If they are overused or misused, their productivity eventually decreases. The ecosystem is then said to be degraded.

Though nature has provided a large genetic, species and ecosystem diversity, to meet all our needs and for the balance of nature, but a large number of species and ecosystems are under serious threat and are being overused and destroyed mainly due to poor man's immediate needs and rich man's greed's.

3.0 The State of Biodiversity in Bangladesh

Bangladesh is exceptionally endowed with a vast variety of flora and fauna due to its unique geo-physical location. An estimated 5,700 species of angiosperms alone, including 68 woody legumes, 130 fiber yielding plants, 500 medicinal plants, 29 orchids, 3 species of gymnosperms and 1,700 pteridophytes has been recorded from the country. Fauna of Bangladesh possesses a wide range of invertebrates and vertebrates in its aquatic and terrestrial ecosystem. The invertebrate fauna of the country has not yet been fully recorded. There has been a fairly good stocktaking of the vertebrate fauna (fishes, amphibians, reptiles, birds and mammals).

The biodiversity of Bangladesh is quite rich because of tropical climatic condition (**Table-1**). The number of species of plants and animals estimated to be present in the biosphere ranges from 20 to 25 million. But only about 1.5 million species of plants, animals and other life forms are known to science in the world at present. A huge number of species of plants and animals are still undiscovered and each day there is a new addition to our knowledge in species diversity. It is believed that a large number of species of plants and animals are becoming extinct every year. If this rapid rate of extinction continues many species will become extinct before they are identified and explored. The extinction of species in such a scale is highly detrimental to mankind. Though the plant and animal diversity is good as compared to the other countries, but the rate of species extinction and threatened species number is quite high.

Table-1: Species Diversity in Bangladesh as compared to World

Name of major Biodiversity group	Number of species in the world	Number of species available in Bangladesh	Diversity as compare to whole world (%)
Bacteria	4,760	300	6.30
Fungi	46,983	6,000	12.77
Plants			

Algae	26,900	2,700	10.03
Bryophytes	17,000	290	1.70
Pteridophyte	13000	195	1.50
Gymnosperm	750	20	2.66
Angiosperm	2,50,000	5,000	2.00
Animals			
Protozoa	31,250	300	0.96
Cnidarian	10,105	102	1.00
Ctenophora	100	10	10.00
Rotifera	2,500	76	3.04
Echinoderms	7000	11	0.15
Gastropoda	3,000	318	10.60
Platyhelminthes	17,511	126	0.71
Arthopods (Crabs, crustaceans & shrimp)	38,000	185	0.48
Coral and Jellyfish	9,000	350	3.88
Annelids and Nematods	30,028	176	0.58
Insects			
Bees	20000	18	0.09
Spiders	45000	421	0.93
Aphids	4000	30	0.42
Butterflies	17500	323	1.84
Dung beetle	7000	30	0.42
Lady bugs	5000	93	1.86
Firefly	2000	25	1.25
Mosquitos	3000	113	3.76
Other insects	796500	70,000	8.78
Mollusks	66,536	479	0.71
Fresh water fishes	33,200	658 (fresh water 251 and marine 407)	1.98
Marine fishes			
Amphibians	7,448	64	0.85
Reptiles	10,272	171	1.66
Birds	10,424	706	6.77
Mammals	4,170	139	3.33

In 2015 animal species survey, zoologists have described 175 protozoans, 400 spongs, 350 corals and jelly fishes, 126 annelids and helminthes, 185 crustaceans, 70,000 insects (approx), 479 mollusks, 658 fishes, 64 amphibians, 171 reptiles, 706 birds and 139 mammals (IUCN, 2015). We have lost 31 species of wildlife has been extinct in the last hundred years. Among them Indian Rhino, Javan Rhino, Sumatran

Rhino, Swamp Deer, Striped Hyena, Gaur, Black Buck, Blue Bull, Sloth Bear, Wild Buffalo and Marsh Crocodile etc. As per IUCN assessment (2015), 56 species are critically endangered, 190 endangered, 153 vulnerable and 90 species are threatened.

3.1 Faunal Diversity

In 2015 animal species survey and assessment, zoologists described 175 protozoans, 400 spongs, 350 corals and jelly fishes, 126 annelids and helminthes, 161 crustaceans, 70,000 insects (approx), 489 mollusks, 708 fishes, 64 amphibians, 171 reptiles, 711 birds and 138 mammals (IUCN, 2015) (**Table-2**).

Fauna of Bangladesh possesses a wide range of invertebrates and vertebrates in its aquatic and terrestrial habitats. The invertebrate fauna of the country has not yet been fully recorded. However, the warm and humid climate of the country is favorable to lower organisms, especially the insect fauna. There has been a fairly good stocktaking of the vertebrate fauna (fishes, amphibians, reptiles, birds and mammals). We have **lost 31 species** of wildlife permanently in the last hundred years. Among them Indian Rhino, Javan Rhino, Sumatran Rhino, Swamp Deer, Striped Hyena, Gaur, Black Buck, Blue Bull, Sloth Bear, Wild Buffalo and Marsh Crocodile etc. As per IUCN (2015) assessment, 56 species are critically endangered, 190 endangered, 153 vulnerable and 90 species are threatened.

Table-2: Present Status of Wildlife in Bangladesh (IUCN Assessment Report - 2015)

Categories	Number of total Species in Bangladesh (assessed)	Extinct	Critical Endangered	Endangered	Vulnerable	Nearly Threatened	Least Concern	Data deficient	Not Evaluated
Mammals	138	11	17	12	9	9	34	39	7
Birds	566	19	10	12	17	29	424	55	0
Reptiles	167	1	17	10	11	18	63	27	20
Amphibians	49	0	2	3	5	6	27	6	0
Fresh water fishes	253	0	9	30	25	27	122	40	0
Crustaceans	141	0	0	2	11	1	47	79	1
Butterflies	305	0	1	121	75	0	84	32	0
Total	**1,619**	**31**	**56**	**190**	**153**	**90**	**802**	**278**	**28**

As per IUCN (2015) report most of the animal's species in Bangladesh are threatened, endangered and vulnerable. Recent animal species survey also indicates that 31 species of wildlife have been extinct from Bangladesh in the last century like Indian Rhino, Sumatran Rhino, Javan Rhino, Swamp Deer, Sloth Bear, Wild Buffalo, Blue Bull, Grey Wolf, Black Buck, Striped Hyena, Indian Peafowl, Green Peafowl, Pink-headed Duck, White-winged Wood Duck, Sarus Crane, King Vulture, Spot-billed Pelican, Greater Adjutant, Greater Florian, Grey Francolin and Marsh Crocodile etc. Many species of wildlife have become critically endangered, rare, endangered and threatened and some of them have reached at the verge of extinction.

