



BIODIVERSITY OF TANGUAR HAOR: A RAMSAR SITE OF BANGLADESH

Volume II: Flora



INTERNATIONAL UNION FOR CONSERVATION OF NATURE



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Biodiversity of Tanguar Haor: A Ramsar Site of Bangladesh

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Preface

Wetlands are amongst the Earth's most productive ecosystems. In Bangladesh these are of great importance because of the extensive food webs and rich biodiversity they support. In the past, wetlands have been undervalued. However, in recent times, awareness increases of the fact that natural wetlands provide many services toward mankind through various functions, products e.g., fish, fuelwood, timber, rice, and attributes i.e., biodiversity, aesthetic beauty, cultural heritage and archaeology.

Bangladesh's most important freshwater wetlands occur in the Hoar Basin apart from the Ganges-Brahmaputra delta, which is low lying plains in eastern Mymensingh and western Sylhet Divisions, in the north-eastern part of the country. Tanguar haor is located in two Upazillas (sub-districts) namely Tahirpur and Dharmapasha of Sunamganj district in Sylhet Division. The Tanguar Haor basin, which is an area of 10,000 hectares of land, also supports about 60,000 populations with its resources.

Tanguar haor has outstanding conservation value, being a natural freshwater wetlands in the country, seasonally harbouring up to 60,000 migratory waterfowl along with many resident birds, more than 140 fish species and last vestiges of swamp forest. But the floral and faunal diversity of Tanguar Haor is under extensive threat because of unsustainable use of resources.

In 1999, Government of Bangladesh declared the Tanguar Haor Basin as an “Ecologically Critical Area” to highlight its ecological importance and to monitor its environmental quality. In 2000, the haor basin was declared as the country's second RAMSAR site – wetland of international importance.

With the declaration of Tanguar Haor as a RAMSAR site, government has its commitment to preserve the ecosystem and floral and faunal diversity including its migratory birds from illegal hunters. The Government developed a comprehensive management plan – the Tanguar Haor Management Plan (THMP), which envisaged 'wise use' of its natural resources vis-a-vis a plan to uplift economic conditions of the local people. Importance were given to aware local community for preserving the natural resources and biodiversity and eventually protect it from degradation and overexploitation.

On the above context, IUCN Bangladesh has taken an initiative to carry out this recent study on biodiversity under the project "Community Based Sustainable Management of Tanguar Haor". The project is being implemented by the Ministry of Environment and Forest through IUCN Bangladesh Country Office with financial assistance from Swiss Agency for Development and Cooperation (SDC). As an outcome of the project this book aims to share information on threatened and most important biodiversity with the local community in Tanguar Haor.

This is an expectation of IUCN Bangladesh that the book will be an immense help to monitor changes of important floral diversity of the Tanguar Haor. We also hope that this book will help local people of Tanguar Haor to categorize, understand flora, watch and take conservation initiatives by reducing overexploitation, hunting, poaching of natural resources. On the other hand, this book will also be a great source of material for the researchers who are currently or in future will continue their study on flora of Tanguar Haor.

Dhaka
December 2012

Ishtiaq Uddin Ahmad
Country Representative
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We would like express our gratitude to Mr. Golam Nur, President, Central Co-management Committee (CCC) of Tanguar Haor Community and also the Presidents of four Union Committee (UCCs).

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Special thanks to all staff of Tanguar Haor project.

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Dhaka
December 2012

Research Team

Acronyms, Abbreviation and Glossary

Bbc	Bangladesh Bird Club
<i>beel</i>	more or less permanent bodies of water that remain in haors or floodplains during the dry season
BNH	Bangladesh National Herbarium
CBD	Conservation on Biological Diversity
CBSTP	Community Based Sustainable Management of Tanguar Haor Project
CWBMP	Coastal and Wetland Biodiversity Management Project
ECAMU	Ecologically Critically Management Unit
FAP	Flood Action Plan
FGD	Focus Group Discussion
GoB	Government of Bangladesh
GRIS	Global Resistance on Invasive Species
<i>haor</i>	Backswamps or bowl shaped depressions between the natural levees of a river, that are submerged every year by monsoonal floods from April until October
<i>haor basin</i>	A low lying region in northeastern Bangladesh where most of the country's haors occur
IUCN	International Union for Conservation of Nature and Natural Resources
<i>Kandas</i>	Levees or ridges, often used for habitation
<i>Khal</i>	Small channel (natural/ artificial)
<i>Khas land</i>	Government owned land
MoEF	Ministry of Environment and Forests
NCS	National Conservation Strategy
NCSIP	National Conservation Strategy Implementation Programme
NCSIP-1	NCS Implementation Project No.1
NERP	Northeast Regional Water Management Project
NGO	Non Government Organization
Ramsar site	Wetland of International Importance (Under the 'Convention of Wetlands of International Importance, especially with regard to waterfowl', also known as the Ramsar Convention after the Iranian city of Ramsar, where it was launched in 1971)
RCS	Ramsar Convention Strategy
RCSP	Ramsar Convention Strategic Plan
Reeds	Tall, robust grass like vegetation of swamps; usually refers to the species <i>Phragmites karka</i> , Common Reed
SDC	Swiss Agency for Development and Cooperation
Swamp forest	Forest that is seasonally flooded with freshwater
Union	Smallest administrative unit of local government in Bangladesh
WI	Wetland International



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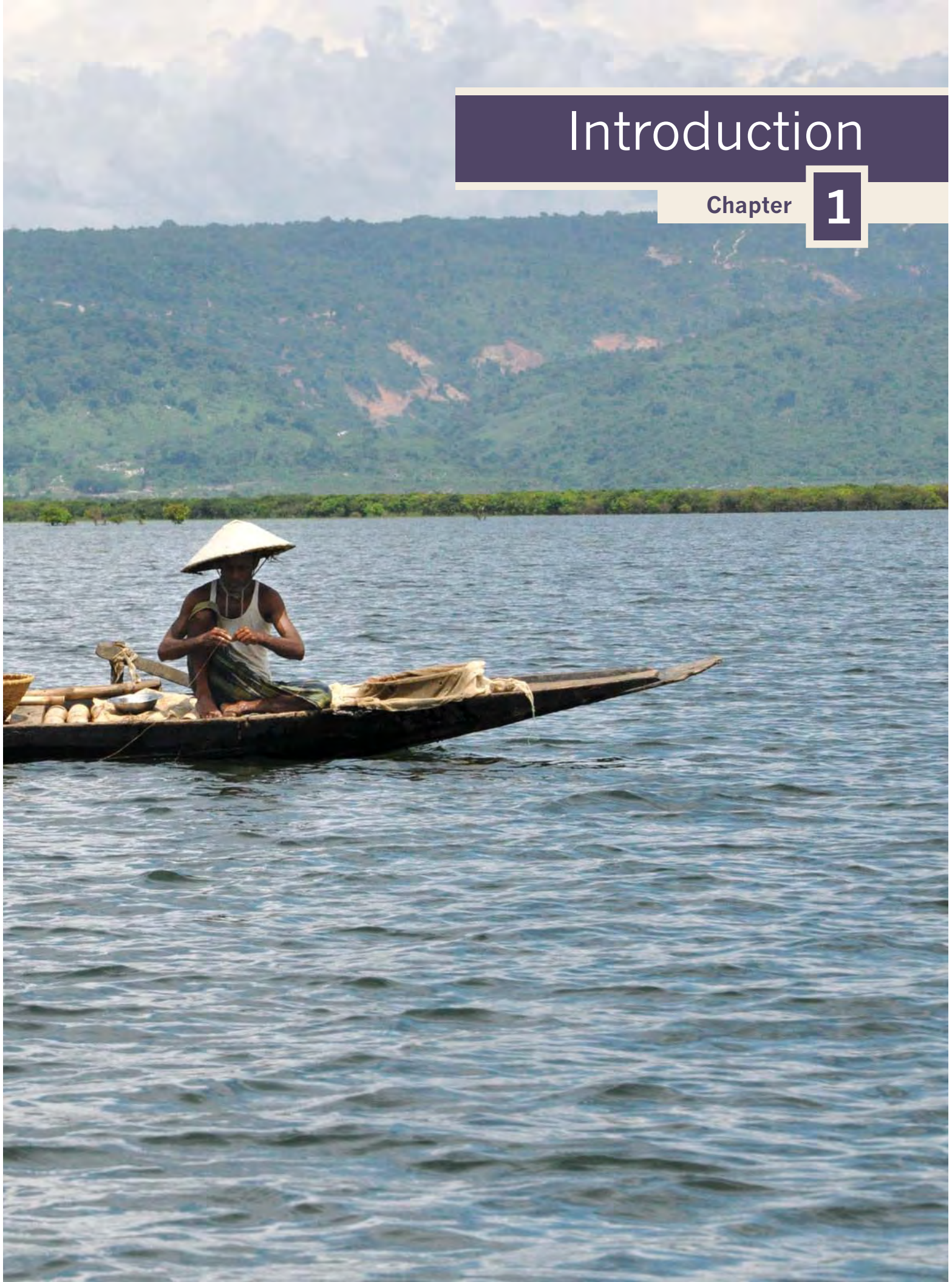
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Introduction

Chapter

1



Bangladesh, located in the delta of one of the world's major river systems, is a land of vast water and wetlands. More than two thirds of the country's land mass may be classified as wetlands according to the definition enunciated in the Ramsar Convention.

Wetland ecosystems are of great importance to Bangladesh due to their extent and of the critical economic and ecological role that they play in sustaining life and livelihoods in the country.



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Tanguar Haor



Tanguar Haor is one of the most important wetlands not only of Bangladesh but also of South Asia (BirdLife International, 2012). It is a unique wetland ecosystem of great national importance in Bangladesh and has now gained international focus.

There are three prominent seasons observed in Tanguar Haor. **During full-flood**, when huge water inundates all the Zones of *haor* excepts the settlements, every micro-habitats within Tanguar Haor and adjacent areas becomes deeply flooded. All the reeds, grass and other plant communities in the *haor* go under water and remain submerged for nearly 5 months. During this situation there are some resident birds seen: Spotbill Duck, Purple Swampphen, Cinnamon Bittern, Yellow Bittern, Little Cormorant, etc. Nest of rats, ants and other insects are also seen on the tree tops and their branches. Rats, Toads and Frogs in good numbers have been seen among the terrestrial zones. **During post monsoon**, after gradual recession of water from the area, all the microhabitat: (Swamp, Reed lands, Grassland, Mudflats, Canals, Natural levees, Rivers) take their shapes and exposes with their identical morphological features in a gradual way. At that movement, some early visitors are observed; Grey headed Fish Eagle, Palla's Fish Eagle, Brown headed Gull, Lesser



Sandplover and some passage migrant birds such as Eurasian Curlews, Whimbrels, Little Stint etc. **During winter**, with all the dominant ecological features of wetland. Tanguar Haor becomes a paradise of birds. This is the prime time when all most all the winter visitor birds are congregated in the *haor* areas.



Different sense in different seasons
(Winter, Summer & Rainy season)

The Government of Bangladesh declared Tanguar Haor as an Ecologically Critical Area in 1999 considering its critical condition as a result of overexploitation of its natural resources and declared as a Ramsar site in the year 2000 (GoB, 2004). The rich biodiversity, notable occurrence of wildlife especially waterfowl is the most significant features that allowed this area to gain the designation as a Ramsar site. Tanguar Haor is also extremely rich in terms of fisheries resources that play a critical role in Bangladesh's economy. It directly sustains the livelihoods of over 56,000 people from 88 surrounding villages and largely contributes to the country's food production and food security.

A project titled 'Community Based Sustainable Management of Tanguar Haor' is being implemented by the Ministry of Environment and Forest through the IUCN Bangladesh Country Office with financial assistance from Swiss Agency for Development and Cooperation (SDC).

The project strategy undertook a programmatic approach, and proposed to be implemented in three stages, as follows:

1. Preparatory Stage (18 months), activities focused on building the knowledge base on *hoar* resources and resource users, in particular resource inventorying, social situation, villages, population, user groups, location and types of resources used, current access practices and community-resource connections, determining maximum harvest limits of resources etc., community mobilization and organization and awareness raising, some service delivery to community, piloting resource harvesting and initiate outlining a model for collaborative management; and providing the preliminary elements of institutional structures. The major

expected output of the Preparatory Stage was a detailed action strategy for the development stage.

2. In the Development Stage (3-5 years), models outlined for collaborative management, different piloting activities initiated and action plan developed in the Preparatory Stage were to be further implemented and scaled up. It was expected, as a consequence, capacity of CBOs and District Administration will be sufficiently built to establish a Tanguar Haor authority.

3. In the Consolidation Stage (3 years), results obtained in the previous stages would be consolidated and the overall goal is achieved.



Awareness programme

To achieve the wise use principle of Ramsar Convention, the project aims at setting up and completing a series of activities, one of which most importantly, is to conduct a study on biodiversity assessment and a study to improve ecosystem integrity. Among the other essentials, floral assessment is an integral part of the management plan to improve and restore ecosystem functions.



Pallas's Fish Eagle

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The most intensive series of studies carried out at Tanguar Haor prior to the NCSIP-1 (National Conservation Strategy Implementation Project) was a project named North-East Regional Project (NERP, 1990-93) under the Flood Action Plan. Under this study (Wetland Specialist Study by FAP 6), the whole *haor* basin in greater Sylhet and Mymensingh districts was studied in detail. Moreover, it had also studied hydrology, fisheries and socio-economics of the region as well as producing a portfolio of investment plans for the wetlands. Subsequently, NCSIP-1 studied the biodiversity of Tanguar Haor in late 1990s. Under this project small scale winter bird census had been carried out by the 'Wetland International' voluntarily helped by Bangladesh Bird Club. But, no single study has been conducted on wildlife and flora involving the community people in Tanguar Haor.

Considering the lack of sufficient knowledge on wetland biodiversity of this region, an initiative has been taken through this present study to collate all the information available in literature and incorporate the results of research so far conducted by the IUCN and its partners. A comprehensive survey on biodiversity of Tanguar Haor has been conducted to understand the present status, habitat classification, population density and

diversity of wildlife. During the wildlife survey, conducted between March and April 2011, the status of wildlife (focusing on waterfowl) including habitat condition, comparative analysis of some *beels* (*beels*- smaller wetlands, some of which combine forming a *haor*, in terms of water birds diversity) was studied. Consequently, another study on flora has been carried out during November 2011 which depicts a clear view on the status of this wetland.

The survey findings will act as a baseline which would be monitored time to time with some specific monitoring indicators. Biodiversity monitoring will be done by biodiversity experts (baseline survey) and trained community people. A user friendly monitoring format (See Table- 7.1, Chapter 7) has been developed for the community to perform biodiversity monitoring.

1.1 Diversity of Fauna in Tanguar Haor

Based on Nishat (1993), Karim (1993), NERP (1993a) and BNH (1997), it is estimated that a total of 141 fish species, 11 amphibians, 34 reptiles (6 turtles, 7 lizards and 21 snakes), 206 birds and 31 mammals occur in this *haor* (Gieson and Rashid, 1997).

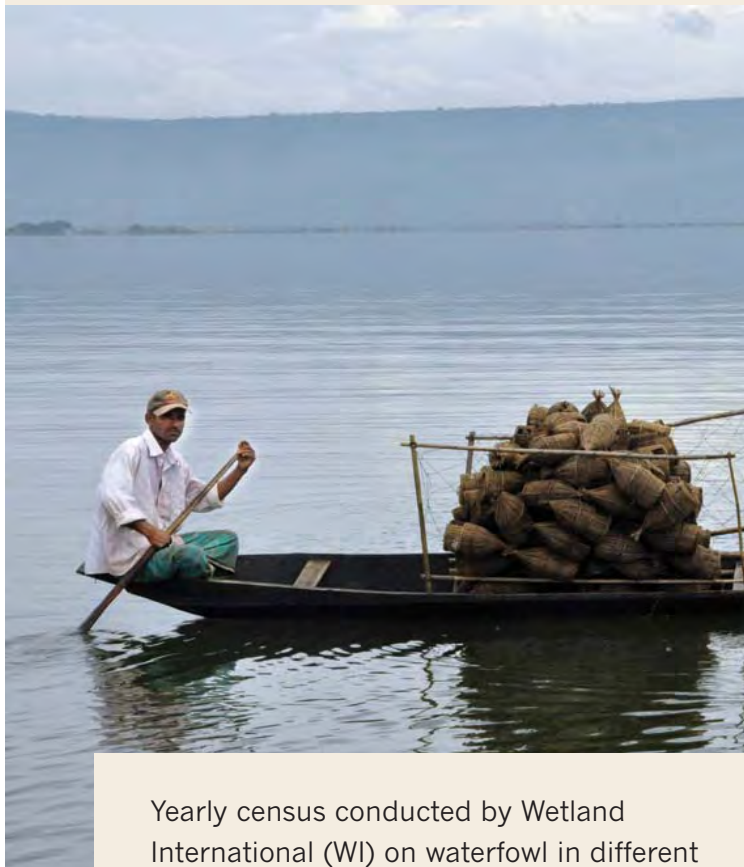


Wildlife in Tanguar Haor-row-wise(Greylag goose, Greater spotted eagle, Common Stonechat, Intermediate egret, Skittering frog, Spotted flap shell turtle, Black redstar, Brahminy kite, Rat snake, Northern shoveler)



Wildlife in Tanguar Haor-row-wise (Striated grass, Ruddy shelduck, Fishing cat, Northern pintail, Black winged stilt, Common kestrel, Ferruginous pochard, Great crested grebe, Marsh sandpiper)

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Yearly census conducted by Wetland International (WI) on waterfowl in different wetlands in Bangladesh with the help of Bangladesh Bird Club (Bbc). On an average fifty thousand individuals of around 80 species reside every year in Tanguar Haor. Of them about 60 species of migratory birds come there in winter as this *haor* is an ideal place for their food and habitat.

1.1.1 Fisheries Resources in Tanguar Haor

The fisheries resources of Tanguar Haor is very rich and has a high importance in terms of fish production, fish habitat, breeding support, national economy and livelihood support. It is one of the 'Mother Fisheries' of a total of six in the country. The *haor* is very important in terms of fish species diversity. Based on DoZ (1997), Nurazzaman (1997) and Khan (1997) the estimated number of fish species is 141 under 35 families. The number is around half of Bangladesh's total 260 freshwater fish species. Not only the number, the *haor* supports very important fish species, many rare species and some threatened species. It supports 10 IUCN Red



Traditional fishing

Data Book listed and 22 CITES-listed species. The critically endangered species like *Bagarius bagarius*, *Clupisoma garua*, *Crossocheilus latius*, *Ctenops nobilis*, *Eutropiichthys vacha*, *Labeo boga*, *Mystus seenghala*, *Notopterus chitala*, *Pangasius pangasius*, *Rasbora elanga*, *Rasbora*, *Rita rita*, *Rohtee cotio*, *Silonia silondia* and *Tor tor* are available in Tanguar Haor.

Tanguar Haor is dominant with indigenous fish species which include Rui (*Labeo rohita*), Mrigel (*Cirrhinus cirrhosus* or *Cirrhinus mrigala*), Shoal (*Channa striatus*), Puti (*Puntius*



ticto), Chanda (*Chanda nama*), Boal (*Wallago attu*) and invertebrate Chingri or prawn (*Macrobrachium spp*), etc. The other important fish species are Aier (*Mystus aor*), Magur (*Clarius batracus*), Baem (*Anguilla bengalesis*), Gutum (*Lepidocephalus guntea*), Lasu (*Cirrhinus reba*), Fali (*Notopterus notopterus*) etc. In the 1999-2000 fiscal year, the government earned Tk 70,73,184 as revenue just from fisheries of the haor (Talukder, 2006). Three species Pipla, or Tila Shol (*Channa barca*), *Labeo boggut* and *Nandina* (*Labeo nandina*) are considered as extinct, 16 species are critically endangered and 26 are endangered (Gieson and Rashid, 1997).



1.1.2 Present Status of Wildlife in Tanguar Haor

During 2011 survey 19 mammals species where found in the Tanguar Haor area.

Birds of the Tanguar Haor are harmoniously linked and adapted with the seasonal hydrological cycle. These linkages and adaptations are closely interlinked with the birds feeding, breeding and migratory behaviours. A total of 219 birds species were found in Tanguar Haor. During 2011 survey period 167 species (total individuals-65,010) were identified. Among them 50.08% are



aquatic and 49.10% are terrestrial. The survey team found 50.29% migratory and 49.70% resident birds. Of all the birds 12.57% were ducks, 6.58% were raptorial and 18.56% were waders.

During this present survey (2011) period, 24 species of reptiles and 8 species of amphibians were recorded from Tanguar Haor. (Alam *et al* 2012)





Hijol forest

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1.2 Diversity of Flora in Tanguar Haor

Principal wetland habitats of Tanguar Haor include open water vegetation (with submerged and floating aquatic vegetation), seasonally-inundated mixed – herbaceous vegetation, reed beds and rice fields. Hijol (*Barringtonia acutangula*) and Koroch (*Millettia pinnata*) are dominant tree species in swamp forests. There are more than 1,000 Hijol trees in the Rangchi forest. Larger (around 6,000) number of Hijol stand are also found on the bank of Foiller beel, Amtarpur, Rajardair and Indrapur. Thousand of Koroch trees swath the embankments around Tanguar Haor from Galgoilla to Goinnakuri and along the banks of canals at south of the Bagh mara Gop. There are still existence of huge reed beds with dominant species like Nal (*Phragmites karka*), bon Tulshi (*Ocimum americanum*), Guizza kata (*Rosa clinophylla*) and Chailla (*Hemarthria protensa*) in the Tanguar Haor. But all these are now under threat of depletion due to indiscriminate harvesting by the dwellers around Tanguar Haor for their everyday use as fuel, fencing, roofing and

fodder. However during last couple of years a large number of *Barringtonia acutangula* and *Millettia pinnata* species were replanted on different Kandas.

Different types of habitat and vegetation communities found in Tanguar Haor are as follows:

- ▶ **Submerged vegetations** (e.g., *Hydrilla verticillata*, *Potamogeton crispus*, *Najas sp.*, *Ottelia alismoides* etc.), are fully under water vegetations. Migratory dabbling ducks and some resident aquatic birds feed on parts of these vegetations.
- ▶ **Free floating vegetations** (e.g., *Eichhornia crassipes*, *Utricularia aurea*, *Sylvania natans* etc.), found in the Tanguar Haor are used as nesting sites by some aquatic birds such as Pheasant-tailed Jacana, Bronze-winged Jacana, Purple Swamphen, Whiskered Tern, etc. Rodents found in haor also live in and build nests inside such floating vegetation, especially *E. crassipes*.
- ▶ **Rooted floating vegetations** (e.g., *Trapa maximowiczii*, *Echinochloa colona*, *Hygorhyza aristata*, *Limnophila indica*, etc).

Fish fingerlings often take refuge in such plants while others feed on algae accumulated on these plants. Aquatic insects and snails also feed on these plants.

- ▶ **Sedges and meadows vegetations** (e.g., *Alternanthera philoxeroides*, *Schumannianthus dichotomus*, *Eclipta alba*, *Enhydra fluctuans*, *Scirpus juncooides*, etc.). These types of vegetation provide shelter and food source of some aquatic animals. Local people also take as food and used for making mats of various types.
- ▶ **Reed vegetations** (e.g., *Asclepias curassavica*, *Asparagus racemosus*, *Ficus heterophylla*, *Lippia alba*, *Phragmites karka* etc.), are the main nesting ground of some resident ducks viz., Spot-billed Duck, Cotton Pygmy Goose and some other aquatic resident birds.
- ▶ **Fresh water swamp forest vegetations** (e.g., *Barringtonia acutangula*, *Millettia pinnata*, *Crataeva magna*, *Phyllanthus distichus*, *Trewia nudiflora*, etc.), may be natural and locally introduced species consists of evergreen trees forming dense canopy. Some birds and mammals use this type of forest as roosting and nesting places.
- ▶ **Crop field vegetations** (e.g., *Alternanthera sessilis*, *Cotula hemisphaerica*, *Cynodon dactylon*, *Cyperus cephalotes*, etc.), have been found around the Tanguar Haor which are the important source of food for the migratory ducks and fodder for cattle.
- ▶ **Homestead vegetations** e.g., *Barringtonia acutangula*, *Bambusa arundinacea*, *Dendrocalamus strictus*, *Musa paradisiaca*, *Areca cathecu*, *Calamus tenuis*, *Caryota urens*, *Cocos nucifera*, *Albizia procera*, etc.), have been found in Tanguar Haor with rich species diversity. Many species of terrestrial birds take shelter in such vegetation and build nest or roost on the trees and bamboos.

1.3 Diversity of Phytoplankton in Tanguar Haor

In any aquatic ecosystem the phytoplankton works as the backbone of food chain that in turn keep all the predatory animals alive in wetlands and other aquatic environments. The phytoplankton communities of the Tanguar Haor wetlands are very much linked with zooplankton and fish productivity. Muzaffar and Ahmed (2006), so far found 107 genera of phytoplankton representing six classes. These are as follows:

- ▶ **Chlorophyceae:** *Radiofilum*, *Eudorina*, *Gonium*, *Pandorina*, *Pleodorina*, *Platydorina*, *Volvox*, *Pyrobotrys*, *Sphaerocystis*, *Gloeocystis*, *Palmodictyon*, *Nannochloris*, *Ulothrix*, *Chlorococcum*, *Mycanthococcus*, *Golenkinia*, *Dictyosphaerium*, *Characium*, *Pediastrum*, *Euastropsis*, *Ankistrodesmus*, *Cerasterias*, *Glaucocystis*, *Kirchneriella*, *Pachycladon*, *Selenestrum*, *Trochiscia*, *Westella*, *Coelastrum*, *Crucigenia*, *Scenedesmus*, *Mougeotia*, *Eremosphaera*, *Spirogyra*, *Gonatozygon*, *Closterium*, *Pleurotaenium*, *Cosmarium*, *Sirocladium*, *Micrasterias*, *Staurostrum*, *Xanthidium*, *Arthrodesmus*, *Spondylosium*, *Desmidium*, *Hyalotheca*, *Sphaerosozma*, *Euglenoidea*, *Trachelomonas* and *Pyrobotrys*.
- ▶ **Xanthophyceae:** *Botryococcus*.
- ▶ **Chrysophyceae:** *Synura*, *Uroglenopsis*, *Dinobryon*, *Gloeobotrys* and *Phaeosphaera*.
- ▶ **Bacillariophyceae:** *Melosira*, *Coscinodiscus*, *Biddulphia*, *Fragilaria*, *Synedra*, *Navicula*, *Pinnularia*, *Nitzschia*, *Amphora*, *Cymbella* and *Suriella*.
- ▶ **Dinophyceae:** *Gyaulux*, *Ceratium*, *Peridinium*, *Glenodinium* and *Attheya*.
- ▶ **Cyanophyceae:** *Chroococcus*, *Gloeocapsa*, *Synechocystis*, *Aphanocapsa*, *Synechococcus*, *Microcystis*, *Merismopedia*, *Eucapsis*, *Dactylococcopsis*,

Coelosphaerium, *Spirulina*, *Oscillatoria*, *Borzia*, *Lyngbia*, *Schizothrix*, *Trichodesmium*, *Anabaena*, *Nostoc*, *Anabaenopsis*, *Nodularia*, *Tolypothrix*, *Rivularia* and *Gloeotrichia*. Blooms of *Microcystis* dominated the phytoplankton community throughout the study period but were particularly acute during the early part of the high water period.

1.4 Threats to Tanguar Haor

Tanguar Haor supports a spectacular array of flora and fauna but these are now facing serious threats due to natural resource depletion, habitat degradation, soil erosion, water pollution, forest degradation, and poaching of wildlife.

1.4.1 Threats to swamp forest and reed beds

The Swamp forests that once used to be common in Tanguar Haor have now become very thin due to clearing, cutting and other anthropogenic activities, though vestiges remains as mentioned in the previous chapter. Except at the bank of Foillar beel,

natural regeneration of this forest type hardly visible in the wetlands.

The reed beds have also been severely reduced because of continued over-harvesting for fuel and converting land into agricultural fields. As a result, certain aquatic species that used to be common in the area, have now become very rare or are fast disappearing. This process threatens the integrity of the haor ecosystem (GoB, 2004).

Degradation of the conditions of swamp forests and reed beds has lead to several impacts on resource use and livelihoods of the local people. Swamp forest provides food and shelter for fish population and therefore, a reduction in fish production; species diversity and the waterfowl population have been observed over the past few decades.



Illegal reed collection by local people



Illegal fishing using monofilament

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1.4.2 Threats to fisheries

Tanguar Haor is extremely rich in fisheries resources. The varied number of fish species is linked with the complex network of food web in the entire ecosystem and so maintaining the integrity of the food web is a must for ecological balance of the *haor* and to increase fish production in Bangladesh.

Harvesting of the last fish, dewatering of certain key areas, repeated fish harvest every year and leaving only a few fish for breeding are the most unsustainable methods used for fishing in Tanguar Haor. These have probably contributed to disappearance of a large number of fish in the natural system which would lead to genetic erosion and is a threat to indigenous fish species (GoB, 2004).

On the other hand, unsustainable use and destruction of swamp forests and reeds, brings a negative effect to fisheries resources as it provides the shelter and feed to the fish. Water pollution is another threat to floral and faunal species which sometimes occurs due to coal storage and transportation at Tekerhat point. Thousands of boats continuously

pollute the water through oil spill which is ultimately affecting the fish population, Another concerning issue is the illegal fish catching by local people using the monofilament net and other illegal fishing gears.



Fishing by Lar Borshi

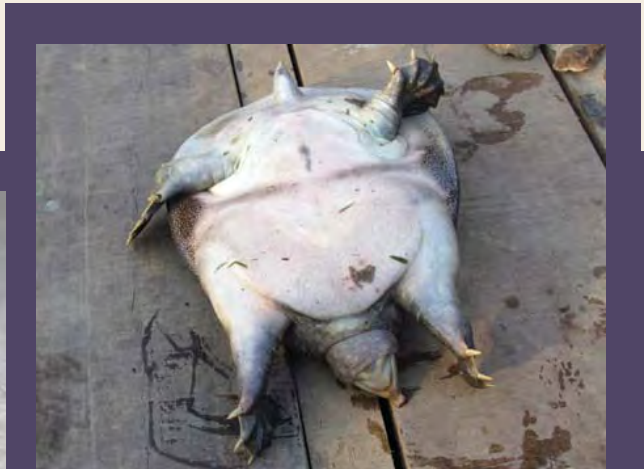
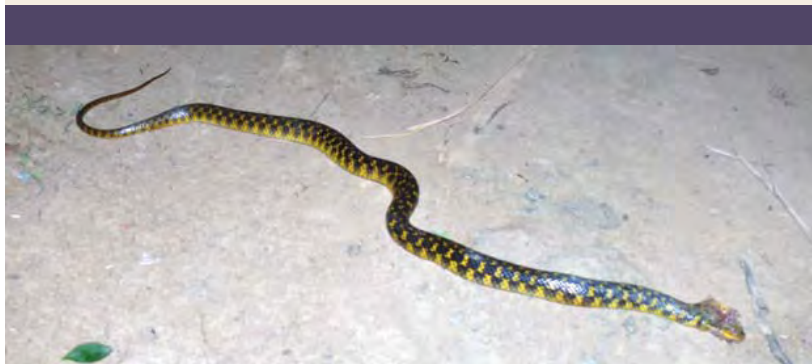
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1.4.3 Threats to wildlife

Tanguar Haor is well recognized and acknowledged as home to a large number of waterfowl, both resident and migratory. It provides a breeding area for many birds and other wildlife. The interplay of huge flocks of water birds and luxuriant swamp vegetation was used to attract naturalists and tourists. This glory is however now lost. Each year about 60,000-1,20,000 waterfowl visit Tanguar Haor. They are mostly migratory bird species. But this number has dropped due to a combination of factors: habitat degradation (e.g., decrease of swamp forest and reed beds), shortages of food, human pressure and illegal hunting (GoB, 2004).

found in Tanguar Haor and a few other areas of Bangladesh, builds nests only in *haor* basin and adjacent areas on tall trees along the periphery of *haor* during the winter season. This species is threatened due to the destruction of its nesting sites. Conservation efforts can help to increase the number of this bird as well as other wildlife.

In addition, the migrant fisher folk sometimes harvest turtles and tortoises for consumption and lead to over-exploitation of fish resources as well. At the same time, these temporary migrants build fishing camps which collect



Many species of wildlife have disappeared over the past few decades. Some are threatened nationally and globally. For example, the globally threatened Pallas's Fish Eagle (*Haliaeetus leucoryphus*) has a global population of about 2,500 to 10,000. This species was included in 2009 IUCN Red List Category (as evaluated by BirdLife International- the official Red List Authority for birds for IUCN) as a vulnerable one. The Pallas's Fish Eagle can only be

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Wildlife threats

fuel wood from swamp forests and use the swamp vegetation (reeds) for the construction of temporary hamlets within the reed beds and pose threats to birds and other wildlife species.

1.4.4 Threats to conservation implementation:

The conservation strategy should include a balanced approach to fishing (through restrictions in space and time) and must also protect swamp forests, reed beds as well as provide shelter for all the migratory birds which take refuge during the winter months. But there are some limitations in implementing any conservation initiative. According to the presentation by Ecologically Critical Area Management Unit (ECAMU) - Coastal and Wetland Biodiversity Management Project (CWBMP)¹ and Bevanger *et al*, (2001), the main challenges for biodiversity conservation at Tanguar Haor are:

- illiteracy of local *haor* dependent people;
- lack of community participation;
- poverty of the local *haor* dependant people;
- biodiversity status may be disrupted after termination of the existing management system, because community motivation and system involvement are absent; and
- insufficient policy frameworks and legislative provisions for biodiversity conservation and protected wetland management.



Indian spot-billed duck

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Dam construction by local community

© IUCN Bangladesh Country Office



Commercial fishing

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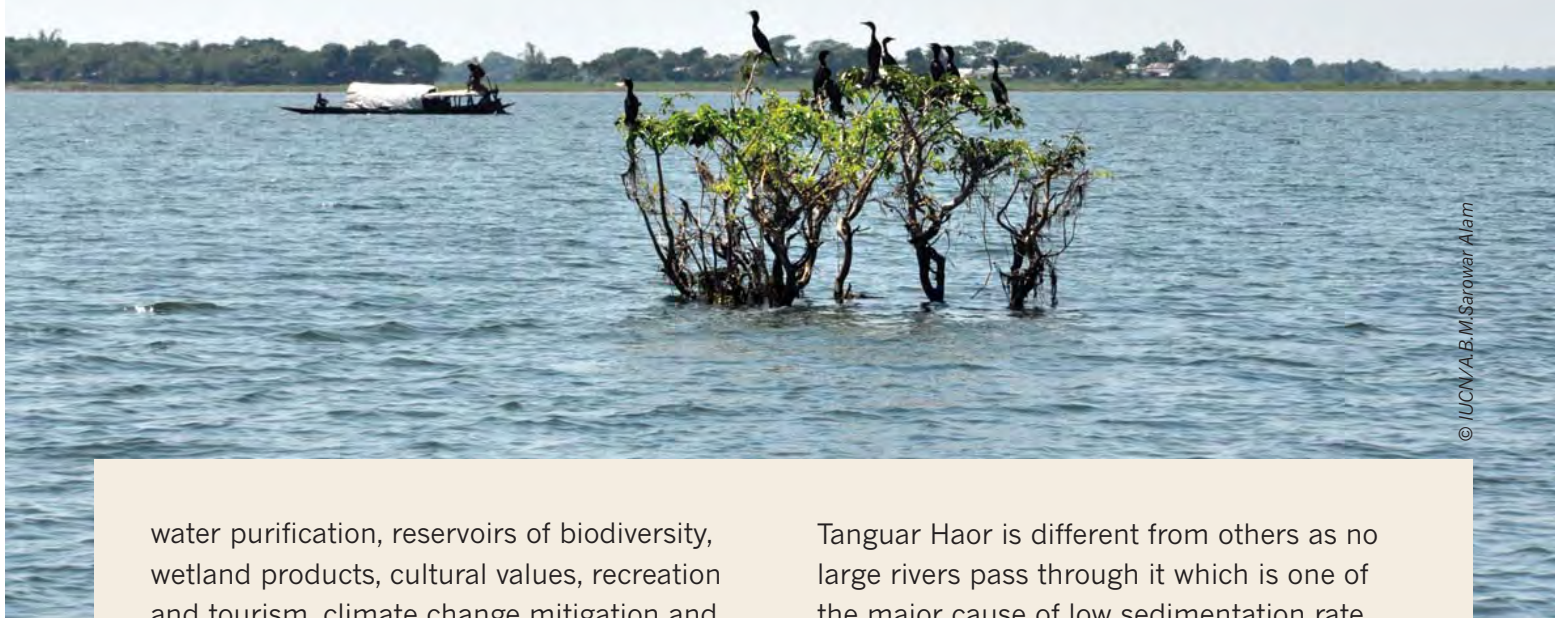
1.5 Economic Value of Tanguar Haor

Tanguar Haor systems have a great economic value as they provide various services without any investment towards nature – making a vital contribution to human health and well-being. Wetland ecosystems of this *haor* are parts of our natural wealth. The set of Ramsar Factsheets outlined (2011) the 'ecosystem services' – the benefits of people obtained from wetlands ecosystems. They illustrate the great diversity of ecosystem services delivered by wetlands and their values which covers: flood control, groundwater replenishment, shoreline stabilization and storm protection, sediment and nutrient retention and export,

1. ECAMU-CWBMP,

<<http://www.undp.org.bd/projects/prodocs/CWBMP/Study%20Tour%20Tanguar%20Haor%20Draft%20ppt.pdf>> accessed on 8 January 2012

Little cormorant



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water purification, reservoirs of biodiversity, wetland products, cultural values, recreation and tourism, climate change mitigation and adaptation. However, not all wetlands provide all of the services at one time. Different wetlands provide a range of services according to their type, size and location.

Economic evaluation of Tanguar Haor could be assessed as below through evaluation of services which the *haor* ecosystem provides:

1.5.1 Biological set up

Tanguar Haor is a large back-water swamp and an association of many smaller soccer shaped depressions between ridges or banks of river systems at the foothill of the Meghalayan-Joyanti Hills of India. Water is available here all year round, but varies from 7,000 cubic meter/Sec to 220 cubic meter/sec in July and February respectively. The *haor* is enriched with clear water which is mainly due to low sediment load in the water. In case of a river the water flows constantly, but in a *haor* the water current is subdued which provides a relatively stable and shallow depth of water in most areas - a unique ecosystem.

Tanguar Haor is different from others as no large rivers pass through it which is one of the major cause of low sedimentation rate. However, in the monsoon, hill streams contribute some sedimentation in the upper edge of the *haor* and in adjacent cluster villages. This also creates a unique character to the *beels* which provides a good breeding ground and habitat for the shallow water fish. Siltation trends are not significant, hence it is not considered as threat to the habitat of fish species, instead adds some nutrients to the soil which has a positive impact on agricultural activity. The ridges, known locally as *Kanda*, located in between *beels* which supports swamp forests and reed beds. In *Kandas*, some agricultural activities are done by the local community but primarily used as grazing land for cows, buffalos and birds. Fishes are known to breed here when these become submerged. Tanguar Haor also includes rice-field habitats that play important ecological roles and support a range of biodiversity, including internationally important populations of migratory waterbirds.

1.5.2 Large fishing ground

There is great importance of Tanguar Haor for fish production, maintaining biodiversity, meeting local and regional demands and also serve as a good source of fish fry for other water bodies. Perennially flooded parts of the Tanguar Haor are rich in fish resources. The relatively clear water of Tanguar Haor provides good habitat for aquatic macrophytes which supports a good breeding ground for fish and act as a shelter for brood fish. Submerged vegetation is a good habitat for small and medium size fish, where as natural reeds and other vegetation provide a natural ecological balance for shelter of other mother fish. Moreover there is a good abundance of food and biological environment to boost up the maturity of fishes that is greatly augmented by the supply of additional water from hill streams which keeps the reservoir on flow even during the dry season. The recent trend shows that 70% of households depend on fish resources of the Tanguar Haor.

1.5.3 Occupational status of the *haor* people

Wetland resources play critical roles in the lives of those residing in and around Tanguar Haor. Most economic activities carried out in the area, including commercial fishing, trade in fuel wood, hunting and trapping waterfowl, harvesting and sale of grasses and reeds and

farming is based on these resources.

Earlier studies confirmed that more than two-thirds of households in Tanguar Haor are either directly or indirectly dependent on the *haor*. Fishing and farming are the principal occupations of people living in Tanguar Haor. An estimation of economic activities of local community of Tanguar Haor area has been given below in Table 1.1. It is clear from the table that occupational status is largely depend on fish resources and people of Tanguar Haor are becoming more and more engaged in fishing than ever before.



Duck rearing

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Tradition fishing

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Table 1.1. Type of involvement in fishing activities

Type of involvement	Percent of HH
Fish catch	55.5
Wholesale fish business	3.9
Retail fish business	21.6
Dry fishing activities	0.5
Trap making activities	0.5
Net/trap selling	0.4
Boatman	6
Fishing labor	1.9
Ice selling	0.1
Others	9.5
Total	100
Involved in fishing	65.41

Source: IUCN Survey, 2008

Table 1.2. Source wise distribution of annual income of the households

Source of Income	Percentage of HH	Annual Average income
Agriculture	67	21212
Day labourer	52	23300
Open access fisheries	38	21053
Culture fisheries	1	14417
Fish business	5	28145
Transportation	4	25441
Small business	18	32782
Remittance (inland and abroad)	3	20444
Others	21	16988
Total Income	100	46769
Income from Haor	95%	38059
Income from Haor (non agriculture)	72%	30553

Source: IUCN Survey, 2008

According to the Bangladesh Bureau of Statistics the national average household size is 4.9 (BBS 2007), but in Tanguar Haor it is nearly 6, for a population living in poverty this is not very high compared to the national average. About 67 percent of the households reported that their occupation is agriculture (including both primary and secondary occupation) and despite the fact that it is a major fishing area, about 48 percent of the households had fishing income. In this connection, it should be noted that households in *haor* regions

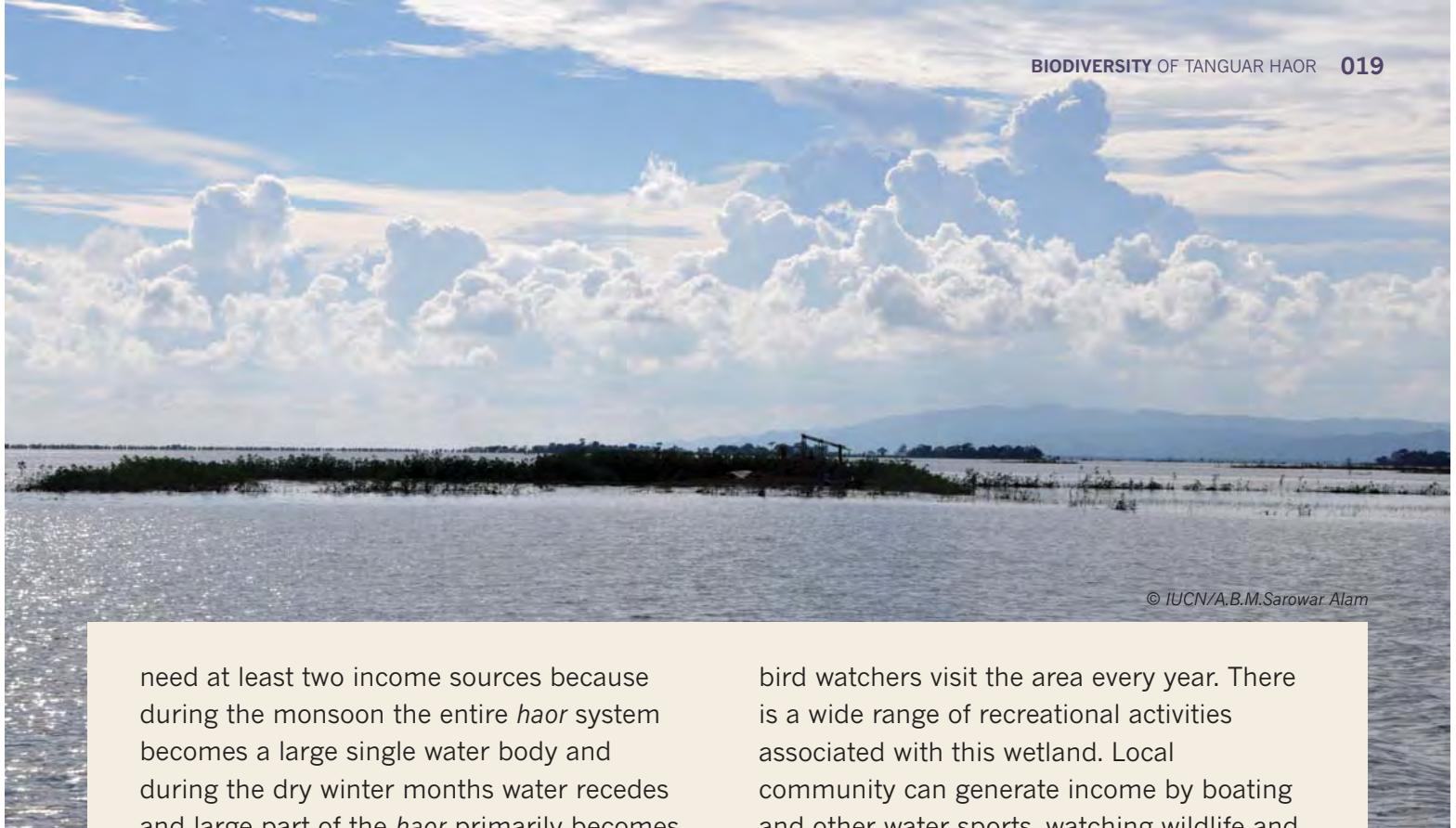


Rice cultivation

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Table 1.3: Involvement of local community in different occupation

Occupation	Percentage (%) of involved household head		
	According to NCS fisheries report (1987)	According to Kabir and Amin (2007) from field survey of 2005	According to household survey, IUCN (2008)
Agriculture	62	56	36.78
Fishing	8	15.7	21.56
Day labour	18	7.3	21.07
Businessman	2	2	7.55
Sand and coal	-	-	3.4
Collection	-	19.3	9.87
Others	10		



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need at least two income sources because during the monsoon the entire *haor* system becomes a large single water body and during the dry winter months water recedes and large part of the *haor* primarily becomes cropland. Table 1.2 shows the details of the occupational distribution of the households. It also shows that 52 percent of the households earn their income as day labourer, while 18 percent are engaged in small businesses, and only 4 percent are involved in local mines (coal and sand mining activities). At the same time, nearly 16 percent reported no specific sources of income.

Traditionally, in the winter season residents of Tanguar Haor were able to graze their cattle in fallow land or *Kandas*. Grasses, reeds, twigs and leaves were harvested for fuel and thatching. Branches or whole tree-tops were collected from swamp forests for use in constructing enclosures, called *khola* or *kathha*, which entice fish to breed in them. The Hijal (*Barringtonia acutangula*), a wetland tree species, is widely favored for this purpose.

1.5.4 Recreation, tourism and research

The natural beauty as well as the diversity of wildlife and plant life in Tanguar Haor makes it an ideal location for recreation, tourism and research work. Hundreds of ornithologists and

bird watchers visit the area every year. There is a wide range of recreational activities associated with this wetland. Local community can generate income by boating and other water sports, watching wildlife and even art and literature/cultural show.

1.5.5 Food and Nutrition Status

The main food items are rice, vegetables, and fish. However, average intake per person is much lower than the daily calorie needs. Only 49 percent households eat potato weekly, only 2.8 percent eat red meat, 12.55 percent eat poultry, 21 percent use milk or milk based products, 42 percent eat eggs and only 5 percent take fruits per week.

1.5.6 Indirect value of Tanguar Haor

There are some activities which do not have direct value but play an important ecological role. Among them grazing of cows, buffalos, goats, harvesting reeds and other vegetation, and collecting fuel woods and food materials are very important for the local people. Duck rearing is also a good option in this area. Local habitants have these privileges without providing any fee.

However, over harvesting of these resources is a major problem and unlimited access to these valuable resources should be kept under control to help restore biodiversity for future uses.

1.6 Conservation Importance of Tanguar Haor

Tanguar Haor, listed in the Directory of Asian Wetlands (Scott, 1989) and has been identified by Rashid & Scott (1992) as a key wetland site of international importance, especially because of its vital link in an international network of sites for migratory waterbirds. Tanguar Haor fulfills at least three of the criteria established for declaring a wetland of international importance, as adopted by the Montreux Conference of the contracting parties (Davis, 1994), each of which alone is sufficient for proposing a Ramsar site. The three criteria met by Tanguar Haor are:

Criterion 1: *A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.* Tanguar Haor qualifies for this criterion based on it hosting a critically endangered bird, several endangered, vulnerable and threatened floral and faunal species such as Baer's Pochard, Pallas's Fish Eagle, Fishing Cats, Bengal Rose and Ferruginous Pochard etc.

Criterion 2: *A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.* Tanguar Haor supports around 50,000 waterfowl, on average, during the winter migratory season.

Criterion 3: *A wetland should be considered internationally important if it regularly supports*

1% of the individuals in a population of one species or subspecies of waterbird.

In 2001, a minimum of 2,500 Baer's Pochard was counted, which represents 50% (estimated global population is 5,000 by BirdLife International, 2001) and 90,900 (2002) Ferruginous Pochard from Tanguar Haor, which represents 90% of the global population estimate (100,000) by Birdlife International, 2002.

1.7 Wise Use of Ramsar site

According to RCS (2010) an updated definition of "wise use" is "Wise use of wetlands is the maintenance of their ecological character, achieved through the implementation of ecosystem approaches², within the context of sustainable development³."

According to the Ramsar Convention Strategic Plan (RCSP) 2009-2015, Goal 1 covers wise use of wetlands and the related benefits for biodiversity and human well-being. The strategies for wise use of all wetlands have been expressed as below:

1.7.1 RCSP 2009-15: GOAL 1. Wise Use

To work towards achieving the wise use of all wetlands by ensuring that all Contracting Parties develop, adopt and use the necessary and appropriate instruments and measures, with the participation of the local indigenous and non-indigenous population and making use of traditional knowledge, while at the same time ensuring that conservation and wise use of wetlands contribute to poverty eradication, mitigation of and adaptation to climate change, as well as prevention of disease and of natural disasters.

2. Including inter alia the Convention on Biological Diversity's "Ecosystem Approach" (CBD COP5 Decision V/6) and that applied by HELCOM and OSPAR (Declaration of the First Joint Ministerial Meeting of the Helsinki and OSPAR Commissions, Bremen 25-26 June 2003).

3. The phrase "in the context of sustainable development" is intended to recognize that whilst some wetland development is inevitable and that many developments have important benefits to society, developments can be facilitated in sustainable ways by approaches elaborated under the Convention, and it is not appropriate to imply that 'development' is an objective for every wetland.

STRATEGY 1.1 Wetland inventory and assessment

Describe, assess and monitor the extent and condition of all types of wetlands as defined by the Ramsar Convention and wetland resources at relevant scales, in order to inform and underpin implementation of the Convention, in particular in the application of its provisions concerning the wise use of all wetlands. (CPs, advised by STRP and assisted by IOPs)

STRATEGY 1.2 Global wetland information

Develop a global wetland information system, through partnerships, to be covered by voluntary contributions, to increase accessibility of data and information on wetlands. (CPs, Secretariat, advised by STRP and assisted by IOPs)

STRATEGY 1.3 Policy, legislation and institutions

Develop and implement policies, legislation, and practices, including growth and development of appropriate institutions, in all Contracting Parties to ensure that the wise use provisions of the Convention are being effectively applied. (CPs, Secretariat)

STRATEGY 1.4 Cross-sectoral recognition of wetland services

Increase recognition of and attention in decision-making to the significance of wetlands for reasons of biodiversity conservation, water supply, coastal protection, integrated coastal zone management, flood defense, climate change mitigation and/or adaptation, food security, poverty eradication, tourism, cultural heritage, and scientific research, by developing and disseminating methodologies to achieve wise use of wetlands. (CPs, Secretariat, STRP, IOPs)

STRATEGY 1.5 Recognition of role of the Convention

Raise the profile of the Convention by highlighting its capacity as a unique mechanism for wetland ecosystem

management at all levels; promote the usefulness of the Convention as a possible implementation mechanism to meet the goals and targets of other global conventions and processes. (CPs, Secretariat, STRP, IOPs)

STRATEGY 1.6 Science-based management of wetlands

Promote successful implementation of the wise use concept by ensuring that national policies and wetland management plans are based on the best available scientific knowledge, including technical and traditional knowledge. (CPs, Secretariat, STRP, IOPs)

STRATEGY 1.7 Integrated Water Resources Management

Ensure that policies and implementation of Integrated Water Resources Management (IWRM), applying an ecosystem-based approach, are, included in the planning activities in all Contracting Parties and in their decision-making processes, particularly concerning groundwater management, catchment/river basin management, coastal and nearshore marine zone planning, and climate change mitigation and/or adaptation activities. (CPs, STRP, IOPs)

STRATEGY 1.8 Wetland restoration

Identify priority wetlands and wetland systems where restoration or rehabilitation would be beneficial and yield long-term environmental, social, or economic benefits, and implement the necessary measures to recover these sites and systems. (CPs, Secretariat, IOPs)

STRATEGY 1.9 Invasive alien species

Encourage Contracting Parties to develop a national inventory of invasive alien species that currently and/or potentially impact the ecological character of wetlands, especially Ramsar sites, and ensure mutual supportiveness between the national inventory and IUCN's Global Register on Invasive Species (GRIS); develop guidance and

promote procedures and actions to prevent, control or eradicate such species in wetland systems. (CPs, STRP, other agencies, IOPs)

STRATEGY 1.10 Private sector

Promote the involvement of the private sector in the conservation and wise use of wetlands. (CPs, Secretariat)

STRATEGY 1.11 Incentive measures

Promote incentive measures that encourage the application of the wise use provisions of the Convention. (CPs, Secretariat, IOPs)

level who can then pass on their expertise to lower levels, and involve the cooperation of governmental and non-governmental organizations, using local resources and institutions whenever possible. Three broad types of training appear to be of particular relevance for wetland professionals:

- ▶ Courses on integrated management
- ▶ Courses on wetland management techniques
- ▶ Courses for field staff



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1.7.2 Additional guidance on the implementation of the wise use concept (1993)

Research

Research can be anything that expands upon basic knowledge. Particular areas that may deserve attention are both identification and quantification of wetland values, sustainability of wetland use, and landscape functioning and modification. Contracting Parties should take positive steps to acquire and, when possible, share any knowledge developed on wetland values, functions and uses.

Training

Training activities and transfer of appropriate knowledge should be an integrated component of all wise use projects. Those activities should be as catalytic as possible, and seek to train potential trainers at regional

1.8 Preceding Exploration in Tanguar Haor

In the study report on “Resource Rights, Sustainable Livelihoods, Environmental Security and Conflict Mitigation in South Asia” of IUCN Asia, the management system of wetland in pre-colonial Bangladesh has been described as below (Waliuzzaman, *et al.*, undated):

“Fisheries were traditionally managed and dominated as common property resources through complex systems of rights evolved in and enforced by local communities. It was during this period that the traditional property rights of fishers and non-fishers began to be regulated and restricted through statutory law. Leasing was often short-

term, with few incentives to protect fish stocks and every incentive to maximise income by intensive fishing. Some fishers managed to become lessees but the majority did not and throughout the colonial period had practically no property rights in water or in fish.

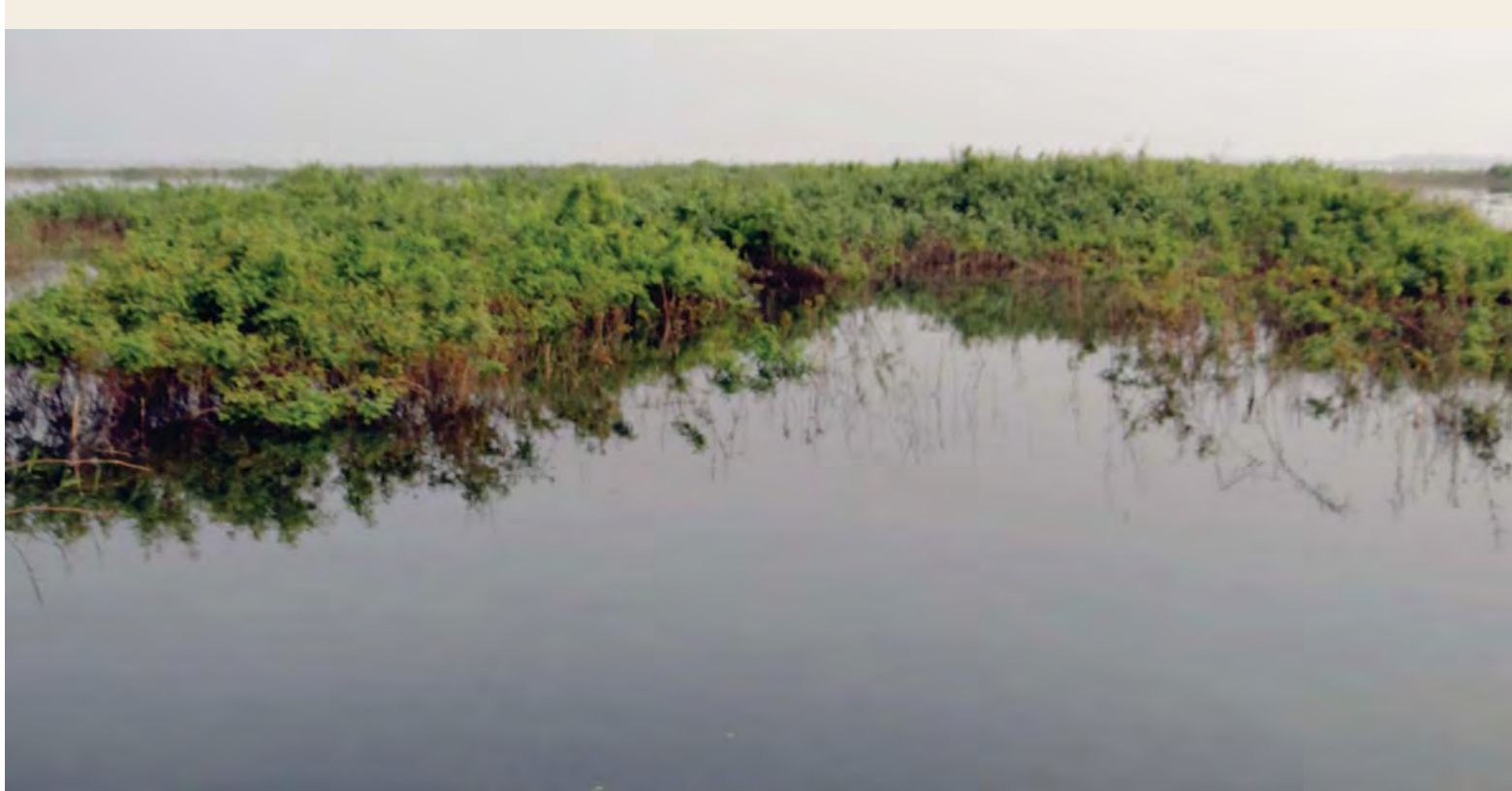
Leasing in Tanguar Haor was abolished by law in 2001 when the area was designated an ecologically critical area, and the lessee was removed in 2003. Tanguar Haor, currently and until 2014, is being managed by the Ministry of Environment and Forests. The role of local communities in this new arrangement is in the process of being defined but it appears that the new regime will involve a measure of exclusion and further curtailment of their rights to access and use the wetland resources.”

Until now, limited research has been carried out on Tanguar Haor mainly by NERP (1993), the annual Asian Waterfowl Census, and National Conservation Strategy

Implementaiton Project (NCSIP-1). All these studies have focused on fisheries, flora, fauna and socio economic aspect of Tanguar Haor area.

According to GoB (2004), a total of 208 bird species have been recorded at Tanguar Haor which is 30% of the total species recorded in Bangladesh, 92 waterbirds, 33 are reed land/ grassland/ marsh dwelling passerine birds, 15 are birds of prey and 68 are birds of village groe and /or foothill forests. Of the total number of species 98 species are migratory and 110 are resident species. Two bird species are listed as rare under IUCN classification (*Haliacetus leucorhyphus* and *Printa burnesii*), two are indeterminate (*Pellorneum palustre*, *Chjaetornis striatus*) and four are listed by CITES (App.1: *Haiacetus leucorhyphus*, *Falco peregrines*; App.2: *Platelea leucordia*, *Sarkidiornis melanotos*). Tanguar Haor provides a habitat for various globally threatened wildlife species including 1 ambhibian, 3 turtles, two lizards, 4 snakes, 10 birds and 6 mammals.

A study on “The effects of the flood cycle on the diversity and composition of the



phytoplankton community of a seasonally flooded Ramsar wetland in Bangladesh” has been conducted by Muzaffar and Ahmed (2006). They investigated the seasonal variation in the diversity and abundance of phytoplankton assemblages in Tanguar Haor.

In another study, Muzaffar (2004) quantified diurnal time-activity budgets for Ferruginous Pochard, *Aythya nyroca* wintering in Tanguar Haor, Bangladesh.

In a presentation by Ecologically Critical Area Management Unit (ECAMU) - Coastal and Wetland Biodiversity Management Project (CWBMP) Wild bird diversity of Tanguar Haor has been described as:

- ▶ Migratory ducks like Eurasian Wigeon (*Anas penelope*), Common Coot (*Fulica atra*), Brown headed Gull (*Larus brunnicephalus*) and Ruddy Shelduck (*Tadorna ferruginea*);
- ▶ Resident waterfowls like Spot-bill Duck (*Anas poecilorhyncha*), Pheasant-tailed Jacana (*Hydrophasianus chirurgus*), Bronzed-winged Jacana (*Metopidius indicus*), Common Moorhen (*Gallinula chloropus*), Little Grebe (*Trachybaptus ruficollis*), Grey Heron (*Ardea cinerea*); and
- ▶ Raptor birds like Black Kite (*Milvus migrans*), Brahminy Kite (*Haliastur indus*) and Pallas's Fish Eagle (*Haliaeetus leucoryphus*).

In a study report of IUCN Asia on “Sustainable Livelihoods, Environmental Security and Conflict Mitigation” a brief on Tanguar Haor resources was given. Tanguar Haor has provided its inhabitants with nearly everything they need for their subsistence, including rice, fish, vegetables, pasture, wild fruit, building material and fuel. Fish is the most important of all the resources taken from haor waters, but area residents also harvest rice and a number of other crops and

medicinal plants, both cultivated and wild, which are a major food source for the landless and destitute during the monsoon and the pre-harvest winter months. The ecosystem services provided by Tanguar Haor are yet to be fully documented. Tanguar Haor supports as many as 150 of an estimated total of 200 wetland plant species occurring in haor areas across the country. Tanguar Haor is also home to 141 varieties of fish, more than half of Bangladesh's 260 freshwater fish species. This includes 55 fish species that are threatened in Bangladesh, of which 28 are endangered. Of these 28 endangered fish species, 17 are found only in Tanguar Haor. In addition, 11 amphibians, 34 reptiles, 206 bird species and 31 mammals are found in the area (Giesen and Rashid, 1997). During the winter months, Tanguar Haor sees the arrival of more than half a million migratory water birds. Winter is also the time when the Pallas's fish eagle nests in wetland trees and the Bengal rose blooms in the fields.

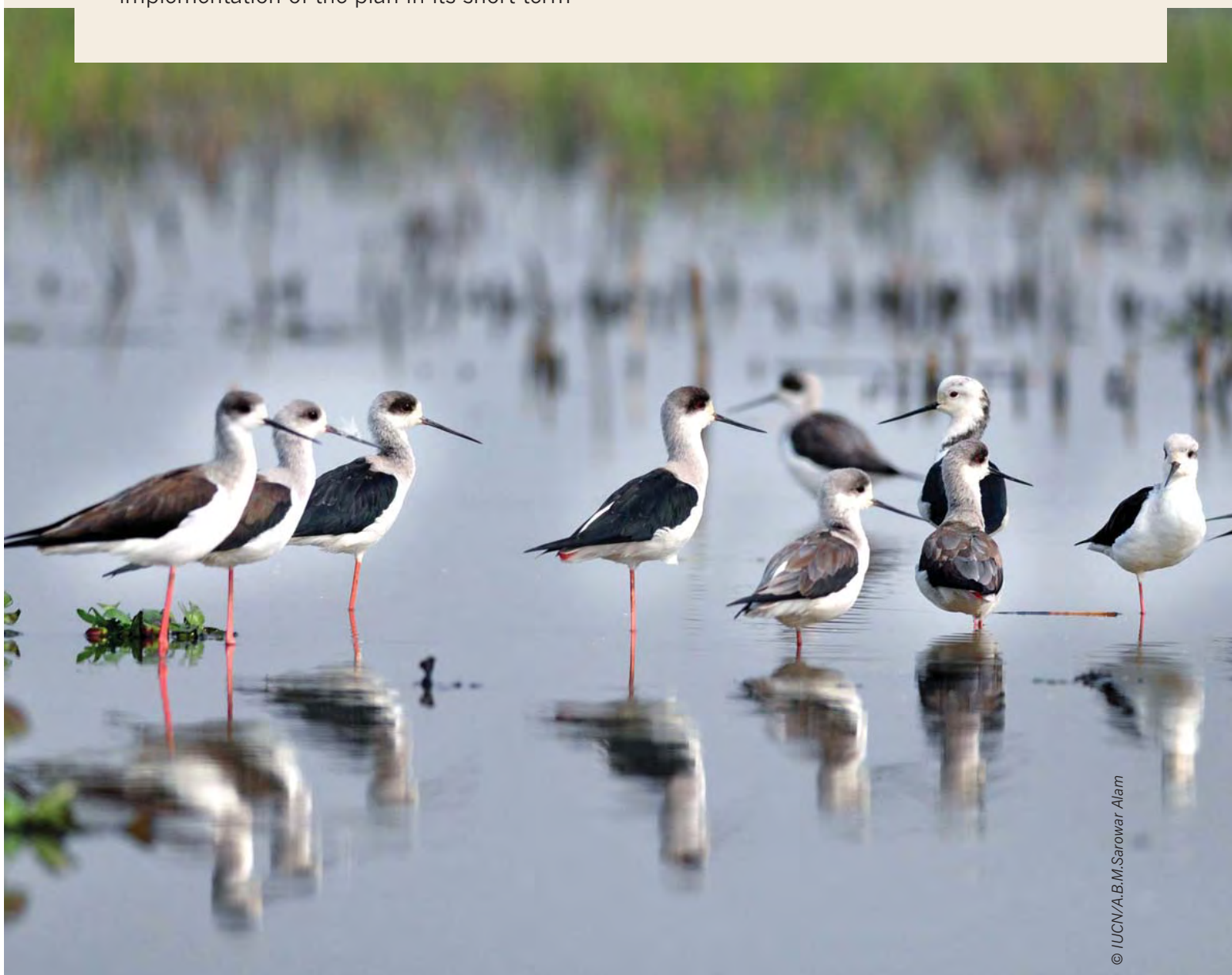
During the appraisal mission of Tanguar Haor wetland biodiversity conservation project, Bevanger *et al.* (2001) stated findings from the Tanguar Haor management plan (THMP) in which major biodiversity threats for Tanguar Haor were:

- 1) No control over exploitation of fisheries resources, habitat destruction (e.g., last vestiges of swamp forest are under threat), decline of fisheries production and introduction of exotic fish species
- 2) Waterfowl poaching and numbers of migratory waterfowl are dropping
- 3) Depletion of other natural resources, such as reed lands and swamp forest
- 4) Gaps in knowledge about biodiversity
- 5) Insufficient policy frameworks and legislative provisions for biodiversity conservation and protected wetland management

A case study of Boateng (2010) explained that a formal institutional framework and management plan for Tanguar Haor wetland has been developed through the effort of local Environmental NGOs, some government agencies and with the financial support from IUCN. The local community, commercial leaseholders, and all stakeholders involved were brought together to develop sustainable and community based resource management for Tanguar Haor. Analysis of the Institutional arrangements and interactions of Tanguar Haor resource management revealed a “bottom up” institutional framework. The implementation of the plan in its short term

of five years paved the way for the envisaged long-term option of community based management in Bangladesh. Both the local communities and the elites are benefiting from Tanguar Haor natural resources and thus the long-term survival of the unique biodiversity of Tanguar Haor is guaranteed.

A brief review of the existing laws, plans and policies related to the wetland management of Bangladesh are provided by Huq (1993), Giesen and Rashid (1997), and GoB (2002). For the management of Tanguar Haor, the most relevant of these are in the table below :



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Black winged stilt

Year	Sectoral Laws, Policies and Legislations	Specification of the Laws
1977	The Haor Development Board Ordinance	It requires the Board to prepare projects and schemes to develop the haors and other depressed low lying areas. Very short duration of the Board mainly executed a few projects related to flood control, land reclamation and extension of agriculture fisheries.
1982	Protection and Conservation of Fish (Amendment) Ordinance	Prohibits unsustainable fishing techniques, and calls for conservation of fish resources.
1985	Land Management Manual	Guidelines for leaseholders, for sustainable exploitation of fisheries resources.
1992	National Conservation Strategy	Recommendations for achieving sustainable development in all sectors. NCSIP -1 is implementation mechanism.
1992	Ramsar Convention (Ratified by Bangladesh)	Sustainable (Wise) use of wetland resources, if appropriate, with community based management.
1995	National Environmental Management Action Plan	Halt degradation: promote sustainable use, conservation of biodiversity.
1997	Environment Conservation Act (1995) and Environment Conservation Rules (1997)	Focus on EIA and protection of Ecologically Critical Areas.
1997	Tanguar Haor Management Plan	Sustainable Management (wise use) of the haor dealing with community based haor management.
1999	Notification of Ecologically Critical Areas	Enactment of the ECA clause in the Environmental Conservation Act (1995) and Rules (1997)
2000	Tanguar Haor Management Plan (revised)	Emphasis on implementation of wise use principle prescribed in Ramsar guidelines and community based haor management.

Source: Huq, 1993; GoB, 2002; Giesen and Rashid, 1997; Kabir and Amin (2007)



Surma river

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1.9. Organization of the Book

The main target of this book is to share the information on biodiversity (flora, fish, amphibians, reptiles, birds, mammals), and its changes due to various threats, which will ultimately alert local communities to improve their knowledge in biodiversity conservation.

The book begins with the Preface followed by Acknowledgements, Introduction and Salient Geographical Features of Bangladesh, Biodiversity Assessment Method and Present Flora Status of Tanguar Haor. The species profile chapter will represent the most important and popular plants species in reference to Tanguar Haor. This section of the book helps enthusiastic community people to identify plants easily.

The last chapter of this book describes Community led monitoring of Biodiversity and conservation practices. The reference section is followed by the appendices. In the Appendix section, a complete checklist of flora with present status in Tanguar Haor have been provided.

This book is volume II for flora of Tanguar Haor which is part of a series "Biodiversity of Tanguar Haor". Volume I of this series is on wildlife and volume III is on fish. We hope that this initiative will create awareness not only to Tanguar Haor community but also across the whole country. This book will also contribute to policy matters in Bangladesh such as the development of any future legislation and establishment of conservation priorities.



Salient Geological Features of Tanguar Haor

Chapter

2



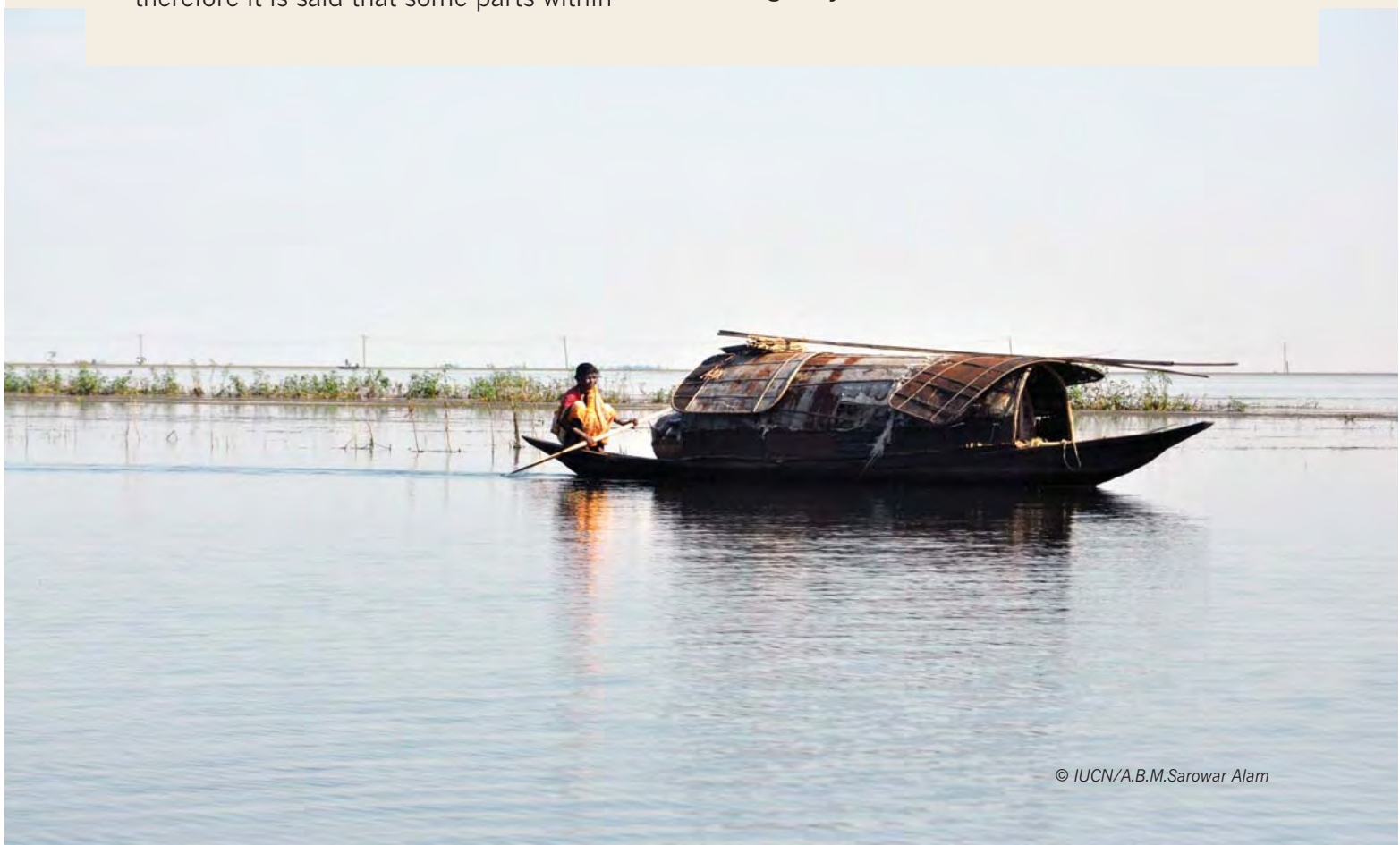
2.1 Geological History

Tanguar Haor, being a part of the world largest Geosyncline has its own Geological History of formation. The structural setting of the Bengal basin suggests that it is located in the Sylhet Trough of the Bengal Foredeep. At the north of it there located Shillong plateau where at the right Indian mobile belt is located.

The geological process includes uplifting and subsidence due to active tectonic plates therefore it is said that some parts within

Bangladesh have been uplifted and some parts are still sinking. Morgan and McIntire (1959) carried out a Systematic study and found uplifting and subsidence in Bengal basin (Rashid, 2008). The Sylhet basin is one of the major subsidence zones (BUP/CEARS/CRU 1994: Hoque 1982, quoted in Rashid 2008)

Although the rate of subsidence is not fully known but this subsidence is largely offsetted as the entire region is being fed by huge quantity of sediments carried out from the Meghalayan hills.



2.2 Geomorphology

Tanguar Haor is one of the largest wetland systems in the northeast region of Bangladesh with relative natural state. Approximately, one-third of it lies in Tahirpur *Upazila* and two-third lies in Dharmapasha *Upazila*, both of which are located in Sunamgonj District of Sylhet Division (Figure 2.2(a)). The haor consists of 46-50 *beels* of various sizes (Akondo, 1989; BFD, 2012). The total area of Tanguar Haor is approximately 160 square kilometers of which 2802.36 ha is permanent waterbodies (Banglapedia, 2006). The *haor* is located at an altitude of only 2.5-5.5 meters above mean sea level.

The wetland is bounded on the north by the Shillong Plateau, an elevated block of Pre-Cambrian Basement rock which has been draped over by late Mesozoic and Cenozoic sediments. The south face of the plateau has been dissected by steep, V-shaped canyon that follows structurally through controlled valleys. The southern escarpment of the plateau is bordered by the east-west trending Dauki Fault which forms a distinct lineament separating the lowlands in Bangladesh from the mountains in India (NERP, 1993b).

Most of the *haor* area is covered by the Young Piedmont. Alluvial plain which comprises the alluvial fans of the Shillong plateau and also

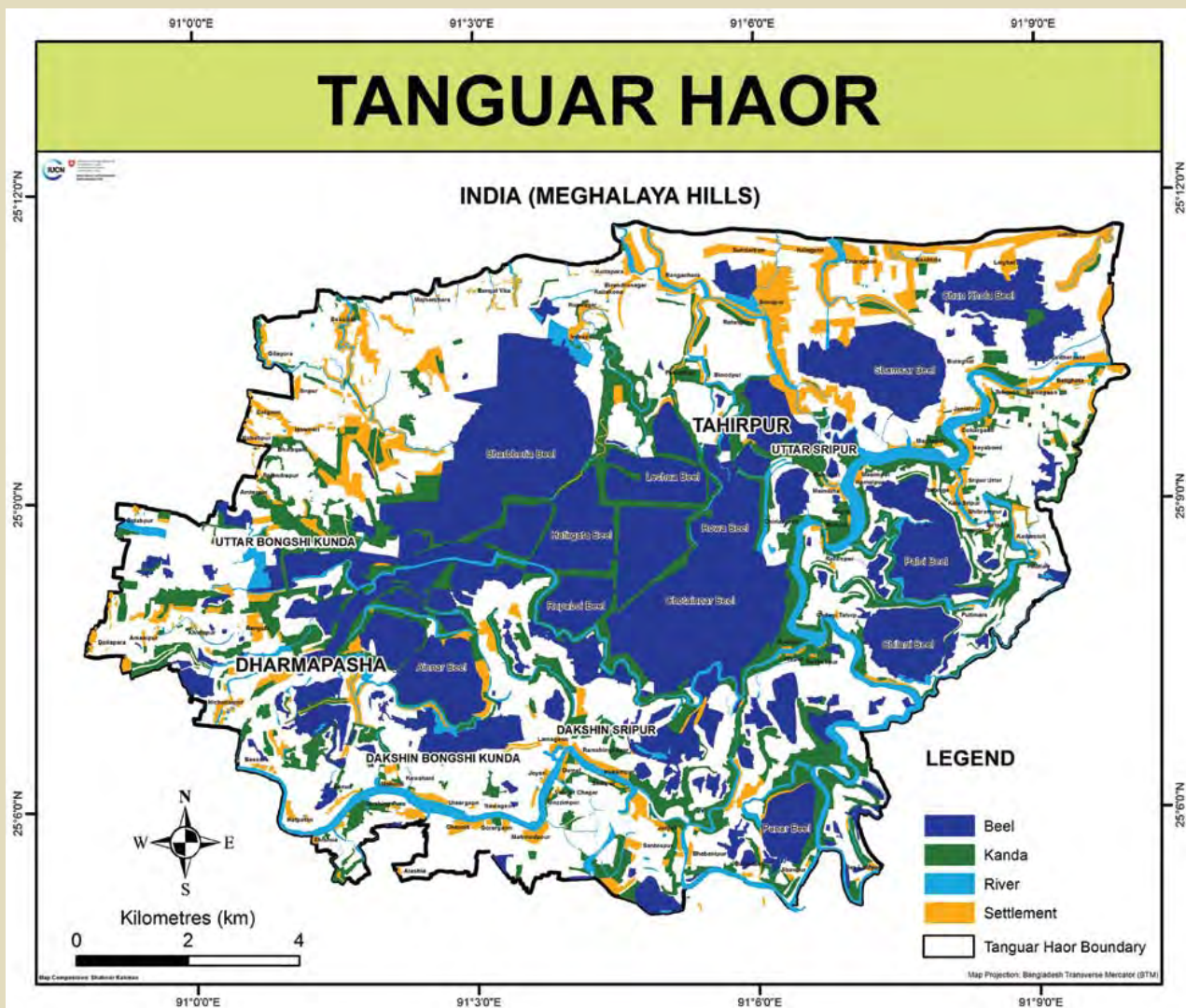
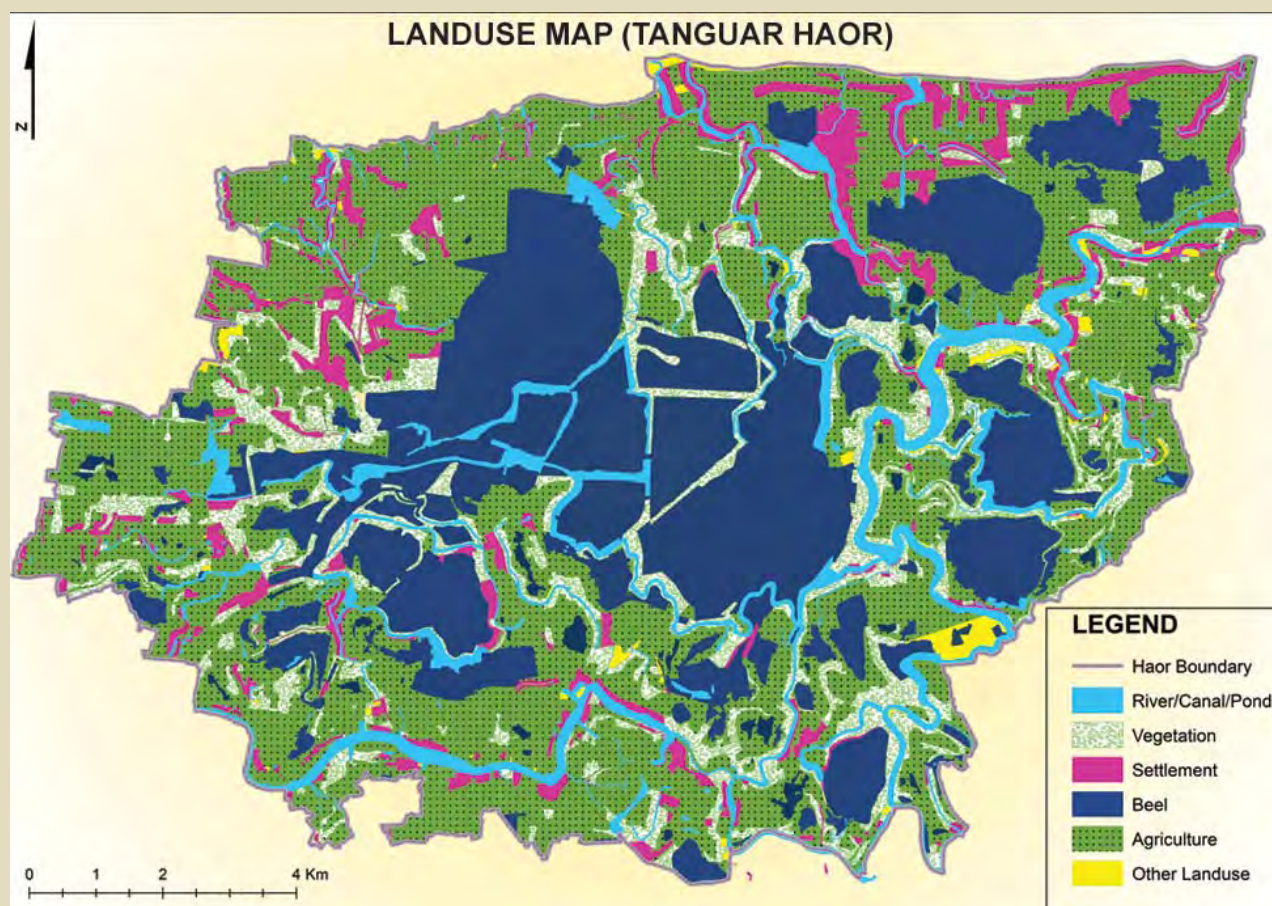


Figure 2.2 (a): Map of Tanguar Haor



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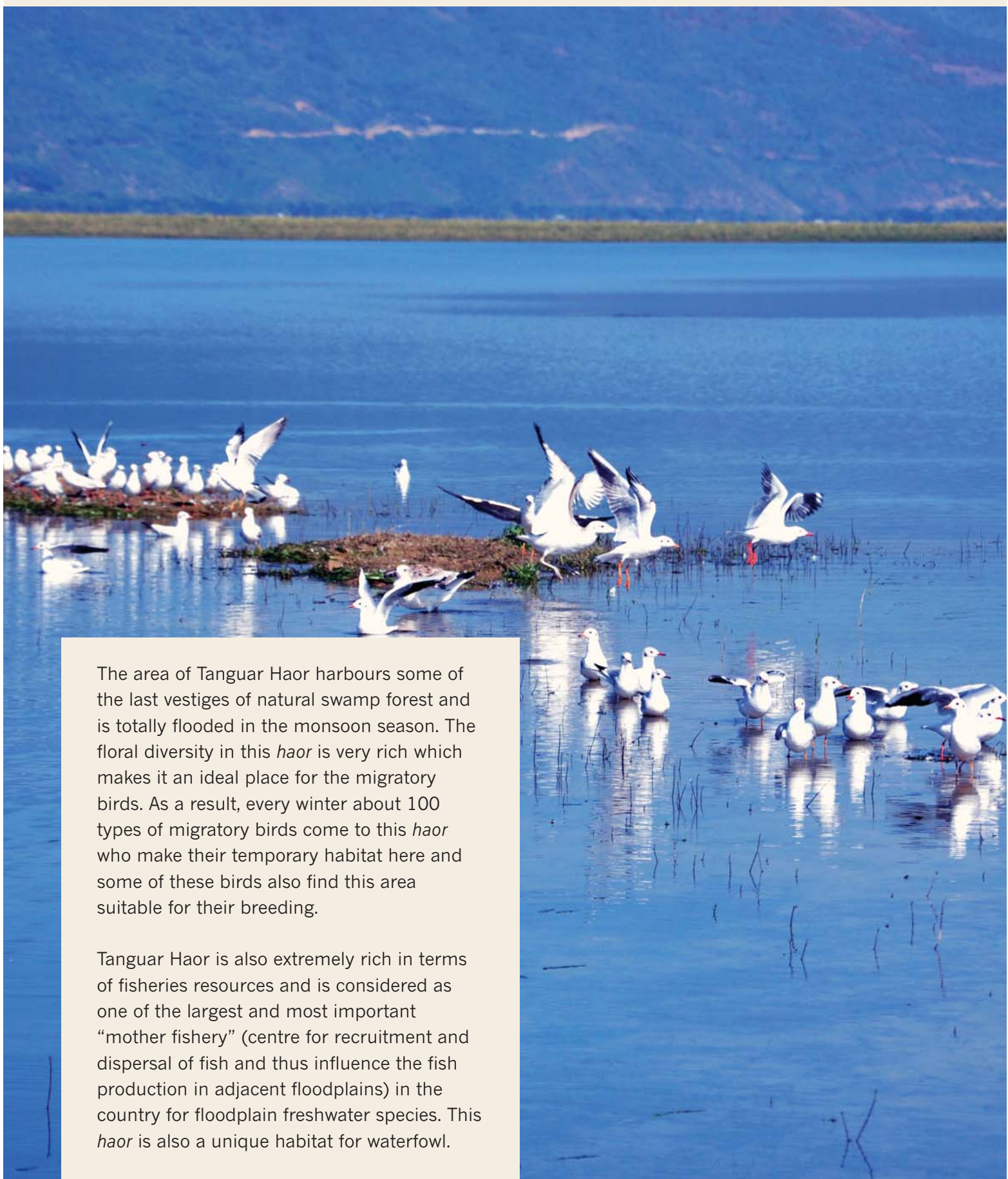
Figure 2.2 (b): Landuse Map of Tanguar Haor

the adjoining basins and basin depressions. The fan soils are poorly to imperfectly drained, strongly mottled brown, loamy sands to clay loams, poorly structured to strongly to very strongly acid reaction. The very poorly drained basin deposits comprise strongly reduced heavy clay lacking any sign of profile development.