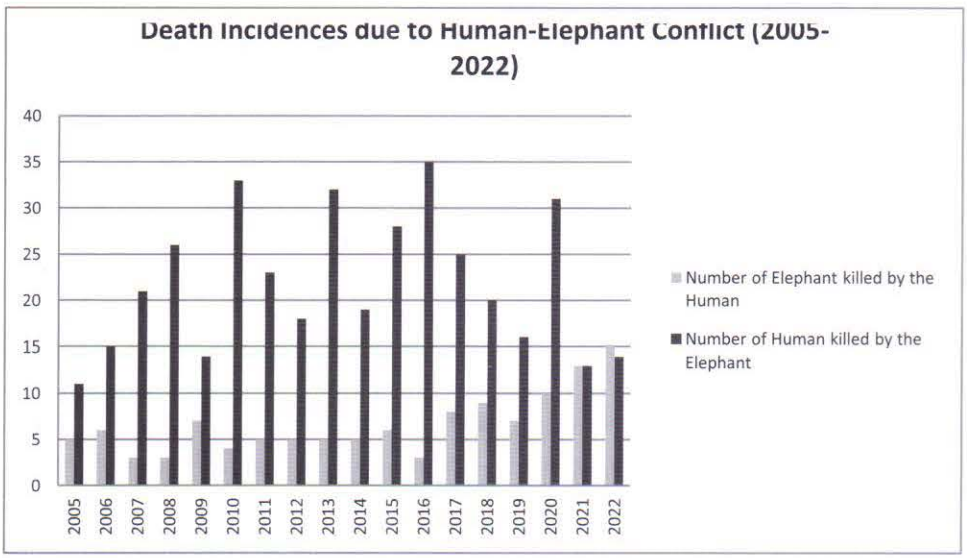
Mammals: Members of the class Mammalia, including humans. Today there are some 4,500 species of mammals worldwide, of which roughly a tenth occur within the Indian subcontinent. In Bangladesh there are 139 species of mammals. They range in size from tiny shrews and pipistrelle bats, which weigh only a few grams, and measure a few centimeters, to elephants that stand over 3 metres at the shoulder and can weigh over 4 metric tons. The largest mammal, the Blue Whale, is nearly 30 metres in length and weighs up to 150 metric tons. Of the inland mammals, 40 have come under different categories of threats: 11 extinct, 17 critically endangered, 12 endangered, and 9 vulnerable.

Asian Elephant (*Elephas maximus*) is the largest land animal in the world. They are playing vital role in the conservation of forest ecosystem. In Bangladesh it is critically endangered animal and their population

size including resident and non-resident has been reduced to 300 to 200 recently. Human-elephant conflict has become a national issue and in the year **2022 a total of 15 elephants** has been killed by local people through electrocution and shotgun bullet injury and on other hand a total of 14 peoples (up to November 2022) has been killed by elephant. This is an alarming news for us.

Table-3: Death Incidences due to Human-Elephant Conflict from 2005-2022 (up to November 2022)

Year	Number of Elephant killed by the Human	Number of Human killed by the Elephant	Remarks
2005	5	11	As per BFD record
2006	6	15	do
2007	3	21	do
2008	3	26	do
2009	7	14	do
2010	4	33	Highest human killing incidence
2011	5	23	As per BFD record
2012	5	18	do
2013	5	32	do
2014	5	19	do
2015	6	28	do
2016	3	35	do
2017	8	25	do
2018	9	20	do
2019	7	16	do
2020	10	31	do
2021	13	13	do
2022	15	14	Highest elephant killing incidence



News items on elephants and human-elephant conflict appearing in the mainstream media recently is because of **Rohingya refugee crisis** at Teknaf and Ukhia area. Huge number of camps have been established on the elephant corridors. A total of 9000 acres forest and elephant habitats have been deforested and damaged.

Bengal Tiger (*Panthera tigris tigris*), locally known as Bagh, of the family Felidae, order Carnivora, is the largest living cat on earth. It is regarded as the national animal of Bangladesh. It was once found in all the forests of Bangladesh, but is now confined to the mangrove forests of the Sundarbans and is treated as a **critically endangered** animal. According to the last camera trapping survey the estimated number of tiger is about **114.** This population is also under big threat. In the recent years **human-tiger killing incidences have been deceased** substantially.

Hilsha (*Tenualosa ilisha*) of the family Clupeidae, order Clupeiformes, is recognized as the **national fish** of Bangladesh. The fish is anadromous; ie it moves towards a riverine area from a marine environment during the breeding season. Hilsa constitutes the largest single fishery in the open waters of Bangladesh in both inland and marine sectors. Due to the present sustainable conservation initiatives their population size has been increased.

Magpie-robin or Oriental Magpie Robin (*Copsychus saularis*), locally known as Doel of the family Muscicapidae, order Passeriformes, is the **national bird** of Bangladesh. This trim black-and-white bulbul-sized, cocked tail bird is found throughout the country. Their present status is satisfactory.

Fishes: There are about 22,000 species of fishes worldwide, in about 450 families. Almost 40% of the species live in fresh water. In Bangladesh there are 407 species of marine fishes, of these species, 56 are cartilaginous fishes (class Chondrichthyes), in 3 orders and 15 families; and rest are bony fishes (class Osteichthyes). There are 251 species of inland fishes (in freshwaters and brackish water).