Tanguar Haor is located right at the foothills of the Meghalaya Hills. Apart from these features, location of this haor is another factor for its high biomass production. The *haor* system is mainly rendered with the blackflow of river waters from Baulai, Patnai and Jadukata rivers. Few hill streams flow into the *haor* system but the major water thrust comes from the south because of the back flow. The hill streams do bring in some sediment but considering the volume of water held in the

haor and the area of the *haor* itself. It is significant that because of the low quantity of silt and its dissemination during flooding season this *haor* is still deep enough compared to the other *haors* where the rate of sedimentation is comparatively higher.

Due to this backflow the water is relatively clean, free from suspending materials and with less residual matter. As a result the water is transparent and sunlight can penetrate to quite a considerable depth. This increases the lotic area of the water body facilitating the photosynthesis and making it the most productive area (with high biomass) within the northeastern *haor* basin. It is because of these important physical features that this wetland is still capable of maintaining the ecosystem to its near-natural state resulting in high biomass production.



The area of Tanguar Haor harbours some of the last vestiges of natural swamp forest and is totally flooded in the monsoon season. The floral diversity in this *haor* is very rich which makes it an ideal place for the migratory birds. As a result, every winter about 100 types of migratory birds come to this *haor* who make their temporary habitat here and some of these birds also find this area suitable for their breeding.

Tanguar Haor is also extremely rich in terms of fisheries resources and is considered as one of the largest and most important “mother fishery” (centre for recruitment and dispersal of fish and thus influence the fish production in adjacent floodplains) in the country for floodplain freshwater species. This *haor* is also a unique habitat for waterfowl.

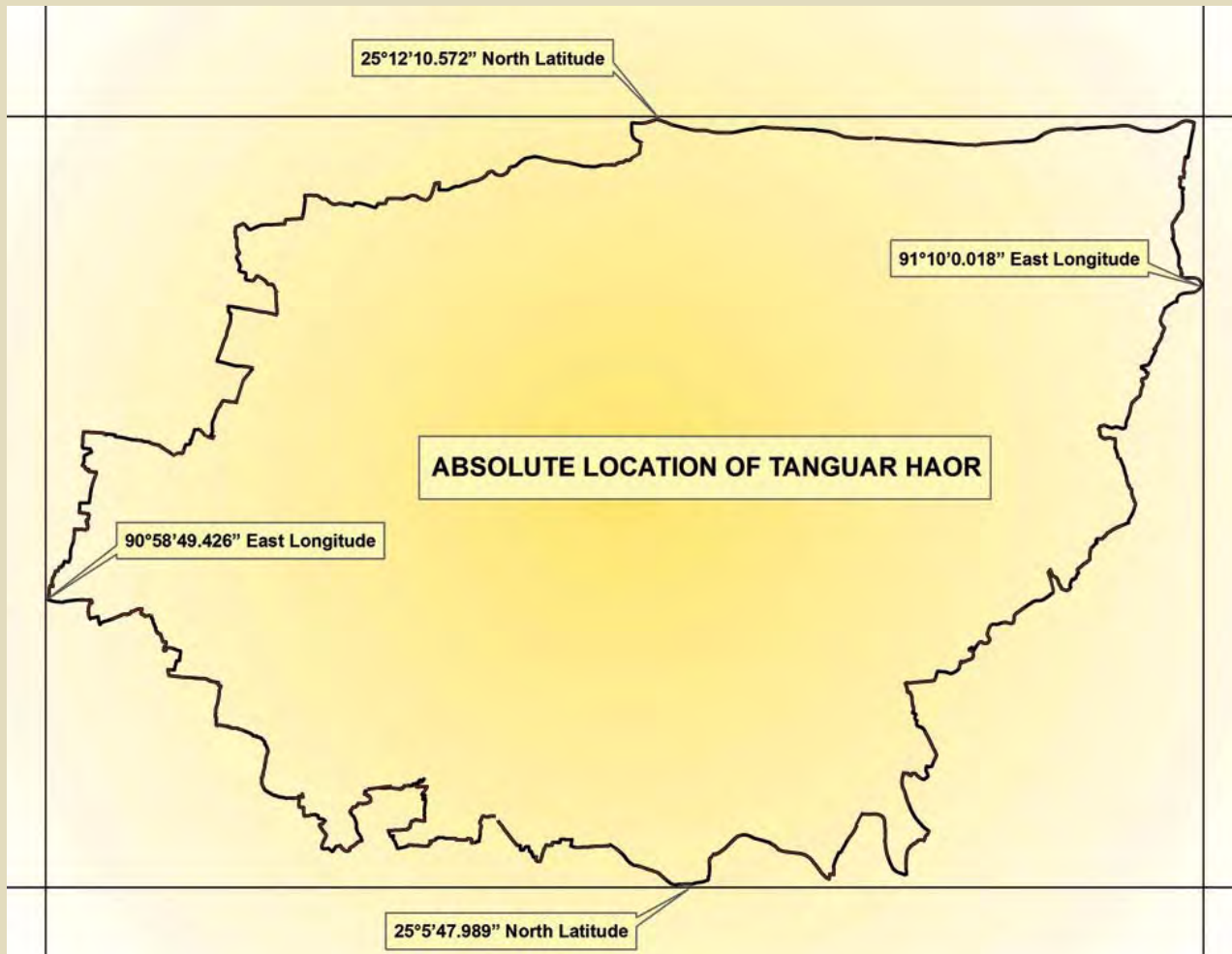


Figure 2.2.1(a): Map of Absolute Geographic Location of Tanguar Haor

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2.2.1 Geographical Location

The Location of Tanguar Haor can be described in three ways e.g. Absolute Geographic Location, Relative Location and Physiographic Location.

Absolute Geographic Location

Tanguar Haor is located in the northeastern part of Bangladesh, between $25^{\circ} 12' 10.572''$ and $25^{\circ} 5' 47.989''$ North Latitude and $90^{\circ} 58' 49.426''$ and $91^{\circ} 10' 0.018''$ East Longitude. The total area of Tanguar Haor is approximately 160 square kilometers including all Geographic features and Landuse.

Relative Location

Tanguar Haor is Located in Northwestern part of Sunamganj district of Sylhet division. It shares a border of approximately 17 kilometers with Nongstoin, India in its North. The Haor is almost 2.5 kilometers away from neighboring Netrokona district in the west.

Within Total area of Tanguar Haor there are two *Upazilas* of Sunamganj district e.g. Tahirpur and Dharmapasha and four unions e.g. Uttar Bangshikunda, Dakshin Bangshikunada, Uttar Sreepur, Dakshin Sreepur. Within its geographic boundary Tanguar Haor possesses 88 villages.

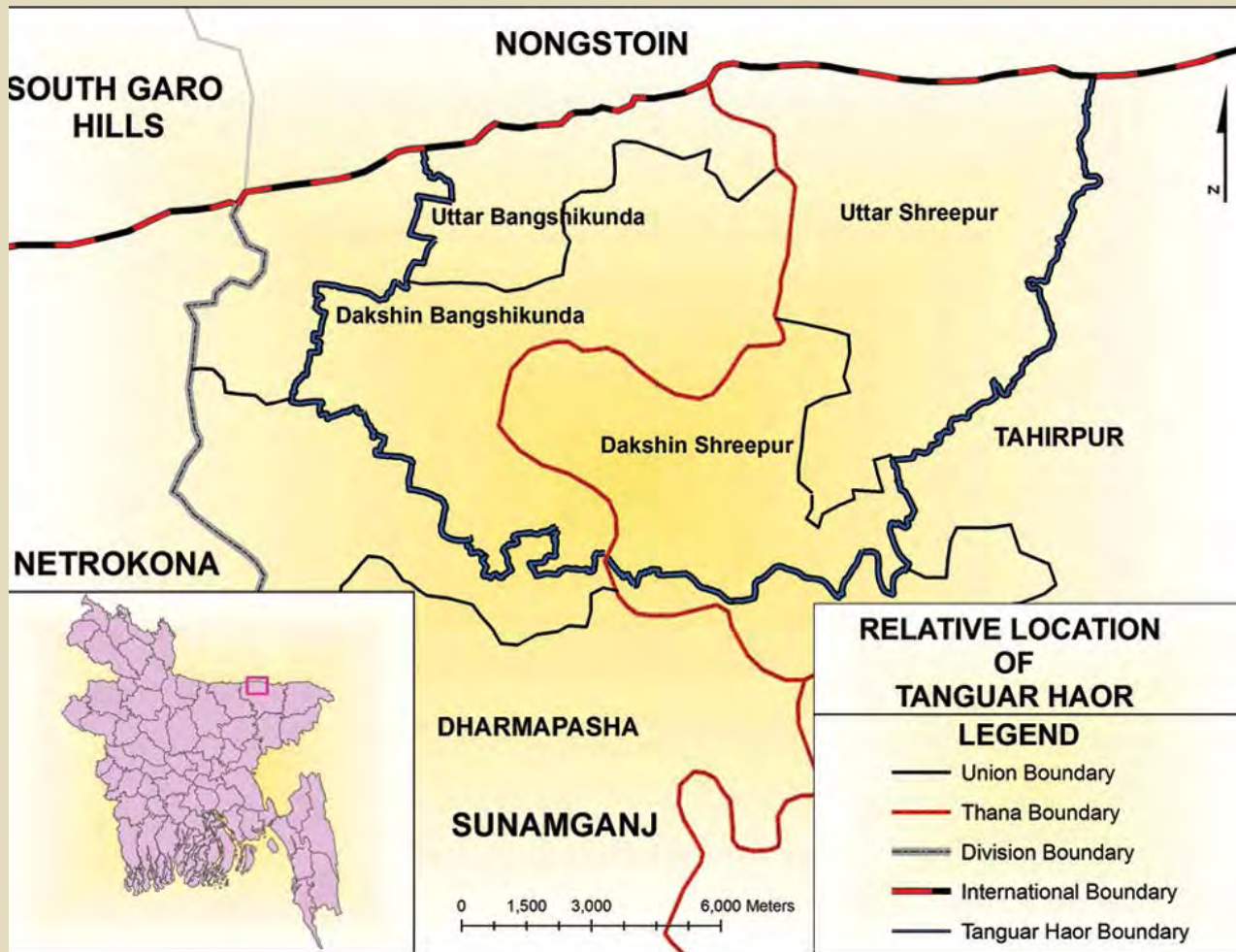


Figure 2.2.1(b): Map of Relative Geographic Location of Tanguar Haor

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Physiographic Location

The entire Bangladesh has been divided into three major classes' e.g. Hills of Pleistocene epoch, Terraces and floodplain. Some scholars have stretched this class into many sub divisions. On the basis of physical features, drainage pattern and land levels, Bangladesh has been divided into 55 sub-regions (Rashid, 2005). According to this classification, Tanguar Haor is situated in Meghalaya Piedmont Depression under *haor* Basin.

From the major three classifications, the flood plain division can again be classified into nine classes (Rashid, 2008). The location of

Tanguar Haor falls in Surma-Kusiyara Floodplain under this sub-classification.

Considering Bio-ecological zones (Nishat *et al*, 2002) entire Bangladesh is divided into 25 sub-divisions and Tanguar Haor falls in the division of *haor* Basin.

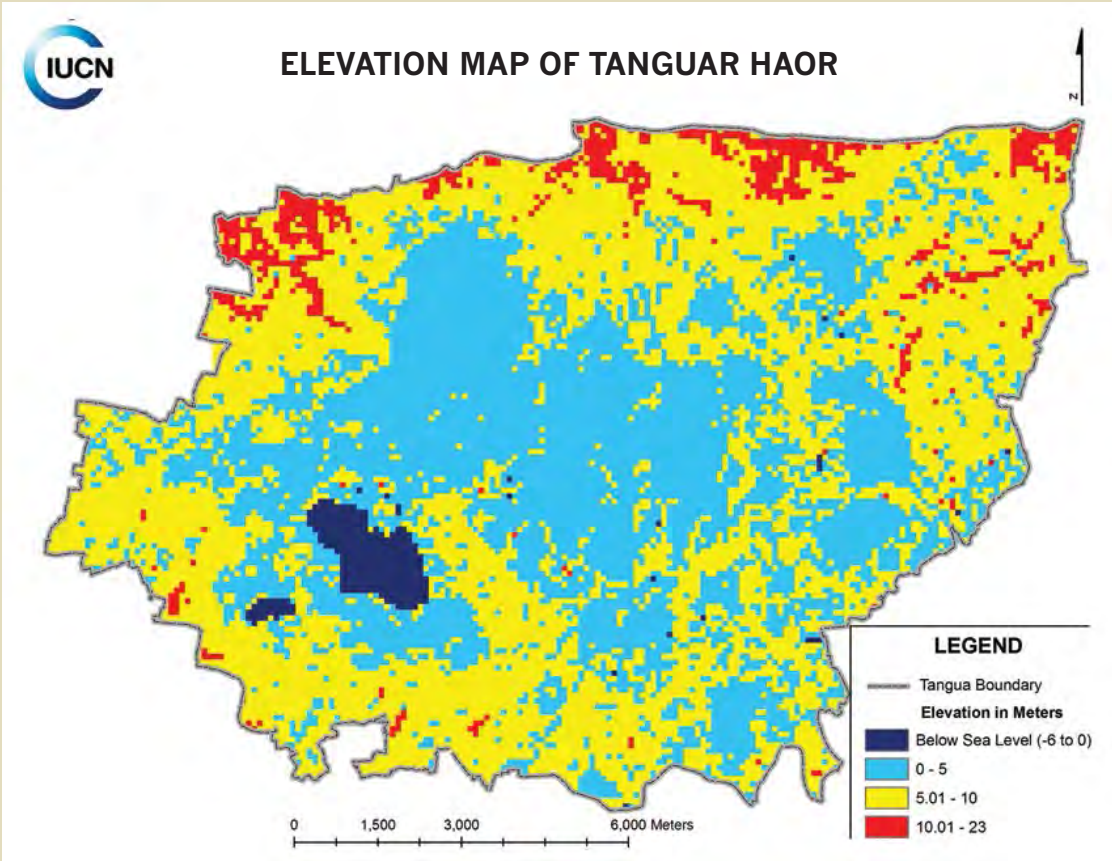


Figure 2.2.1(c): Elevation Map of Tanguar Haor

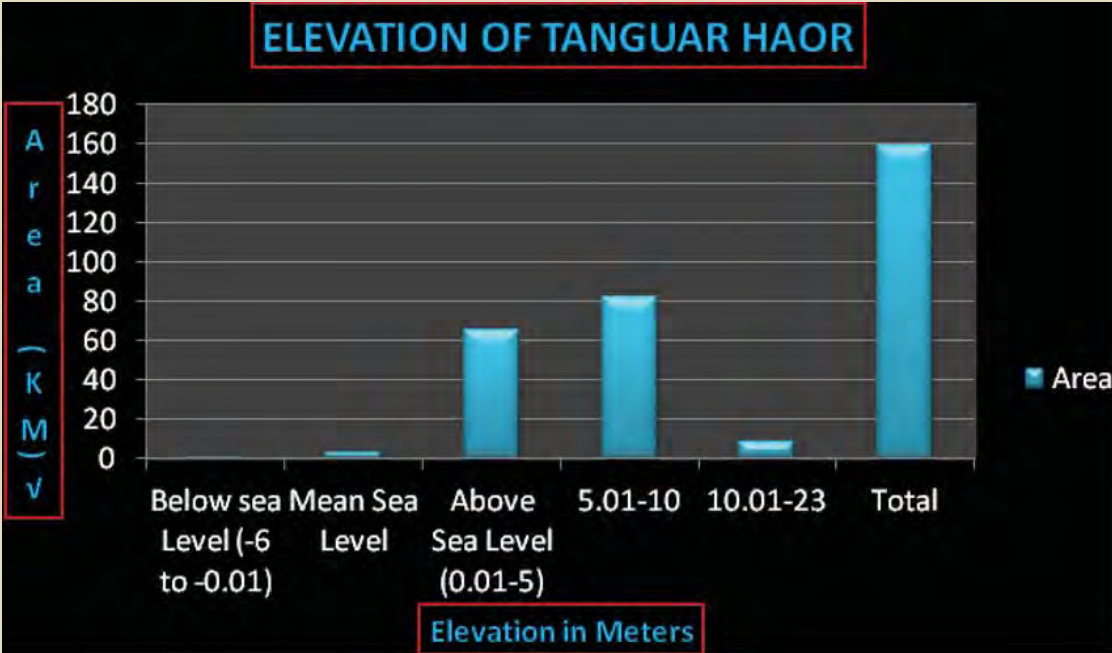


Figure 2.2.1(d): Elevation of Tanguar Haor

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2.3 Habitation

Tanguar Haor is a unique habitat for wetland plants, freshwater fish and wetland associated wildlife. It is made up of about 54 small, medium and large interconnecting *beels* some of which are perennial and others seasonal. The higher grounds located in between *beels* are locally known as *kanda*. In the rainy season all the *beels* are united as one large lake, or *haor*, making Tanguar Haor

the larger freshwater wetland in Bangladesh. Deeper *beels* are connected with rivers in some places but these *beels* are also interlinked with each other which make a unique character of these *beels* elsewhere in the country. Additional information on some important habitation statuses and the status of land ownership (Table 2.1) and a resource map of Tanguar Haor (Figure 2.2) are given below:

Table 2.1: Status of Land ownership and its distribution in Tanguar Haor area

Distribution of land ownership				
Land category	Area in Hectare			
	<i>Khash</i> land	Private land	Distributed land from <i>Khash</i> land	Total
Beel	524.07	4.64	3123.16	3651.87
Reed	163.49	47.25	265.02	475.76
River	348.41	1.01	0	349.42
Fallow land	13.07	0.52	46.54	60.13
Seasonal fallow land	1168.23	3617.21	783.19	5568.63
Cultivated	93.47	3097.34	141.62	3332.43
Seed bed	114.07	141.47	4.76	260.3
Human settlement area	7.3	94.1	1.57	102.97
<i>Khal/Nala/chara</i>	203.91	1.47	2.33	207.71
Pond/ <i>Doba</i>	45.16	37.96	0.45	83.57

Source: Final draft report on “community based sustainable management of Tanguar Haor program (CBSMTHP) by IUCN

Beels of Tanguar Haor are unique because of good combinations between floral and faunal distribution. There are about 54 *beels* (Tanguar Haor Resource Mapping, 2007, CBS

& TSP, IUCN) in Tanguar Haor. Among them 16 are perennial. Total area of the *beel* is 3651.91 hectares. Some major *beels* are as follows which will represent the whole Tanguar Haor:



Figure 2.3.1(a): Major *Beels* of Tanguar Haor

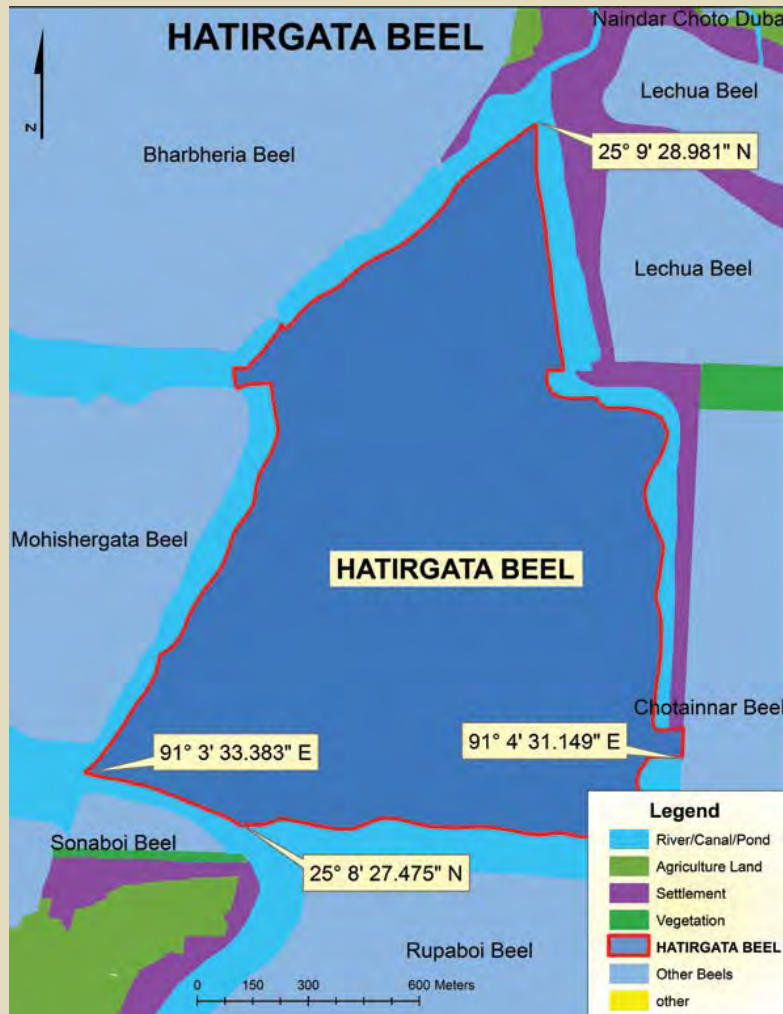


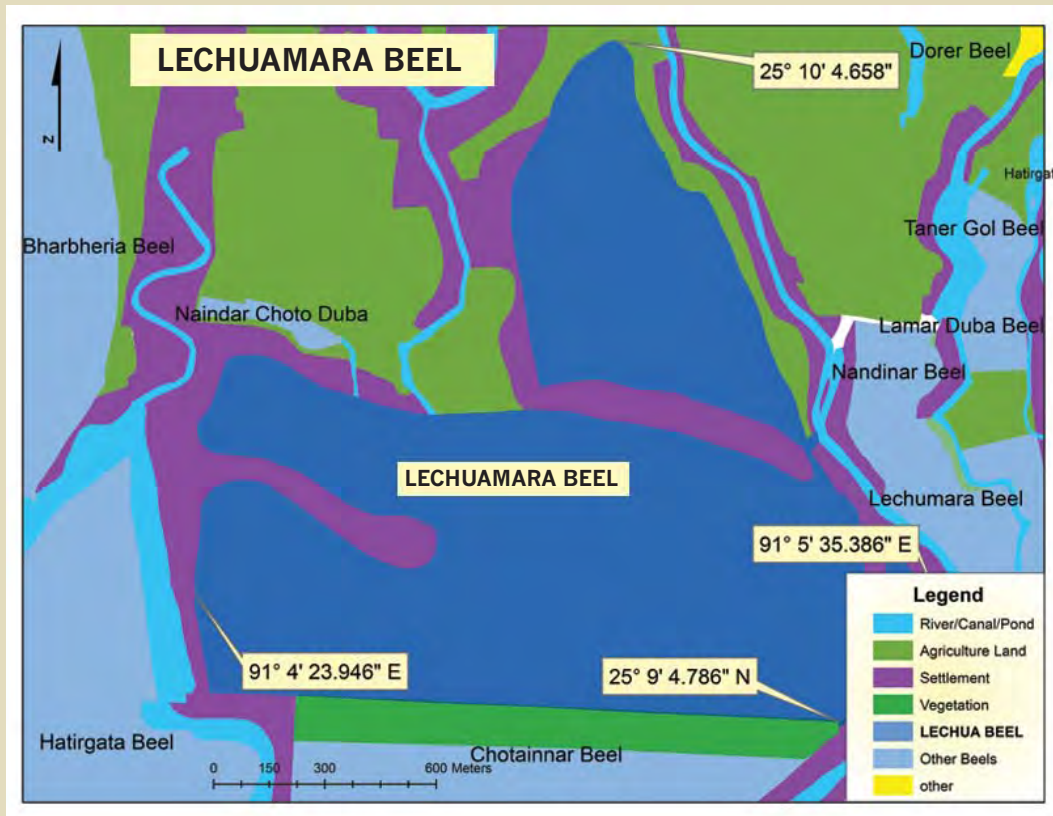
Figure 2.3.1(b): Hatirghata Beel of Tanguar Haor

Hatirgatha beel

The *beel* is located (25° 08' 54'' N 91° 04' 3.8'' E) almost in the middle of the Tanguar Haor and north-west of Tahirpur *upazilla*. The *beel* is now declared a micro fish sanctuary and may also be declared as a bird sanctuary.

Rare and globally threatened Baer's Pochard and Baikal Teal are found at this *beel*. Presence of these birds indicates the potentiality of this *beel* in terms of feeding, roosting and foraging ground. The *beel* is home to a few submerged, free-floating and rooted floating plants which is also a receptive feature for these wetland birds. Newly planted *Hijal* and *Karoch* in the banks (locally known as *kanda*) of the *beel* will be an added advantage for the birds and other aquatic wildlife. Gadwalls (51.82%) are found as dominant species of the *beel* and among the other duck the species presence of Tufted duck, Garganey and Eurasian Wigeon in this *beel* are remarkable.





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Figure 2.3.1(c): Lechuamara beel of Tanguar Haor

Lechuamara beel

This beel ($25^{\circ} 8' 33''$ N $91^{\circ} 04' 23''$ E) is closely associated with the Hatirgatha beel and also situated in Tahirpur upazila. This beel is a micro fish and bird sanctuary declared by Tanguar Haor project authority. The beel is most prospective ground for water birds. Appropriate shallowness of water, presence of adequate submerged, free-floating, rooted floating, sedges and meadows, reed swamps plants along with other phyto and

zooplankton etc. make this beel paradise for winter visitors as well as resident waterbirds. The beel provides breeding grounds and roosting habitat viz. Kandas and reed lands with particular vegetation e.g. *Nal*, *Khagra*, *Hogla* (*Typha elephantina*), *Chailla ghash* (*Hemarthria protensa*), *Binnya* (*Vitiveria zizanioides*) for thousands of ducks, geese and other water-loving bird and wildlife species. Among the rare birds, Mallard can be seen at this beel.



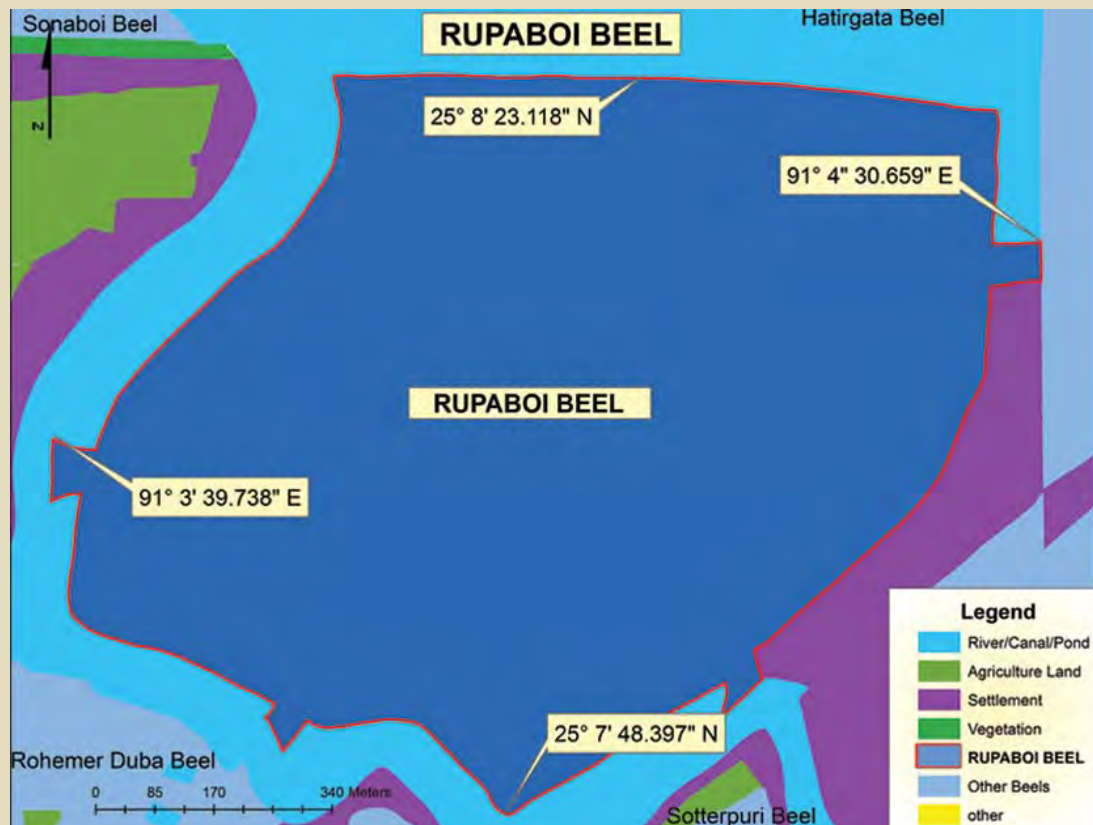


Figure 2.3.1(d): Rupaboi beel of Tanguar Haor

Rupaboi beel

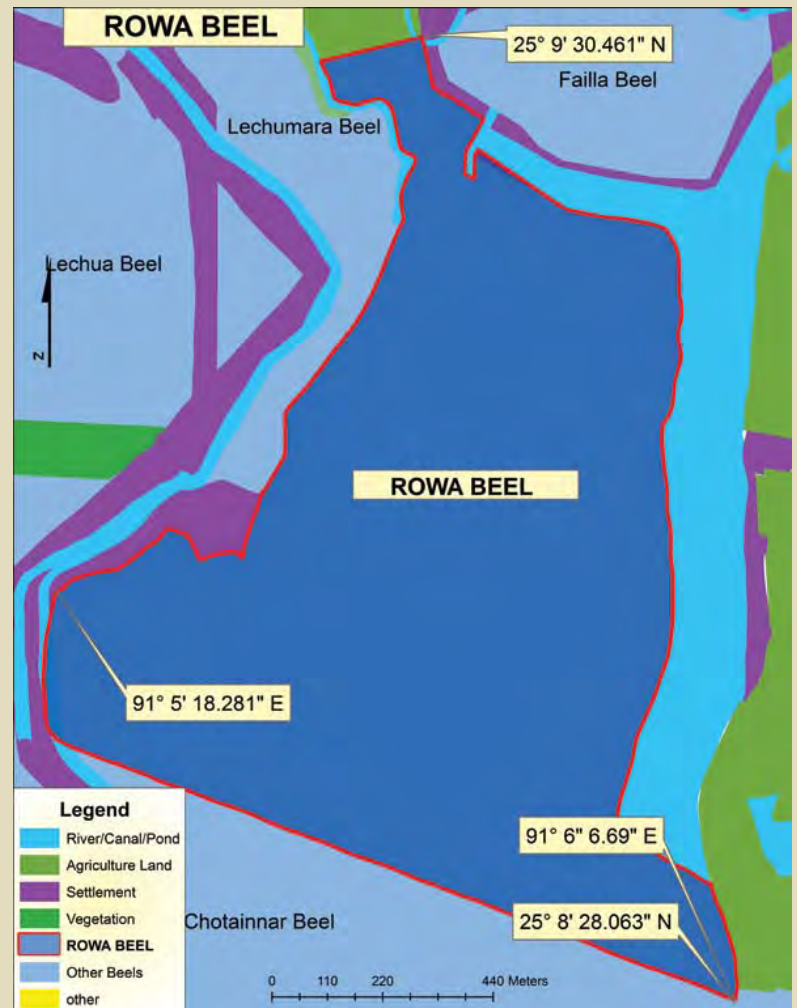
This *beel* (25° 8' 8.7" N 91° 04' 17.2" E) is surrounded by Hatirgatha to the north, to the east by Chotainna canal, to the south by Sotterpuri *beel* and to the west by a few agricultural lands. It is also in the *upazila* of Tahirpur. It is a micro fish sanctuary. Birds diversity and population status of this *beel* is not as noteworthy as Lecuamara and

Hatirgatha *beel* but presence of some reed land with *Nal*, *Khagra*, grasslands and bushy undergrowth makes this *beel* a suitable habitat for water birds. Red-crested Pochard, Spotted Redshank, Great Crested Grebe and Oriental Darter are some rare birds recorded from the *beel* while the survey was conducted (2011).



Rowa beel

Although the *beel* ($25^{\circ} 8' 20.2''$ N $91^{\circ} 04' 17''$ E) is not a designated bird sanctuary, it represents a large number of water birds. However, part of this *beel* is declared as a fish sanctuary and this area is restricted as no fishing zone. Fishing and other anthropogenic interventions are strictly prohibited in this zone. The periphery of the *beel* embraces huge aquatic weeds and existence of reed lands with *Nal*, *Khagra* and other reed swamp vegetation species allow the habitat to be suitable for water birds and other wildlife. Ruff, Common Redshank, Eurasian Coot and Oriental Darter are some rare birds seen in this *beel* (4,222 individual).



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Figure 2.3.1(e): Rowa beel of Tanguar Haor

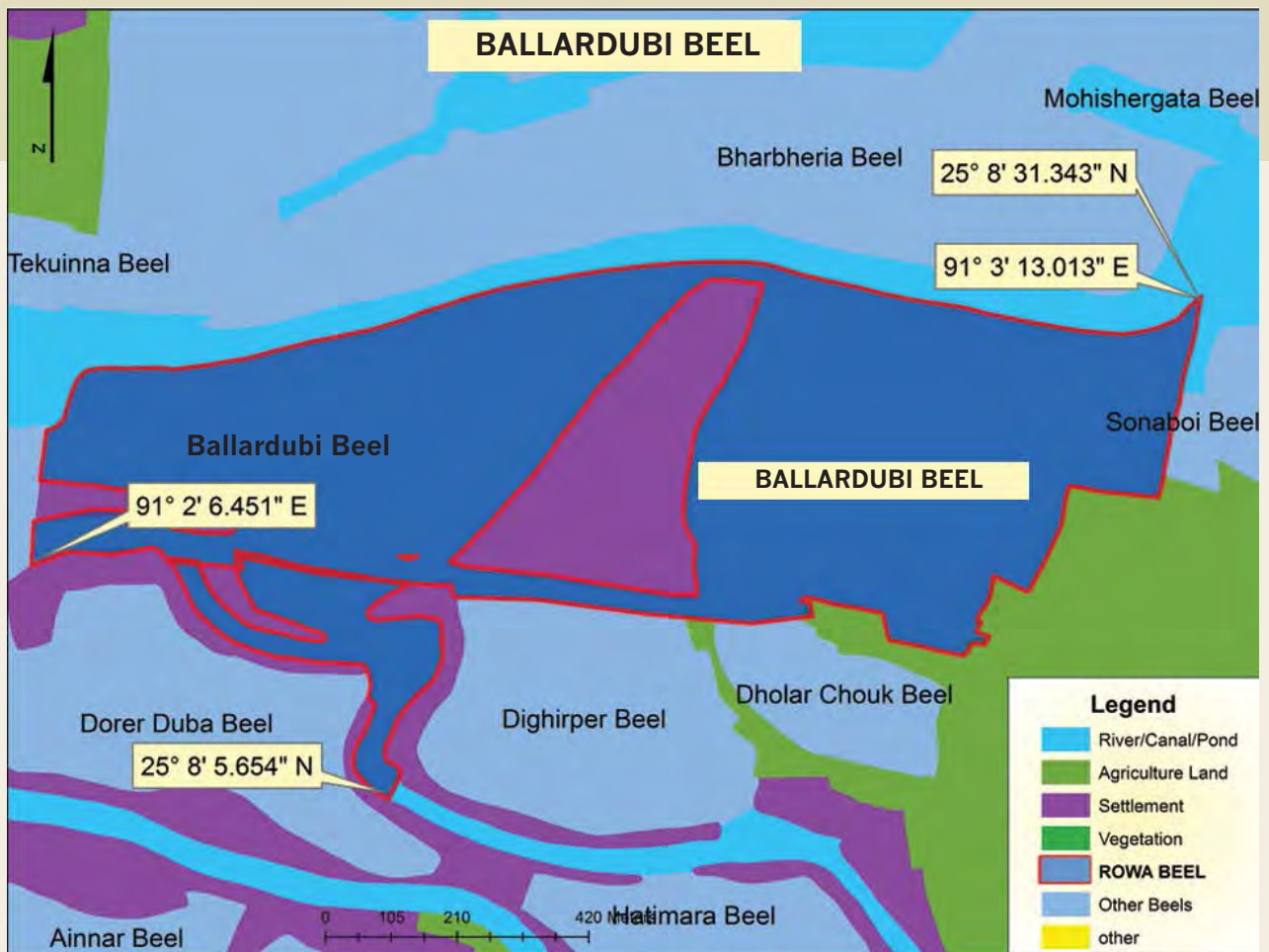


Ballardubi beel

The beel ($25^{\circ} 8' 12.9''$ N $91^{\circ} 05' 28''$ E) is situated partly in both Tahirpur and Dharmapasha *Upazila* and is connected to Tekunna beel through a channel. It is also declared as a fish sanctuary.



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Figure 2.3.1(f): Ballardubi Beel of Tanguar Haor

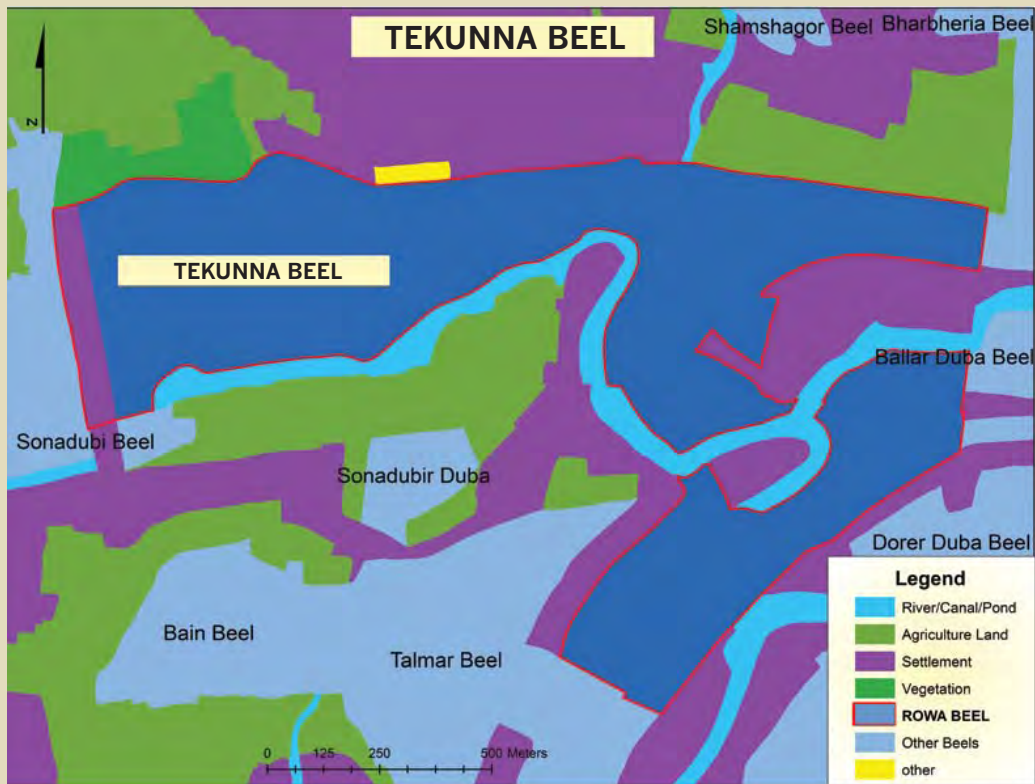


Figure 2.3.1(g): Tekunna Beel of Tanguar Haor

Tekunna beel

This large shallow *beel* ($25^{\circ} 8' 34.1''$ N $91^{\circ} 01' 43''$ E) is situated in Dharmapasha *Upazila*. It is a fish sanctuary and directly connected with Ballardubi and Sonadubi *beel*. A few parcels of cultivable/agriculture land exist around the *beel*. The *kandas* of Tekunna *beel*

is a suitable roosting and nesting ground for water birds. Different varieties of herbs viz. Khagra (*Phragmitis karka*), Binnya (*Vetiveria zizanioides*) and Chailla ghash existed in the *kanda* which attracted water birds to nest inside these patch.



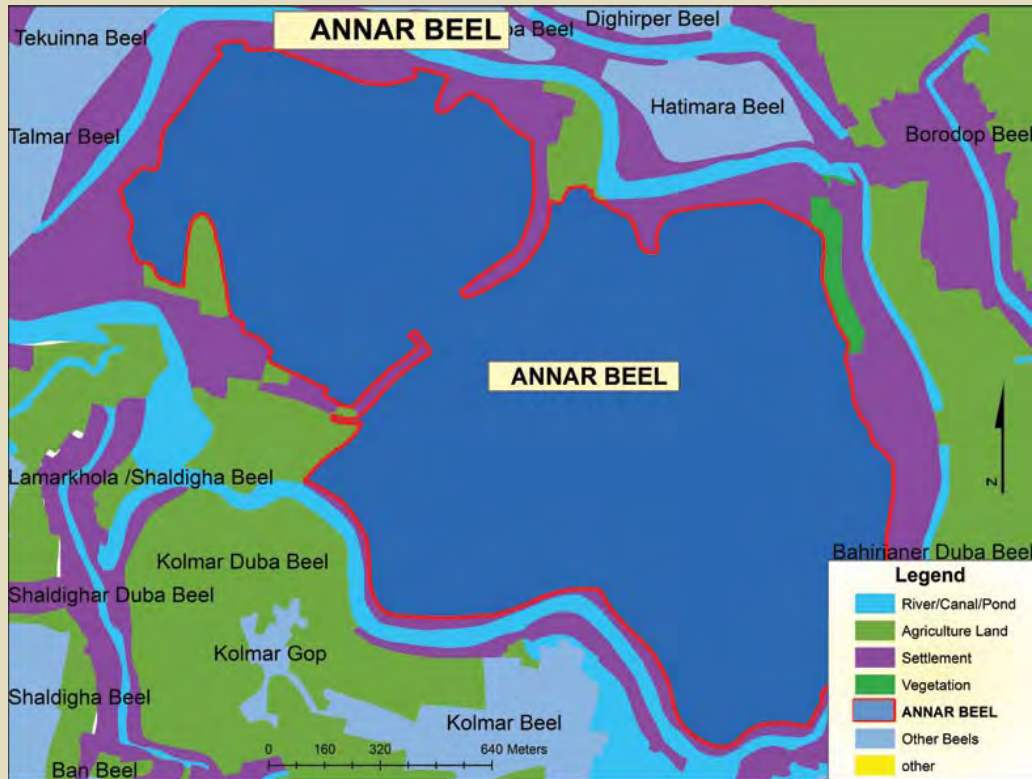


Figure 2.3.1(h): Annar Beel of Tanguar Haor

Annar beel

This *beel* (25° 07.384'N 91° 02.029'E) is connected with Tekunna *beel* through a narrow strip like canal. It is also situated in Dharmapasha *Upazila*. The *beel* supports few

submerged, free-floating and rooted floating plants which attract ducks, egrets, Herons etc. The surrounding *kandas* of this *beel* provide good nesting and roosting amenities for a few waders and other grassbirds.



Berberia beel

This *beel* (25° 9'15" N 91° 03'37.3"E) is a bird sanctuary declared by the Tanguar Haor project. It is located partly at Tahirpur and Dharmapasha *upazila*. *Jhaji, pata sheola, kochuripana, Khudipana, Shingara, panchuli, joina, shada shapla, chandmala, ichadal* etc. make this beel a unique habitat for water birds, frogs and other wildlife. The *beel* has the desirable depth for dabbling ducks like Eurasian widgeon, Gadwall, Mallard and Northern Shoveler etc. This is an ideal habitat for migratory waterfowl. Among the rare

sightings from this beel is the significant presence of Falcated Duck and Common Pochard. This beel is also declared as micro fish sanctuary. It is also an excellent site for fish egg spawning too. However, diversity of bird species of this beel is less than other bird sanctuaries in the Tanguar Haor. This is because of the anthropogenic disturbance. People from the beel adjacent villages' viz. Rupnagar, Indrapur, Kandapara, Bakatola, Bangalvita previously came regularly and collected resources to meet their needs.



2.3.2 Kanda

Beels of Tanguar Haor retain water throughout the year. Intermediate place between the Haor basin and homestead land are called *kanda*. There are about 180 *kandas* (IUCN) in Tanguar Haor. These *Kandas* support the major plant communities during drier months. At the onset of monsoon or floods all these *kandas* go under water transforming the entire wetland into a single sheet of water changing the whole scenario. The depth of flooding during monsoon ranging from 2 to 10 meters depending on the ground elevation. Usually reed swamp plants are

found in these *kanda*. *Kanda* is fairly deeply flooded during the rainy season and dry out during the dry season. There are many *Kandas* in the Tanguar Haor area which are *khas* land though some agricultural practices are done but mainly works as grazing land for cows, buffalos, birds and fish to breed once they started submerged.

The major *Kandas* of Tanguar Haor are Lachuamara, Rupaboi, Rowa beel interconnected *kanda*, Ballardubi beel *Kanda*, Tekunna and Annar beel *kanda*, Hatirghata beel *Kanda* and Berberia beel *Kanda*.





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2.3.3 River

Tanguar Haor is in North-East part of Bangladesh, adjacent to the Indian border, is part of a wetland/floodplain complex of the Kushiya and Surma river basin. These two rivers are among the main tributaries of the Meghna river. This site is also influenced by Dhanu, Baulai and Jadukata Rivers.

Meghalayan Hills are in the North from where a number of hill streams flow into the *haor*. Other important *haors* like Matian, Shanir and Gurmar are closely and have some dependency and connectivity with some degree of variation. Total river area within the Tanguar Haor is 359.39 hectares.

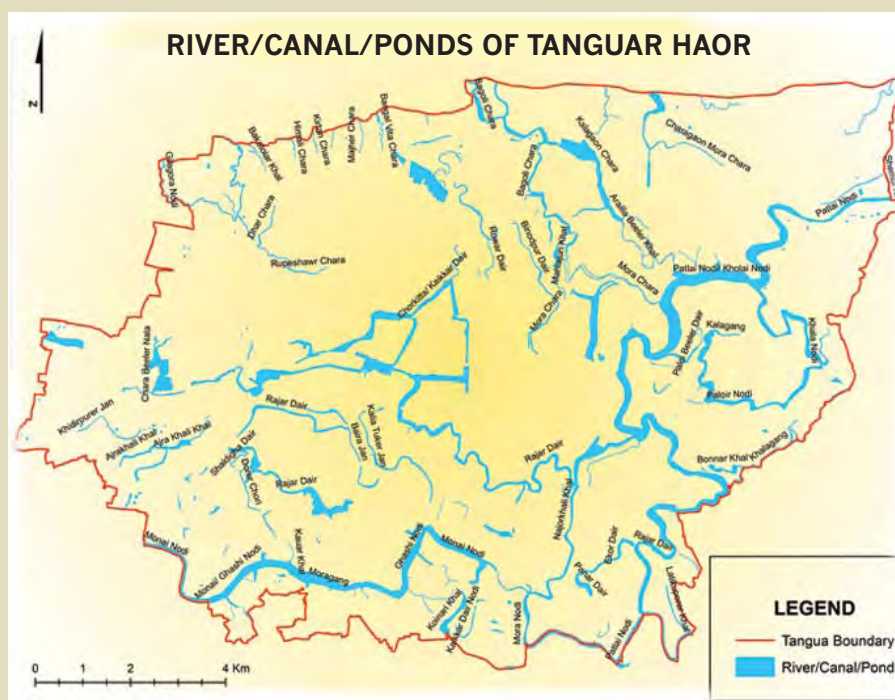
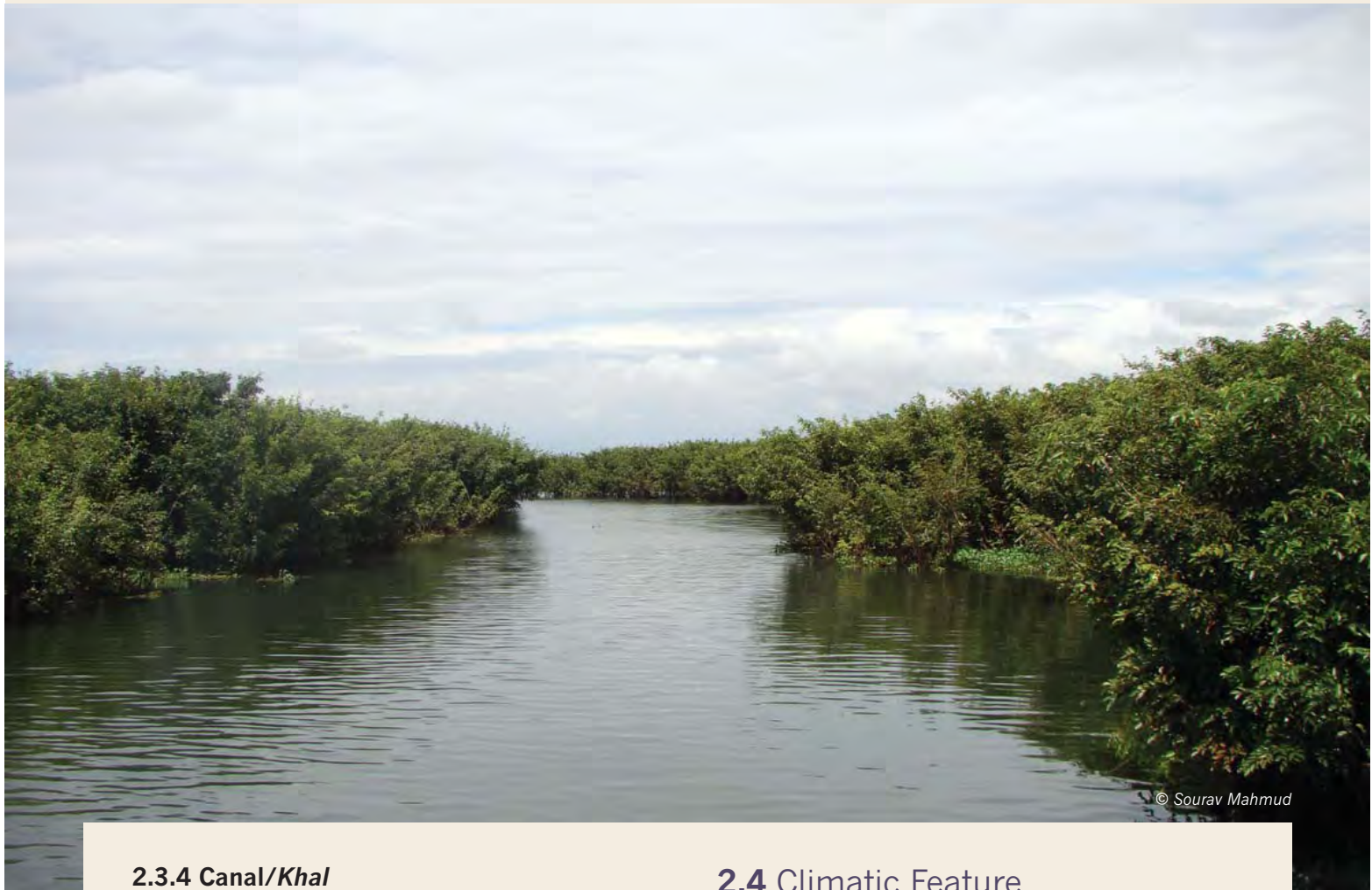


Figure 2.3.3: Map of River/Canal/Ponds of Tanguar Haor

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2.3.4 Canal/Khal

About 44 narrow water canals slope down to the Tanguar Haor from Indian Territory and 30% of these have constant flow throughout the year while rest only remain alive in the monsoon. These hill streams (narrow canals and rivers) bring in huge sediments to the *beels* and adjacent upland (villages).

Chattainna Canal

This canal is located ($25^{\circ} 8' 22.3''$ N $91^{\circ} 05' 12.3''$ E) at Tahirpur *Upazila* and is directly connected to Rupaboi beel. Reed swamps, *Nal*, *Khagra*, *Dholkalmi*, *Phutki* and other herb/shrub etc. are seen to have existed on both side of the canal which supports a number of rare birds like Ruddy-breasted Crane, Indian Spot-billed Duck and other wildlife. Presence of Rare Glossy Ibis has attracted focus on this canal. A big *Karach* forest patch was observed at the Joypur village end adjacent to this canal.

2.4 Climatic Feature

The climatic condition of Tanguar Haor is sub tropical-monsoon with three dominating seasons, summer, monsoon and winter. Average annual rainfall is about 4,196 mm in the northern part of Sunamganj with 65-69 % of the total rainfall occurring in the summer. Evaporation enhances rainfall during the spring causing flash floods in Tanguar Haor. Summer starts from the month of April to June with the temperature ranging from $30.9 \sim 33.4^{\circ}\text{C}$, monsoon from May to September and winter from October to February where the temperature ranges from $8.5 \sim 16.6^{\circ}\text{C}$. Humidity is about 83% in wet season and 64% in dry season. Climatic data (Rainfall, Evaporation and Temperature) for the following BMD meteorological stations has been collected for this study (Table 2.2).

Table 2.2: Rainfall, Evaporation and Temperature Stations with Periods of Records

Data Type	Station No. (Name)	District	Periods of Records
Rainfall	CL 121 (Mohanganj)	Netrokona	1980-2006
	CL 127 (Sunamganj)	Sunamganj	1980-2008
	CL 49 (Laurergarh)	Sunamganj	1996-2010
	CL 124 (Pagla)	Sunamganj	1980-2004
	CL 123 (Netrokona)	Netrokona	2007-2011
Evaporation	CL 127 (Sunamganj)	Sunamganj	2007-2010
	CL --- (Sreemongal)		
Temperature	Sylhet	Sylhet	1981-2010

Source: BMD & BWMD, 2010

2.4.1 Rainfall

The north-eastern part of Bangladesh experiences higher rainfall than other parts of Bangladesh due to its physiographic considerations. Total number of rainy days in Sylhet is less than that of Sunamganj with higher annual normal rainfall (4,195.9 mm in Sylhet, 5,990.3 mm in Sunamganj). More

than 80% of annual total rainfall occurs during the May to October period in both Sylhet and Sunamganj area. The rainfall distributions in March to October, April to October and May to October for Sylhet and Sunamganj stations show similar percentages (Table 2.3).

Table 2.3: Average Normal Rainfall (mm) at Sylhet and Sunamganj

Month	Sylhet	Sunamganj
	Amount of Rainfall (mm)	Amount of Rainfall (mm)
January	9.4	18.47
February	36.2	42.15
March	155.3	121.34
April	375.6	358.14
May	569.6	643.80
June	818.4	1015.13
July	819.2	1421.70
August	612.6	1184.17

Month	Sylhet	Sunamganj
	Amount of Rainfall (mm)	Amount of Rainfall (mm)
September	535.9	885.40
October	223.9	274.15
November	30.4	22.53
December	9.4	13.32
Annual Total	4195.9	5990.3

Source: BMD & BWMD, 2010

According to the rainfall analysis, highest rainfall occurs in the months from June to August occurring at Laurerghar (CL 49), Sunamganj (CL 127) and Mohanganj (CL 121) stations [Figure 2.4.1 (a,b,c)]. Highest average rainfall (1242.47 mm in August) was found at the Laurerghar station. The

Mohanganj station shows peak during the months of June and July with a sudden rise in the months of August and September. Sunamganj station records show general trend of rainfall distribution similar to the other parts of the country.

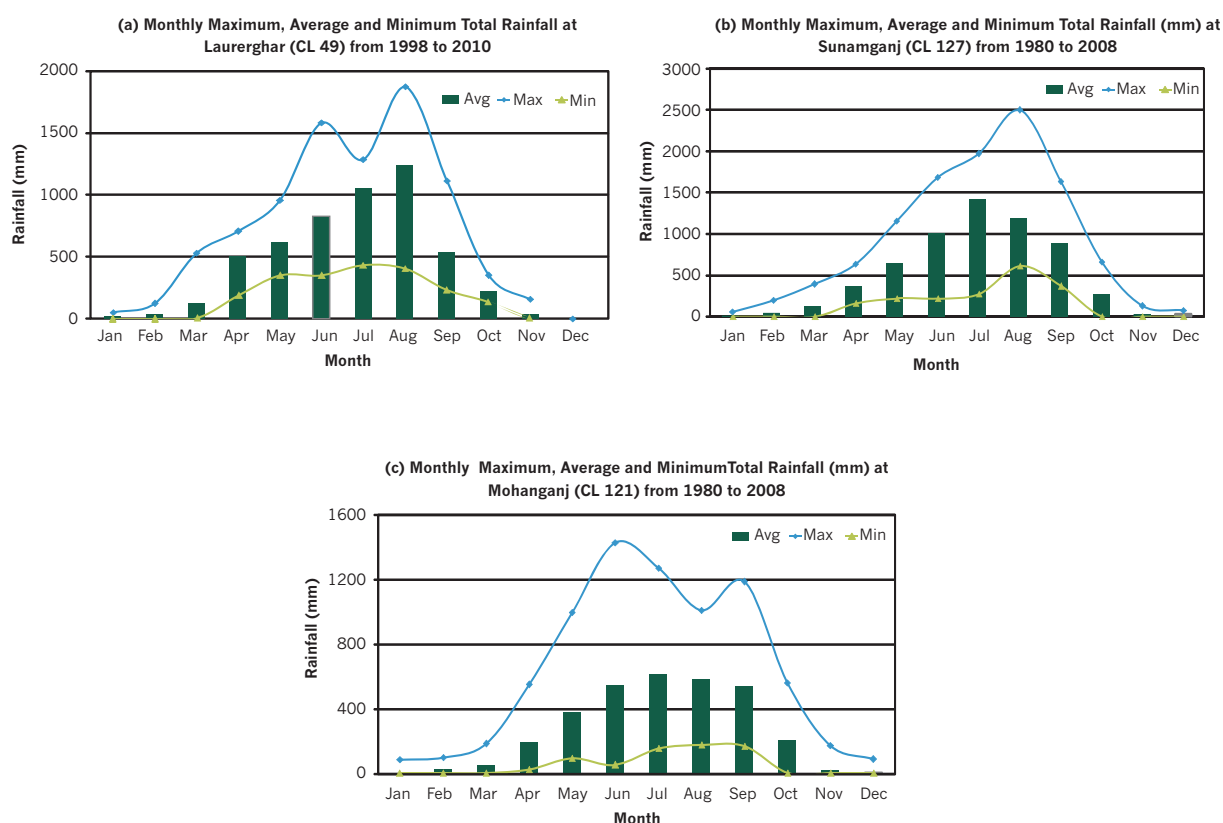


Figure 2.4.1 (a, b & c): Monthly, Maximum and Average Total Rainfall (mm) at Laurerghar (CL 49), Sunamganj (CL 127) and at Mohanganj (CL 121) stations from 1980 to 2008

2.4.2 Evaporation

Balance amongst rainfall, temperature and evaporation maintains the hydro-meteorological system in Tanguar Haor area. Evaporation from open water and transpiration from vegetation are functions of solar radiation, temperature, wind speed, humidity and atmospheric pressure, characteristics of the surrounding

environment and type and condition of vegetation. Monthly distributions of evaporation for Sunamganj shows average monthly evaporation of about 522.19 mm. Highest monthly evaporation at Sunamganj station has been observed during the months of March to June and lowest during the months from December to February (Figure 2.4.2a).

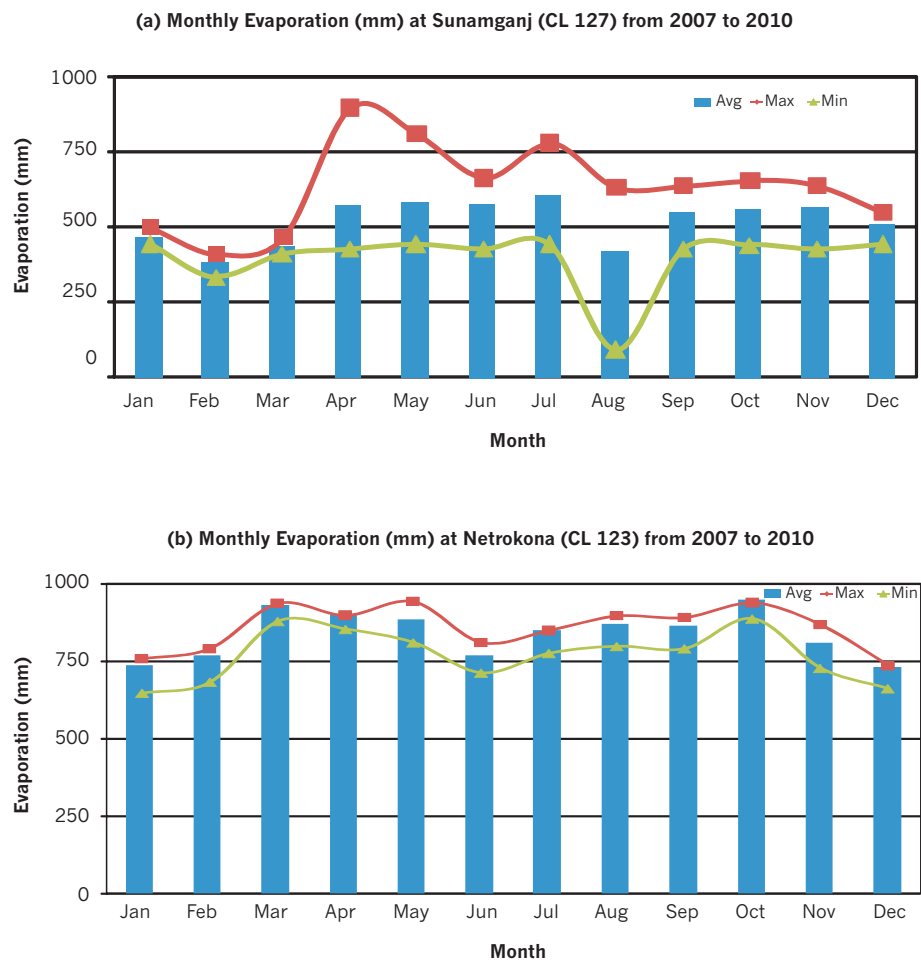


Figure 2.4.2 (a, b): Monthly Evaporation (mm) at Sunamganj (CL 127) and Netrokona (CL 123) Station from 2007 to 2010

Monthly average evaporation at Netrokona station (CL 123) shows the similar pattern as the Sunamganj station. The evaporation ranges from 647.19 ~ 940.73 mm with an

average monthly evaporation of about 812.29 mm from the year 2007 to 2010 (Figure 2.4.2b).

2.4.3 Temperature

Temperature is an important meteorological parameter for maintaining ecological balance

in Tanguar Haor. The Sylhet area has been experiencing temperature ranges from 9.68 ~ 35.7°C (from January to December).

Maximum and Minimum Temperature (°C) at Sylhet from 1981 to 2010

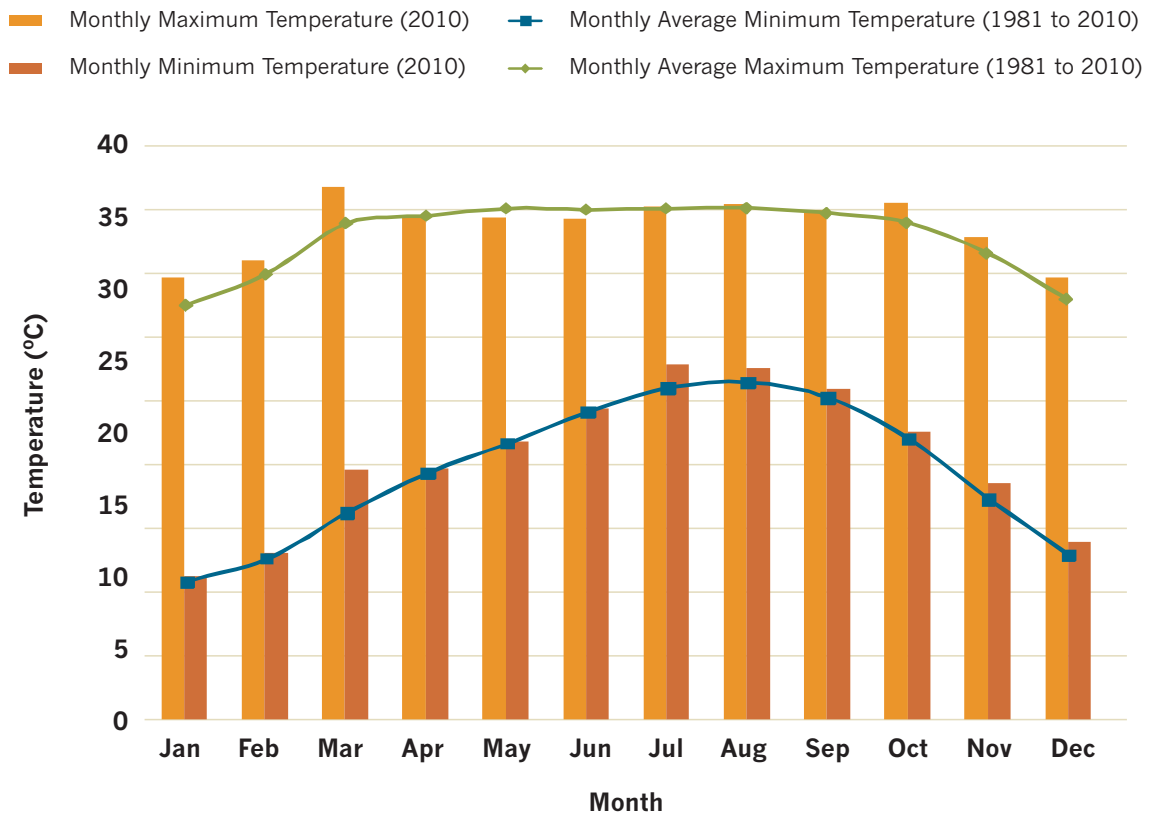


Figure 2.4.3: Maximum and Minimum Temperature (°C) at Sylhet Station from 1981 to 2010

According to the historical monthly maximum and minimum temperature analysis (from 1981 to 2010), maximum temperature occurs in the month of March-April while minimum temperature occurs in December and January (Figure 2.4.3).

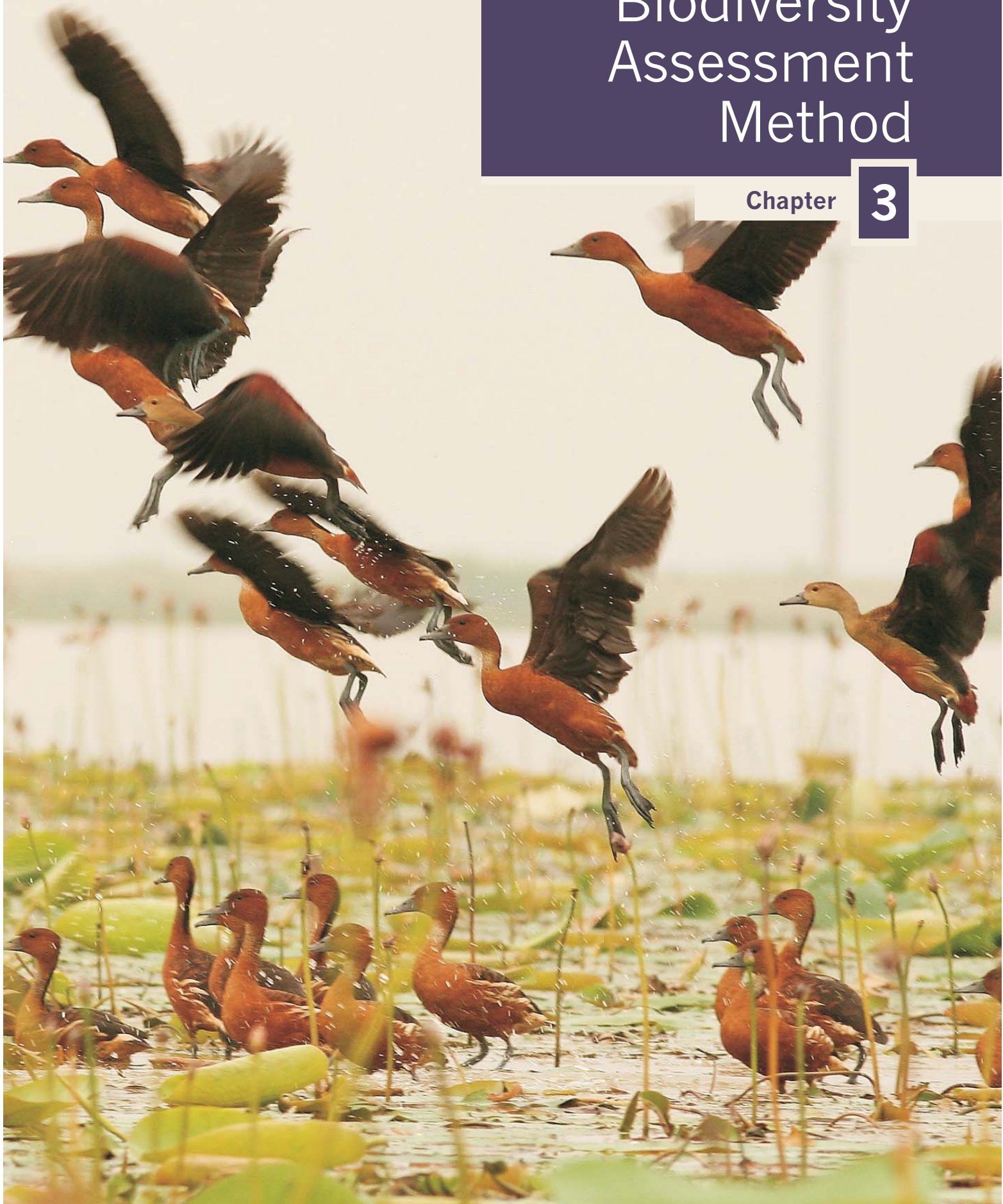




Biodiversity Assessment Method

Chapter

3



Biodiversity is a broad term and commonly defined through three different components: intraspecific genes (genetic diversity), interspecific species (species diversity) and ecosystems (ecological diversity) (UNEP, 2003). Each of these have structural, compositional, and functional attributes. Identifying, measuring and monitoring of these are complex. To overcome this problem national and international initiatives are needed to identify simplified and significant methodologies of biodiversity assessment. During the study in Tanguar Haor, with special emphasis to species diversity, three main rationales were identified for biodiversity assessment, are as follows:

- Firstly, conducting biodiversity surveys for establishing inventories;
- Secondly, to conduct a gap analysis in our knowledge pertaining to Tanguar Haor; and
- Thirdly, for monitoring biodiversity changes.

A survey of biodiversity has been conducted in the major sites of Tanguar Haor. Different methodologies were undertaken to study faunal diversity (birds, mammals, amphibians, reptiles & fish diversity) and also for floral diversity. Collection of data was based on the direct observation of the faunal and floral diversity in the field. Further interviews with local people were taken to gather information regarding past records of some birds and other wildlife. With a description of study sites, the details survey methodologies are given below:





3.1 Study Sites

According to the statistics of GOB, around 54 *beels* occupied the *haor*, out of which major 12 *beels* were selected through a random primary assessment which involves identification of bird sanctuaries (e.g., Berberia, Lechuamara), fish sanctuaries (e.g., Rupaboi, Rowa etc.), no fishing zone, fishing zone etc., to represent the whole *haor*'s scenario. The selected *beels* are Hatirgatha, Lechuamara, Rupaboi, Rowa, Ballardubi, Tekunna, Bagmara, Chattania, Berebiria, Annar, Ulan, Kolmar located at Tanguar Haor. The survey also includes some terrestrial grounds of Indrapur, Birendranagar, Ratanpur, Binodpur, Paniakhali, Rupnagar, Kandapara, Bakatola, Banglavita, Lamagaon, Gologlia, Noagaon, Rongchi etc. The following map (Figure-3) shows the study area where the survey was conducted on flora and wildlife.

3.2 Floral Survey Methods

3.2.1 Materials

The present work deals with the vascular plants (Pteridophytes, Gymnosperms and Angiosperms) of the *haor* and is mainly based on fresh plant collections through extensive field work from the study areas. Data collected from the field were used for Quantitative analysis.

3.2.2 Methods for Qualitative Study

The floristic survey of Tanguar Haor was done by using area maps and regular field visits, accompanied with the collection of specimens of all available plant species. Six botanical exploration tours were made during 2010-11 and over four hundred plant specimens were collected. Country boat was used to collect specimens from the *haor* area; where as, in other dry areas of the *haor* were reached by walking on foot.

In general, the routine herbarium methods were followed for processing herbarium sheets of collected sample. Those herbarium sheets were examined at the Bangladesh National Herbarium for identification with comparing correctly identified and properly labelled herbarium specimen preserved at BNH. Then it was also compared with the description and species key by Khan & Halim (1987), Cook (1996) and Fassett (1997). After identification, the specimens have been preserved at the IUCN Bangladesh Country Office.

Description of the species with their valid names, synonyms, english name (if any), local name (if any), habitat, distribution, uses, state of occurrence in TH area and National conservation status have been furnished for each species.

Plant species having local name and their uses were recorded by interrogating local people during the period of field survey. State of occurrence in TH area of each species was determined based on actual field observations. National conservation status of each species was cited from Encyclopedia of Flora and Fauna of Bangladesh edited by Uddin *et al.* (2007) and Uddin *et al.* (2008).

3.2.3 Methods for Quantitative Study

Vegetation analysis of a particular area needs several things. First of all observation of the floristic composition of the area is necessary. Then data should be collected for quantitative analysis. For the total species documentation field screening is required. Random sampling is the best for the reliable result, but it does not always work well. Total random sampling may not represent the diversity.

Several sampling methods have been used for studying the structure of sociological order in any plant community viz. quadrature method, transect method, loop method and point method. Application of the method

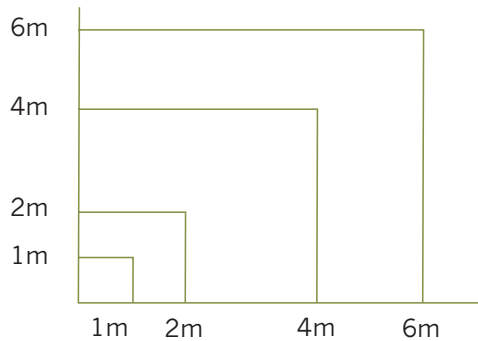
depends on the topography of research area and type of vegetation. Generally line transects method is suitable for the vegetation analysis of sloppy area of hilly regions. However, quadrature method is the most applied method for the collection of quantitative data for vegetation analysis because of its wide coverage of the habitat. For the present vegetation study, randomized quadrature method of sampling was used. The quadrature is a square sample plot or unit for a detailed analysis of vegetation. In vegetation analysis, quadrates of any size, shape, number and arrangement can be used.

To determine the quadrature size for the particular site, quadrature size of 0.5×0.5 sqm was laid out and recorded each species name and their individual number. Then the quadrature size was increased to 1×1 sqm and again recorded each species name and their individual number. Quadrature size was further increase to 2×2 sqm, 4×4 sqm and so on to record the same information as done for the above two.

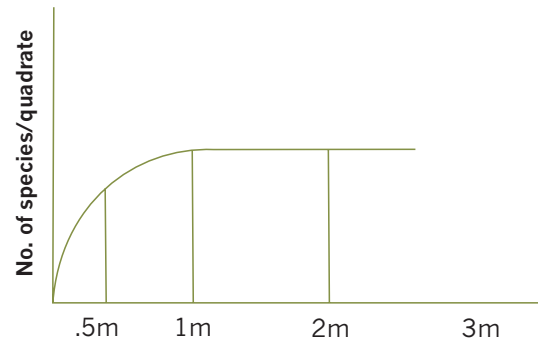
The number of individual of each species obtained per quadrature was then plotted against the size of quadrature as below. Those data produced a curve known as species-area curve. From that species-area curve, it could be shown that the number of species recorded in 1×1 sqm quadrature was similar to 4×4 sqm and 6×6 sqm quadrature size. However, the species recorded in 0.5×0.5 sqm quadrature was lesser than that of 1×1 sqm sized quadrature. That distinctly indicated the optimum size for the survey was 1×1 sqm quadrature, which would be economical as well.



Floral survey



Determining size of Quadrate



Species-area curve

Coexistence and competition both are affected directly by the number of individuals in the community. Therefore, it is essential to know the quantitative structure of a community. To characterize the community as a whole certain parameters are used viz. the total count of individuals of each species, mean value of individuals of a species per plot. To get a clear picture of a community structure in quantitative terms, value estimation of frequency, density, abundance and diversity index are essential. The values of those parameters were calculated by using the following standard formulas.

Density =	$\frac{\text{Total number of individuals in all quadrate}}{\text{Total number of quadrate studied}}$	
Frequency =	$\frac{\text{Number of quadrate in which species occurred}}{\text{Total number of quadrate studied}}$	X 100
Abundance =	$\frac{\text{Total number of individuals of species in all quadrate}}{\text{Total no of quadrate in which the species occurred}}$	X 100

There are two methods for the determination of the diversity index of the species of the study area. These are

1. Shannon-wiener index (H) = $-\sum P_i \log_n P_i$
2. Simpson Index = $D = \frac{\sum n(n-1)}{N(N-1)}$

n = the total number of organisms of a particular species

N = the total number of organisms of all species

Simpson's Index of Diversity = 1 - D

The value of this index also ranges between 0 and 1, but now, the greater the value, the greater the sample diversity. This makes more sense. In this case, the index represents the probability that two individuals randomly selected from a sample will belong to different species.



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3.3 Wildlife Survey Methodology

The survey was focused primarily on waterfowls. In addition, other species of amphibians, reptiles and mammals were also surveyed during the field visits.

3.3.1 Mammal Survey Methods

Transect line Transect line (1 km) has been used during the survey of mammals, as strip transect sampling (Buckland *et al.* 2001) is the most suitable to estimate the population status and relative abundance of wildlife. Observation of all individuals at the line and estimation of the proportion has been completed.

In this method the observer(s) slowly walks on a relatively straight line through the study area and counts the objects from both sides. For Tanguar Haor boat surveys were conducted on the *beels*, *kandas* and some terrestrial area. The initial location of the

object is always needed to be considered, as the object might move after watching the observer(s). If any object is observed beyond the pre-decided observation-range, or if the object is coming from the back (in order to avoid duplication), the observation was not recorded.

Focus Group Discussion

Focus group discussion was carried out through questionnaire surveys to collect data which was used in clarification of information obtained.

Literature review

An extensive review of literature on mammals of the Tanguar Haor was carried out to find a list of all species historically known to occur here.

Individual recorded

Individual number of mammals was recorded through direct field visits and surveys.

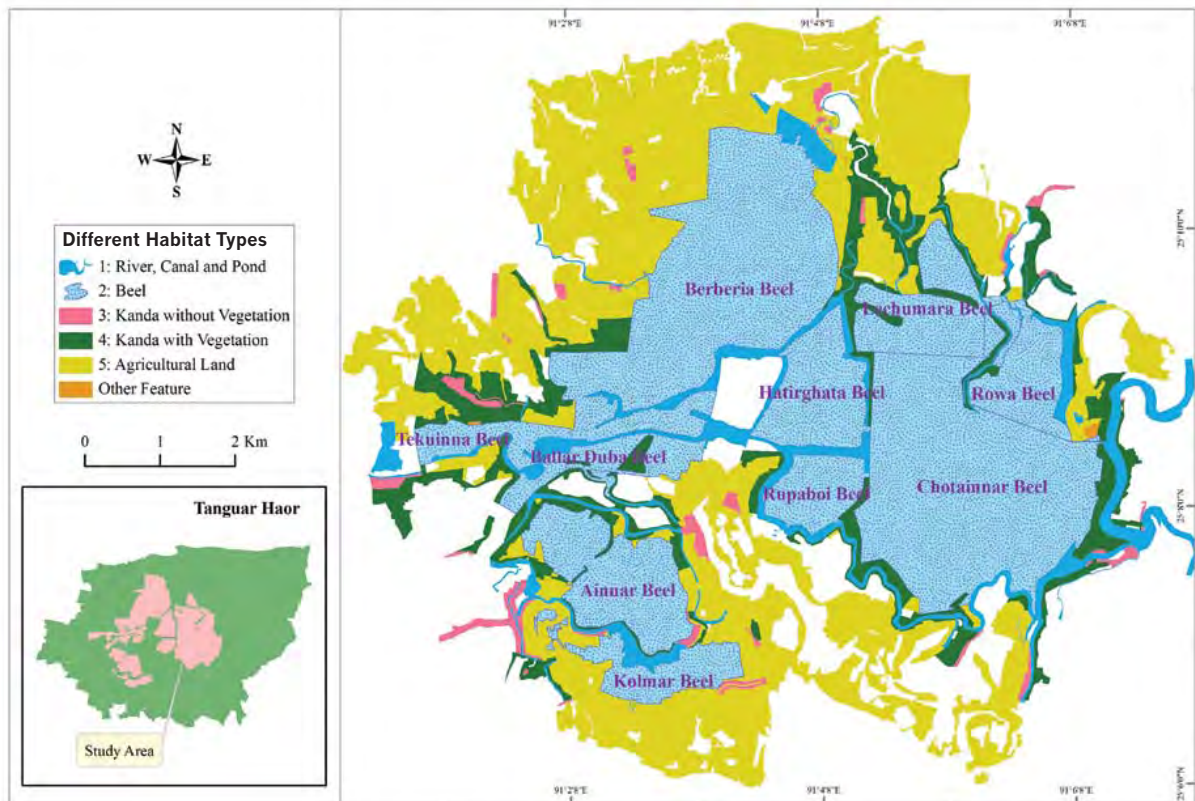


Figure 3: Map of study areas for Flora and Wildlife survey

3.3.2. Bird Survey Methods

Data was collected by strip transect sampling, opportunistic survey and visual observation. The methods are briefly described below:

Strip transect sampling

Strip transect sampling has also been followed during bird survey. This survey was conducted in morning and afternoons when the birds are most active. Transects were located in areas which are suitable in terms of observation in each study site.



Waterfowl census



Bird ringing

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This method assumes that all objects in the strip are recorded, so the observer(s) is very careful in observing and recording the objects. Even then, the observer(s) may miss some of the objects in the strip, but it should not be more than 5% of the total objects, so that the error is statistically insignificant. The more areas covered in strip transects subsequently leads to a lower error in the result. Transects should be located predominately in places of the study sites where there is a probability of high biodiversity and hence a high number of objects. Even if any centre line of transect is slightly undulated, the observation-strip is maintained roughly straight by manipulating the observation distance to that particular area. The birds will observe and identify properly and carefully, so that there is no misidentification.

Opportunistic survey

In the opportunistic survey, any important or interesting observation/information was recorded at any time while in the field. This method is suitable for recording the occurrences, relative abundance and distribution of different species of birds and other wildlife, especially for those species which are rare or uncommon.

Although the opportunistic survey is an informal way of collecting information, the outcome can be very useful. However, if this is not carried out with sufficient care, wrong information can be recorded and the results can be biased. The method gives the opportunity to record scatter but important observations and information on rare and/or threatened birds and other wildlife, which cannot be studied formally due to their rarity.

Identification of birds

The birds were observed either through a pair of wide angle binoculars, telescope or by the naked eye. Notes were taken on ecological and ethological aspects of all observations. The identification was based mainly on external morphology, calling (Mitchell 1977), flight and sitting postures and behaviours. Birds were identified with the help of key characteristics and illustrations guide Birds of Indian Subcontinent by Grimmett, R. et al., (1999), Birds of South Asia The Ripley Guide by P. C. Rasmussen and Anderton (2005) etc.

Population status of birds

The status of birds was determined by direct field visit-method (Khan 1980). The relative abundance of birds was assessed as: 'Very Common' (seen in 80-100% of visits), 'Common' (seen in 50-79% of visits), 'Uncommon' (seen in 20-49% of visits), or 'Rare' (seen in <19% of visits). For wintering migrants, abundance was assessed only during the months they were present. The global threat status was done following the 2000 Red List of Threatened Species and National Threat Status which was done following the Encyclopedia of Flora and Fauna of Bangladesh (Asiatic Society, 2008), Volume-26. The taxonomy and scientific nomenclature of the birds was given according to Grimmett *et al.*, (1999) when checklists have been arranged following Khan (2010).

Diversity of birds

Diversity is probably one of the most misused and incorrectly calculated attributes. Perhaps the most common misconception is that species richness and diversity are synonymous. Although related, they are distinct. Species richness is the total number of species presents in a given area or samples whereas diversity takes into account how individuals are distributed amongst those species, i.e., the species frequency distribution. In fact, it turns out that nearly all quantitative measures of diversity are some combination of the two components, species richness and evenness, where evenness describes how equally individuals are distributed amongst the species. After collecting data by using the strip transect method to analyze bird community diversity, Shannon-Wiener's (H') and Simpson's diversity indices was used. The Shannon-Wiener index is generally used in ecological studies concerned with the number and abundance of rare species while

Simpson's index considers more abundant or common species (Peet, 1974).

Shannon-Wiener's diversity index (H') = $\sum P_i \ln P_i$

Where,

$P_i = n_i/N$ is the Proportion of all the birds individuals to the i th species.

n_i = number of individuals or amount (e.g. biomass) of each species (the i th species)

N = total number of individuals (or amount) for the site, and $\ln$ = the natural log of the number. Values range from 0 to 5, usually ranging from 1.5 to 3.5.

3.3.3 Reptiles and Amphibians Survey Methods

The survey was conducted between May and June on the selected sites for the survey. The total study sites were divided into few categories according to the habitat required by the amphibians or reptilians. For both the amphibian and reptilians the study sites were divided into different habitat niches. The surveys were conducted almost everywhere on the study sites; paddy fields, some



Freshwater shark

forested areas, edges of forest, roadsides, drainage system, under logs, human debris, holes on the ground, tree holes, burrows, leaf litter, under low lying vegetation, rain water puddles, polluted water, temporary stagnant water and from slow to fast moving streams etc. A variety of methods were employed to survey the herpetofauna:

Transect lines (1km long) were establish at 6 sites. Diurnal censuses were conducted for herpetofauna along each transect. This involved slowly walking along the transect line, pausing at regular intervals and recording the number of each species were observed. Each transact was examined five times during the following daytime intervals: early morning and late afternoon and sometimes during the evening.

Opportunistic searches were conducted for reptiles and amphibians over a wider area. The search generally comprised walking slowly through various habitats.

Nocturnal searches were conducted for frogs and reptiles. These searches were mostly targeted at, or near, aquatic environments but nocturnal searches, specifically targeting geckos, frogs and snakes were also conducted in bushy habitats and holes, hollows or burrows.

3.4 Fish Survey Methods

1. Review commercial harvest and data collection and development of framework section (including laps/gaps if any), fisheries and reeds.
2. Review non commercial harvest and data collection and development of framework section (including laps/ gaps if any), fisheries and reeds.
3. Review illegal harvest and data collection

and development of framework section (this is new, not yet done), fisheries and reeds.