Among the inland fishes, the family Cyprinidae (order Cypriniformes) includes the largest number of species: 57 species under 23 genera; these include carps (Rui, Catla, Mrigel, Kalibaus, etc); barbs (Punti, Mahashol, etc); and minnows (Darkina, Chela, Mola, etc). About 55 species of catfishes (Tengra, Air, Shingi, Magur, etc), are found in the freshwaters of Bangladesh. Loaches (Rani, Gutum, Puiya, Panga, etc) are the least explored fish species (about 11 species). Once abundant in the wetlands, the snakehead fishes (Shol, Taki, Gajar etc) are now becoming rare. Of the five species of the family Channidae three are threatened: the Barca snakehead (Pipla shol), *Channa barca*, is critically endangered, the Giant snakehead (Gajar), *Channa marulius*, is endangered, and the Asiatic snake-head (Telo Taki), *Channa orientalis*, is vulnerable. Of the eels (usually with two lateral gill-openings), the Gangetic Mudeel (kuicha), *Monopterus cuchia*, is unique in possessing a single gill-opening on the ventral side. Once abundant, the species is now a vulnerable species. Another beautiful eel, the one-stripe spinyeel (Tara Baim), *Macrognathus aral*, is also now vulnerable. The snake-eels (2 species), *Pisodonophis* species., are not usually eaten by the local people, and face no threats at the moment. The largest eel is the Indian Longfin Eel (Bamosh/ Bamchara/Bao Baim/Telkoma), *Anguilla bengalensis*, found in the estuaries and freshwaters. Of the gars or crocodile fishes (Kaikka, Kumerir Khil), the Deocata Pipefish, *Microphis deocata*, is now endangered.

Some 76 species of fishes are often included both as freshwater and marine in Bangladesh. The most important (culturally and economically) is the Hilsa (Ilish), *Tenualosa ilisha*. It is the largest single species fishery from the major rivers, and currently the hilsa fishery contributes significantly to production from inland sources. Carps are the major fishes in pond culture. The most preferred fish (because of its taste) in Bangladesh is the Climbing Perch (Koi), *Anabas testudineus* (family Anabantidae, order Perciformes). Although most of the perciforms are marine, the majority enter the estuaries and rivers, such as Pony fishes (Tak-chama), Jew fishes (Poa), thread-fins (Tapasi), mullets (Bata), pomfrets (Rupchanda), etc.

Amphibians: There are about 5000 species of amphibians worldwide. Frogs and toads alone are included in 28 families, 338 genera and about 4360 species, which have the widest distribution, especially the members of the family Ranidae. In Bangladesh the class Amphibia is represented only by the members of

the order Anura (frogs and toads). The country has **64 species** of amphibians of which 8 are listed as threatened. The country earned about US $ 26 million by exporting bullfrog legs (*Hoplobatrachus tigerinus*) during 1988-1993. Frog leg export is now banned as per Wildlife (Conservation and Security) Act 2012.

Reptiles: Cold-blooded vertebrates of the class Reptilia, comprising the turtles and tortoises, lizards, worm lizards, snakes, crocodilians, and the tuatara; primarily tetrapod (4-legged), but the legs are lost in snakes and in some lizards.

The total number of reptile species in Bangladesh is **171**. Of the inland reptiles 2 are crocodilians. The marsh crocodile (*Crocodylus palustris*) is no longer found in the wild. Among the inland reptiles 58 face different categories of threats: 12 (2 crocodilians, 7 turtles and tortoises, 1 lizard, and 2 snakes) are critically endangered, 24 (11 turtles and tortoises, 2 lizards and 11 snakes) are endangered, and 22 (2 turtles and tortoises, 5 lizards, and 15 snakes) are vulnerable. The status of the marine reptiles could not be evaluated locally due to paucity of data. However, all the 5 species that are found in Bangladesh waters are globally threatened: the Hawksbill Turtle *Eretmochelys imbricata* is critically endangered; and the Loggerhead Turtle *Caretta carett*, Green Turtle *Chelonia mydas*, Olive Ridley Turtle *Lepidochelys olivacea*, and Leatherback Turtle *Dermochelys coriacea* are endangered.

Turtle and tortoise: The order Testudines is divided into 12 families and comprises about 250 species and 90 genera of turtles and tortoises distributed worldwide in tropical and temperate zones. In Bangladesh turtles and tortoises (order Testudines) are divided into 5 families (3 inland and 2 marine) with 27 species (22 inland and 5 marine).

Of the 22 inland species, 20 face different categories of threats. Seven are critically endangered, 11 endangered, and 2 vulnerable. The status of the remaining two could not be assessed due to paucity of data. The critically endangered species are Bora Kaitta, River Terrapin (*Batagur baska*); Dhoor Kasim, Three-striped Roof Turtle, (*Kachuga dhongoka*); Halud Pahari Kasim, Elongated Tortoise (*Indotestudo elongata*); Pahari Kasim, Asian Giant Tortoise (*Manouria emys*); Bostami Kasim, Bostami Turtle/Black Soft Shell Turtle (*Aspideretes nigricans*); Sim Kasim, Asiatic Soft Shell Turtle/Narrowheaded Soft Shell Turtle (*Chitra indica*); and Jata Kasim, Bibron's Soft Shell Turtle (*Pelochelys bibroni*).

Lizards: About 4,300 species of lizards belong to 420 genera and 26 families occur worldwide. In Bangladesh the lizards (order Lacertilia) are divided into 4 families (Gekkonidae, Agamidae, Scincidae and Varanidae) with 18 species (all inland). Of the 18 species, 8 face different categories of threats. One (Flying Lizard/ Draco *Draco blanfordii*) is critically endangered, 2 (Ram Godi/kalo Gui, Ring Lizard/ Monitor Lizard/Two-banded Monitor *Varanus salvator*, and Gui/Sona Gui /Holdey Shap, Yellow Monitor/Common Lizard *Varanus flavescens*) are endangered, and 5 are vulnerable.