4. Review harvest status and prescribe harvest limit of reeds (mainly based on local knowledge (part by part/ percentage/ time gap etc.) and data collection and development of framework section (this is new, not yet done).
5. Field trial/ test of the community led data collection (blending comfortable and workable approach: technical and social convenience).



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Fish survey

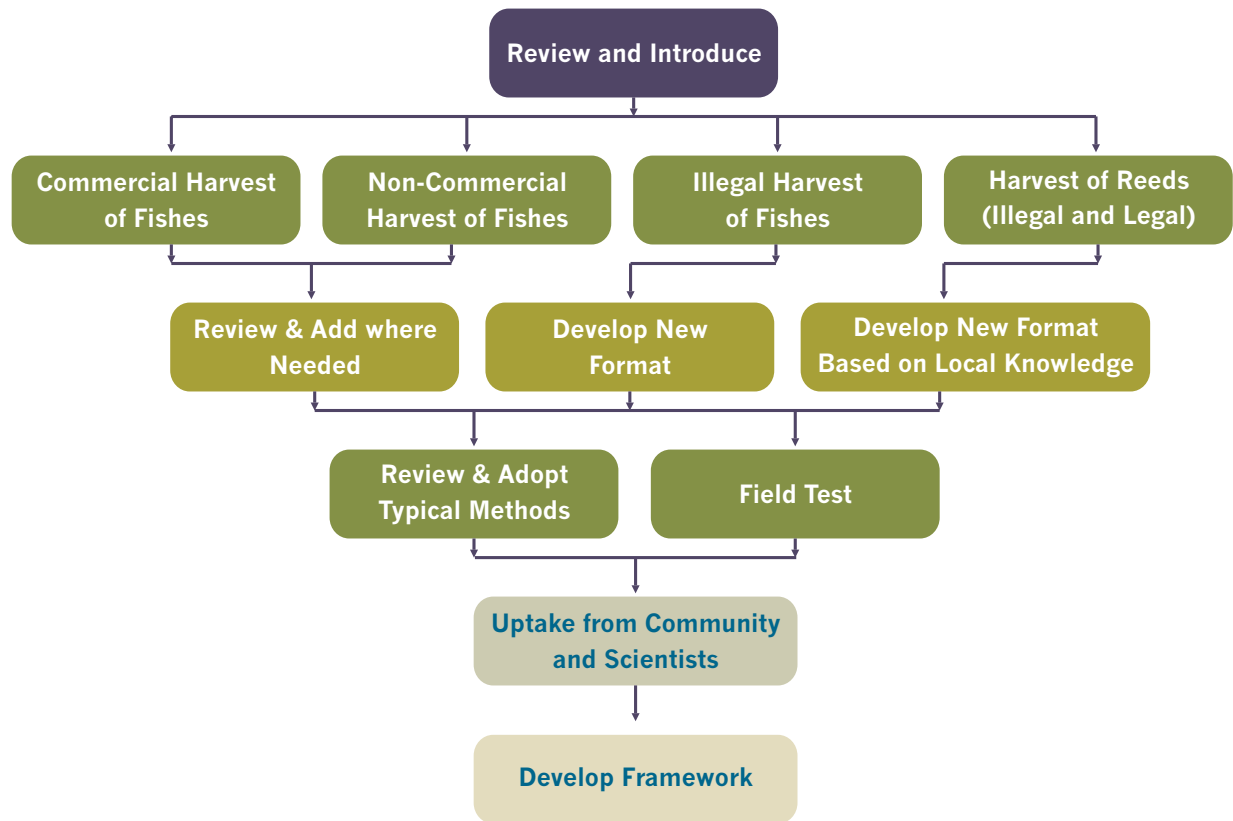
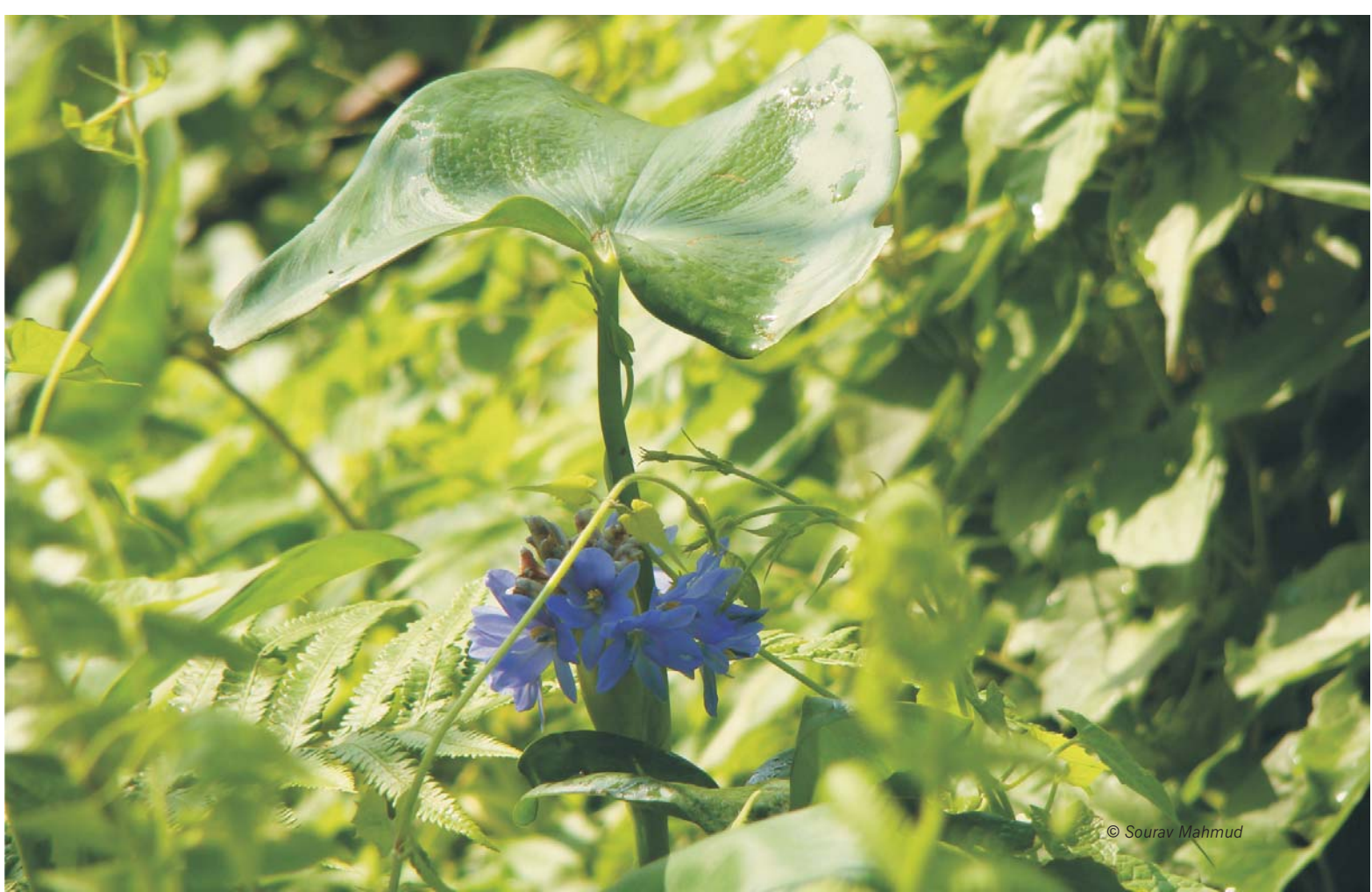
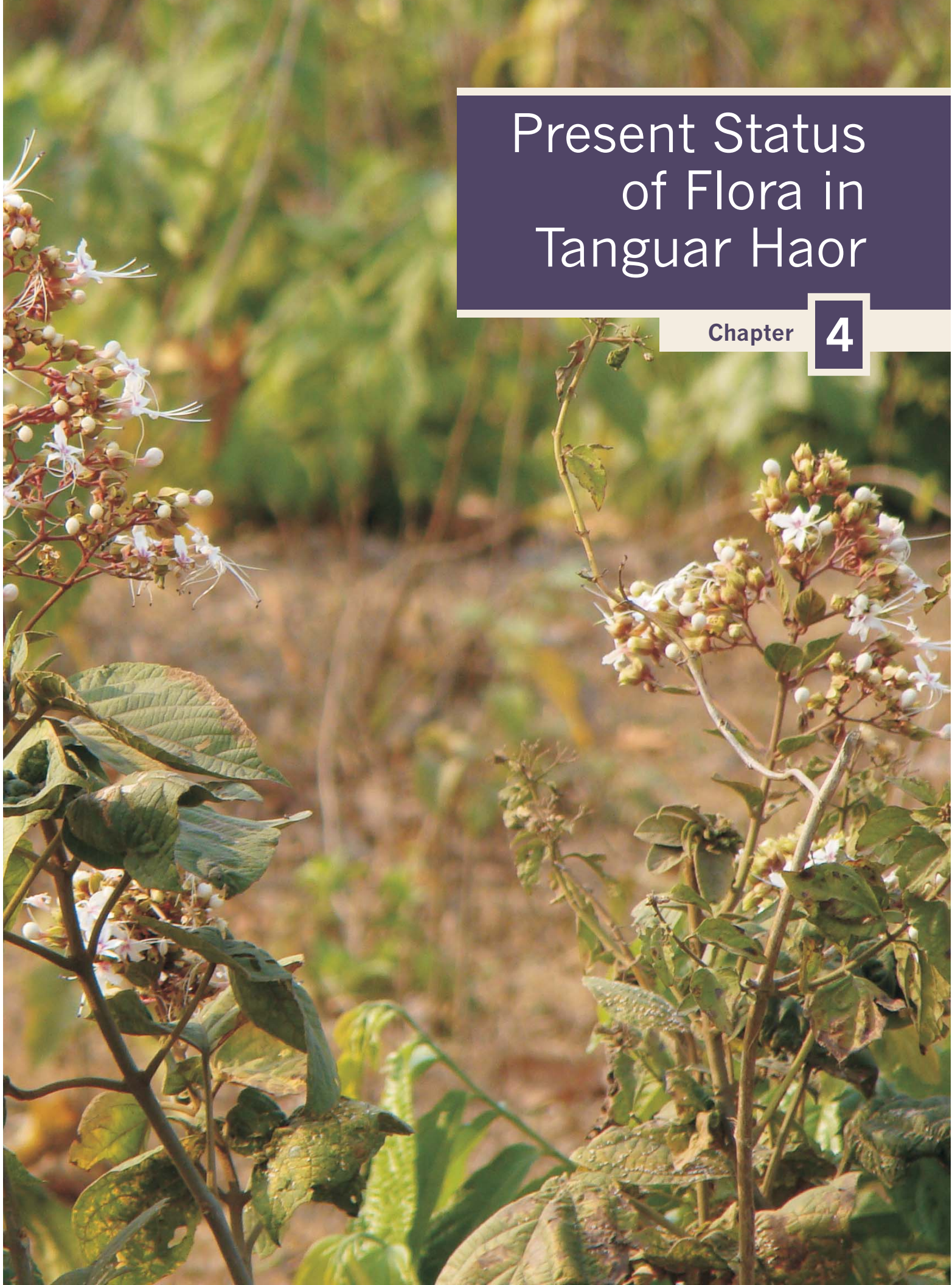


Figure 3.1: Flow chart summarizes the approach and methodologies for this assignment.







Present Status of Flora in Tanguar Haor

Chapter

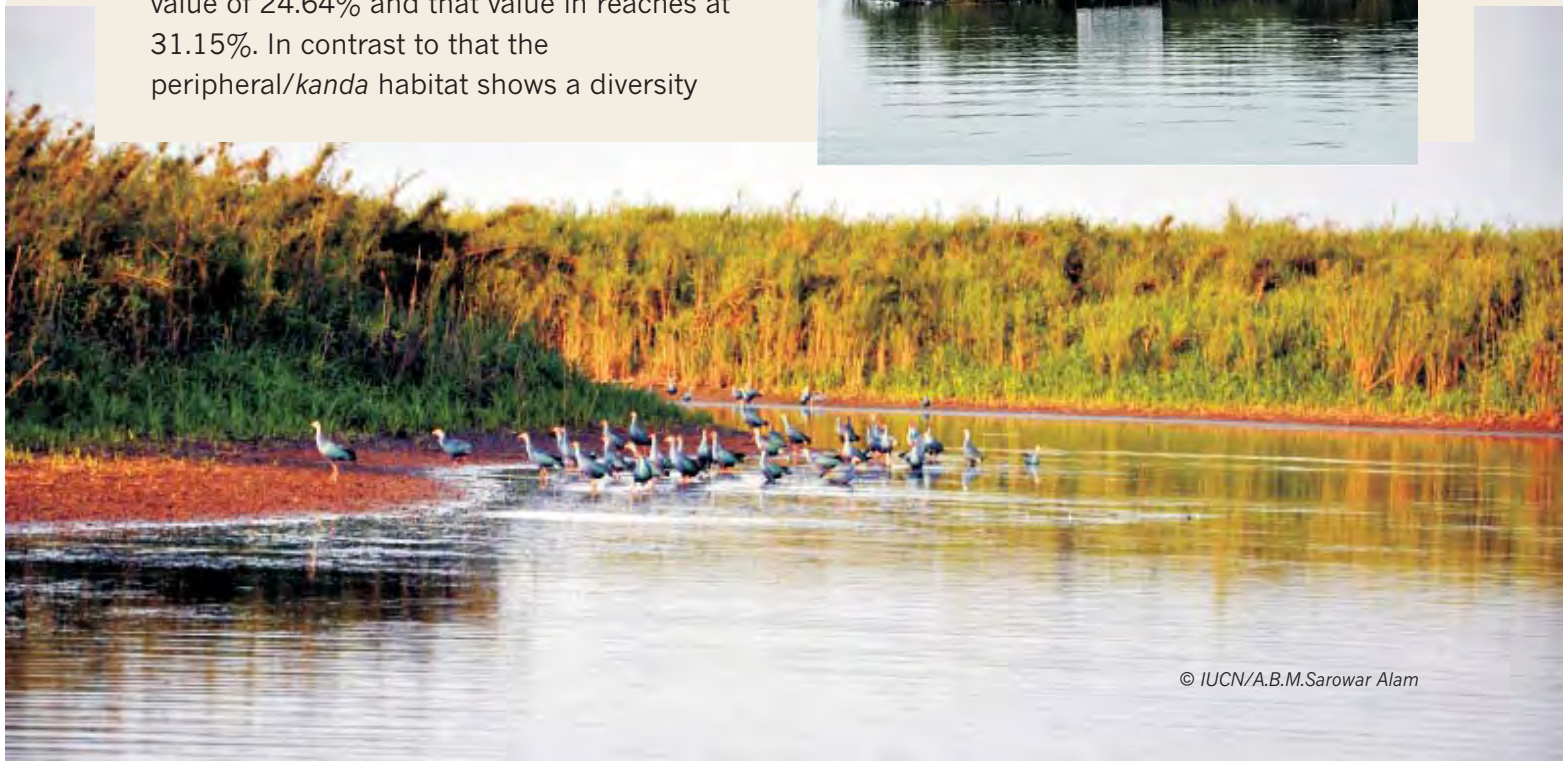
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Annar beel: A total of 31 species under 21 families have been recorded in the area. The analysis shows that the diversity value of the permanently submerged area of the *beel* is 7.42 % during the winter and that reaches at 24.014% during the summer. However, that value of peripheral/*kanda* region is 36.66 % in the winter and 47.46% in the summer. The peripheral/*kanda* habitat is dominated by *Hemarthria protensa*, *Ficus heterophyllus*, *Cynodon dactylon* etc, whereas, the permanently submerged habitat is dominated by *Vallisneria spiralis* and *Hydrilla verticillata*.

Ballardubi beel: The number of recorded plant species of this area is 32 under 18 families. During winter, the permanent submerged area of the *beel* shows a diversity value of 24.64% and that value in reaches at 31.15%. In contrast to that the peripheral/*kanda* habitat shows a diversity

value of 33.63 % in winter and 46.01% in summer. The *kanda* habitat is dominated by *Hemarthria protensa*, *Ficus heterophyllus*, *Cynodon dactylon* etc. and the permanent submerged habitat of the *beel* is dominated by *Hydrilla verticillata*, *Najas minor*, *Trapa bispinosa*.

Berberia beel: The recorded plant species number of the *beel* is 35 which belong to 16 families. The diversity value of the permanent submerged area is 26.55% during the winter and 28.07 % in the summer. Whereas, that



values in the peripheral/*kanda* area are 29.52 % and 50.17 % during winter and summer respectively. The dominated species of *kanda* area is *Hemarthria protensa*, *Lippia alba*, *Cynodon dactylon*, *Phyllanthus reticulatus*, *Ficus heterophyllus* etc. and those of Permanently submerged area are *Hydrilla verticillata*, *Vallisneria spiralis*, *Najas minor* etc.

Chattania Khal: The number of recorded plant species from the *beel* area is 30 under 19 families. The study has found a diversity value of 25.07% in the permanent submerged area during the winter and that value reaches at 32.64% in the summer season. However, the diversity value of the *kanda* area is 48.59% in winter and 47.87% in summer. The *kanda* area is dominated by *Ficus heterophyllus*, *Persicaria glabra*, *Pteris vittata*, *Hemarthria protensa*, *Cynodon dactylon* etc. and those of the permanent submerged area are *Hydrilla verticillata*, *Trapa maximowiczii*, *Najas minor*, *Hygroryza aristata*, *Vallisneria spiralis*.

Hatirgatha beel: A total of 28 plant species under 16 families have been recorded from the area. The analysis has found that the diversity value in the permanent submerged area of the *beel* is 4.73% during the winter and that reaches up to 32.03% in the summer. On the other hand, that value in the *kanda* area is 37.02 % in the winter and 34.57 % in the summer. The *kanda* area is dominated by *Hemarthria protensa*, *Cynodon*

dactylon *Alternanthera sessilis* etc. and those of the permanently submerged area are *Hydrilla verticillata*, *Najas minor*, *Vallisneria spiralis*.

Kalmar beel: The study has found 32 plant species distributed under 21 families from *beel* area. The analysis has shown that the diversity value of the permanently submerged area is 28.93% during the winter and 34.72 % in the summer. However, that value in the *kanda* area is 51.03 % in the winter and 46.22 % in the summer. The *kanda* area is dominated by *Ficus heterophyllus*, *Persicaria glaber*, *Pteris vittata*, *Alternanthera sessilis*, *Cryptocoryne retrospiraais subsp. albida*, *Cynodon dactylon*, *Hemarthria protensa* and those of the permanently submerged area are *Hydrilla verticillata*, *Vallisneria spiralis*, *Najas minor*, *Trapa maximowiczii*.

Lechuamara beel: The number of plant species recorded from the *beel* area is 29 under 17 families. The study has found that the diversity value in the permanently submerged area of the *beel* is 31.35% during the winter season and 36.02 % in the summer. Whereas, that value in the *kanda* area is 48.18% and 43.713 % during the winter and summer respectively. The dominant species of *kanda* area are *Hemarthria protensa*, *Lippia alba*, *Cynodon dactylon*, *Phyllanthus reticulatus*, *Ficus heterophyllus* and those of the permanent submerged area are *Hydrilla verticillata*, *Vallisneria spiralis*, *Najas minor*, *Trapa maximowiczii* etc.





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Rupaboi beel: A total of 35 plant species under 18 families have been recorded from the area. The diversity values in the permanently submerged area are 15.93% and 23.65% during the winter and the summer respectively. However, that value in the *kanda* area is 36.46% in the winter and 45.78% in the summer. The *kanda* area is dominated by *Ficus heterophyllus*, *Persicaria glaber*, *Pteris vittata*, *Hemarthria protensa*, *Cynodon dactylon* and those of the permanently submerged area are *Hydrilla verticillata*, *Vallisneria spiralis*, *Najas minor*, *Trapa maximowiczii* etc.

Rowa beel: The study has found that 40 plant species distributed under 21 families from the *beel* area. The analysis has shown that the diversity value of the permanently submerged area is 52.86% during the winter and 35.44% in the summer. However, that value in the *kanda* area is 51.66 % in the

winter and 48.48% in the summer. The *kanda* area is dominated by *Ficus heterophyllus*, *Pteris vittata*, *Lippia alba*, *Cynodon dactylon*, *Persicaria viscosa*, *Phyllanthus reticulatus* etc. and those of the permanently submerged area are *Trapa maximowiczii*, *Najas minor*, *Hydrilla verticillata*, *Vallisneria spiralis* etc.

Tekunna beel: The number of recorded plant species from the *beel* area is 23 under 17 families. The study has found a diversity value of 10.77% in the *kanda* area during the winter season and that value reaches at 15.07% in the summer season. However, the diversity value of the permanently submerged area is 38.54% in the winter and 41.95% in the summer. The *kanda* area is dominated by *Lepironia articulate*, *Lippia alba*, *Cynodon dactylon* and those of the permanently submerged area are *Najas minor*, *Hydrilla verticillata*, *Vallisneria spiralis* etc.

The diversity of different studied areas is as follows:

Table 4.1. Area-wise comparative diversity of different beels.

Name of the beel	Diversity Value	
	Permanently submerged area	Peripheral/ <i>Kanda</i> area
Ballardubi beel	1.13	1.547
Hatirgatha beel	0.22	1.703
Lechuamara beel	1.442	2.216
Rowa beel	2.431	2.376
Rupaboi beel	0.733	1.677
Chattania <i>khal</i> beel		1.795

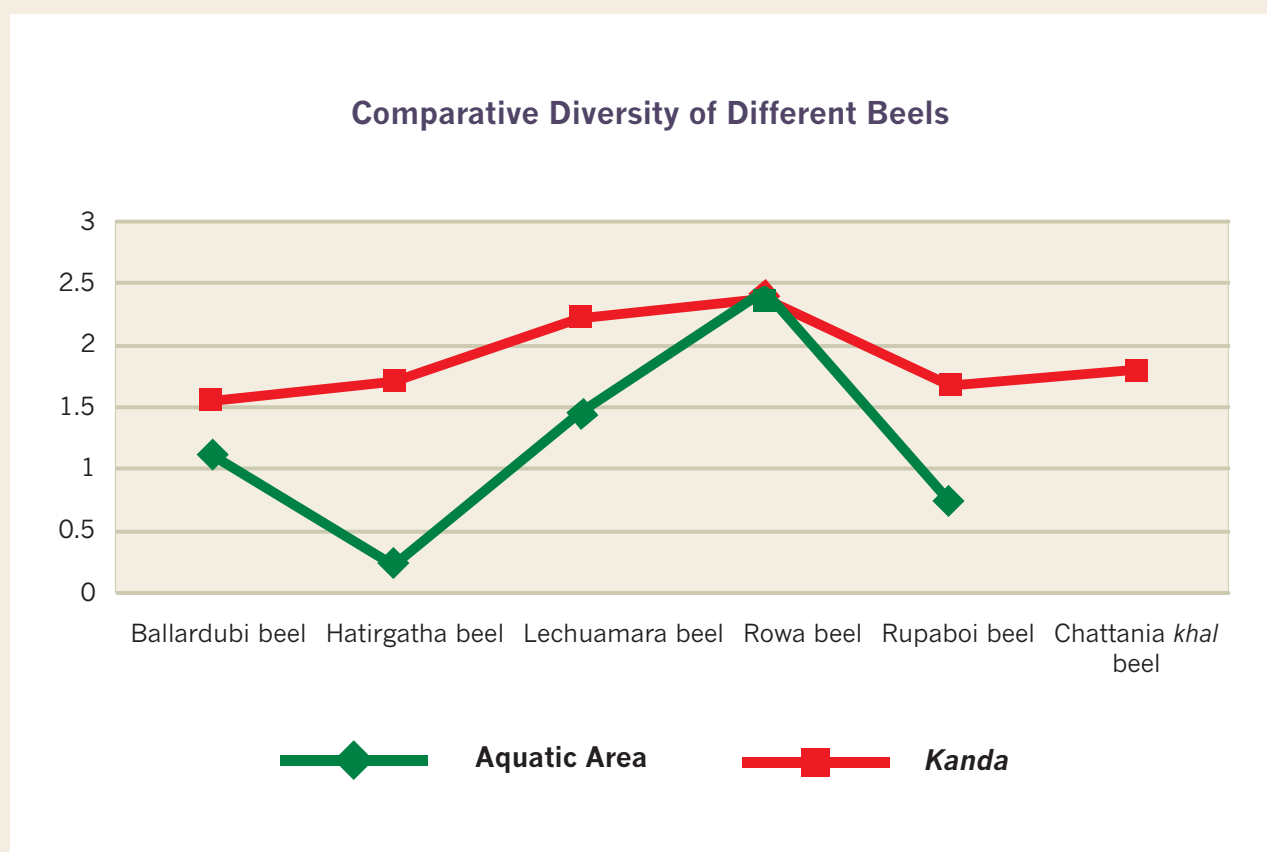
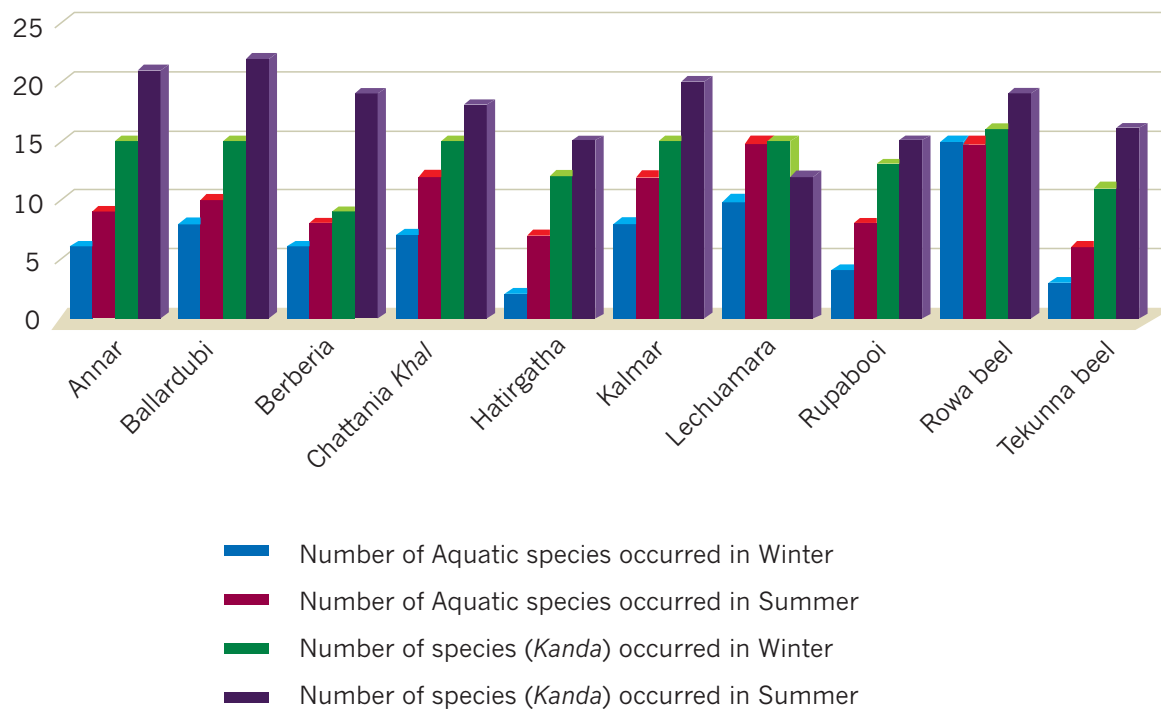


Figure 4.1. Comparative diversity Value of different beel

Table 4.2. Habitat-wise floral diversity status of different beels

Sl. no	Name of Beel	Number of species occurred			
		Aquatic		Kanda	
		Winter	Summer	Winter	Summer
1	Annar beel	6	9	15	21
2	Ballardubi beel	8	10	15	22
3	Berberia beel	6	8	9	19
4	Chattania <i>khal</i> beel	7	12	15	18
5	Hatirgatha beel	2	7	12	15
6	Kalmar beel	8	12	15	20
7	Lechuamara beel	10	15	15	12
8	Rupaboi beel	4	8	13	15
9	Rowa beel	15	15	16	19
10	Tekunna beel	3	6	11	16

Floral Diversity Status of Different Beels**Figure 4.2.** Comparison of seasonal floral diversity of both aquatic (permanently submerged area) and kanda habitats of different beels

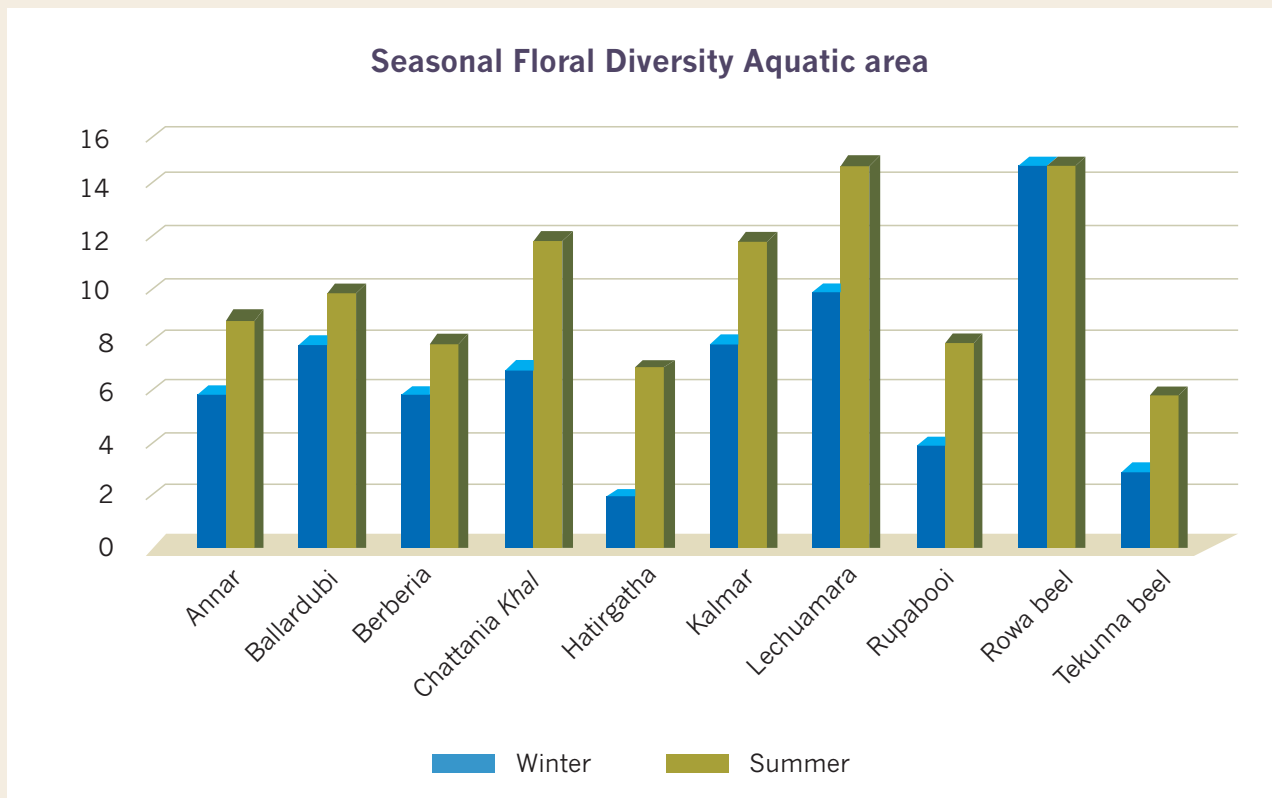


Figure 4.3. Comparison of seasonal floral diversity of aquatic (permanently submerged area) habitat of different beels

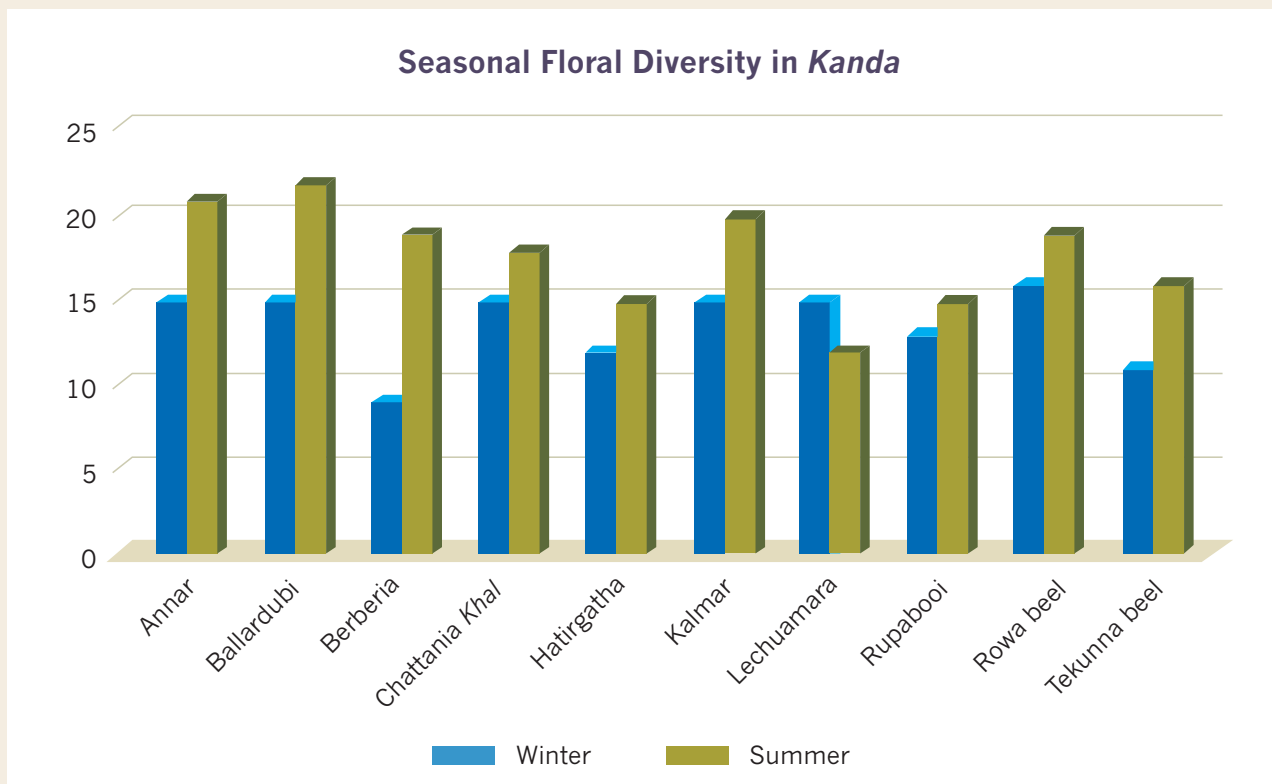
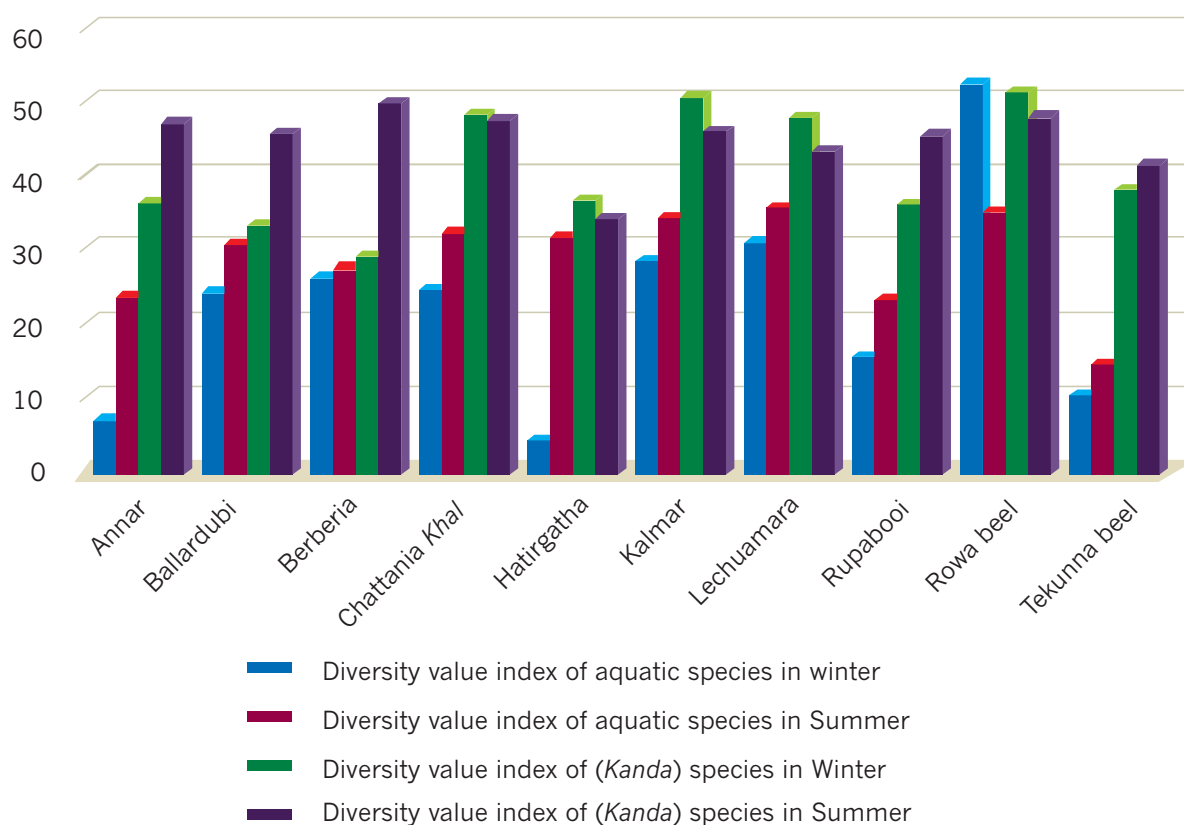


Figure. 4.4. Comparison of seasonal floral diversity of *kanda* (peripheral) area of different beels

Table 4.5. Comparative seasonal diversity value index of different habitats among the beels

Sl. no	Name of Beel	Diversity value index of species			
		Aquatic		Kanda	
		Winter	Summer	Winter	Summer
1	Annar	7.42	24.014	36.66	47.46
2	Ballardubi	24.64	31.15	33.63	46.01
3	Berberia	26.55	28.07	29.52	50.17
4	Chattania <i>Khal</i>	25.07	32.64	48.59	47.87
5	Hatirgatha	4.73	32.03	37.02	34.57
6	Kalmar	28.93	34.72	51.03	46.22
7	Lechuamara	31.35	36.02	48.18	43.713
8	Rupabooi	15.93	23.65	36.46	45.78
9	Rowa beel	52.86	35.44	51.66	48.48
10	Tekunna beel	10.77	15.07	38.54	41.95

Seasonal Diversity Value Index of Different Habitats**Figure. 4.5** Comparative seasonal diversity index of aquatic habitat

4.1 Present Status of Floral Diversity in the Haor area

Very Rare	Rare	Common	Very common	Abundant
<i>Duchesnea indica</i> and <i>Hydrocotyle sibthorpioides</i>	<i>Alternanthera ficoidea</i> , <i>Aniseia martinicensis</i> , <i>Aponogeton undulatus</i> , <i>Asparagus racemosus</i> , <i>Azolla pinnata</i> , <i>Calamus longisetus</i> , <i>Cardiospermum halicacabum</i> , <i>Ceratophyllum demersum</i> , <i>Chylocalyx perfoliatus</i> , <i>Cissampelos pareira</i> var. <i>hirsuta</i> , <i>Clerodendrum indicum</i> , <i>Crateva magna</i> , <i>Enhydra fluctuans</i> , <i>Hygroryza aristata</i> , <i>Marsilea quadrifolia</i> , <i>Mazus pumilus</i> , <i>Nymphaea nouchali</i> , <i>Nymphoides indicum</i> , <i>Pistia stratiotes</i> , <i>Potamogeton mucronatus</i> , <i>Rorippa heterophylla</i> , <i>Salix tetrasperma</i> , <i>Salvinia cucullata</i> , <i>Schumannianthus dichotomus</i> , and <i>Vitex negundo</i>	<i>Alternanthera sessilis</i> , <i>Aponogeton nutans</i> , <i>Centella asiatica</i> , <i>Chenopodium album</i> , <i>Coix lacryma-jobi</i> , <i>Coccinia grandis</i> , <i>Commelina benghalensis</i> , <i>Cotula hemispherica</i> , <i>Crotalaria pallida</i> , <i>Cryptocoryne retrospiraiis</i> subsp. <i>albida</i> , <i>Cyperus compressus</i> , <i>Cyperus rotundus</i> , <i>Echinochloa crusgalli</i> , <i>Eclipta alba</i> , <i>Eichhornia crassipes</i> , <i>Glinus oppositifolius</i> , <i>Hedyotis corymbosa</i> , <i>Heliotropium indicum</i> , <i>Ipomoea aquatica</i> , <i>Lemna perpusilla</i> , <i>Leucas indica</i> , <i>Limnophila heterophylla</i> , <i>Lindernia antipoda</i> , <i>Lippia alba</i> , <i>Ludwigia octovalvis</i> , <i>Ludwigia perennis</i> , <i>Merremia gemella</i> , <i>Nechamandra alternifolia</i> , <i>Nymphaea capensis</i> , <i>Nymphaea pubescens</i> , <i>Nymphaea rubra</i> , <i>Nymphoides hydrophylla</i> , <i>Ottelia alismoides</i> , <i>Oxystelma secamone</i> , <i>Panicum paludosum</i> , <i>Persicaria lanata</i> , <i>Persicaria lapathifolia</i> , <i>Persicaria viscosa</i> , <i>Phragmites karka</i> , <i>Phyla nodiflora</i> , <i>Potamogeton crispus</i> , <i>Pongamia pinnata</i> , <i>Potamogeton crispus</i> , <i>Rosa clinophylla</i> , <i>Rumex dentatus</i> , <i>Schoenoplectus junccoides</i> , <i>Senna tora</i> , <i>Sida rhombifolia</i> , <i>Solanum americanum</i> , <i>Trewia nudiflora</i> , <i>Utricularia aurea</i> , <i>Vicia sativa</i> , <i>Xanthium indicum</i> and <i>Vetiveria zizanioides</i>	<i>Barringtonia acutangula</i> , <i>Cleome hassleriana</i> , <i>Cynodon dactylon</i> , <i>Eleocharis dulcis</i> , <i>Fimbristylis aestivalis</i> , <i>Gnaphalium luteo-album</i> , <i>Hemarthria protensa</i> , <i>Ipomoea fistulosa</i> , <i>Ludwigia adscendens</i> , <i>Najas minor</i> , <i>Persicaria glabra</i> , <i>Persicaria orientalis</i> , <i>Phyllanthus reticulatus</i> , <i>Physalis angularata</i> , <i>Polygonum plebeium</i> , <i>Pteris vittata</i> , <i>Ricinus communis</i> , <i>Saccharum munja</i> , <i>Sagittaria sagittifolia</i> , and <i>Trapa bispinosa</i>	<i>Ficus heterophylla</i> , <i>Hydrilla verticillata</i> , and <i>Vallisneria spiralis</i>

Note: Four species (i.e. *Rosa clinophylla*, *Calamus longisetus*, *Cissampelos pareira* var. *hirsuta*, and *Cleome hassleriana*) occurring in the haor area are vulnerable in national context. Moreover, three other species (i.e. *Aponogeton nutans*, *Aponogeton undulatus* and *Asparagus racemosus*) are near threatened in national context also. However, none of the species are threatened in the haor area.