Snakes: About 2,700 species, of snakes belonging to about 450 genera and 18 families, occur worldwide, mostly in the tropics. In Bangladesh the 79 (inland: 67, marine: 12) species of snakes (order Serpentes) are divided into 7 families (6 inland and 1 marine). Of the 67 inland species 15 are venomous, belonging to the Elapidae (10 species) and Viperidae (5 species); all marine species are venomous. In Bangladesh the critically endangered snakes are Golbahar/Ajagar, Reticulated Python *Python reticulata*, and Chandrobora, Russell's Viper *Vipera russellii*. Eleven species are endangered, and 15 are vulnerable.

Crocodile and Gharial: These carnivorous reptiles belong to the order Crocodilia. The order has 3 families; Crocodylidae: crocodiles, 13 species; Alligatoridae: alligators, 2 species, and caymans 5 species; and Gavialidae: gharials, 2 species found in tropical and subtropical regions. Bangladesh has 1 species of crocidile and one species of gharial. The largest of all crocodiles is the saltwater crocodile, *Crocodylus porosus,* found in the Sundarbans and estuaries. The marsh crocodile, or mugger (*C. palustris*), is a freshwater species of India and Sri Lanka. In Bangladesh the species no longer exists in the wild; however, a few (1/2) are still surviving in a pond near the shrine of the saint Khan Jahan Ali in a southern district, Bagherhat. We have enough captive muggers at the safari park's and zoo's.

The family Gavialidae contains two species of extremely thin-snouted crocodilians. Bangladesh has one species, the gharial (*Gavialis gangeticus*). It occurs in the northern part of Bangladesh in the river Padma. All 2 species of crocodiles and Gharial are critically endangered.

Birds: Belong to the class Aves, and consist of approximately 10,000 species, grouped into 24 orders. The order Passeriformes (known as passerines or songbirds) contains more than half of the known bird species. The remaining orders are known collectively as non-passerines. Over 1200 bird species occur in the Indian region. Bangladesh has **706** species of birds of which 301 are resident and 319 are migratory. Sarus Crane (*Grus antigone*) is the largest (standing about 1.75 m) bird in the subcontinent, but it is now rare in Bangladesh. A few flower peckers and sunbirds, smaller than the sparrow, are perhaps the smallest. The bird population in Bangladesh is shrinking fast. Today about 41 species are threatened in Bangladesh, of which 19 are critically endangered, 18 endangered and 4 are vulnerable. The Pinheaded Duck (*Rhodonessa caryophyllacea*), the Nukta or Comb Duck (*Sarkidiornis melanotos*), the Common Peafowl (*Pavo cristatus*), and the Burmese Peafowl (P. muticus) which were more or less widely distributed until 70 or 80 years ago, have virtually disappeared from Bangladesh.

Invertebrate fauna of the hemipteran insects only about 30 aphid species under 20 genera have so far been listed in the country. This group is of major economic importance both for the direct damage they cause to crops and for the viral diseases they transmit. Winged adults are dispersed by wind currents. Many other hemipteran and hemipteran insects have been recorded from Bangladesh.

Bees are hymenopteran insects, characterized by many branched hairs on the body. The group contains both solitary and social forms, but all feed on nectar and pollen. There are about 20,000 species of bees under 19 families worldwide. In Bangladesh 18 species have so far been reported, of which 4 are honey bees: *Apis cerana indica, A. dorsata, A. florea*, and *A. mellifera*, and 2 are bumlebees: *Bombus eximius,* reported from Sylhet and *B. montivagus*, reported from the Chittagong Hill Tracts.

Beetles are the insects belonging to the order Coleoptera. In terms of number of species, Coleoptera is the largest order in the animal and plant kingdoms. The order contains some of the largest insects (eg Goliath and Hercules beetles, over 15 cm in length), as well as some of the smallest (ptiliid beetles less than 0.5 mm in length). The different groups of beetles are named as bark beetle, bombardier beetle, cardinal beetle, carrion beetle, chick beetle, deathwatch beetle, dermestid beetle, diving beetle, firefly, ground beetle, ladybird beetle, leaf beetle, long-horned beetle, rove beetle, scarabaeid beetle, tenebrionid beetle, whirligig, woodworm, etc.

About 30 species under 8 genera of scarab **dung beetle** fauna have so far been reported from Bangladesh, mostly of genus Onthophagous. About 30 species of leaf-eating scarabeids have also been recorded from Bangladesh. Over 4200 species of ladybird beetles under 490 genera have been described worldwide. About 80 species of beneficial ladybirds, and about 13 species of phytophagous ladybirds have so far been reported from Bangladesh. Some common genera in the crop fields of Bangladesh are Micraspis, Coccinella, Harmonia, Menochilus, Cheilomenes, Propylea, and Brumus, Firefly is a small, nocturnal, luminescent, carnivorous beetle of the family Lampyridae, order Coleoptera. There are about 2000 species of firefly worldwide belonging to 100 genera and seven subfamilies; about 280 species occur in Asia. In Bangladesh about 20 species have been reported including *Lamprophorus tenebrous, Lampyris marginella, Luciola chinensis,* and *L. ovalis*.

Fly is a common term applied to numerous flying insects. More specifically, however, the name is given to the 'true' flies of the order Diptera. Worldwide there are over 85,000 described species of dipterans. In Bangladesh the common indoor fly species are the house fly (*Musca domestica*), the lesser house fly (*Fannia canicularis*), the biting house fly or stable fly (*Stomoxys*), the blue bottles or blow flies (*Calliphora*), the green bottles (Lucilia), and the flesh flies (*Sarcophaga*). Outdoor flies include the black flies, the deer flies, the horse flies, the hover flies, the daddy long legs or crane flies and many muscoids. The sand flies (*Phlebotomus*) are common both indoors and outdoors. So far 5 species of fruit flies have been recognized: (i) *Dacus cucurbitae*, (ii) *D. tau*, (iii) *D. diversus*, (iv) *D. dorsalis*, and (v) *D. zonatus*.

Mosquito is a blood sucking insect belonging to the order Diptera, family Culicidae. Important genera are Anopheles, Culex, Aedes, Mansonia, Psorophora, and Haemagogus. Only the female mosquitoes suck blood from different vertebrate hosts, since a blood meal is essential before laying eggs. Males suck plant juices. Over 1600 species of mosquitoes are known worldwide; 113 species have so far been recorded from Bangladesh. *An. dirus, An. philippinensis, An. minimus*, and *An. sundaicus* are the malaria vectors. Filariasis is transmitted by *Culex quinquefasciatus* and *Mansonia* sp.); *Aedes aegypti* and *Ae. albopictus* are responsible for spreading **Dengue**; Japanese Encephalitis is transmitted by *Cx. tritaeniorhynchus*.

Spiders are members of the order Araneae, class Arachnida, having four pairs of legs, a large abdomen, and a combined head and thorax. Most of the spiders are terrestrial and predatory in habit. Worldwide about 37,296 species of spiders have so far been recorded in 3,450 genera, and 106 families. In Bangladesh more than 400 species of spiders have been recorded in 134 genera, and 22 families. Most of the Bangladesh spiders belong to Araneidae (90) and Salticidae (83), followed by Thomisidae (48), Theridiidae (36), Tetragnathidae (35), Clubionidae (22), Lycosidae (19) and Oxyopidae (18).

Crustaceans are predominantly aquatic; a few live in moist places on land, and a few are parasitic. The class Crustacea includes the crabs, shrimps, lobsters, barnacles, water fleas, fish lice, hermit crabs, sow bugs, and pill-bugs. Crustacea comprises some 42,000 species. Many commercially important fresh and marine-water crabs, shrimps and lobsters are abundantly found in Bangladesh. Of the four species of freshwater and 11 species of marine crabs recorded from Bangladesh, the most commercially exploited species of the coastal area is *Scylla serrata* (mud crab). *Neptunus pelagicus, N. sanguinolentus,* and *Gelasimus annulipes* are also commercially important marine crabs. Of the four species of freshwater crabs *Paratelphusa lamelliforns* is used as food. There are about 10 species of freshwater shrimps/prawns and 19 species of marine shrimps in Bangladesh. The freshwater species, *Macrobrachium rosenbergii* is commercially important. Six penaeid species viz, *Penaeus merguiensis* (banana shrimp), *P. monodon* (tiger shrimp), *P. indicus* (white shrimp),' *P. semisulcatus* (green tiger shrimp), *Metapenaeus monoceros* (brown shrimp), and *M. brevicornis* are of commercial importance. Six species of lobsters are found to occur in the Day of Bengal: *Panulirus polyphagus* and *Thenus orientalis* are the two most commercially important species.

Crabs have a reduced abdomen concealed beneath a short broad cephalothorax, and the first pair of limbs is modified as pincers. There are more than 4500 species of decapod crustaceans worldwide. There are about 16 species of crabs so far reported from Bangladesh waters, of which some species are commercially important.

Echinoderms are marine invertebrates of the phylum Echinodermata. The phylum comprises about 6000 species including starfishes or sea stars, sea urchins, sand dollars, sea cucumbers, brittle stars, sea lilies and feather stars, characterized by a pentamerous body, radial symmetry and a water-vascular system. The taxonomy of the echinoderms is poorly studied in the Indian subcontinent including Bangladesh. Two species of starfishes have been reported from Bangladesh. Many members of sand dollars, sea cucumbers, and sea-urchins are found in good numbers in the coastal belt of Bangladesh.

3.2 Floral Biodiversity

Flora of Bangladesh has been endowed with a rich plant diversity base because of its fertile alluvial land, warm and humid climate. More than 5000 plant species occur in Bangladesh, of which 300 or so species are exotic and 8 are endemic. Ninety-five vascular plants have been rated as threatened, of which 92 are angiosperms, and 3 gymnosperms. About 2000 species and varieties of algae have been recorded. The fungal flora has been recorded. There are about 250 species of bryophytes in the country. Of the 195 species of pteridophytes that occur in Bangladesh, 230 are ferns. There are 3611 species of flowering plants (angiosperm) in the country. Bangladesh has 7 species of gymnosperms; of these 3 are threatened (1 cycas, 2 gnetum). The country has 3 species of rice, of which there are about 10,000 varieties.

4.0 Influence of Ecosystems and Habitat Types on Biodiversity

Different habitats provide livelihood support to the large number of peoples of the country. Biodiversity loss and ecosystem degradation undermines the supply of ecosystem services vital for climate change mitigation.

Animal species diversity is the integral part of diversity of natural ecosystem. Bangladesh is rich in animal diversity due to the diversity of their habitats. Major habitats are forests, rivers, seas, wetlands (haor, baor, beel, lake, pond, canal etc.), agriculture lands, non-agriculture lands, villages, estuaries and urban areas etc. The area of different diverse ecosystem is 1,42,905.0 sq.km out of 1,43,998.0 sq.km area of Bangladesh (**Table-4**). Forests are the major habitats of wild animal like tropical evergreen, semi-evergreen, mangrove, mixed evergreen, Sal, swamp, coastal and village forests.

Table-4: Distribution of Different Animal Habitat Types in Bangladesh

S.L. No.	Habitat Types	Area (sq.km)
1.	Forest lands	19,610.0
2.	Rivers	6,400.0
3.	Wetlands (haor, baor, beel, lake, pond, canal etc.)	4,245.0
4.	Agriculture lands	77,600.0
5.	Non-agriculture lands and villages	1,900.0
6.	Non-agriculture lands and villages	8,400.0
7.	Urban areas	7,000.0
8.	Village infrastructure	7,000.0
9.	Estuaries and marine	8,600.0
10.	Road, Railway and other linear infrastructure	2,100.0
11.	Salt extraction area	50.0
	Total	**1,42,905.0**

**Source: Asian Wetland Bureau.

Biodiversity differs with ecosystems. Every ecosystem has its own biodiversity. Important ecosystems are forests, grasslands, aquatic, mangrove and ocean ecosystems (**Table-5**). The level of biodiversity is discussed below:

Table-5: Area wise distribution of forest land according to ecosystem type in Bangladesh

S.L. No.	Ecosystem types	Area (Hector)	Percentage in respect of total country area
1.	Hill forest ecosystem	6,80,000.0	4.61
2.	Mangrove forest ecosystem	6,01,700.0	4.13
3.	Mangrove plantation ecosystem	2,00,000.0	1.36
4.	Sal forest ecosystem	1,20,000.0	0.81
5.	Wetland ecosystem	6,97,000.0	4.72
6.	Village forest and woodlots	2,70,000.0	1.83
	Total	**26,00,000**	**17.62**

**Source: Bangladesh Forest Department.

4.1 Forest Ecosystems: Forest ecosystems differ widely depending upon climate water regimes and soil conditions. Forest ecosystems are complex ecosystems and contain a large variety of flora and fauna. The flora includes large giant trees, small trees, shrubs, herbs, forbes, grasses, climbers, and undergrowth's.

Each forest ecosystem has its own characteristic faunal community of mammals, birds, reptiles, amphibian, insects and other animals. The forests are under serious problems. A large forest area is already degraded causing a substantial loss to biodiversity.

4.2 Mangrove Ecosystem: Mangroves are taxonomically a diverse group of woody spermatophytes which possess a common ability to survive and perpetuate themselves along sheltered tropical coastline in saline environments under tidal influence.

Mangrove ecosystems are inhabited by a variety of salt tolerant inter-tidal halophytic plants and innumerable taxa of invertebrate and vertebrate fauna. The important genera include *Rhizophora, Ceriops, Bruguiera, Derris, Xylocarpus, Sonneratia, Acanthus, Avicennia, Heritiera, Nypa, Phoenix,* etc. The fauna in mangrove ecosystem is quite diverse and interesting. Apart from the famous royal Bengal tiger and estuarine crocodile, there are different kinds of monkeys, otters, deer, fishing cat, snakes, wild pig, etc. These ecosystems are favored by a variety of birds both resident and migratory.

4.3 Wetland ecosystem: Wetlands include a wide range of habitats both natural and man-made. Wetlands are those habitats where land remains submerged under water for whole or part of the year. A large variety of plant communities grow in these habitats. These plants are generally called wetland plants or macrophytes. The plants belonging to aquatic habitats belong to 59 families. There are about 470 species of flowering aquatic plants in Bangladesh which are about half of the aquatic plants of the world. Panaceas with 29 genera and about 40 families and Cyperaceae with 15 genera and about 100 species are the largest group of plants. The growths and life forms among these plants vary considerably. These plants may be free floating without roots entirely submerged floating, rooted in sediments (Rhizophytes), vegetative parts emergent for most of the year (Halophytes) and plants with leaves floating (Ephydates).

The fauna in the wetlands are highly diverse. Among the estimated 1,500 of vertebrates of the country, about 550 (**Table-6**) vertebrate species (except Sundarbans) are dependent on wetlands for all or part of their life. About **260** species of freshwater fish exist in wetlands of Bangladesh. All wetlands are subject to sedimentation composed of clay soils rich in organic matter, and crops, which can tolerate waterlogging, and inundation cover the vast flood areas of wetland. Before the introduction of mechanized dry-season irrigation in the 1960's, deep water rice or broadcast aman rice (floating rice) used to be the major crop in the wetlands during the rains.

Table-6: State of Faunal and Floral Biodiversity in the Wetlands of Bangladesh

		Wetlands Biodiversity	
Name of major Biodiversity group	**Number of species in Bangladesh**	**Number of species available in the wetlands**	**Diversity as compare to whole country (%)**
Arthopods (Crabs & crustaceans)	161	89	55.2
Molluks	489	61 (except marine molluks)	12.47
Fin fishes	652	260	39.87
Shell fishes	56	25	44.64
Amphibians	64	11	17.18
Reptiles	171	32	18.71
Birds	711	208 (including water and shore birds)	29.25
Mammals	139	18	13.04

4.4 Oceanic ecosystem: Oceanic systems are the largest on the earth. The oceans and smaller seas together cover about 71 percent of the earth surface. The oceans contain about 98.5 percent to total water while inland wetlands only 1.5 percent. The oceans are generally divided on the basis of depth into: (i)

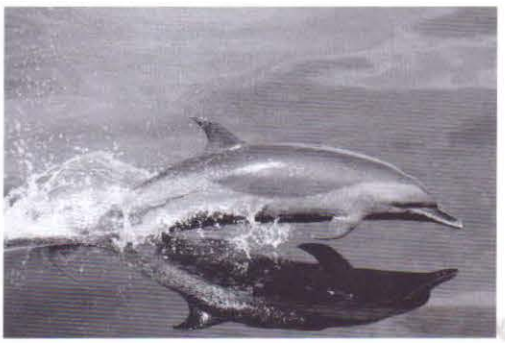
euphotic zone up to 200 m depth, (ii) twilight zone; 200 m to 800 rn depth, (iii) aphotic zone: from 800 m to 6000 m in depth and (iv) ocean floor deeper than 6000 m depth.

Most plants and animals live in euphotic zone. Coral reefs are one of the important formations in the sea for housing different kinds of animals. Coral reefs are wail like formations in coastal regions of tropical oceans which He just under water but can extend to considerable depths. These reefs are occupied by numerous organisms like corals, sponges, algae, and several others. The euphotic zone is inhabited by different kinds of fishes, crabs, shrimps, oysters, tunicates, various crustaceans, gastropods, etc.

Mangrove forest

Wetland habitat

Hill Forest



Oceanic ecosystem

5.0 Causes of Biodiversity Loss

In Bangladesh main causes of biodiversity loss and habitats destruction are population pressure; over exploitation of natural resources, deforestation, degradation and fragmentation of hill forest, coastal and mangrove forests; uncontrolled extraction of fresh water and marine fishes; huntin g & killing of wild animals; encroachment of forest and wetlands; pollution and climate change; industrial extension & road development through the forests and wetlands; and rapid urbanization etc. Due to habitat loss human-wildlife conflict has been increased in 2021, there are about 30

We've managed to control fire, practice agriculture, and build transportation vehicles. We've built factories, dams, solar panels and we're constantly finding new ways of exploring space. Still, the human race's thirst to use, modify and transform natural ecosystems seems endless.