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4.2. Wetland Vegetation Analysis Based on Habitat Classification

Wetlands are dynamic component of environment that can experience natural fluctuations of water both in quantity and quality. As a consequence, some wetland plants are capable to withstand both flooding and short periods of drought within a single year. As primary producers, wetland plants have a vital role in wetland ecology. Wetland plants perform a number of other significant functions as well including: (a) maintaining water quality by filtering out nutrients and sediments; (b) providing food, shelter and breeding habitat for both aquatic and terrestrial fauna; and (c) preventing soil

erosion. Wetland areas are also valued for their landscape amenity, a large part of which is a consequence of the specialized and diverse plant species that are found in them. Bangladesh is a country of wetlands having 7% of land permanently remains under water. In Bangladesh, two sites have been recognized as internationally important wetlands under the Convention on Wetlands of International Importance especially as Waterfowl Habitats (Ramsar Convention). Tanguar Haor is one of those two Ramsar sites.



Wetland vegetation can be divided into two broad categories:

4.2.1. Aquatic Macrophytes

Are plants that live either completely submerged or floating or have some small portion of the plant emerging from the water. They may be attached (i.e. *Potamogeton*) or unattached to the substratum (i.e. *Lemna*). This category of vegetation can be further divided into three types:

4.2.1.1. Submerged Vegetation

Submerged plants spend their entire life cycle beneath the surface of the water. Nearly all are rooted in the substrate. The term submerged aquatic vegetation (SAV) refers to all underwater flowering plants. Submerged vegetation is confined into the shallow water bodies where enough light penetrates into the water column to allow plant growth from the bottom. Those flowering plants are rooted in the sediment and therefore, require a sandy or soft

substrate for growth. Submerged vegetation plays a key role in influencing the structure and ecology of aquatic ecosystems. Some important ecological functions of these are: (a) Modification of water flow and reduction in wave turbulence, (b) Accelerated deposition of sediment and organic matter, (c) Physical binding of sediments beneath the canopy, and (d) Nutrient cycling between the water column and sediments.

Because of their high rates of primary production and particle deposition, SAV beds



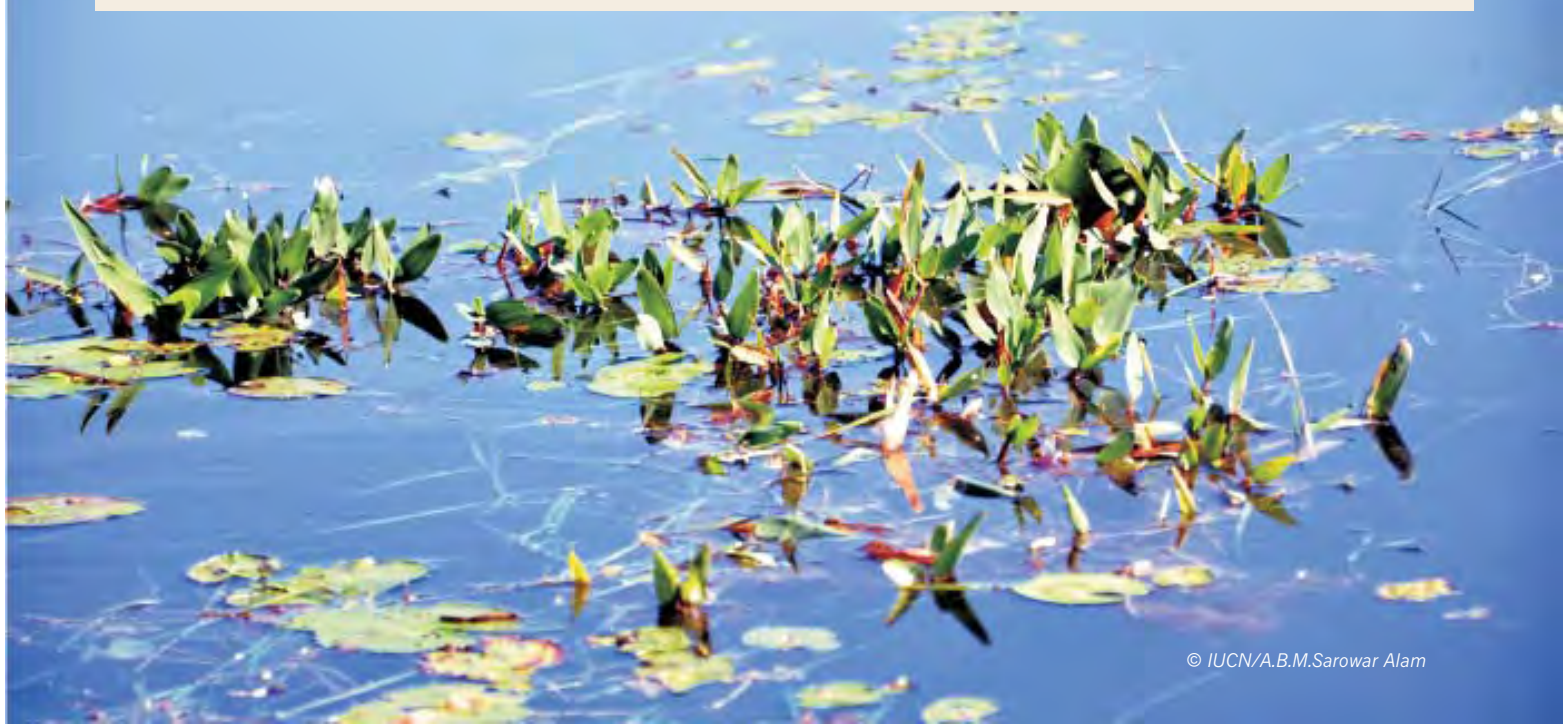
are important nutrient sources and sinks. Submerged vegetation constitutes recruitment areas and shelter for benthic fauna, zooplankton and fish fry, and provides important food sources to waterfowl. Some ducks, Jacanas, swamp hen, fishes, shrimp, and snails graze directly on the living grasses, while other animals (i.e. clams and oysters), filter bacteria-laden detritus (dead plant tissue) from the water to obtain nutrients. The plants form dense beds that restrict fishing. Different types of submerged vegetations are found in Tanguar Haor. Different *beels* of Tanguar Haor have different concentration of these vegetation community. Berberia, Hartirgatha, Lechuamara, Ballardubi and Rowa possess high density of this type of vegetation. On the other hand Tekunna, Rupaboi and Annar beel show less density with submerge vegetation because of varying human pressure and different physical factors.

Twelve submerged species have been recorded in the Tanguar Haor area during the study period. Those are: *Hydrilla verticillata*, *Aponogeton nutans*, *Aponogeton undulatus*, *Limnophila heterophylla*, *Nechamandra alternifolia*, *Ottelia alismoides*, *Utricularia aurea*, *Ceratophyllum demersum*, *Potamogeton*

mucronatus, *Potamogeton crispus*, *Najas minor*, *Vallisneria spiralis*.

4.2.1.2. Free Floating Vegetations

This type of vegetation floats freely on the water. Leaves and stems of floating plants float on the water's surface. Roots may or may not be present and there is no connection to the bottom substrate. Most floating plants have a suitable counterpoise to prevent the plant from being turned upside down by ripples and waves. For example, *Azolla pinnata* and most of the duckweeds the counterpoise consists of one or more dangling roots. In *Salvinia cucullata* dissected leaves looking much like hanging roots act as counterpoises. There are various adaptations to afford protection against wetting. The larger duckweeds have a very smooth and glistening surface from which water rolls in the spheroid form. There are some free floating vegetations found in the Tanguar Haor which are used as nesting ground by some aquatic insect and other aquatic animals. These types of plants can reproduce quickly and completely cover the water surface under favorable condition. Vegetative propagation is usually effected with great rapidity by the branching and budding of the stem and the separation of these branches. The duckweeds



and other free-floating plants frequently cover great areas very closely and largely prevent the formation of waves when one throws a stone into the water. In the south the water hyacinth covers large areas of *beels*, causing much inconvenience to navigation. Invasion by mats of free-floating plants is among the most important threats to the functioning and biodiversity of freshwater ecosystems. Free floating plants can reduce *haor* productivity and contribute to oxygen depletion resulting fish death. These types of plants are found in almost all the *beels*. However, most of them found in the Berberia, Lechuamara, Rowa, Rupaboi, Hatirgatha, Tekunna and Annar beels. Seven free-floating species have been found in the Tanguoar Haor area during the study period. Those species are *Azolla pinnata*, *Eichhornia crassipes*, *Lemna perpusilla*, *Nymphoides hydrophylla*, *Nymphoides indicum*, *Pistia stratiotes*, *Salvinia cucullata*.

4.2.1.3. Attached-Floating Vegetations

Attached-floating plants have leaves that float on the surface water while the roots are anchored in the substrate. Stems connect the leaves, which are circular or oval and have a tough leathery texture, to the bottom. These plants sometimes spread so vigorously and thus may reach nuisance levels, particularly in shallow or clear *beels*. This type of vegetation is seen more or less in all beels. However, denser vegetation is found in Berberia, Lechuamara, Hatirgatha and Rowa beels than remaining other *beels*. Aquatic birds such as Pheasant-tailed Jacana, Purple Swamphen, Whiskered Tern build their nest on this types of vegetation. A number of such attached-floating species have been found in the Tanguar Haor area to form this community. Some of them are: *Enhydra fluctuans*, *Ipomoea aquatica*, *Nymphaea nouchali*, *Nymphaea rubra*, *Nymphaea pubescens*, *Ludwigia adscendens* etc.



4.2.2. Emergent Macrophytes

Are wetland plants which are always rooted in the sediment and whose growth habit results in the plant protruding above the water surface. They are able to reproduce by either vegetative means or by the production of seed. Vegetative reproduction is more common and much more rapid than reproduction by seed. It involves growth of a below ground rhizome which grows parallel to the ground and produces a clone of its parent a short distance away. This mechanism allows emergent plant populations to change their distribution in response to changes in the wetland's hydrological regime. Emergent macrophytes such as sedges and rushes are able to respond to long term changes in water levels with recruitment of new individuals taking place either further upslope or downslope in response to higher or lower water levels. This category of vegetation can be further divided into three types:

4.2.2.1. Sedges Meadows Vegetations

Sedge Meadows and Marshes are open wetlands with less than 25 percent shrub or tree cover, and in many cases woody plants are absent. They are a common wetland community type occurring along *haor* margins. They tend to be part of larger wetland complexes. They are permanently saturated and seasonally flooded. The soils are typically shallow, well-decomposed sedge peat but they also occur on mineral soils with a high organic content in the surface layers. The vegetation is firmly rooted in the organic or mineral substrate, and they typically do not form floating mats when they are inundated. These types of vegetation provide shelter and food source of some aquatic animals. Local people also use some plant as vegetables. Lechuamara, Berberia, Hatirgatha and Rowa beels have these types of vegetation.

The study has identified 35 plant species in sedges meadows vegetations from Tanguar Haor area. Usually sedge meadows vegetation of the area are dominated by the sedges (Cyperaceae) growing on saturated soils. Most of the sedges present are *Eleocharis dulcis* (spike-rushes) but also *Schoenoplectus mucronatus* (bulrushes), *Fimbristilis dichotoma* and *Cyperus compressus*. Grasses (Poaceae), especially *Hemarthria protensa*, *Vetiveria zizanioides* and *Echinochloa crusgalli* can also be present. Other herbaceous plants that are frequently found in this community include *Alternanthera philoxeroides*, *Eclipta alba*, *Ludwigia perennis*, *Persicaria glabra*, *Xanthium indicum* etc.



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4.2.2.2. Reed beds

Reed beds is wetland habitat dominated by the Common Reed (*Phragmites karka*). Reeds are tall grass and they can grow up to 3 meters. Reeds can grow both in salt or fresh water but tend to grow at the water's edge where their roots are wet for most of the year. They grow close together in thick mats of vegetation forming islands often surrounded by open water.

Reed beds are a threatened habitat as the land is often in demand for agriculture. Reed beds is a very important habitat for birds viz.

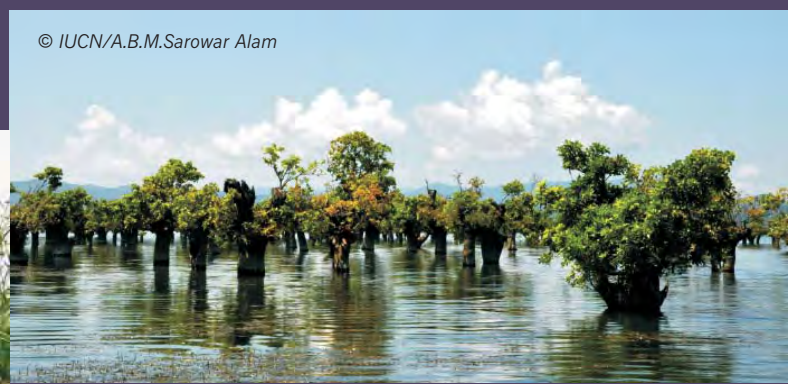
Spot billed duck, Cotton pygmy goose. They build nest among the reed stems to stop the young being thrown out by the reeds swaying in the wind. Many insects such as moths, beetles and snails also depend on them. Reed beds can help with water purification by trapping sediment in the water and use up the nutrients, which helps to clean the water. Reeds are used for basket weaving and for thatching the roofs of houses.

Only a few other plants grow among the reeds. Few of such plant species are:

Oxystelma secamone, *Asparagus racemosus*, *Ficus heterophylla*, *Lippia javanica*, *Duchesnea indica* and *Saccharum spontaneum*.

the swamp forest exhibit different strategies for survival in the soft and water logged conditions, typical tricks include growth of buttresses, stilt roots as well as different types of pneumatophores.

This type of vegetation can be seen in the Chattania *khal* beel, Rupaboi beel and Tekunna beel in Tangaor Haor area. Some birds and mammals use this forest type as resting and nesting place. However, there is a great concern for this swamp forest habitat



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4.2.2.3. Fresh Water Swamp Forest

Freshwater Swamp Forest habitat is typically found on the low lying alluvial plains and associated with river and stream systems. These Fresh Water Swamp Forests cover significant portions of lowland in Bangladesh and have suffered significant depletion through logging, sand mining and reclamation for other commercial uses. Fresh Water Swamp Forests come about due to flat low lying land becoming inundated due to rainfall runoff and inflow from surrounding river system. In swamp forests, the water table is typically very close to the surface. This continuous inundation gives rise to a habitat that is floristically distinct from the surrounding forests. The trees that reside in

due to over logging and suspected seepage from upstream reservoirs results in significantly changed circumstances for many swamp forest species. This swamp forest is all that remains of this habitat reside conservation status of vulnerable even though some may be considered common within the swamp forest habitat, examples of this would be *Rosa clinophylla*. Common swamp forest tree species such as *Millettia pinnata*, *Trawia Nudiflora*, *Barringtonia acutangula*, *Crataeva magna* and *Salix tetrasperma* reproduce by the production and dispersion of seed. As a consequence, they are unable to respond to rapid changes in water levels. They can however tolerate several years of continuous inundation before tree death occurs. One cultivated shrubby plant is also found among that vegetation (i.e. *Schumannianthus dichotomus*).



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There are another two types of vegetation are common in the haor area e.g. cultivated land vegetation and homestead vegetation.

4.2.3. Cultivated Land Vegetation

A large number of cultivated land is seen throughout the Tanguar Haor area during the winter season when most of the part of the *haor* becomes dry. This seasonal wetlands often have a higher diversity of aquatic and fringing vegetation in comparison to permanent wetlands. This is because there are a greater number of microhabitats in seasonal wetlands. Those lands act as important ground for the migratory ducks and also for local people. Local people cultivate rice and other crops during that season. This type of land is found in Lechuamara beel, Berberia beel, Rupaboi beel and Kalmar beel area. This ground is very rich in species diversity. A total of 60 herbaceous taxa have been recorded from that area during the study area. Some of them are: *Alternanthera sessilis*, *Cotula hemispherica*,

Cynodon dactylon, *Heliotropium indicum*, *Leucas zeylanica*, *Kyllinga nemoralis*, *Eleocharis dulcis* etc.

4.2.4. Homestead Vegetation

Like most villages in Bangladesh, homestead vegetation of Tangor Haor is rich in species diversity. The backyards of village homes often have dense growth of planted and natural vegetation and are particularly important in supporting a number of wildlife. This wildlife use the homestead vegetation and surrounding crop fields (Rice, Wheat, Jute, etc.) for their food and shelter. The common species those constitute homestead vegetation are *Mangifera indica*, *Artocarpus heterophyllus*, *Syzygium cumini*, *Litchi chinensis*, *Ziziphus mauritiana*, *Anthocephalus cadamba*, *Albizia procera*, *Bambusa spp.*, *Bombax ceiba*, *Diospyros perigrina*, *Erythrina variegata*, *Borassus flabellifer*, *Cocos nucifera*, *Barringtonia acutangula*, *Ficus hispida*, *Ficus racemosa* etc.



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4.3.1. The Ecological Characteristic, particularly of the vegetation patterns, differs

sharply between permanent and seasonal water bodies. In the monsoon, permanent water body shows higher species diversity than winter season. However, seasonally dried land shows highest species diversity in the winter season and lesser in monsoon. Seasonal variation has enormous effects on the species growth. Different plant species grow in different season and some species can grow all the year round.

Plant species appearing at the winter are: *Chenopodium album*, *Cleome hassleriana*, *Crotalaria pallida*, *Eclipta alba*, *Heliotropium indicum*, *Physalis angulata*, *Rorippa heterophylla*, *Solanum americanum* etc.

Plant species appearing at the summer are: *Phylla nodiflora*, *Sagittaria sagittifolia*, *Trapa bispinosa* etc.

Plant species occurring all the year round are: *Asparagus racemosus*, *Calamus longispinosa*, *Coix lachryma-jobi*, *Cynodon dactylon*, *Ficus heterophylla*, *Ipomoea fistulosa*, *Lippia alba*, *Saccharum munja* etc.

4.3 Taxonomic Classification

Plant Group	Family	Species
Non flowering plants		
Pteridophytes	Azollaceae	<i>Azolla pinnata</i>
	Marsileaceae	<i>Marsilea quadrifolia</i>
	Pteridaceae	<i>Pteris vittata</i>
	Salviniaceae	<i>Salvinia cucullata</i>
Flowering plants		
	Alismataceae	<i>Sagittaria sagittifolia</i>
	Aponogetonaceae	<i>Aponogeton nutans</i>
		<i>Aponogeton undulatus</i>
	Araceae	<i>Cryptocoryne retrospiraiis subsp. albida</i>
		<i>Pistia stratiotes</i>

Plant Group	Family	Species
Monocot	Arecaceae	<i>Calamus longisetus</i>
	Commelinaceae	<i>Commelina benghalensis</i>
	Cyperaceae	<i>Cyperus compressus</i>
		<i>Cyperus compressus</i>
		<i>Cyperus rotundus</i>
		<i>Eleocharis dulcis</i>
		<i>Fimbristylis aestivalis</i>
		<i>Schoenoplectus junccoides</i>
	Hydrocharitaceae	<i>Hydrilla verticillata</i>
		<i>Nechamandra alternifolia</i>
		<i>Ottelia alismoides</i>
		<i>Vallisneria spiralis</i>
	Lemnaceae	<i>Lemna perpusilla</i>
	Liliaceae	<i>Asparagus racemosus</i>
	Marantaceae	<i>Schumannianthus dichotomus</i>
	Najadaceae	<i>Najas minor</i>
	Poaceae	<i>Coix lacryma-jobi</i>
		<i>Cynodon dactylon</i>
		<i>Echinochloa crusgalli</i>
		<i>Hemarthria protensa</i>
		<i>Hygroryza aristata</i>
		<i>Panicum paludosum</i>
		<i>Phragmites karka</i>
		<i>Saccharum munja</i>
		<i>Vetiveria zizanioides</i>
	Pontederiaceae	<i>Eichhornia crassipes</i>
	Potamogetonaceae	<i>Potamogeton crispus</i>
		<i>Potamogeton mucronatus</i>

Plant Group	Family	Species
Dicot	Amaranthaceae	<i>Alternanthera ficoidea</i>
		<i>Alternanthera philoxeroides</i>
		<i>Alternanthera sessilis</i>
	Apiaceae	<i>Centella asiatica</i>
		<i>Hydrocotyle sibthorpioides</i>
	Asclepiadaceae	<i>Oxystelma secamone</i>
	Asteraceae	<i>Cotula hemispherica</i>
		<i>Eclipta alba</i>
		<i>Enhydra fluctuans</i>
		<i>Gnaphalium luteo-album</i>
		<i>Xanthium indicum</i>
	Boraginaceae.	<i>Heliotropium indicum</i>
	Brassicaceae	<i>Rorippa heterophylla</i>
	Caesalpiniaceae	<i>Senna tora</i>
	Capparaceae	<i>Cleome hassleriana</i>
		<i>Crateva magna</i>
	Ceratophyllaceae	<i>Ceratophyllum demersum</i>
	Chenopodiaceae	<i>Chenopodium album</i>
	Convolvulaceae	<i>Aniseia martinicensis</i>
		<i>Ipomoea aquatica</i>
		<i>Ipomoea fistulosa</i>
		<i>Merremia gemella</i>
	Cucurbitaceae	<i>Coccinia grandis</i>
	Euphorbiaceae	<i>Phyllanthus reticulatus</i>
		<i>Ricinus communis</i>
		<i>Trewia nudiflora</i>
	Fabaceae	<i>Crotalaria pallida</i>
		<i>Millettia pinnata</i>
		<i>Vicia sativa</i>
	Lamiaceae	<i>Leucas indica</i>
	Lecythidaceae	<i>Barringtonia acutangula</i>

Plant Group	Family	Species
	Lentibulariaceae	<i>Utricularia aurea</i>
	Lythraceae	<i>Rotalla sp</i>
	Malvaceae	<i>Sida rhombifolia</i>
	Menispermaceae	<i>Cissampelos pareira var. hirsuta</i>
	Menyanthaceae	<i>Nymphoides hydrophylla</i>
		<i>Nymphoides indicum</i>
	Molluginaceae	<i>Glinus oppositifolius</i>
	Moraceae	<i>Ficus heterophylla</i>
	Nymphaeaceae	<i>Nymphaea capensis</i>
		<i>Nymphaea nouchali</i>
		<i>Nymphaea pubescens</i>
		<i>Nymphaea rubra</i>
	Onagraceae	<i>Ludwigia adscendens</i>
		<i>Ludwigia octovalvis</i>
		<i>Ludwigia perennis</i>
	Polygonaceae	<i>Chylocalyx perfoliatus</i>
		<i>Persicaria glabra</i>
		<i>Persicaria lanata</i>
		<i>Persicaria lapathifolia</i>
		<i>Persicaria orientalis</i>
		<i>Persicaria viscosa</i>
		<i>Polygonum plebeium</i>
		<i>Rumex dentatus</i>
	Rosaceae	<i>Duchesnea indica</i>
		<i>Rosa clinophylla</i>
	Rubiaceae	<i>Hedyotis corymbosa</i>
	Salicaceae	<i>Salix tetrasperma</i>
	Sapindaceae	<i>Cardiospermum halicacabum</i>
	Scrophulariaceae	<i>Limnophila heterophylla</i>
		<i>Lindernia antipoda</i>
		<i>Mazus pumilus</i>

Plant Group	Family	Species
	Solanaceae	<i>Physalis angulata</i>
		<i>Solanum americanum</i>
		<i>Trapa maximowiczii</i>
	Trapaceae	<i>Clerodendrum indicum</i>
	Verbenaceae	<i>Lippia alba</i>
		<i>Phyla nodiflora</i>
		<i>Vitex negundo</i>

4.4. Taxonomic Enumeration

The present study has revealed that a total member of 104 species under 88 genera and 51 families are found in Tanguar Haor area. Among them four 4 species are pteridophytes and remaining 100 species are angiosperms. Monocot group of angiosperm plants

represents by 32 species under 26 genera and 14 families. However, Dicot group of angiosperm plants represents by 68 species under 58 genera and 33 families. Among the monocot families Poaceae appears as the largest family with 9 species, whereas, Polygonaceae appears as the largest family among the dicot families with 8 species.

Plant Group	Family	Genus	species
Pterodophytes	4	4	4
Monocot	14	26	32
Dicot	33	58	68

Taxonomic Enumeration

Sl. No	Name of family	No of genus	No of species
1.	Alismataceae	1	1
2.	Amaranthaceae	1	3
3.	Apiaceae	2	2
4.	Aponogetonaceae	1	2
5.	Araceae	2	2
6.	Arecaceae	1	1
7.	Asclepiadaceae	1	1

Sl. No	Name of family	No of genus	No of species
8.	Asteraceae	5	5
9.	Azollaceae	1	1
10.	Boraginaceae	1	1
11.	Brassicaceae	1	1
12.	Caesalpiniaceae	1	1
13.	Capparaceae	2	2
14.	Ceratophyllaceae	1	1
15.	Chenopodiaceae	1	1
16.	Commelinaceae	1	1
17.	Convolvulaceae	3	4
18.	Cucurbitaceae	1	1
19.	Cyperaceae	4	5
20.	Euphorbiaceae	3	3
21.	Fabaceae	3	3
22.	Hydrocharitaceae	4	4
23.	Lamiaceae	1	1
24.	Lecythidaceae	1	1
25.	Lemnaceae	1	1
26.	Lentibulariaceae	1	1
27.	Liliaceae	1	1
28.	Malvaceae	1	1
29.	Marantaceae	1	1
30.	Marsileaceae	1	1
31.	Menispermaceae	1	1
32.	Menyanthaceae	1	2
33.	Molluginaceae	1	1
34.	Moraceae	1	1
35.	Najadaceae	1	1
36.	Nymphaeaceae	1	4
37.	Onagraceae	1	3
38.	Poaceae	9	9

Sl. No	Name of family	No of genus	No of species
39.	Polygonaceae	4	8
40.	Pontederiaceae	1	1
41.	Potamogetonaceae	1	2
42.	Pteridaceae	1	1
43.	Rosaceae	2	2
44.	Rubiaceae	1	1
45.	Salicaceae	1	1
46.	Salviniaceae	1	1
47.	Sapindaceae	1	1
48.	Scrophulariaceae	3	3
49.	Solanaceae	2	2
50.	Trapaceae	1	1
51.	Verbenaceae	4	4
Total	51	88	104

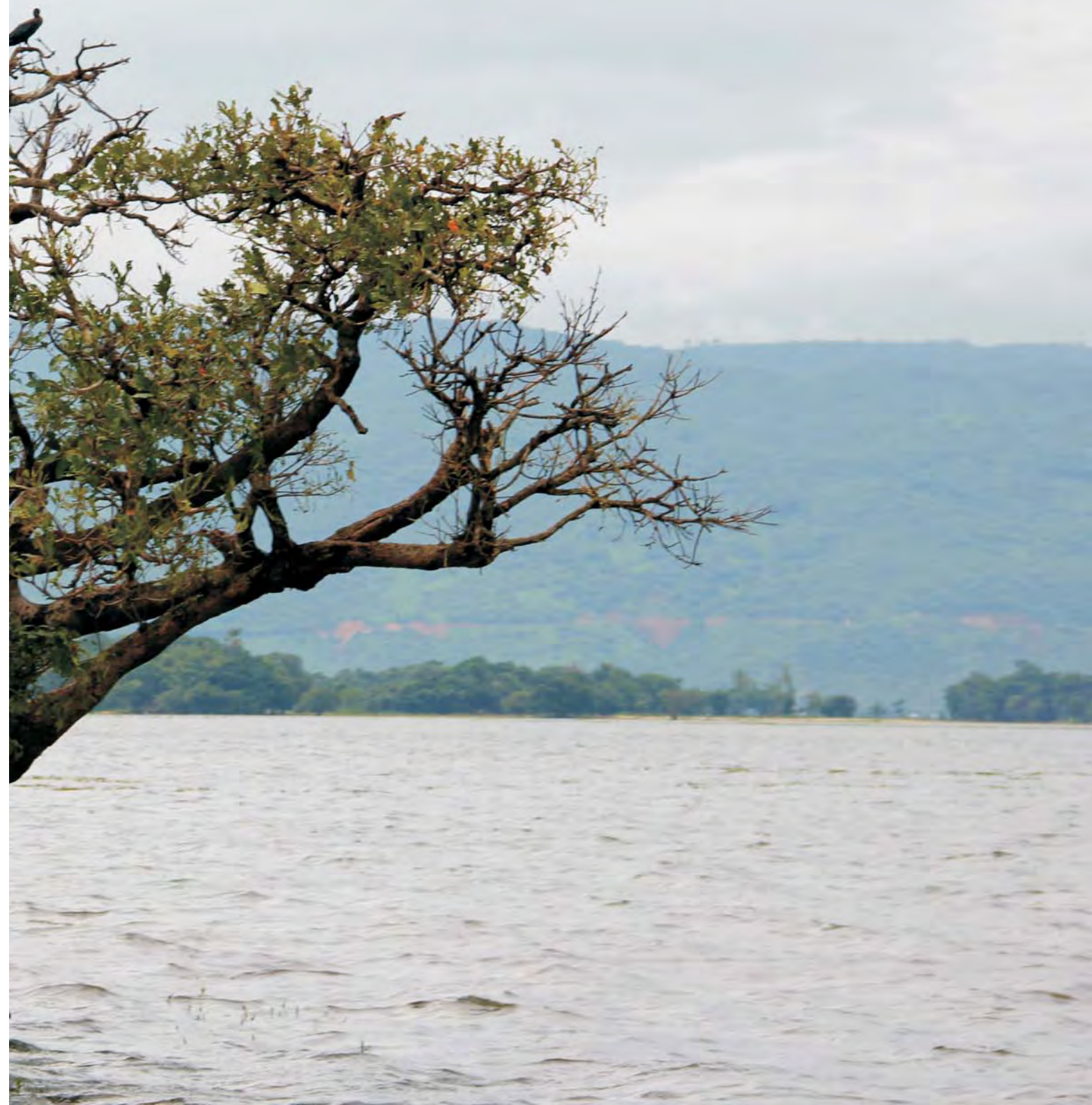




Species Profile

Chapter

5



Azolla pinnata

Scientific name: *Azolla pinnata* R. Br.

Synonyms: *Salvinia imbricata* Roxb. ex Griff.,
Azolla decomposita Zoll.

Family: Azollaceae

English names: Water Fern, Red Duckweed,
Water velvet.

Local names: Lal Khudipana, Rhode pana.



Description: A free-floating, small, aquatic, annual herb. Rhizome slender, zigzag, branching alternately to left and right bearing leaves in two alternate rows, which hang down into the water. Fronds triangular, green, blue-green, or dark red, many rounded or angular overlapping the rhizome. Sori on the submerged leaf-lobes near the bases of the branches, enclosed by indusia, each containing one megasporangium or numerous microsporangia. The papillose on the upper surface of the floating leaves water repellent.

Habitat: It occurs as free floating on stagnant water bodies, and rarely found in slow moving water bodies also.

Distribution: Widespread in India, Myanmar, Africa, Australasia, and introduced in England. In Bangladesh, it occurs all over the country.

Propagation: Vegetatively by fragments of stem and sexually by spores.

Uses: It can fix atmospheric nitrogen thus can be used as biofertilizer. It is used as fish food also.

State of occurrence in TH area: Rare.

National Conservation status: Least Concern (lc).

Marsilea quadrifolia



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Scientific name: *Marsilea quadrifolia* L.

Synonym: *Marsilea europea* Desv.

Family: Marsileaceae

English name: Water Clover.

Local name: Susni Shak.

Description: A creeping, rhizomatous, much branched, aquatic herb. Fronds petiolate, quadrifoliate, leaflets triangular, outer margins entire or crenellate, texture thin, veins many, fine anastomosing. Sporocarp arising from the base of the leaf stalk; usually crowded or rarely in groups of 2 or 3, very rarely solitary, broadly oblong to elliptical, glabrous, dark brown to black, sorol number 16-20.

Habitat: Marshland, along the margins of swamps and lakes.

Distribution: India, Myanmar, Europe, Russia, China, Japan, Australia and North America. It is widespread in Bangladesh.

Uses: Fresh leaves are used as vegetable. The decoction of the leaves along with ginger is used in cough, spastic condition of leg muscles and bronchitis and also as a sedative in insomnia.

Propagation: By spores and stolons.

State of occurrence in TH area: Rare.

National Conservation status: Least Concern (lc).

Pteris vittata

Scientific name: *Pteris vittata* L.
Synonym: *Pteris longifolia* Bedd.
Family: Pteridaceae
English name: Sunfern.
Local name: Dhekia.

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Description: Rhizome suberect, densely scaly at the apex. Stipe tufted, rigid erect, up to 1 m long or more, abaxially rounded, adaxially grooved, pale brown to black. Fronds simply pinnate, clustered; lamina lanceolate, pinnae up to 35 pairs, opposite or sub-opposite, linear-lanceolate, apex acuminate, basal pinnae progressively reduced, terminal pinnae like the lateral ones; veins distinct. Spores trilete, tetrahedral.

Habitat: Shady places, generally brick walls and stones; sometimes found in boggy region.

Distribution: Tropical and subtropical regions of the World. In Bangladesh, it grows all over the country.

Uses: Sometimes eaten as vegetable. It can be used as an arsenic indicator.

Propagation: By spores.

State of occurrence in TH area: Very common.

National Conservation status: Least Concern (lc).

Salvinia cucullata



Scientific name: *Salvinia cucullata* Roxb.
ex Bory

Family: Salviniaceae

English name: Salvinia.

Local names: Indurkani, Kantopa.

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Description: A small, free floating, aquatic fern. Rhizome horizontally zigzag, floats just under the water surface. Fronds dimorphic, submerged ones filliform and floating ones cup-shaped, floating leaves stalked, upper surface hairy. Sporocarps borne at the base of the submerged leaves, sporocarps of two types, bearing either megasporangia that are few in number (ca. 10), each with single megaspore, or many microsporangia, each with 64 microspores. Spores of 2 kinds and sizes, both globose, trilete. Megagametophytes floating on water surface with archegonia directed downward; microgametophytes remaining fixed to sporangium wall.

Habitat: Fresh water tanks, lakes, ponds and slow-moving canals.

Distribution: Tropical America and Africa, South and South-east Asia, Europe and Australia. Widespread in Bangladesh

Uses: Harvested biomass can be used as compost fertilizer. Floating fresh plants can provide shelter to fishes in beels, haors and ponds.

Propagation: Vegetatively by bud formation and sexually by spores.

State of occurrence in TH area: Rare.

National Conservation status: Least Concern (lc).

Sagittaria sagittifolia

Scientific name: *Sagittaria sagittifolia* L.

Synonyms: *Alisma sagittaria* Stokes, *Sagittaria acuminata* Sm.

Family: Alismataceae

English names: Arrow Head, Giant Arrowhead.

Local names: Muyamuya, Chhotokut.



Description: Vigorous, marginal, scapigerous, aquatic, perennial herb with long stolons ending in tubers, grows up to 80 cm tall. Leaves arrowhead-like, base hastate or sagittate, apex acute or obtuse, margins entire, glabrous. Inflorescence a raceme. Flowers of upper whorls male and lower whorls female, trimerous, actinomorphic, white. Fruit an achene, obliquely obovate, winged. Seeds pale brown, float easily to long distance.

Habitat: Low lands, shallow water ditches, lakes, rivers and brackish water bays.

Distribution: Worldwide. In Bangladesh, the species occurs throughout the world.

Uses: Tubers are eaten for high starch and protein values. Sometimes, it is used as fodder.

Propagation: By seeds and stolons.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Aponogeton nutans

Scientific name: *Aponogeton nutans*
Engl. & Krause

Synonyms: *Saururus natans* L.,
Aponogeton monostachyon L. f.

Family: Aponogetonaceae

English names: Drifting Sword Plant,
Sword-leaf Lace Plant.

Local name: Not known.

Description: An aquatic herb with obovoid or elongated, stoloniferous rootstock. Leaves oblong or linear-oblong or linear-lanceolate, apex acute or obtuse, base rounded. Petiole 9-15 cm in submerged leaves and 40-60 cm in floating leaves. Inflorescence a pedunculate spike, dense flowered. Flowers bisexual, perianth segments 2, yellow. Fruit a follicle, sub-globose, with a short terminal beak. Seeds ribbed, striate.

Habitat: Slow moving water courses, in paddy fields, streams and ponds.

Distribution: India, Myanmar, Vietnam, Cambodia, China, Indonesia and Taiwan. In Bangladesh, it is found all over the country.

Propagation: By tubers and seeds.

Uses: Tuber is a good source of starch and eaten raw.

State of occurrence in TH area: Common.

National conservation status: Near Threatened (nt).



Aponogeton undulatus

Scientific name: *Aponogeton undulatus* Roxb.

Synonyms: *Aponogeton microphyllum* Roxb.

Family: Aponogetonaceae

English name: Not known.

Local name: Ghechu.



Description: A tuberous, aquatic herb with both submerged and floating leaves. Submerged leaf transparent or opaque, cuneate or round at both ends, margins undulate. Floating leaves leathery, base rounded or cordate, apex cuneate. Inflorescence a spike, laxly flowered. Flowers white. Fruit a follicle, with a short terminal beak. Seeds with smooth testa.

Habitat: Fresh water ponds, ditches, beels.

Distribution: India, Thailand, China and Malaysia. In Bangladesh, it is found in the eastern and southern parts of the country.

Uses: Root stocks are eaten raw.

Propagation: By seeds and tuber.

State of occurrence in TH area: Rare.

National conservation status: Near Threatened (nt).



Lemna perpusilla

Scientific name: *Lemna perpusilla* Torrey

Synonyms: *Lemna paucicostata* Hegelm.

Family: Lemnaceae

English name: Common Duckweed.

Local name: Khudipana, Kutipana.



Description: Free floating, freshwater aquatic herb, with 1-3 leaves, with a single root stock. Leaves ovate to obovate-oblong, margins entire, obtuse at both ends, green. Stipe hyaline, slit of budding pouch coincides with the margin of the leaves. Fruit asymmetric, ellipsoid, margin winged. Seeds 7 in number, compressed, whitish, with 12-18 longitudinal ribs.

Habitat: Freshwater ponds, ditches, lakes, slow moving canals, rice fields and other stagnant water bodies.

Distribution: Worldwide. In Bangladesh, it occurs throughout the country.

Uses: The plant is a good water purifier. It is often used as an aquarium plant. It is also grown as a commercial crop as fish, duck and cattle feed.

Propagation: By buds and turions.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Cyperus rotundus

Scientific name: *Cyperus rotundus* L.

Synonyms: *Schoenus tuberosus* Burm. f., *Cyperus bulbosus* Camus

Family: Cyperaceae

English names: Coco-grass, Purple Nut Sedge

Local names: Mutha, Nagarmutha, Sadakufi, Vedha grass.

Description: Stoloniferous, perennial sedge, up to 60 cm tall; stolons terminated by an ellipsoid or globose-ovoid, blackish tuber. Leaves basal, several, blade linear, margins scabrid, apex gradually acuminate. Involucral bracts 2 - 3 (- 5), the longest equalling or shorter than inflorescence. Inflorescence simple, rarely compound. Spikes usually solitary, obovoid, glabrous. Spikelets 3 - 10 per spike, spicately arranged, suberect to patent, narrowly oblong to linear, flattened, 10 - 40- flowered. Nutlets cylindric to cylindric-obovate, trigonous, apiculate, maturing brown, minutely punctate.





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Habitat: Open or slightly shaded grounds, lawns, roadsides and waste places.

Distribution: Widely distributed in the warmer regions of the world. In Bangladesh, the plant occurs throughout the country.

Uses: Tubers of the plant are eaten raw, cooked or roasted and the grains are also eaten during famine. Roots are pungent, acrid, cooling, astringent, bitter, appetizer, stomachache, and anthelmintic. Tubers are used in leprosy, thirst, fever, blood diseases, biliousness, dysentery, pruritus, pain, vomiting, epilepsy, ophthalmia,

Propagation: By seeds and tubers.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Eleocharis dulcis

Scientific name: *Eleocharis dulcis* (Burm. f.) Trin. ex Hensch.

Synonyms: *Andropogon dulce* Burm. f. (1768), *Eleocharis plantaginea* (Retz.) Roem. & Schult.

Family: Cyperaceae.

English names: Chinese Water Chestnut, Ground Chestnut, Grey Sedge.

Local name: Chesra.

Description: Stoloniferous, perennial sedge; elongated stolons terminated by a small, subglobose, brownish to blackish tuber. Stems 40-200 cm high, tufted, terete, finely longitudinally striate, transversely septate, spongy, hollowed, deep green. Leaf sheaths are bladeless, membranous, apex truncate, reddish brown. Spikelet cylindrical, broader

than culms, subobtusate at apex, whitish. Glumes many per spikelet, elliptic-oblong to oblong-obovate. Perianth segments 6 - 8, filiform. Nutlets obovate to subglobose, biconvex with obtuse edges, maturing shiny yellowish or greyish brown, indistinctly longitudinally striate.

Habitat: Open marshy places along coast and inland.

Distribution: Widely distributed in the Old World tropics. In Bangladesh, it is found throughout the country.

Uses: In China, corms of the plant are eaten raw or cooked. Tribal people use tuber paste for curing burn wounds and allergic eruption in India.

Propagation: By seeds.

State of occurrence in TH area: Very common.

National conservation status: Least Concern (lc).





Cryptocoryne retrospiraiis

Scientific name: *Cryptocoryne retrospiraiis* (Roxb.) Fischer subsp. *albida* (Parker) Rataj

Synonym: *Cryptocoryne albida* R.N. Parker

Family: Araceae.

English name: Not known.

Local name: Basori.



Description: Aquatic or terrestrial, rhizomatous herb, submerged or sometimes growing in marsh. Leaves petiolate, blades sheathed at the base, linear-lanceolate, apex acute or acuminate, base cuneate, margins entire or inconspicuously undulate. Inflorescence of pedunculate spadix; spathe limb open and somewhat spreading at the base, tightly spiral, marking with brown to purple, ciliate along the margin; pistillate portion 4-6 mm long, a few neutrals just above the pistillate flowers, staminate portion 3 mm long and with a terminal short conical appendix. Syncarp with sub-fusiform, longitudinally ridged seeds.

Habitat: Shallowly tided sandy grounds and banks of streams, ditches, canals, beels and haors.

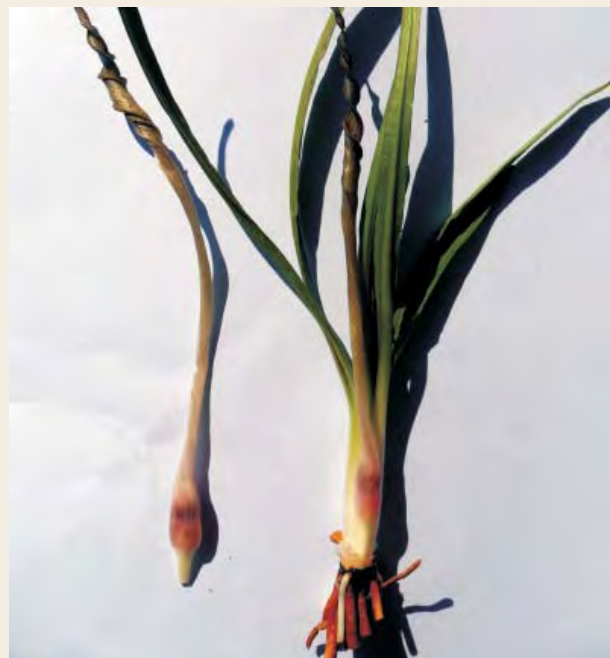
Distribution: Mostly occurs in tropical Asia and Africa. In Bangladesh, it is distributed throughout the country.

Use: Not known.

Propagation: By rhizomes and seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).



Saccharum munja



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Description: Tall perennial herb, stems up to 4 m tall. Leaves linear, flat or markedly channelled, the midrib occupying the greater part of the width, glaucous; sheath shortly silky at the base, pale straw colored. Inflorescence of panicles, silky greenish-brown. Spikelets heteromorphous, callus bearded with whitish or greyish hairs up to 2.5 mm long; glumes equal, membranous, lower glume of sessile spikelet hairy on the back, the upper glume glabrous, both glumes of pedicelled spikelet hairy; lower lemma oblong- elliptic, hairy on the back; upper lemma ovate-lanceolate, ciliate on the margins, acute or very shortly awned, the awn not visible beyond the glumes.

Habitat: Seasonally inundated places, river banks, margins of lakes.

Distribution: America, Europe, Souther and Eastern Asia and Australia.

Scientific name: *Saccharum munja* Roxb.

Synonym: *Saccharum bengalense* Retz.

Family: Poaceae

English name: Tall Cane.

Local names: Binna, Kana, Munja, Sarkanda.

Uses: It is used for thatching roofs, making baskets and ropes. Tender plant is only eaten by cattle during the scarcity of food.

Propagation: By seeds.

State of occurrence in TH area: Very Common.

National conservation status: Least Concern (lc).

Fimbristylis aestivalis



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Scientific name: *Fimbristylis aestivalis* (Retz.)

Vahl

Synonym: *Scirpus aestivalis* Retz.

Family: Cyperaceae

English name: Not known.

Local name: Not known.

Description: Annual herbs; stems densely tufted, up to 20 cm height, trigonous, smooth, light green. Leaves basal, blades narrowly linear, apex subacute, margins incurved, light green, densely to sparsely pilose on both surfaces. Involucral bracts 2 - 3 - (6), filiform, the lowest longer than the corymb. Inflorescence simple to compound corymb,



subglobose. Spikelets solitary, ovoid-conical or oblong-conical, compactly 10 - 40 flowered. Glumes yellowish brown, membranous, ovate. Nutlets obovate, biconvex, short stipitate, maturing yellowish, shiny, smooth or faintly cancellate.

Habitat: Open wet places including rice fields and wet sandy shores of inland lakes.

Distribution: Tropical and subtropical regions of the World. In Bangladesh, the plant occurs throughout the country.

Uses: Sometimes used as fodder but commonly known as a noxious weed of ricefield.

Propagation: By seeds.

State of occurrence in TH area: Very common.

National conservation status: Least Concern (lc).

Ottelia alismoides

Scientific name: *Ottelia alismoides* (L.) Pers.

Synonym: *Stratiotes alismoides* L.

Family: Hydrocharitaceae

English names: Duck Lettuce, Water Plantain.

Local names: Panikola, Ram karola, Shama kola.

Description: A submerged herb, rooting in the mud. Floating leaves broadly ovate, orbicular or cordate-reniform, transparent to translucent, apex obtuse, base cordate or rhomboid, margins dentate or entire; submerged leaves elliptic-lanceolate, apex acute, base attenuate, petiole up to 60 cm long. Spathes peduncled, membranous with 3 or more wings, sessile female and hermaphrodite ones 1-flowered. Flowers trimerous, white with a yellow spotted base. Fruits ovoid to cylindrical. Seeds fusiform, many, dark purple to black when mature, densely covered in whitish, unicellular hairs.



Habitat: Shallow ponds, streams, stagnant pools, ditches and lakes.

Distribution: Tropical Asia, Africa and Australia, and introduced in Europe and North America. In Bangladesh, it is found all over the country.

Uses: The leaves and inflorescences are eaten as a cooked vegetable in SE Asia.

Propagation: By seeds and tubers.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).



Panicum paludosum

Description: An aquatic perennial grass, stem up to 130 cm high, spongy below, erect or geniculate, rooting at the lower nodes, sometimes floating. Leaf blades linear to linear-lanceolate, blunt or sharply acute, margin scaberulous, ligule a ring of white hairs. Inflorescence a panicle, ovate or oblong, widely spreading. Spikelets elliptic-lanceolate or narrowly lanceolate, green. Glumes ovate-orbicular, hyaline. Lower florets barren or staminate, upper florets bisexual. Lemmas ovate to elliptic-lanceolate, faintly 7-nerved. Caryopsis oblong, rounded at the apex.

Habitat: Common in wet lands, marshes, submerged or floated in shallow and still water and along the banks of streams and backwater.

Distribution: Pakistan, Nepal, India, Sri Lanka, through Myanmar to South East Asia and tropical Australia. In Bangladesh, the species commonly occurs throughout the country.

Uses: A good fodder grass eaten by buffaloes and elephants.

Propagation: By seeds and rooted culms.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).



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Scientific name: *Panicum paludosum* Roxb.

Synonyms: *Panicum nutans* Koen. ex Trin., *Panicum proliferum* Hook. f.

Family: Poaceae

English name: Not known.

Local names: Barti, Kalam, Kalash Nar.

Coix lacryma-jobi

Description: A coarse, tufted, annual grass, culms up to 3 m high. Leaf blades linear-lanceolate, apex acuminate, base cordate, ligules ovate. Inflorescence on flattened peduncles clustered in the upper leaf axils, each consists of an involucre, a female spike and a male spike. Male spikelets elliptic or elliptic-lanceolate. Female spikelets globose, bony, shining, white, grey or bluish. Glumes ovate-elliptic or elliptic-lanceolate. Lemmas elliptic-lanceolate or oblong-lanceolate. Paleas elliptic-lanceolate, oblong-lanceolate or ovate-oblong.

Habitat: Marshy places, water courses, banks of streams, rivers, backwaters, ponds, paddy fields and other wetlands.

Distribution: Tropics of the World. In Bangladesh, the species commonly occurs throughout the country.

Uses: It is grown either for its grain, from which a porridge and beer can be made. The stem and leaves provide a useful fodder.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Scientific name: *Coix lacryma-jobi* L.

Synonyms: *Coix lachryma* L., *Coix pendula* Salisb.

Family: Poaceae

English names: Adlay, Job's Tears.

Local names: Kalokunch, Kawoakathi, Tasbi, Kaich.



Vetiveria zizanioides

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Scientific name: *Vetiveria zizanioides* (L.) Nash

Synonyms: *Phalaris zizanioides* L., *Vetiveria odoratissima* Lem.-Lisanc.

Family: Poaceae

English names: Khas-khas Grass, Vetiver Grass.

Local names: Binna, Gandha binna, Gandha Mul, Khas-khas.

Description: A perennial grass, culms tufted, up to 3 m tall. Leaf blades tessellate-veined, folded towards the base, flat upwards, sheaths glabrous, stramineous at age, margin eciliate. Inflorescence of oblong panicle, usually contracted. Spikelets sessile and pedicellate. Glumes 3-7 nerved, spinulose, awnless. Lemmas tip minutely bilobed, awned. Caryopsis apparently rarely formed.

Habitat: Seasonally inundated grassy areas around tanks and ponds, and ditches in lowlands.

Distribution: Pakistan, India, Sri Lanka, Nepal, Myanmar, South East Asia, tropical Africa and

introduced to the West Indies. In Bangladesh, the species occurs throughout the country.

Uses: The roots are aromatic and are the source of vetiver oil, an ingredient in perfumes. The roots are also woven into fragrant mats, rugs, fans, and bundles of roots are used in wardrobes to discourage insects or simply to provide a pleasant aroma.

Propagation: By seeds, rhizomes and roots.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).





Schoenoplectus juncooides

Uses: Rarely eaten by cattle.

Propagation: By seeds.

State of occurrence in TH area:
Common.

National conservation status: Least Concern (lc).

Scientific name: *Schoenoplectus juncooides* (Roxb.) Palla

Synonyms: *Scirpus juncooides* Roxb.

Family: Cyperaceae

English names: Bulrush, Hard-stem bulrush.

Local name: Chechra.

Description: Perennial sedge. Stem tufted, subterete, light green. Leaves bladeless, sheaths brownish. Inflorescence pseudolateral, capitate, with 2-12 spikes. Spikelets oblong to ovoid-oblong, straw coloured, densely many flowered. Glumes ovate-oval, pale brown, 1-3 nerved. Nutlets broadly obovate, unequally biconvex, contracted to the base, apex rounded to mucronate, shiny dark brown.

Habitat: Ricefields, riverbank, and margins of lakes, ponds and swamps.

Distribution: Tropical Africa, Asia and Australia. In Bangladesh, it is found all over the country.



Vallisneria spiralis

Scientific name: *Vallisneria spiralis* L.

Synonyms: *Vallisneria aethiopica* Fenzl.,
Vallisneria gracilis.

Family: Hydrocharitaceae

English names: Eel-grass, Tape-grass, Wild Celery.

Local names: Baicha, Bicha, Patajhang, Patseola.

Description: Perennial or occasionally annual, submerged stemless, stoloniferous, dioecious herb. Leaves radical, narrow, linear ribbon-shaped, margin serrate, varying in length with depth of the water, translucent. Male flowers numerous, minute, white, spathe shortly pedunculate, ovoid, break off at the base when the flowers emerge and float on the

water surface. Female flowers solitary, spathe 3-toothed, carried to the water surface in flower by uncoiling of the long filiform spiral scape. Fruit linear, included in the spathe. Seeds numerous.

Habitat: Fresh water tanks, lakes, ponds and haors.

Distribution: Widespread from India, Nepal, China, Sri Lanka, Indochina, Malaysia, Indonesia, Philippines, Japan and Australia. In Bangladesh, it is found all over the country.

Uses: The leaves are eaten in Japan and used as animal fodder in China. It is one of the favourite food of Grass carp fish.

Propagation: By seeds.

State of occurrence in TH area: Abundantly occur.

National conservation status: Least Concern (lc).



**Scientific name:**

Nechamandra alternifolia
(Roxb.) Thw.

Synonyms: *Vallisneria*

alternifolia Roxb.,
Nechamandra roxburghii
Planch.

Family: Hydrocharitaceae

English name:

Nechamandra.

Local name: Rasnajhangi.

Nechamandra alternifolia

Description: A submerged, dioecious herb with filiform, ascending stem. Leaves cauline, sometimes clustered, distichous, linear-lanceolate, flat, band shaped, veins parallel, sheath amplexicaul at the base, margin and apex with unicellular spines. Inflorescences axillary, clustered, spathe of 2 united bracts. Male flowers small, numerous, opening on the water surface. Female spathe sessile, solitary, axillary. Fruit an ovoid utricle, breaking irregularly. Seeds numerous, ovoid, with reticulate seed coat.

Habitat: Ponds, tanks, lakes, rivers and ditches.

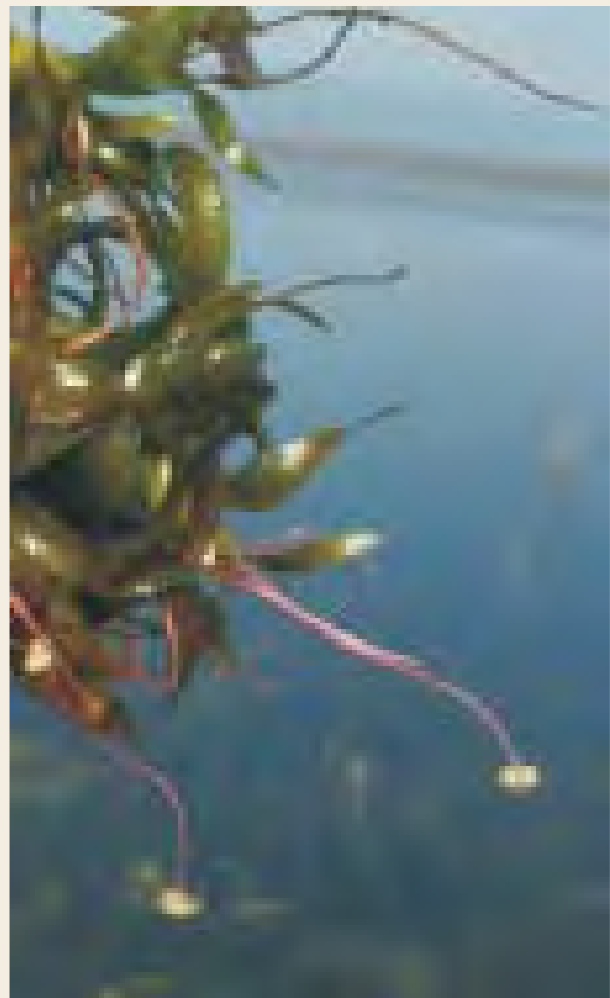
Distribution: Tropical Asia including India. In Bangladesh, it is found all over the country.

Uses: Not known.

Propagation: By seeds.

State of occurrence in TH area: Very Common.

National conservation status: Least Concern (lc).





Calamus longisetus

Scientific name: *Calamus longisetus* Griff.

Synonyms: *Calamus tigrinus* Kurz

Family: Arecaceae.

English name: Not known.

Local name: Uddom bet.

Description: Erect to climbing, tufted palm. Stem with sheath 8-10 cm diameter, internodes 18-25 cm long. Leafsheath greenish-yellow, densely armed, spines blackish-brown, flat, erect. Leaves ecirrate, 3-4 m long, leaflets 40-5 on either sides, solitary towards the top, alternate. Inflorescence a flabelliform spadix, up to 5 m long, both male and female seems to be alike. Fruits ellipsoid-ovoid, apiculate, supported by lacerated perianth, covered with dark brown to blackish scales. Seeds oblong-ovoid light brown, endosperm homogeneous.



Habitat: Dry hill slopes, sandy-loam soils of mixed evergreen forests.

Distribution: India, Myanmar, Thailand, Indonesia and Malaya Peninsula. In Bangladesh, it occurs in Cox's Bazar district and cultivated elsewhere.

Propagation: By seeds and suckers.

Uses: Stem is used in making furniture, walking-sticks, batons and wickerwork. Fruits are eaten sometimes.

State of occurrence in TH area: Rare.

National conservation status: Vulnerable (VU).



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Pistia stratiotes

Scientific name: *Pistia stratiotes* L.
Synonyms: *Zala asiatica* Lour., *Pistia minor* Blume
Family: Araceae
English names: Water Lettuce, Tropical Duckweed.
Local name: Topapana.

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Description: A stoloniferous, monoecious, free floating, aquatic herb. Stem bearing a rosette of leaves, with several adventitious roots clothed with plumosely spreading root-hairs. Leaves subsessile, obovate to ovate-cuneate, apex rounded to truncate, green, densely pubescent on both surfaces. Inflorescence of pedunculate spadix; spathe oblong-ovate, acute to acuminate, with a constriction at about the middle lower half, subconvolute, light yellowish-green to white, tomentose, margins and exterior fimbriate-pilose; spadix shorter than spathe, with 1 female flower below and 2-8 male flower above; males with 2 united stamens; ovary flask-shaped. Fruit a 8-20 seeded berry, crowned by the persistent stigma, membranous. Seeds oblong to truncate, reddish-brown.

Habitat: Fresh water ponds, ditches, slow-running streams and irrigation canals.

Distribution: Pantropical. In Bangladesh, it is found almost everywhere.

Uses: It is cultivated as a fodder plant. The leaves of the plant possess antiseptic, antitubercular, antidiysenteric and anthelmintic properties, and are used for the treatment of eczema, leprosy, piles, ulcers, syphilis, cough and asthma. Ash of the plants is used in curing ringworm infection.

Propagation: By stolons.

State of occurrence in TH area: Rare.

National conservation status: Least Concern (lc).

Cyperus compressus

Scientific name: *Cyperus compressus* L.

Synonyms: *Cyperus brachiatus* Poir.,
Cyperus pectiniformis R. & S.

Family: Cyperaceae.

English name: Hedgehog sedge, Poor
Land Flat Sedge.

Local names: Chancha.

Description: Terrestrial, tufted, annual herbs; stem up to 40 height, trigonous. Leaves few, basal, blade linear, flat to channeled, apex gradually narrowed to acute, scabrous at the top. Involucral bracts 3 - 5, patent, the lower ones surpassing the inflorescence. Inflorescence simple, rarely reduced to a single, sessile cluster. Spikes solitary, ovate. Spikelets 3 - 10 per spike, subdigitately arranged on the very short rachis, linear to oblong-lanceolate. Nutlets broadly obovoid, trigonous, broadly stipitate, apiculate, maturing shiny dark brown to blackish, minutely punctate.

Habitat: Open grasslands, waste places, waysides, seashores and cultivated grounds.

Distribution: Topical, subtropical and many temperate regions of the world. In Bangladesh, the plant occurs throughout the country.



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Uses: It is known as a harmful weed of crops.

Propagation: By seeds and tubers.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).



Hydrilla verticillata



Description: A perennial, submerged rooted herb. Stem much branched, slender, produces tuber-like rhizomes that spread horizontally. Leaves sessile, arranged in whorls with generally 2-8 leaves per whorl, blades oblong or spear-shaped, green, often with reddish-brown dots and dashes, margins sharply serrate-dentate, apex acute. Flowers solitary and inconspicuous, monoecious or dioecious. Male flower solitary, floating after being released from the spathe, reddish-white. Female perianth tubular, limbs as in the male flower, style filiform. Fruit subulate, smooth or softly echinate. Seeds ellipsoid, glabrous, dark brown.

Habitat: Freshwater tanks, beels, lakes, ditches, ponds and rivers.

Distribution: America, Europe, Africa, South and East Asia to Australia. In Bangladesh, it is found throughout the country.

Uses: It supplies oxygen in aquatic habitat. Leaves and stems are eaten by fishes and birds.

Propagation: By seeds and tubers.

State of occurrence in TH area: Abundant.

National conservation status: Least Concern (lc).

Scientific name: *Hydrilla verticillata* (L. f.) Royle

Synonyms: *Serpicula verticillata* L. f., *Hydrilla angustifolia*

Family: Hydrocharitaceae

English names: Whorled-leaved Hydrilla, Florida Elodea

Local names: Jhangi, Kureli, Kanjal.

Hemarthria protensa

Scientific name: *Hemarthria protensa* Steud.

Synonyms: *Rottboellia protensa* (Steud.) Hack., *Manisuris protensa* (Steud.) Hitchc.

Family: Poaceae.

English name: Not known.

Local name: Chalia, Chailla.



Description: A perennial grass, stem 90-180 cm tall, usually prostrate, sometimes erect, green or sometimes purple. Leaf blades linear-lanceolate, contracted in the lower part, apex acuminate, flat or canaliculate, glabrous, margin smooth, ligules very short, truncate, ciliate. Inflorescence an axillary, pseudo-spike. Spikelets paired, linear-lanceolate. Glumes coriaceous, awned. Lower florets neuter, upper florets bisexual. Lemmas broadly oblong, obtuse, hyaline. Paleas linear, obtuse. Caryopsis oblong, somewhat flattened, hilum basal, punctate.

Habitat: Marshes, plains and hills.

Distribution: Widely distributed in South and South-east Asia. In Bangladesh, the species occurs in the districts of Panchagarh, Rajshahi, Tangail, Mymensingh, Dhaka, Sunamganj and Comilla.

Uses: Used as a fodder grass. In *haor* region this specie is uses to protect homestead platforms from wave erosion.

Propagation: Commonly occur the stem, also propagate by seed.

State of occurrence in TH area: Very common.

National conservation status: Least Concern (lc).

Commelina benghalensis

Description: A creeping, much branched, annual or sometimes perennial herbs, rooting at basal nodes. Stem pubescent. Leaves ovate-elliptic or broadly ovate, apex acute to obtuse, margins entire, pubescent or glabrous. Inflorescence of leaf opposed, 2-3 flowered cymes, emerging from a funnel-shaped spathaceous bract. Flowers bluish-violet. Fruit a capsule, broadly ovoid-oblong, 3-celled. Seeds cylindric, truncate at one end, transversely rugose.

Habitat: Shady and damp places, hill slopes, roadsides, and other waste places.

Distribution: Worldwide. In Bangladesh, it occurs throughout the country.

Propagation: By seeds and nodal segments.

Uses: The plant is used medicinally as a diuretic, febrifuge and anti-inflammatory. It is used as animal fodder and also eaten by humans as a cooked vegetable.

State of occurrence in TH area: Common.

National conservation status: Least concern (lc).

Scientific name: *Commelina benghalensis* L.

Synonyms: *Commelina pyrrholepharis* Hassk., *Commelina rufociliata*.

Family: Commelinaceae

English names: Blue Commelina, Bengal Day Flower.

Local names: Kanchira, Dholpata.





Asparagus racemosus



Description: A profusely branched, spreading or ascending climber with reflexed spines, up to 3 m long; stems glabrous, smooth or grooved; roots with many, elongate tubers. Leaves scale-like, minute, cladodes presents mainly on branches and towards the end of stems, triquetrous, acicular-crenate. Inflorescence a raceme. Flower bisexual,

Scientific name: *Asparagus racemosus* Willd.

Synonyms: *Asparagus penduliflora*

Family: Liliaceae (Asparagaceae).

English names: Wild Asparagus, Sparrow grass.

Local name: Shatamuli.

pedicellate, white, sweet scented. Perianth segments 6, oblong to ovate-oblong. Fruit aglobose berry, yellowish green or white. Seeds 1-3 per fruit, globose or angled.

Habitat: Evergreen forests, deciduous forests, scrub jungles and also can survive in temporarily flooded areas.

Distribution: Tropical and subtropical regions of Africa, Asia and Australia. In Bangladesh, the species rarely occurs in the northern, central and eastern parts of the country.

Uses: Tubers of the plant are used for the treatment of gastric ulcer, dyspepsia, nervous disorder and gonorrhoea. It is also used as a tonic and having anti-cancerous properties.

Propagation: By seeds and tubers.

State of occurrence in TH area: Uncommon.

National conservation status: Near Threatened (nt).



Najas minor



Scientific name: *Najas minor* (Pers.) All.

Synonyms: *Fluvialis minor* Pers.

Family: Najadaceae

English names: Brittle Najad, Brittle Waternymph.

Local name: Jhaudham.

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Description: A monoecious, fragile, submerged, aquatic herb with dicotomous branches. slender or robust. Stems without spines, plumose or bushy towards the apex because of closely packed curved leaves. Leaf sheaths truncate to lacerate, blades linear, apex obtuse, margins with a few broad-based upcurved spinules. Male flowers enclosed within a ellipsoid spathe, ending above the perianth in a short cylindric neck, perianth closely investing the anthers. Female flower without a spathe. Fruits ellipsoid. Seeds elliptical-oblong, slightly curved at apex, clearly pitted, pits rectangular.

Habitat: Stagnant fresh water and moribund rivers.

Distribution: Tropical and warm temperate regions of Europe, Africa, America and Asia. In Bangladesh, it occurs throughout the country.

Uses: Plant is eaten by fishes.

Propagation: By seeds and rhizomes.

State of occurrence in TH area: Very Common.

National conservation status: Least Concern (lc).

Potamogeton crispus

Description: A perennial, rhizomatous, submerged, aquatic herb. Stolons lying flat just below the surface of the substrate, often developing turions at the tips. Stem slender, 10-70 cm long, somewhat flattened, angular, usually dichotomously branched, reddish. Leaves broadly linear to oblong, undulate, translucent, serrate, 3-5 veined, usually oblong, rarely acute, stipules deciduous, free. Inflorescence dense spikes with 2-10 flowers. Flowers greenish-white. Drupelets globose, usually united below, 5-6 mm long including the $\pm$ 2 mm long curved beak.

Habitat: Ponds, lakes, ditches, beels and haors.

Distribution: Temperate and subtropical regions of the World. In Bangladesh, it is found throughout the country.

Uses: Leaves are eaten as vegetables.

Propagation: By seed and tubers.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Scientific name: *Potamogeton crispus* L.

Family: Potamogetonaceae.

English name: Curly-leaf pondweed.

Local name: Not known.



Hygroryza aristata



Scientific name: *Hygroryza aristata* (Retz.) Nees

Synonyms: *Pharus aristatus* Retz., *Leersia aristata* (Retz.) Roxb.

Family: Poaceae

English names: Water Stargrass, Asian Watergrass

Local names: Uridhan, Janglidhan, Phutki.

Description: A mat-forming perennial grass; stems 20-100 cm long, creeping or trailing, spongy, with whorled feathery roots at the nodes. Leaf-blades ovate-oblong, ovate-lanceolate or lanceolate, blunt or acute at the apex, rounded to cordate at the base, scaberulous above, smooth and glaucous



beneath. Panicle ob-triangular, 3-6 cm long and wide, the lower branches spreading or sometimes deflexed. Spikelets 1-flowered, solitary, lanceolate, 6-8 × 3-4 mm, awned, pale green. Caryopsis oblong, 4-6 mm long, narrowed at the base, obtuse at the tip.

Habitat: Dry lowlands, still waters of lakes, ponds, canals, tanks and marshes, margins of paddy fields.

Distribution: India, Sri Lanka, Pakistan, Myanmar, southern China and South East Asia. In Bangladesh, the species frequently occurs throughout the country.

Uses: Cattle are fond of this grass and the grain is said to be eaten by the poorer people. Seed is useful in biliousness. It causes flatulence and constipation.

Propagation: By seeds and stolons.

State of occurrence in TH area: Rare.

National conservation status: Least Concern (lc).





Eichhornia crassipes

Scientific name: *Eichhornia crassipes* (Mart.) Solms

Synonyms: *Pontederia crassipes* Mart., *Eichhornia speciosa* Kunth

Family: Pontederiaceae

English name: Water Hyacinth.

Local names: Kachuripana, Jarmuni, Tagor.

Description: A perennial free floating, aquatic herb with long fibrous roots from a very short leafy main stem. Leaves radical with spongy petioles; leaf blades broadly ovate or rhomboid, shallowly cordate or rounded at the base, broadly obtuse at the apex, waxy, glabrous. Inflorescence a peduncled spike up to 30 cm long; bracts 2, anisomorphic. Flowers very showy, perianth tube curved slightly, base green, lobes ovate to ovate-

oblong or obovate, lilac with a bright yellow, blue bordered median blotch. Fruit a capsule, linear-oblong, 3-chambered. Seeds ovoid.

Habitat: Stagnant or slow moving fresh water.

Distribution: Tropical to subtropical countries throughout the world. In Bangladesh, it is found throughout the country.

Uses: It purifies water by absorbing pollutants like lead, mercury, strontium-90 and other carcinogenic compounds. Vegetative parts mainly young inflorescences used as vegetables. It is used for making furniture, rope and handbags. Compost plant is used as manure. Floating seed bed is made with the plant. The plant is also used as a fodder.

Propagation: Vegetative propagation through stolons, and sexual reproduction by seeds are also notable.

Status of occurrence in TH Area: Common.

Conservation status: Treated as an invasive alien species.

Phragmites karka

Scientific name: *Phragmites karka* (Retz.) Trin. ex Steud.

Synonyms: *Arundo karka* Retz., *Phragmites roxburghii* (Kunth) Steud.
Family: Poaceae

English names:
Tropical Reed, Tall Reed.

Local names: Dharma, Nal, Nalkhagra.



Description: A perennial reed with stoloniferous rhizomes, culms erect, up to 10 m high, hollow. Leaf blades lanceolate, tapering gradually to an acuminate point, margin scabrid. Inflorescence a large, compound, terminal panicle. Spikelets solitary, bisexual. Glumes boat-shaped, 3-nerved. Lemmas narrowly elliptic. Paleas 2-nerved, linear, acute. Caryopsis oblong-cylindrical, crowned by the style base.

Habitat: Slow-running streams, swamp, backwaters, banks of ponds, haor and other man-made habitats.

Distribution: Tropical Africa, Sri Lanka, India, Myanmar, Thailand, Malesia and Australia. In Bangladesh, the species very commonly occurs almost throughout the country.

Uses: Phragmites stands are very important for wildlife. The young foliage may be used as a fodder and old stems are used for thatching and matting. In Romania and Poland, it is harvested in large quantities as raw material for the paper and chemical industries. Indians have used the stems for arrow and for weaving mats and nets. It is an excellent stabilizer of eroding river banks. The plant is useful in biliousness, urinary troubles, vaginal and uterine complaints and heart diseases.

Propagation: By seeds and rhizomes.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

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Scientific name: *Schumannianthus dichotomus* (Roxb.) Gagnep.
Synonyms: *Phrynium dichotomum* Roxb., *Clinogyne dichotoma* (Roxb.) Salisb. ex Benth.
Family: Marantaceae
English name: Mat plant.
Local names: Murta, Pati pata, Pati bet, Mostak.



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Schumannianthus dichotomus

Description: A rhizomatous shrub, up to 4 m long. Stem glossy green, soft cane-like cylindrical, dichotomously branched at the upper half, rootstock tuberous. Leaves oblong-lanceolate or elliptic, apex acuminate, base broadly rounded, petiole narrowly winged to pulvinus. Inflorescence a panicle. Flowers in pairs, trimerous, white. Fruit pear-like. Seed sub-globose.

Habitat: Swamp lands, margin of fresh water ponds and canals.

Distribution: India and Malaysia. In Bangladesh, the species is widely cultivated in wetlands in the northeastern parts of the country.

Uses: The outer part of the split stem is widely used as fibre and used for weaving mats, baskets, bags, novelty items etc. The arillus seeds are occasionally eaten.

Propagation: By seeds, rootstocks and stem cuttings,

State of occurrence in TH area: Rare.

National conservation status: Least Concern (lc).





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Scientific name: *Glinus oppositifolius* (L.) A. DC.

Synonyms: *Mollugo oppositifolia* L., *Mollugo spargula* L.

Family: Molluginaceae

English names: Bitter Cumin, Indian Chickweed

Local names: Gima-sak, Jima.

Glinus oppositifolius

Description: A prostrate annual herb, up to 50 cm long. Leaves are in pseudo-whorls of 3-6 or opposite; leaf blade spoon-shaped or elliptic, base attenuate, apex obtuse or acute, margins with sparse teeth. Flowers pedicellate, greenish white. Fruit a dehiscent capsule, ellipsoid, reddish-brown, distinctly granulate. Seeds numerous, reniform.

Habitat: Moist fallow lands, cultivated fields and walls.

Distribution: From tropical Africa, the eastern Himalayas, Sri Lanka and Myanmar, extending throughout Malesia up to Australia. In Bangladesh, it occurs throughout the country.

Uses: The bitter-tasting shoots and young leaves are eaten as a cooked vegetable. Young leaves are expectorant and febrifuge, and can be used for curing bowel complaints, colds or headaches.

Propagation: By seeds and stem cuttings.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).



Alternanthera philoxeroides

Scientific name: *Alternanthera philoxeroides* (Mart.) Griseb.

Synonyms: *Bucholzia philoxeroides* Mart., *Achyranthes philoxeroides* (Mart.) Stand.

Family: Amaranthaceae

English name: Alligator Weed.

Local names: Helencha, Malancha Shak, Hycha.

Description: Perennial, polymorphic herb, stem up to 4 m long when prostrate, up to 30 cm when erect on dry land, simple or branched, robust, hollow inside, villous to nearly glabrous. Leaves petiolate, opposite, oblong or linear-oblong, lanceolate, base narrowed down, apex acute or obtuse, entire, glabrous. Inflorescence a terminal and apparently axillary, spherical, solitary head, white, pedunculate. Flowers papery, ball-shaped; tepals oblong, glabrous, apex acute or rather obtuse, 1-nerved. Nuts ellipsoid, trigonous.

Habitat: Stagnant or slow moving shallow water bodies, pools, ditches and wet soil.

Distribution: Native of Brazil, common in India, Thailand, Indonesia, Malaysia, China, Australia, New Zealand and USA. In Bangladesh, it is found all over the country.

Propagation: By seeds and stem cuttings.

Uses: Young twigs are used as vegetable and fodder.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).



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Cotula hemispherica

Scientific name: *Cotula hemispherica* (Roxb.) Wall. ex Clarke
Synonym: *Artemisia hemispherica* Roxb.
Family: Asteraceae
English name: Not known.
Local name: Babuni.



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Description: An erect, annual herb. Stem up to 14 cm long, terete, glabrous. Leaves pinnatisect, segments very numerous, linear, rarely subulate, mucronate, sometimes acuminate or acute, half-amplexicaul at the base. Inflorescence a solitary capitulum. Involucral bracts 2-seriate, elliptic-lanceolate. Female florets without corolla. Corolla of hermaphrodite florets yellow. Fruit a cypsela, obovate to linear-oblong, 3-4 angled.

Habitat: Dry sandy soil and wet fallow lands.

Distribution: India and China. In Bangladesh, it is found all over the country.

Uses: Not known.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).





Ceratophyllum demersum

Description: A submerged, rootless herb. Stem long, smooth, delicate, varying in length according to the depth of the water. Leaves densely whorled, once or twice forked, blade flat, linear, bright green, stiff, coarse-textured, variable in amount of toothing. Flowers unisexual, submersed, imperfect, male and female flowers at different nodes, both male and female flowers subtended by an involucre or perianth of 8-15 greenish segments. Fruit a small nutlet, ovoid, green to dark pinkish, provided with 3 spines.

Habitat: Stagnant freshwater bodies.

Distribution: North America, Europe, and temperate and tropical Asia. In Bangladesh, the species occurs throughout the country.

Propagation: By segmented stem and seeds.

Uses: The plant is of value as a protective cover for fresh laid spawn and young fish fry. It is also grown in aquaria.

State of occurrence in TH area: Rare.

National conservation status: Least Concern (lc).

Scientific name: *Ceratophyllum demersum* L.

Family: Ceratophyllaceae

English names: Con's Tail, Hornwort, Rigid hornwort.

Local name: Sheola.



Aniseia martinicensis

Scientific name: *Aniseia martinicensis* (Jacq.)

Choisy

Synonyms: *Convolvulus martinicensis* Jacq.,
Ipomoea uniflora Roem. & Schult.

Family: Convolvulaceae

English name: Whitejacket

Local name: Rada lata.

Description: Twining perennial herb with slender thinly appressed-pilose or glabrescent stems, sometimes rooting below. Leaves narrowly to broadly oblong, apex obtuse, truncate or emarginate, rarely acute, minutely mucronate, base cuneate or attenuate, glabrescent or thinly pubescent, particularly at the margins and on the nerves below; petiole up to 10 mm long. Flowers are usually solitary, pedunculate, white. Fruit a capsule with persistent calyx, elongate-ovoid, brown outside, silvery-white inside. Seeds ovate, minutely pilose on the sides, wooly on the edges.

Habitat: Village thickets, cultivated areas, sometimes in swamp forests and sea shores.

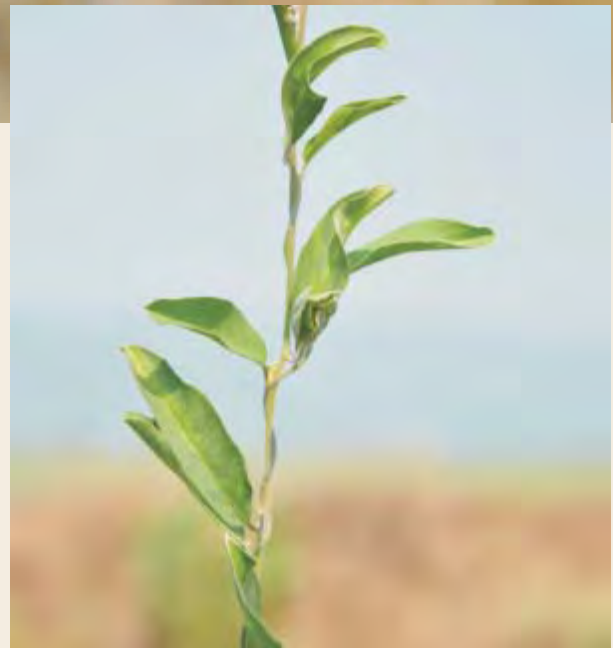
Distribution: Pantropical. In Bangladesh, it occurs in the districts of Chittagong, Cox's Bazar, Khagrachari, Mymensingh, Netrakona and Rangamati.

Propagation: By seeds.

Uses: The plant is purgative. Leaf juice is used in bilious dyspepsia.

State of occurrence in TH area: Rare.

National conservation status: Least Concern (lc).



Cleome hassleriana

Description: Annual or rarely perennial herbs, 30-100 cm tall. Stems branched, glabrous or glabrescent. Leaves 5-7 foliate, the terminal 3-5 leaflets usually larger; leaf-blades oblanceolate to rhomboid-elliptic, margins entire or serrulate-ciliate, apex acute, obtuse, or sometimes acuminate. Inflorescences of terminal racemes, 30-40 cm long. Bracts leaflike, 3-foliate. Flowers polygamous, rosy-pink, gradually turning into white. Fruit a capsule, striate, elongated-cylindrical, glandular-pubescent, greyish at maturity. Seeds reniform, reddish brown to black with white funicular aril.

Habitat: Disturbed areas, roadsides, riverbanks, cropped and abandoned lands.

Distribution: Native of tropical South America. Cultivated as an ornamental in other tropical countries. In Bangladesh, it is found in Dhaka, Chittagong, Sylhet and Sunamgonj districts.

Propagation: By seeds.

Use: It is used as an ornamental plant for its showy flowers.

State of occurrence in TH area: Very common.

National conservation status: Vulnerable (VU).



Scientific name: *Cleome hassleriana* Chodat

Family: Capparaceae

English names: Fringed Spider Flower, Pink Queen.

Local names: Jharna Phul, Swice Phul.



Chylocalyx perfoliatus

Scientific name: *Chylocalyx perfoliatus* (L.) Hassk. ex Miq.
Synonyms: *Polygonum perfoliatum* L., *Persicaria perfoliata* (L.) Gross
Family: Polygonaceae
English names: Devil's tail, Asiatic tearthumb, Thorny Smartweed.
Local name: Kanta Tokpata.

Description: A trailing vine, attaining a length of 3 m. Stem armed with recurved prickles. Leaves petiolate, lamina peltate, deltoid, apex acute to subacute, margin minutely scabrous, ocreas cup-shaped. Inflorescence a short raceme, subtended by an orbicular, leafy bract. Flowers are small, white and generally inconspicuous. Fruit a nut, globose, smooth and shining, metallic blue and segmented, each segment containing a single glossy, black or reddish-black seed.

Habitat: Damp shady places along streams or sunny areas.

Distribution: India, Nepal, Bhutan, China,

Japan, Korea, the Philippines, Taiwan and USA. In Bangladesh, the species occurs in the districts of Rangpur, Khulna, Sylhet and Dhaka.

Uses: Commonly known as a weed. Fruits are a favourite of birds. It is eaten by children. The leaves are eaten as vegetable. In traditional Chinese medicine, it is valued for diuretic, anti-inflammatory, and other effects.

Propagation: By seeds.

State of occurrence in TH area: Rare.

National conservation status: Not Evaluated (NE).

Phyllanthus reticulatus

Scientific name: *Phyllanthus reticulatus* Poir.

Synonyms: *Phyllanthus multiflorus* Willd. *Anisonema multiflora* (Willd.) Wight

Family: Euphorbiaceae

English names: Reticulated Leaf-flaver, Potato Plant.

Local names: Chitki, Pankushi, Panseuli.



Description: A much-branched, erect or scrambling shrub or small tree, up to 5 m tall. Leaves stipulate, petiolate, blades elliptic to ovate, obtuse to rounded at the apex, cuneate at the base, glabrous. Flowers greenish-yellow with a reddish tinge, clustered on the tips of short slender branches, one female and a number of male flowers are grouped together. Fruits globose to oblate, smooth, black with dark purplish at maturity. Seeds trigonous, faintly reticulate, brown.

Habitat: Along watercourses, but also in scrub and hedges, on waste places, and in mixed evergreen forests.

Distribution: Tropical Africa, Asia and Australia. In Bangladesh, the species occurs in most parts of the country.

Uses: Branches are used as fuel wood. Extract of roots is hypoglycaemic, aperient and expectorant. Leaf juice is useful in diarrhoea. Seeds are carminative and emetic.

Propagation: By seeds.

State of occurrence in TH area: Very common.

National conservation status: Least Concern (lc).



Clerodendrum indicum

Scientific name: *Clerodendrum indicum* (L.) O. Kuntze

Synonyms: *Siphonanthus indica* L.,
Clerodendron siphonanthus R. Br.

Family: Verbenaceae

English names: Indian Tube Flower, Indian Glory Bower.

Local names: Bamunhatti, Bonchat.

Description: A perennial, semi-woody shrub, reaching up to 3 m tall. Stem obtusely 4-angled, bark ashy-grey, smooth and shining. Leaves simple, sessile, whorls of 3-6, blades narrowly lanceolate or oblong-lanceolate, apex acuminate, glabrous on both surfaces, margin entire or serrate. Flowers tubular, snow white to creamy-white, pedicellate. Fruit a drupe, dark metallic blue, enclosed partly by the enlarged calyx.

Habitat: Fallow and waste lands, along railway tracts, roadsides and in village thickets.

Distribution: Tropical Africa, Asia and Australia. In Bangladesh, it occurs all over the country.

Uses: The plant is important both for medicinal and ornamental purposes. Leaves are used as a tonic and vermifuge. Root is considered as useful in the treatment of asthma, cough and scrupulous affections. The resin obtained from the plant is used to controlling syphilic rheumatism.

Propagation: By stolons and seeds.

State of occurrence in TH area: Rare.

National conservation status: Least Concern (lc).



Crateva magna

Scientific name: *Crateva magna* (Lour.) DC.

Synonym: *Crateva nurvala* Buch.-Ham.

Family: Capparaceae.

English name: Three-leaf Caper.

Local names: Barun, Bannya, Tikthashak.

Description: Medium sized, deciduous tree, up to 20 m height. Bark lenticellate, greyish-brown, smooth or verrucose. Leaves trifoliate, petiolate; central leaflet elliptic-lanceolate or oblanceolate, lateral ones ovate-elliptic or rhomboidal, base acute to cuneate, apex gradually acuminate with acute tip. Inflorescence of many-flowered, terminal corymbs. Flowers creamy-white turning yellow with purple stamens, polygamous, faintly fragrant. Fruit a berry, oblong-ellipsoid or oblong-ovate, pericarp woody, yellowish-grey, with a powdery crest. Seeds dark brown, tubercled, embedded in creamy pulp.

Habitat: Transitional lands between aquatic and terrestrial habitats (i.e. riversides), and evergreen and mixed deciduous forests.

Distribution: Tropical regions of the World. In Bangladesh, it occurs throughout the country.

Uses: Leaves are used for treatment of skin diseases and in rheumatic joint for relief of pain. Extract of root barks of the plant is used for curing gastric trouble. Young berries are eaten as cooked vegetable.



Propagation: Seeds and suckers.

State of occurrence in TH area: Not very common.

National conservation status: Least Concern (lc).



Crotalaria pallida

Scientific name: *Crotalaria pallida* Ait.

Synonyms: *Crotalaria saltiana* auct. non Andr., *Crotalaria striata* DC.

Family: Fabaceae.

English names: Rattle pod, Salts Rattlebox, Smooth crotalaria.

Local names: Jhun-jhuni, Jhunjhuna.

Description: Perennial herbs or subshrubs; stems ascending or erect, glabrous or appressed short-pubescent. Leaves trifoliolate, leaflets elliptic, ovate, or oblanceolate, apex rounded to acute, occasionally retuse, base cuneate or rounded. Inflorescence of terminal and leaf-opposed racemes. Flowers yellow, with reddish-brown lines. Pods subcylindrical, brown at maturity, stipitate, glabrous or sparsely appressed short-pubescent. Seeds unequal-sided, cordate, finely papillate, mottled grey-green to brown.

Habitat: Pastures, waste ground, along roadsides and river banks, and also in deciduous and evergreen forests.

Distribution: Pantropical. In Bangladesh, the plant is available throughout the country.

Uses: The seeds are sometimes used as substitute for coffee. They are also used for making alcohol. Stem fibre is similar to sunn hemp. A black dye can be prepared from the plant.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Rosa clinophylla

Scientific name: *Rosa clinophylla* Thory

Synonym: *Rosa involucrata* Roxb. ex Lindl.

Family: Rosaceae

English name: Wild rose of Bengal.

Local names: Jongli golap, Ban golap.

Description: A spinous, erect or scandent, bushy shrub, about 2.5-3.0 m high. Leaves pinnately compopund, alternate, stipulate; leaflets 7-9, oblong to elliptic-lanceolate, apex subacute to obtuse, base rounded or obtuse, finely serrate, pubescent beneath. Flowers showy, sweet scented, white but anthers yellow. Calyx tube globose or obovoid, brown or greyish velvety outside, lobes lanceolate or ovate. Petals broadly obovate, retuse at the apex, glabrous. Fruits globose, densely tomentose.