In **Bangladesh** main causes of biodiversity loss, ecosystem and habitats destruction are population pressure; over exploitation of natural resources, deforestation, degradation and fragmentation of hill forest, coastal and mangrove forests; uncontrolled extraction of fresh water and marine fishes; hunting & killing of wild animals; encroachment of forest and wetlands; pollution and climate change; industrial extension & road development through the forests and wetlands; and rapid urbanization etc. The main causes of ecosystem loss are following:

- Over use of natural resources;
- Deforestation, degradation and fragmentation of forests;
- Linear expansion of roads and railways through forests and wetlands;
- Rehabilitation of Rohigays inside the forests;
- Horizontal and vertical extension of agricultural land;
- Encroachment inside forest and wetlands for housing;
- Hunting, poaching and Illegal wildlife trade;
- Industrial, chemical and plastic pollution;
- Continuous land use change for farming;
- Construction of embankment in the coastal and riparian area;
- Dredging and stream channelization for navigation, development and flood control;
- Digging and damming to form ponds and lakes;
- Diversion of flow to or from rivers, wetlands and khals etc;
- Addition of impervious surfaces in the watershed, thereby increasing water and pollutant runoff into wetlands;
- Deposition of fill material for development;
- Frequent natural calamities due to environmental and climate change like drought, cyclone and floods;
- Jhum cultivation in the hill forests
- Monoculture plantation
- Over use of pesticides
- Genetic barrier
- Alien Invasive species
- Forest fire etc.

Impacts of ecosystem degradation are following:

- Serious reduction of animal diversity;
- Extinction and reduction of wildlife including mammals, birds and reptiles;
- Loss of many indigenous plants, weeds and shrubs;
- Loss of natural soil nutrients and natural reservoirs;
- Increase in the recurrence of flashfloods;
- Deterioration of living condition;
- Degeneration of terrestrial and wetland-based ecosystem, occupations, socio-economic institution and cultures;
- Prevention of saline intrusion to both ground and surface water;
- Loss of ability to retain sediments and nutrients;
- Loss of ability to remove toxins from effluents and polluted water;
- Loss of availability of natural wetland products; and
- Reduction of recreation and tourism opportunity.

6.0 Biodiversity Conservation Best Practices

There has been continuous deterioration in the ecosystem and wildlife habitats leading to decrease in wildlife composition and population. Many species of wildlife have become rare, endangered and threatened and some of them have reached at the verge of extinction. Management of habitat to provide optimum living conditions for wild animals in PAs is one the important aspect of wildlife management. Management of ecosystem may involve the management of the following:

a) Protected area declaration b) Flyway site declaration c) Ramsar site declaration d) ECA declaration e) Fish sanctuary declaration etc.

In the past, National Parks and Sanctuaries were notified to preserve major endangered wildlife species such as tigers, lions, elephants, deer, crocodiles, birds like great Indian bustard and several others. The present objective of these areas is however linked to the preservation of relatively intact natural ecosystems, where biological diversity from microscopic unicellular plants and animals, to the giant trees and major mammals can all be preserved.

6.1 Protected area as declared under the Wildlife Act and other international policies

Protected Area declaration and management is one of the important tool for wildlife habitat protection. It creates legal obligation in the area against habitat destruction activities. The categories of Protected Areas are Wildlife Sanctuaries, National Parks, Marine Protected Areas (MPA), Eco parks, Safari Parks, Ecological Critical Areas (ECA) and fish sanctuaries etc. There are 49 Protected Area in Bangladesh which have been manage by Bangladesh Forest Department. The rules and regulations of **Wildlife (Security & Conservation) Act, 2012** are applicable in all PA's.

(a) List of notified Protected Areas (PA) of Bangladesh

SL No	Category of the PA's	No of declared PA's	Area (hectors)
1	National Park	19	53,543.52
2	Wildlife Sanctuary	24	4,05,218.40
3	Special Conservation Area	2	221.59
4	Marine Protected Area	2	3,48,100.00
5	Botanical Garden	1	87.10
6	Ecopark	3	251.88
	Total	**51**	**6,29,101.76**

(b) East Asian-Australasian Flyway Site

Sl. No.	Name of the *Flyway Site*	Location	Area (ha.)	Date of Notification	Remarks
1	Tanguar Haor	Sunamgonj (Tahirpur and Dharmapasha)	9727.00	2011	Wetland
2	Hakaluki Haor	Moulvibazar (Kulawara and Boralekha), Sylhet (Fensugonj and Golapgonj)	18115.00	2011	Wetland
3	Hail Haor	Moulvibazar (Srimongal)	12490.00	2011	Wetland
4	Sonadia	Cox's Bazar (Moheshkhali)	1175.00	2011	Coastal Island
5	Nijhumdeep	Noakhli (Hatia)	16352.00	2011	Coastal Island
		Total...	**60744.00**		

(c) Ramsar Site

Sl. No.	Name of the *Site*	Location	Area (ha.)	Date of Notification	Remarks
1	Sundarbans	Sunamgonj (Tahirpur and Dharmapasha)	317950.08	2011	Mangrove Forest
2	Tanguar Haor	Sunamgonj (Tahirpur and Dharmapasha)	9727.00	2011	Wetland
3	Hakaluki Haor	Moulvibazar (Kulawara and Boralekha), Sylhet (Fensugonj and Golapgonj)	18115.00	2011	Wetland
		Total...	**345792.08**		

6.2 Declaration of Wetlands as Ecological Critical Area (ECA) by the Department of Environment:

Ecological Critical Area (ECA) is the area or ecosystems affected adversely by the change brought through human activities and which is declared by the provision of **Bangladesh Environmental Conservation Act 1995**. These are administered by Department Environment. Since today 13 ECA have been declared (**Table-7**).

Table-7: List of notified Ecological Critical Areas (ECA) of Bangladesh

Sl. No	Name of ECA	Ecosystem type	Location	Area (ha)	Declaration year
1	Sundarban (10 km land ward periphery)	Coastal Marine	Khulna, Bagerhat & Satkhira	2,92,926	1999
2	Cox's Bazar-Teknaf Peninsula	Coastal Marine	Cox's Bazar	20,373	1999
3	St. Martin's Island	Marine Island with coral reefs	Cox's Bazar	1,214	1999
4	Sonadia Island	Marine Island	Cox's Bazar	10,298	1999
5	Hakaluki Haor	Inland Fresh Water Wetland	Sylhet and Moulvibazar	40,466	1999
6	Tanguar Haor	Inland Fresh Water Wetland	Sunamgonj	9,797	1999
7	Marjat Baor	Ox-bow Lake	Jhenaidha	325	1999
8	Gulshan-Baridhara lake	Urban Wetland	Dhaka City	101	2001
9	Buriganga	River	Dhaka	1,336	2009
10	Turag	River	Dhaka	1,184	2009
11	Shitalakhya	River	Dhaka	3,771	2009
12	Balu including Tongi	River	Dhaka	1,315	2009
13	Jaflong-Dawki	River	Dhaka	1,493	2015
			Total	**384599**	

6.3 Declaration of Wetlands as Fish Sanctuary by the Department of Fisheries:

Fish Sanctuary (FS) is a wetland and coastal area where no fishing is allowed, so that fish have a sea haven to breed and grow to increase the fish stock and keep it healthy. These FS are declared as per provision of "Fish Protection and Conservation Act-1950; Fish Protection and Conservation Rule 1985". In case of Hilsa Sanctuary declaration long strip of river in kilometer are used and a total of 433 km river strip has been declared under 6 Hilsa sanctuaries (**Table-8**).

Table-8: List of Fish Sanctuaries of Bangladesh

Sl. No	Name of Project/Fish Sanctuary	Area of Water body (ha)	No. of Sanctuary	Sanctuary area (ha)/Strip (km)
1	Fourth Fisheries Project (FFP)	39040.04	75	1361.45 ha
2	CBFM-2	9359.05	164	85.19 ha
3	PBAEP	545.03	18	26.20 ha
4	IFAD	525.00	18	10.22 ha
5	Fisheries resources development project in closed and open Jalmohal under new Jalmohal policy	1434.46	15	-
6	MACH project	-	56	276.70 ha
7	Hilsa sanctuary	0.00	6	433 km
8	Fish culture in Joboi Beel	-	4	-
9	Fisheries habitat restoration project in inland open waters	642.43	3	4.50 ha
10	Fisheries development and management in chara and Beel in western part of the country	738.75	20	-

But all these efforts of are not enough to conserve the different ecosystems in Bangladesh, because of poor implementation measures and lack integration with local community.

7.0 Recommendations

Restoration and sustainable management of ecosystems can help reduce degradation of biodiversity. The following recommendations are given for sustainable ecosystem management:

- The existing legislations relating to all ecosystem and biodiversity conservation policy should be strictly enforced and formulation of appropriate integrated conservation policy all types of ecosystems are essential;
- Biodiversity loss and ecosystem degradation undermines the supply of ecosystem services vital for mitigation and adaptation.
- Application of biodiversity criteria and safeguards to climate change interventions can enhance the benefits and minimize the risks for biodiversity without jeopardizing mitigation or adaptation objectives.
- Multiple international agreements and national processes relevant to biodiversity conservation should be implemented in ways that are coordinated, mutually supportive and enhance synergies.
- Many of the existing laws, rules and regulations are inconsistent with biodiversity conservation and sustainable management of ecosystems. These should be reviewed and amended.

- Participation of local communities GO/NGO in planning, implementation and management of development interventions should be given due weightage by concern agencies.
- An inventory of the flora and fauna of the different ecosystems should be prepared and the threatened species of mammals, fishes, birds, invertebrates and plants identified.
- A political commitment, considered a pre-requisite for biodiversity conservation and sustainable management of ecosystems has to made.
- The critical ecosystems should be continuously monitored to ensure that effective measures are taken for arresting further degradation and for restoration and preservation of the ecosystem values and functions.
- The mass media should come forward for disseminating information and concerns about all existing ecosystems by highlighting their values and importance.
- Monitoring of impacts from development interventions in the biodiversity conservation should be a component of development project.
- For conservation of wetland ecosystems strictly prohibition of fishing gear, trawler and engine boat etc. in the core breeding area; and imposition of fishing or any activities that destroy or hamper the fish breeding ground; .
- Support to be given to studies relating to tangible and intangible social, economic and environmental values of biodiversity conservation.

Conclusion

Conservation of biodiversity is a constitution obligation of Bangladesh Government as per Article 18A. An effective climate change response requires consideration of the role of, and potential impacts on, biodiversity and ecosystem services. Forest and wetland ecosystems house important carbon stocks. Conservation, restoration and sustainable management of ecosystems can help reduce vulnerability to climatic hazards such as cyclonic storm, sea level rise, flood, drought and zoonotic diseases etc.

Bangladesh government has taken several initiatives for biodiversity conservation like formulation of national laws like Wildlife Act 2012; Protected Area declaration like national park, wildlife sanctuary, special conservation area, marine protected area, botanical garden, eco-park etc; ECA (Ecological Critical Area), fish sanctuary etc. It creates legal obligation in the area against habitat destruction activities. Since today Ministry of Environment, Forest and Climate Change has diclared 19 national parks, 24 wildlife sanctuaries, 2 special conservation area, 2 marine protected areas, 1 botanical garden, 3 eco-parks and 13 Ecological Critical Areas etc. These 51 Protected Areas have been manage by the Bangladesh Forest Department. But these initiatives are not enough to protected biodiversity in the country.

Biodiversity Conservation is a constitutional obligation of Bangladesh Government as per article 18A. As zoologist we have raised our voice conserve the degrading biodiversity, ecosystem for protection of all animal species habitats.

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