Habitat: Edges of fresh water swamp forests.

Distribution: Native to India, Bangladesh and Myanmar. However, found all over the World. In Bangladesh, it occurs naturally in Haor areas of Sunamganj district.

Use: The plant is commonly used as stock for grafting better class roses.

Propagation: By seed and cuttings of twigs.

State of occurrence in TH area: Common.

National conservation status: Vulnerable (VU).



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Heliotropium indicum



Scientific name: *Heliotropium indicum* L.

Synonyms: *Heliophytum indicum*,
Heliotropium parviflorum, *Tiaridium indicum*

Family: Boraginaceae.

English names: Indian heliotrope, Indian turnsole, Erysipela plant.

Local names: Hatisur, Hatisura.

Description: Erect, annual herb, up to 60 cm high. Stem branched, densely scabrous hairy. Leaves simple, lower opposite and upper sub-opposite to alternate, ovate or ovate-oblong, apex acute to sub-acute, margin slightly undulate, base cordate or attenuated, hirsute above and densely pubescent beneath. Inflorescence terminal or leaf-opposed, scorpioid, spike-like, monochasial or one-sided cymes. Flowers white or pale violet-blue, mauve. Fruits deeply lobed and beaked cocci or nutlets.

Habitat: Open waste places, sandy river banks, roadsides and sometimes in cultivated lands.

Distribution: Widespread in all tropical regions of the world. In Bangladesh, it occurs throughout the country.

Uses: The plant usually considered as a common weed in Bangladesh, but important for medicine. The extracted juice from the pounded leaves of the plants is used to cure

wounds, skin ulcers and furuncles. The juice is also used as an eye drop for conjunctivitis. The pounded leaves are used as poultice.

Propagation: By seeds.

State of occurrence in TH area: Common.

National Conservation status: Least Concern (lc).





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Lindernia antipoda

Description: Perennial or annual herbs; stems erect or decumbent, usually rooting at lower nodes, branched at base, glabrous. Leaves elliptic to oblanceolate or obovate, glabrous, cuneate or subacute at the base, subacuminate to obtuse at the apex, margins entire to remotely serrate, sessile. Flowers solitary or in terminal or axillary racemes, pedicelled, pale violet or violet-blue to pale blue or white, occasionally pale purple. Bracts linear or linear-lanceolate to oblong-lanceolate. Calyx 5-lobed, lobes linear-lanceolate, subequal. Corolla bi-labiate. Capsules (fruit) linear-cylindric or subulate-cylindric, glabrous, often dull purple. Seeds oblong to ellipsoid, reticulate.

Habitat: Banks of rivers, tanks and ponds, rice fields, and other moist places.

Distribution: Sri Lanka, India, Bhutan, Nepal, Myanmar, Thailand, Cambodia, Vietnam, Laos,

Scientific name: *Lindernia antipoda* (L.)

Alston

Synonyms: *Ruellia antipoda* L., *Vandellia veronicifolia* (Retz.) Haines.

Family: Scrophulariaceae

English name: Sparrow False Pimpernel.

Local name: Not known

Malaysia, the Philippines, Japan, Papua New Guinea, and Australia. In Bangladesh, this species is common throughout the country.

Use: Not known.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Trapa maximowiczii

Description: Floating, aquatic herb; stem submerged, stoloniferous bears two types of adventitious roots. Leaves rosette, floating on the surface of water, densely villous beneath, petioles swollen. Flowers white, tetramerous, comes out of water or floating on the surface of water. Fruits a large nut, glabrous or hairy, with two sharp spines on two opposite angles, the other two angles sometimes obsolete.

Habitat: Fresh water tanks, Beels, ditches and ponds, often wild.

Distribution: Throughout the warm tropical sub-tropical regions of the World. In Bangladesh, it occurs in the districts of Dhaka, Mymensingh, Naogoan, Rajshahi and Sylhet.

Scientific name: *Trapa maximowiczii* Roxb.

Synonym: *Trapa quadrispinosa* Wall.

Family: Trapaceae

English names: Water Chest Nut, Bull nut.

Local names: Paniphal, kata Singara.

Uses: The nut is eaten either raw or cooked. Dried fruit powder is used during the holy festival for making 'Khirsha'. The nuts are considered to be cooling and useful in bilious affections and diarrhoea.

Propagation: By seeds or rootstocks.

State of occurrence in TH area: Very common.

National conservation status: Least Concern (lc).



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Barringtonia acutangula

Scientific name: *Barringtonia acutangula* (L.) Gaertn.

Synonyms: *Eugenia acutangula* L., *Michelia acutangula* (L.) O. Kuntze

Family: Lecythidaceae

English names: Barringtonia Tree, Indian Oak.

Local names: Hendol, Hijal, Kumia.

Description: Small to medium evergreen tree with spreading crown. Leaves simple, alternate, oblong-elliptic, apex acute to round, base cuneate, minutely denticulate-crenate, glabrous. Inflorescence pendulous racemes. Flowers small, fragrant, dark scarlet or creamy white. Fruit a berry, crowned by persistent calyx, oblong, bluntly quadrangular.

Habitat: Marshy lands, along the rivers, canals and ponds, and mangrove forests.

Distribution: Throughout India from Himalaya to Sri Lanka, Malay and Australia. In Bangladesh, it is common throughout the country in low lying areas.

Propagation: By seeds.

Uses: Wood used for furniture and house making. Leaf juice is useful in diarrhoea and dysentery. Roots are cooling, aperient and expectorant, stimulating and emetic. The fruit



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is astringent to the bowels, lactagogue, vulnerary, anthelmintic. Thus useful in biliousness, bronchitis, sore eyes, lumber pain and hallucinations. Seeds are carminative and emetic.

State of occurrence in TH area: Common but its population is decreasing gradually.

National conservation status: Least Concern (lc).

Ipomoea fistulosa

Scientific name: *Ipomoea fistulosa* Mart. ex Choisy

Synonyms: *Batatas crassicaulis* Benth., *Ipomoea crassicaulis* (Benth.) B. L. Robinson

Family: Convolvulaceae

English name: Pink Morning Glory.

Local names: Dholkolmi, Beragach, Behaya.

Description: Shrub, up to 2.5 m tall, branches ascending, usually fistular, containing milky juice. Leaves simple with long petiole; ovate to ovate-oblong, base cordate to truncate, acuminate, mature leaves pubescent below on the nerves, more or less glabrous above, young leaves densely puberulent on both surfaces. Flowers few to many in axillary cymes or panicles, rarely sub-terminal, pink or pale lilac, dark purplish inside towards the base. Fruit a globose capsule, pale brown, 4-valved, persistent sepals embrace the fruit. Seeds sub-globose, black, sericeo-villous.

Habitat: Fallow lands, roadsides and sides of water bodies.

Distribution: Tropical Africa and Asia. In Bangladesh, it is found all over the country and become an invasive.

Uses: It is cultivated in the gardens for its colourful flowers. Also, cultivated as hedge plant in crop fields. This also used for the prevention of erosion of soil by water current.

Propagation: By seeds and stem cuttings.

State of occurrence in TH area: Very common.

National conservation status: Least Concern (lc).

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Ludwigia adscendens

Scientific name: *Ludwigia adscendens* (L.)

Hara

Synonyms: *Jussiaea repens* L., *Jussiaea adscendens* L.

Family: Onagraceae

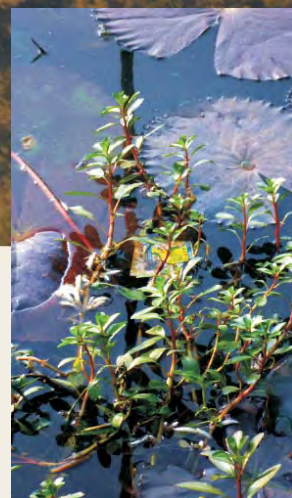
English names: Water Primrose, Water Dragon.

Local names: Kesara-dum, Malcha, Mushi, Molchi, Khaidam.

Description: Aquatic or wetland, annual herbs, rooting at the nodes and with conspicuous white, erect, spindle-shaped, mucronate, pneumatophores arising in clusters at the nodes of floating stem. Leaves simple, alternate, broadly oblong-elliptic, obtuse or retuse, smooth, main veins prominent. Flowers white, solitary in the axils or at the end of branches, sepals deltoid-acuminate, glabrous to villous; petals 5, obovate, rounded at the apex. Fruit a capsule, irregularly dehiscent between the ribs. Seeds uniseriate in each locule, purple-brown, smooth, embedded in coherent cubes of woody endocarp.

Habitat: Marshy stagnant ditches, ponds and rice fields.

Distribution: Indian subcontinent spreading up to China and Malesia to North Australia. In Bangladesh, it is found all over the country.



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Uses: Usually it is a weedy plant but have medicinal values. Leaf extract is taken for curing dysentery. Extracts of leaves and stem exert strong antimicrobial activity similar to that of standard antibiotics. Flower petals possess anti-inflammatory activity.

Propagation: By seeds and broken pieces of floating stems.

State of occurrence in TH area: Very common.

National conservation status: Least Concern (lc).

Helichrysum luteoalbum

Scientific name: *Gnaphalium luteo-album* L.

Synonyms: *Gnaphalium affine* D. Don, *Gnaphalium indicum* Blanco, *Gnaphalium luteo-album*

Family: Asteraceae

English names: Common cudweed, Weedy Cudweed.

Local name: Bara Kamra.



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Description: An erect, annual herb, up to 40 cm tall, stem softly white. Leaves linear-spatulate or oblong-spatulate, apex acute-apiculate, base semi-amplexicaul, margins entire, densely white tomentose or woolly on both surfaces. Inflorescence a terminal, clusters of glistening, yellow heads. Flowers golden-yellow. Fruit a cypsela, oblong-obovoid, with minute sparse hairs or glands, pappus white.

Habitat: Moist fallow lands, roadsides, open fields and the sides of rice fields.

Distribution: Tropical and sub-tropical region of the World. In Bangladesh, it is found all over the country.

Uses: Leaves are astringent and vulnerary. Tomentum is applied in gout as counter irritant.

Propagation: By seeds.

State of occurrence in TH area: Very common.

National conservation status: Least Concern (lc).

Xanthium indicum

Scientific name: *Xanthium indicum*
Koen. ex Roxb.

Synonyms: *Xanthium orientale* L.,
Xanthium strumarium L.

Family: Asteraceae

English names: Common Cocklebur,
Rough Cocklebur.

Local names: Ghagra, Hagra, Khagra.

Description: An erect annual herb, stem up to 60 cm tall, unarmed, hispidulous or pubescent. Leaves petiolate, lamina broadly triangular-ovate or suborbicular, variously lobed, apex acute or acuminate, base cordate-cuneate, margins irregularly serrate-dentate, sparsely hispidulous on both surfaces. Inflorescence of terminal and axillary capitulum, male capitulum globose, female ones ovoid, covered with hooked bristles. Fruit a rostra, thick, divergent, hooked at the apex.

Habitat: Fallow lands, canal banks, valleys, roadsides, open fields, waste places and cultivated fields.

Distribution: America, India, China, Malaysia and Indonesia. In Bangladesh, it is found all over the country.

Uses: Young stems, petioles and leaves are used as a vegetable. The plant is cooling, laxative, fattening, anthelmintic, alexiteric, tonic, digestive, antipyretic, and improves appetite, voice, complexion, and memory. The plant has been reported as fatal to cattle and pigs.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

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Rumex dentatus

Scientific name: *Rumex dentatus* L.
Synonym: *Rumex klotzschianus* Meissn.
Family: Polygonaceae.
English names: Toothed dock, Dentate dock, Indian Sorrel.
Local name: Bon-palong.



Description: Annual, erect herb, up to 70 cm tall. Leaves simple, alternate, lower leaves distinctly petiolate, lamina oblong, glabrous, base rounded or truncate, apex broadly obtuse to round, margins wavy. Inflorescence paniculate raceme. Flowers aggregated in axillary clusters or in whorls, pedicellate, bisexual, tepals 6, inner tepals with spine like teeth and enlarged in fruits. Fruit a nut, enclosed in the enlarged inner tepals.

Habitat: Disturbed lands, roadsides, lakeshores, cultivated fields and mountain slopes.

Distribution: It is native to parts of Eurasia and North Africa, and now widely found elsewhere. In Bangladesh, it occurs in almost all over the country.

Uses: Leaves are sometimes cooked as leafy vegetables. Root is used as an astringent in the treatment of cutaneous disorders.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).



Persicaria lapathifolia

Scientific name: *Persicaria lapathifolia* (L.)
S. F. Gray

Synonyms: *Polygonum lapathifolium* L.,
Polygonum nodosum Pers.

Family: Polygonaceae

English names: Pale Persicaria, Pale
Smartweed.

Local names: Panimorich, Bishkatali.

Description: Annual, erect or decumbent herb. Stem green or with red spots, glabrous or occasionally sparsely hairy, nodes swollen. Leaves lanceolate, base attenuate, apex acute or acuminate, margin hairy. Ocrea tubular, glabrous or sparsely hairy. Inflorescence raceme, densely-flowered. Flowers greenish-white, sometimes reddish, tepals mostly 4, very rarely 5, covered with multicellular yellow scale-like glands. Nuts biconcave, flat, black to dark brown, shining, smooth.



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Habitat: Marshy areas, and occasionally cultivated fields.

Distribution: Africa, America, Asia and Europe. In Bangladesh, the species is found throughout the country.

Uses: Leaf extract has antimicrobial and anti-cancerous properties. It is used for curing skin sores.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Persicaria orientalis

treatment of ulcers and wounds. The plant is also used to kill body lice of cattle.

Propagation: By seed.

State of occurrence in TH area: Very common.

National conservation status: Least Concern (lc).

Scientific name: *Persicaria orientalis* (L.) Spach

Synonyms: *Polygonum orientale* L., *Polygonum pilosum* Roxb.

Family: Polygonaceae

English names: Prince's Feather, Gate Knotweed.

Local name: Bara Panimorich.

Description: An annual herb. Stem simple or much branched, up to 3 m tall, silky pubescent. Leaves simple, alternate, petiolate, blades ovate, ovate-cordate or ovate-lanceolate, apex acuminate, base truncate, rounded or cordate, margins entire. Ocrea tubular, silky villous. Inflorescence of terminal spikes. Flowers densely aggregated, greenish-white. Nut black, plano-convex.

Habitat: In marshy places, on the bank of rivers, ponds, canals, ditches and similar other water bodies; rarely in agricultural lands.

Distribution: Europe, America, Australia, China, India, Indonesia, Japan, Korea, Myanmar and the Philippines. In Bangladesh, the species occurs throughout the country.

Uses: Aqueous extract of the plant is antibacterial, and effective against Gram negative bacteria. Leaf juice is used for the



Persicaria glabra

Scientific name: *Persicaria glabra* (Willd.)

Gomez de la Maza

Synonyms: *Polygonum glabrum* Willd.,
Polygonum persicaria Wall.

Family: Polygonaceae

English name: Smooth Smartweed.

Local names: Lal-kukri, Bihogni.

Description: A glabrous perennial herb. Stem erect or ascending, 60-150 cm long, usually reddish below. Leaves simple, alternate, petiolate, blades lanceolate to elliptic-lanceolate, apex acuminate, base narrowed into the petiole, margins entire, glabrous. Ocrea tubular, glabrous, margin eciliate. Inflorescence of terminal, branched racemes. Flowers pink, eglandular. Nut biconvex, glabrous, shining black.

Habitat: Riverbanks, Beels, Jheels, ditches and similar other inland water bodies.

Distribution: Tropical Africa, India, Nepal, Sri Lanka, Afghanistan, Myanmar, Malaysia, Japan, the Philippines, China and Taiwan. In Bangladesh, it occurs throughout the country.

Uses: Leaf juice is used to relieve colic pain.

Propagation: By Seeds and cuttings.

State of occurrence in TH area: Very common.

National conservation status: Least Concern (lc).



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Utricularia aurea



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Description: A perennial, suspended, aquatic carnivorous herb, possess rhizoids at the base of the inflorescence, about 10 cm long and filiform structure bearing leaf like stolons.. Leaves very numerous, semicircular, divided from the base into 3-5 semiverticillate, primary, filiform or somewhat inflated segments, the secondary segments pinnate, alternate, each pinna dichotomously divided into numerous capillary segments. Inflorescence of racemes, up to 10-flowered; bracts ovate to suborbicular, truncate at the base, acute to acuminate at the apex. Flowers bright yellow with radish brown veins in petals, bi-labiate. Fruit a capsule, globose with a long beak. Seeds polygonal, with margin wing.

Habitat: Standing humus rich fresh water and wet soil i.e. Ditches, Beels, lakes, pools, ponds, river backwaters, swamps, rice fields.

Distribution: South and South-east Asia, China, Japan and Australia. In Bangladesh, the species is found throughout the country.

Use: Not known.

Propagation: By seeds, turions and leaves.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Scientific name: *Utricularia aurea*
Lour.

Synonyms: *Utricularia flexuosa* Vahl,
Utricularia fasciculata Roxb.

Family: Lentibulariaceae

English name: Golden Bladderwort.

Local name: Jhangi.

Sida rhombifolia

Scientific name: *Sida rhombifolia* L.

Synonyms: *Sida retusa* L.,
Sida compressa Wall. ex Mast.

Family: Malvaceae

English names: Queensland
Hemp, Cuba Jute.

Local names: Lal Berela,
Kureta.



Description: Erect much-branched herb or undershrub, 30-150 cm tall, with tough hairy, pale green stem, bark fibrous, having a thick taproot. Leaves petioled, rhomboid-ovate, lanceolate or obovate, acute, acuminate or obtuse, entire or serrate to crenate, minutely stellately hairy; stipules filiform, similar in each pair. Flowers axillary, solitary or in clusters of 2-5, yellow, pentamerous. Fruit a schizocarp, mericarps 8-12, each with 2 short mucro or awns at the apex. Seeds flattened, reniform, brown or black.

Habitat: Roadsides, fallow lands and waste places.

Distribution: Widely distributed in the tropics of the world. In Bangladesh, it occurs throughout the country.

Uses: The plant is used in the treatment of pulmonary tuberculosis. Leaves are used to treat strained muscles, labour pains and



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migraine, and the roots are chewed in dysentery.

Propagation: By seeds and root buds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).



Vitex negundo



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Scientific name: *Vitex negundo* L.

Synonym: *Vitex paniculata* Lamk.

Family: Verbenaceae

English names: Chinese Chaster Tree, Five-leaved Chaster Tree.

Local names: Bara-nishinda, Beguna, Nishinda.

Description: Large shrub or small tree, 8-10 m tall. Leaves digitately 3-5 foliolate, leaflets lanceolate, coarsely toothed, acute to acuminate at the apex, cuneate at the base, dark green above, slightly hairy and pale beneath, common petioles 2-5 cm long. Inflorescence elongated terminal panicles. Flowers faintly scented, purplish-blue or bluish. Calyx 5-toothed, hairy. Petals 5, the upper lip 2-lobed, the lower lip 3-lobed. Fruit a ovoid, succulent drupe, glabrous, purple-black when ripe.

Habitat: Open waste places, sides of streams, even in coastal areas, along the boundary of the dwelling houses, and gardens.

Distribution: India, Nepal, Bhutan, Indo-China, West Asia, North Africa, Malaysia and Myanmar. In Bangladesh, it is found throughout the country.

Uses: The leaves are astringent, febrifuge, sedative, tonic and vermifuge. They are useful in dispersing swellings of the joints from acute rheumatism and of the testes from suppressed gonorrhoea. Leaf extract is reported to have anticancerous properties, sometimes used as lotion for removing foetid discharge from wound and ulcer. Root powder is used as demulcent in piles and wood is used in rheumatism. The root, bark and leaves are used as a vermifuge, expectorant, diuretic and carminative. Dried leaves are smoked for relief of headache, catarrhs and useful in dispersing swelling of joints due to acute rheumatism.

Propagation: By seeds, stem cuttings and root suckers.

State of occurrence in TH area: Rare.

National conservation status: Least Concern (lc).

Description: Annual, erect herb, up to 1 m tall, stem covered with white strigose hairs and stalked glands. Leaves ovate-lanceolate, elliptic-lanceolate to lanceolate, apex acute, base gradually narrowed down to the petiole, ocrea tubular, strigosely hairy, marginal cilia long. Inflorescence a terminal raceme. Flowers pedicellate, tepals 5, crimson to red, eglandular. Nut trigonous, black, smooth, equaling the perianth in length.

Habitat: Usually in lowland areas.

Distribution: India, Nepal, China and Japan. In Bangladesh, the species occurs in the districts of Chittagong, Cox's Bazar, Maulvi Bazar, Panchagarh and Sylhet.

Use: Alcoholic extract of this plant is active against Gram-negative bacteria.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Not Evaluated (NE).

Persicaria viscosa



Scientific name: *Persicaria viscosa* (Buch.-Ham. ex D. Don) Nakai

Synonyms: *Polygonum viscosum* Buch-Ham. ex D. Don

Family: Polygonaceae

English name: Sticky Knotweed.

Local name: Athalo Bishkatali.



Cissampelos pareira

Scientific name: *Cissampelos pareira* L. var. *hirsuta* (Buch.-Ham. ex DC.) Forman

Family: Menispermaceae

English name: Not known.

Local name: Akanadi, Memuka, Tubaki-lata.



Description: A climber. Stem densely or sparsely pubescent or puberulous to glabrous. Leaves orbicular-reniform or cordate, apex obtuse, mucronate, base rounded or cordate, margin entire, veins palmate at the base. Male inflorescence corymbose cymes. Male flowers green to yellowish, sepals 4, petals cupuliform, stamens in synandrium, anthers 4. Female inflorescence thyrsoid, arise from the axil of bract. Female flowers greenish, sepal 1, petal 1. Fruit a drupe, orange or red, pubescent, sessile, oblong, obovate, endocarp obovate.

Habitat: Village thickets, in deciduous or evergreen forests.

Distribution: India, Pakistan, Sri Lanka, Nepal, Thailand to Yunnan and Malesia. In Bangladesh, the species is found in the greater districts of Dhaka, Chittagong, Sylhet, Pabna and Tangail.

Uses: The dried root and bark are used as mild tonics and diuretics in advanced stages of acute and chronic cystitis and catarrhal affections of the bladder.

Propagation: By seeds.

State of occurrence in TH area: Rare.

National conservation status: Vulnerable (VU).

Oxystelma secamone

Scientific name: *Oxystelma secamone* (L.) Karst.

Synonyms: *Periploca secamone* L., *Oxystelma esculentum* (L. f.) R. Br. ex Schult.

Family: Asclepiadaceae

English name: Rosy Milkweed Vine.

Local names: Dudhia Lata, Dudh Lata.



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Description: An extensive perennial twining herb, stem and branches slender, glabrous or glabrescent. Leaves petiolate, lamina oblong to linear, glabrous, apex acute, base obtuse, margins entire. Inflorescence of pedunculate cyme. Flowers usually in pairs, purplish pink to pink or white. Fruit a follicles, ovoid-lanceolate, rounded at both ends, glabrous, green. Seeds ellipsoid, bearing hairs.

Habitat: In Tanguar Haor it is generally found at boggy areas. Sometimes obtained at a place where water presented a few days ago but now semi aired region.

Distribution: Tropical Africa, China, India, Malay Peninsula, Myanmar, Pakistan and Sri

Lanka. In Bangladesh, it is found in the districts of Comilla, Chittagong, Dhaka, Khulna, Rajshahi, Rangamati and Sylhet.

Uses: Fresh roots are used as cure for jaundice. A decoction of the plant is used as a gargle and milky juice is also used for washing ulcers. Roots, leaves and fruits are known to be eaten by poor people in famine times. Roots and leaves are also given to cattle as fodder.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Physalis angulata

Scientific name: *Physalis angulata* L.

Family: Solanaceae

English names: Gooseberry, Hogweed, Balloon Cherry.

Local names: Fotka, Futki.

Description: An annual herb, upto 1 m height. Stem hollowed, quadrangular, green, glabrous. Leaves simple, alternate, ovate to lanceolate, apex acute, base rounded or obtuse, margins irregularly toothed, petiolate. Flowers solitary, axillary, pedicellate, bisexual, pentamerous, pale yellow or white, with or without dark spots. Fruit a globose berry, yellow-orange when ripe, enveloped in the bladder-like enlarged calyx. Seeds discoid, many, brown.

Habitat: Fields, gardens, wastelands, fallow fields, along roadsides, in open forests and forest margins.

Distribution: Tropical & subtropical region of the world. In Bangladesh, it occurs throughout the country.

Uses: The fruit is eaten as a snack and the leaves as a salad, although the taste is bitter. The aerial parts, including the fruits, are used to cure digestive and intestinal problems and various skin problems such as sores, boils and cuts. The sap of the leaves in water is taken as an abortifacient.

Propagation: By seeds.

State of occurrence in TH area: Very common.

National conservation status: Least Concern (lc).





Lippia alba

Scientific name: *Lippia alba* (Mill.) Briton et Wilson

Synonyms: *Lantana alba* Mill., *Lippia geminata* H. B. & K.

Family: Verbenaceae

English name: Not known.

Local names: Pichas-lakri, Pichas-bon, Potpoti.

Description: An odorous undershrub or shrub. Leaves opposite, oblanceolate, apex rounded or obtuse, margins crenulate or serrate, softly strigose hairy, rugose. Inflorescences a very dense, many flowered, cylindrical spike. Flowers sessile, light to rosy-pink, scented, bracteate, bracts white, ovate-acuminate, softly villous. Fruit ellipsoid-globose, separating into 2 pericarps, splitting into 1-2 seeded pyrenes.

Habitat: Mostly in low-laying areas along the banks of the rivers, canals and ponds, sometimes fallow lands of village thickets.

Distribution: Cosmopolitans in tropical and warm temperate regions of the World. In Bangladesh, it occurs all over the country.

Uses: Leaves are used as vegetable in Assam. Dry plants are used as fuel and it creates a bad smell which might be used as mosquito repellent.

Propagation: By stem cuttings and seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).



Limnophila heterophylla

Scientific name: *Limnophila heterophylla* (Roxb.) Benth.

Synonym: *Columnea heterophylla* Roxb.

Family: Scrophulariaceae.

English names: Ambulis, Asian Marshweed, Dwarf Ambulia.

Local name: Not known.



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Description: Perennial, submerged herb. Stem rooting at lower nodes, then ascending up to 50 cm high, usually branched, spongy, aerial part slender, glabrous. Upper leaves in verticils of 3, linear-lanceolate to ovate-oblong, sub-amplexicaul and 3-nerved at the base, subacute at the apex, serrulate, glabrous on both surfaces, intermediate leaves pinnatipartite to pinnatisect, lowest leaves in verticils of 8-12, capillary-multifid. Flowers occur singly in the upper leaves axils, sessile, pale pinkish-violet or pink. Capsule ovoid, glabrous, pale brown, many seeded. Seeds cuneiform, 4-5 angular, muricate, tawny-brown.

Habitat: Shallow ponds, lowlands and paddy fields.

Distribution: India, Nepal, Sri Lanka, Myanmar, Thailand, Cambodia, Laos, China, the Philippines, Malaysia, and Vietnam. In Bangladesh, the species is found in many parts of the country.

Use: Quite commonly used as an aquarium plant.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).



Duchesnea indica

Scientific name: *Duchesnea indica* (Andr.)

Focke

Synonyms: *Fragaria indica* Andr., *Potentilla indica* (Andr.) Wolf

Family: Rosaceae

English names: Indian Strawberry, Wild Strawberry

Local name: Jongli Strawberry.

Description: A prostrate, stoloniferous, perennial herb. Stem slender, creeping with runners, silky hairy. Leaves digitately 3-5 foliate, petiolate, leaflets ovate, obovate, double-toothed or serrate, base cuneate, margins ciliate, upper surface with long white hairs. Flowers are solitary, long pedunculate, polygamous, pentamerous, yellow. The fruit spherical or oblong, turns bright red, looks

like a firm small strawberry but a little rounder, spongy, insipid. Achenes minute, somewhat kidney-shaped, obscurely pitted, on the outer surface of the spongy fruit.

Habitat: waste lands, under partial shady moist condition.

Distribution: It is native to eastern and southern Asia, but has been introduced to many other countries of the World.

Uses: Fruits insipid but eaten raw. It is also used for tongue-ulcer.

Propagation: By seeds and stolons.

State of occurrence in TH area: Very rare.

National conservation status: Not Evaluated (NE).





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Ficus heterophylla

Scientific name: *Ficus heterophylla* L. f.

Synonym: *Ficus scabrella* Roxb.

Family: Moraceae.

English name: N/A.

Local names: Ghoti-sheora, Bhui-dumur, Ballam Dumur.

Description: Creeping shrub, young stem green turns into grayish when old. Leaves alternate, long petioled, variable in shape, base cuneate, rounded or cordate, margin serrate, sometimes variously lobed, apex acute, scabrid hairy on both the surfaces. Fruits (Figs) spherical to pyriform, long peduncled, peduncles 4-12 cm long, axillary, solitary, scabrid, rarely paired, yellowish-orange when ripe.

Habitat: Wet lands and peripheries of other water courses.

Distribution: India, Sri Lanka, Myanmar, Thailand, Vietnam, Cambodia, Laos, Indonesia, Malaysia and South China. In Bangladesh, it is very common throughout the country.

Uses: Leaf juice mixed with milk is given in dysentery. The bitter root bark mixed with coriander seeds is considered a good remedy in coughs and asthma. Fruits are taken as vegetable by the local people. Ripe fruits are eaten by birds. Sometimes local people use them as fuel wood.

Propagation: By seeds, cuttings and suckers.

Status of occurrence in TH area: Abundant.

National Conservation status: Least Concern (lc).



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Solanum americanum

Scientific name: *Solanum americanum* Mill.

Synonym: *Solanum nodiflorum* Jacq.

Family: Solanaceae.

English names: European Black Nightshade, Black nightshade, Hound's Berry.

Local name: Tit begun.



Description: An annual herb or short-lived perennial shrub, erect or suberect, up to 1.5 m tall, glabrous or pubescent. Leaves simple, alternate, petiolate, blades ovate-lanceolate, base attenuate, apex acute to acuminate, margins wavy or large-toothed entire, glabrous or minutely pubescent. Inflorescence an umbel of 3-6 flowers. Flowers pedicellate, bisexual, pentamerous, actinomorphic, white with green base. Fruit a globose berry, bluish-black or purplish-black when ripe. Seeds discoid, compressed, light brown.

Habitat: Dry or moist places of cultivated lands and well-drained soil.



Distribution: Native to South America but now found throughout the tropical and warm temperate regions of the World. In Bangladesh, it occurs widely in the eastern parts of the country.

Uses: The tender shoots, young leaves and unripe green fruits are eaten as a vegetable. The ripe fruits are also edible. Ripe fruits are used in pies, jams and other sweets. A decoction of the leaves is used in a lotion for alleviate neuralgic pains. The fruits have laxative and diuretic properties and the juice is applied against dropsy and to cure eye diseases of chickens.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Polygonum plebeium

Scientific name: *Polygonum plebeium* R. Br.

Synonyms: *Polygonum herniarioides* Delile, *Polygonum roxburghii* Meissn.

Family: Polygonaceae

English name: Knotweed, Prostrate Knotweed.

Local names: Khudi-bishkatali, Mechhua Shak, Chemtisag.



Description: A prostrate, annual herb. Stems branching, growing prostrate along the ground, ranging from 10-60 cm in length, nodes swollen. Leaves sessile, alternate, blades linear-lanceolate, apex acute, margins, having a distinctive thin membranous sheath (ocrea) that encircles the stem at the node. Flowers axillary, 3-4 per axil, pedicellate, pentamerous, greenish-white or light pink inside. Nut black, shining and smooth.

Habitat: Dried up ponds, ditches, riverbanks, disturbed lands, waste places, roadsides, railway embankments and the coast.

Distribution: Throughout the tropical and warm temperate regions of the World. In Bangladesh, it is found throughout the country.

Uses: It is visited by a high number of insect species and has been shown to be an important food for partridge chicks. It is also a favored food of seed eating birds.

It is eaten as a cooked vegetable. The herb is carminative and given in bowel complaints and pneumonia. Aqueous extract of this plant is highly antibacterial.

Propagation: By Seeds.

State of occurrence in TH area: Very common.

National conservation status: Least Concern (lc).

Mazus pumilus

Scientific name: *Mazus pumilus* (Burm. f.) van Steenis

Synonyms: *Lobelia pumila* Burm. f., *Mazus japonicus* (Thunb.) O. Kuntze

Family: Scrophulariaceae

English name: Japanese Mazus.

Local name: Not known.

Description: An erect or prostrate, annual herb. Leaves rosetted below, opposite or alternate above, oblong-oval to obovate-spathulate, base acute, apex obtuse, margins irregularly crenate-serrate, penninerved, glabrous. Flowers in racemes, hermaphrodite, pedicellate; calyx campanulate, 5-partite; corolla bilabiate, purple with white corollas. Fruits a capsules, obovoid, apex rounded, glabrous. Seeds cuneate, truncate at both ends, longitudinally foveolate.

Habitat: Usually in shady and moist places, but sometimes in swamps, farm yards and wet fields also.

Distribution: Russia, South and South-east Asia including China and also extended to New Guinea. In Bangladesh, the species is found all over the country.

Uses: Not known.

Propagation: By seeds.

State of occurrence in TH area: Rare.

National conservation status: Least Concern (lc).





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Vicia sativa

Scientific name: *Vicia sativa* L.

Synonyms: *Vicia angustifolia* Reichard, *Vicia cuneata* Gren. & Godr.

Family: Fabaceae

English names: Common vetch, spring vetch, garden vetch, tare.

Local names: Ankari, Hatka.

Description: An annual, procumbent herb, can reach up to two meters long. Stem quadrangular, glabrous or obscurely downy. Leaves made up of a few pairs of linear, lance-shaped, or wedge-shaped, needle-tipped leaflets, rachis ending in a tendril, stipulate. Flowers solitary or in clusters of 2, axillary, subsessile or shortly, whitish to bluish to red or bright pink-purple. Fruit a compressed pod, narrowly oblong. Seeds 6-18, globose.

Habitat: High lands and newly emerged lands after water removal.

Distribution: Native to southern Europe, also grown in North Africa and continental Asia. In Bangladesh, it is cultivated in some parts of the country.

Uses: It is grown for green manure or livestock fodder. It can fix atmospheric nitrogen.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Hedyotis corymbosa

Scientific name: *Hedyotis corymbosa* (L.) Lamk.

Synonym: *Oldenlandia corymbosa* L.

Family: Rubiaceae

English name: Old World Diamondflower

Local names: Khet Papra, Panki.



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Description: A flaccid, usually diffuse, or sometimes erect herb, up to 50 cm tall; stem angular. Leaves subsessile, linear or linear-lanceolate, apex acute or apiculate, base decurrent, sparsely pubescent. Inflorescence of axillary, pedunculate, 2-5 flowered corymbose cymes. Flowers are small, white, on filiform pedicels. Capsules globose or sometimes slightly pyriform, somewhat didymous. Seeds minute, triangular.

Habitat: Fallow lands, along railway tracts, grass fields, and scrub jungles.

Distribution: India, China, Philippines and Malaysia. In Bangladesh, it occurs almost throughout the country.

Uses: The plant is febrifuge and anthelmintic. It is used in remittent fever and also given in jaundice and other liver complaints.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Rorippa heterophylla

Scientific name: *Rorippa heterophylla* (Blume) Williams

Synonyms: *Nasturtium heterophyllum* Blume, *Rorippa dubia* (Pers.) Hara

Family: Brassicaceae

English name: Not known.

Local name: Not known.



Description: Annual, erect or ascending herb, upto 35 cm tall. Leaves in a rosette and along the stem, the lower narrowly obovate in outline, undivided or lyrate-pinnatipartite with 1-3 pairs of small lateral lobes, terminal lobe ovate, apex obtuse, basally cuneate or truncate, upper leaves undivided, narrowly ovate, margin entire or irregularly crenate or serrate. Racemes terminal, densely flowered. Flowers small, yellow. Fruit a linear siliqua. Seeds subquadrate or ovate-orbicular, reddish-brown.

Habitat: Wide varieties of habitats such as valleys, waste areas, roadsides, wet grounds, grassy places, cultivated places.

Distribution: Tropical regions of the World. In Bangladesh, the species occurs throughout the country.

Uses: Not known.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Not Evaluated (NE).

Merremia gemella

Scientific Name: *Merremia gemella* (N. L. Burman)

Synonyms: *Convolvulus gemellus* Burm. f.

Family: Convolvulaceae

English Name: Not known.

Common/ Local name: Hindi: Musakani, Bangle: Lotii

Plant Description: Herbs, twining or prostrate; axial parts smooth, appressed yellowish pubescent. Stems often rooting at nodes and internodes. Petiole 1.5-6 cm, rarely minutely tuberculate; leaf blade often ovate, 2.5-6.5 X 1.5-4.3 cm, glabrous or short pilose, base broadly cordate, proximal margin entire, undulate or coarsely crenate, sometimes 3-lobed, apex $\pm$ attenuate, mucronulate. Pedicel 3-6 mm. Sepals broadly obovate to $\pm$ circular, $\pm$ unequal, margin scarious, emarginate, slightly mucronulate or not, slightly enlarged in fruit; outer 2 abaxially $\pm$ pilose, 4-6 mm; inner 3 subglabrous, 6-7 mm. Corolla yellow, campanulate to funnellform, 1.5-2 cm, midpetaline bands dark, glabrous outside; limb shallowly 5-lobed; lobes emarginate and mucronulate.

Habitat: Herbs, twining or prostrate; axial parts smooth, appressed yellowish pubescent. Stems often rooting at nodes and internodes.

Distribution: Southeast Asia to tropical Australia. In Bangladesh, it is found in Dhaka, Netrakona, Sunamganj and Sylhet districts.

Uses: The seeds are laxative, used for curing inflammation, abdominal diseases, headache, joint pain, liver and spleen complaint.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

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Leucas indica

Scientific name: *Leucas indica* (L.) R. Br. ex Vatke

Synonym: *Leonurus indicus* L., *Leucas lavandulaefolia* Smith

Family: Lamiaceae

English name: Leucas.

Local names: Dondokalosh, Hal-kusa, Shetodrone.

Description: An erect or diffuse, aromatic, annual herb. Stem pubescent, quadrangular, grooved. Leaves shortly petioled, linear or oblong-lanceolate or elliptic-lanceolate, apex acute, base acute, margin obscurely crenate. Inflorescence terminal and axillary, many-flowered whorled, Flowers bi-labiate, white. Nutlets obovoid-oblong, angular on inner face, rounded on outer, smooth, brownish-black.

Habitat: Cultivated lands, roadsides and waste places.

Distribution: India and Myanmar. In Bangladesh, it is found all over the country.

Uses: Leaves are roasted and eaten with salt for loss of appetite. Sometimes, cooked young shoots are eaten.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (Ic).



Ricinus communis



Description: Soft shrubs or small tree-like. Leaves palmately compound, alternate, petiolate, 7-9 lobed, leaf blade lanceolate, acuminate to acute, dark green above, paler beneath. Inflorescence terminal panicle. Flowers dioecious; male flowers yellowish-green with prominent creamy stamens; female flowers born at the tips of the spikes, have prominent red stigmas. Fruit a spiny, greenish (to reddish-purple) capsule. Seeds oval, shiny, bean-like, brownish.

Habitat: Waste places, village grooves and shrubberies.

Distribution: It is widely cultivated throughout the tropics, subtropics and temperate regions of the World. In Bangladesh, the species is found throughout the country.

Uses: Leaf paste is applied to head to relieve headache, and is used as poultice for boils. The seed is administered in the treatment of joint pains and constipation. A decoction of root is prescribed for treatment of inflammation, rheumatism, asthma and bronchitis.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Scientific name: *Ricinus communis* L.

Family: Euphorbiaceae

English names: Castor, Castor Bean, Castor-oil Plant.

Local names: Bherenda, Gabbherenda, Reri, Venna.



Chenopodium album

Scientific name: *Chenopodium album* L.

Family: Chenopodiaceae

English names: White Goosefoot, Pigweed, Lamb's Quarters.

Local names: Batua Shak, Bathuwa Shak, Beley shak, Chandan Betu.



Description: An erect, aromatic, annual herb, up to 1 m tall. Leaves simple, alternate, petiolate, ovate to ovate-rhomboid, apex rounded or acute, base narrowly to broadly cuneate, margins coarsely toothed, farinose abaxially. Inflorescences glomerules in terminal and lateral compound spikes. Flowers minute, pentamerous, short pedicelled, whitish-green. Fruit a membranous utricle, depressed-ovoid, smooth to papillate. Seeds smooth, lenticular, blackish-brown.

Habitat: Crop fields, open waste lands and sandy riverbanks.

Distribution: In most countries of the world. In Bangladesh, the plant grows as a common weed all over the country.

Uses: Young shoots and leaves are used as leafy vegetable. The leaves are used medicinally in the treatment of hepatic disorders and spleen enlargement, dysentery, piles and hiccup. It is also used as laxative, anthelmintic, aphrodisiac and tonic.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Salix tetrasperma

Scientific name: *Salix tetrasperma* Roxb.

Synonyms: *Salix nilagirica* Miq.

Family: Salicaceae

English name: Indian Willow.

Local names: Bhesh, Panibaj, Panijoma, Panihijal.

Description: Medium sized, deciduous tree; bark fissured, branches drooping, young shoots silky tomentose. Leaves simple, alternate, stipulate, ovate-lanceolate to elliptic, margins minutely serrulate, narrowed towards the base, acute to cuspidate at the apex, pubescent to tomentose on both surfaces. Inflorescence of catkins. Flowers monoecious; male flowers sessile, sweet-scented, yellowish, pendulous; female flowers pedicellate, greenish. Fruit a capsule, cylindrical, in groups of 3 to 4. Seeds 3-4 per capsule, with numerous fine white silky hairs.

Habitat: In forests, swamps and near streams at low altitudes.

Distribution: Throughout tropical and subtropical India, Myanmar, Taiwan, China, Malay Peninsula and Indonesia. In Bangladesh, it is found naturally in the districts of Sylhet, Chittagong, Manikganj, Feni, Faridpur and Kustia.

Uses: The wood is used for posts, ploughs, planking, making match boxes and also suitable for wall construction. The leaves are used as fodder. Bark is used to treat fever, whooping cough, folk medicine as antirheumatic, sedative and analgesic.

Propagation: By hardwood cuttings and by layerings.

State of occurrence in TH area: Rare.

National conservation status: Least Concern (lc).



Nymphoides indicum

Scientific name: *Nymphoides indicum* (L.) O. Kuntze

Synonyms: *Menyanthes indica* L., *Limnanthemum indicum* (L.) Griseb.

Family: Menyanthaceae

English names: White Water Fringe, Water Snowflake.

Local names: Panchuli, Chandmalla.



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Description: A floating, rhizomatous, stoloniferous, annual herb. Leaves petiolate, blades orbicular, deeply cordate, with obtuse basal lobes and a triangular sinus and with somewhat sinuate margin. Inflorescence of umbel-like cluster of 15-50 flowered. Flowers bisexual, distylic, appearing above the water between the basal lobes of leaf, pedicellate, pure white or with a yellow or orange base; calyx lobes 5-7, ovate lanceolate; corolla tubes up to 2.5 mm long, lobes 5-7, linear-lanceolate to oblong-lanceolate, inner surface and margins densely fimbriate. Fruits subglobose. Seeds globose, numerous, shining, yellowish-white.

Habitat: The margins of fresh and brackish water tanks, lakes, pools and rivers.

Distribution: Pantropical. In Bangladesh, it occurs throughout the country.

Uses: The plants are used as a substitute for Chiratta (*Swertia chirata* Karst.) in fever and jaundice. Rhizomes are used in making soups and curries.

Propagation: Propagation done by seed and also by vegetative part.

State of occurrence in TH area: Rare.

National conservation status: Least Concern (lc).



Nymphoides hydrophylla

Scientific name: *Nymphoides hydrophylla* (Lour.) O. Kuntze

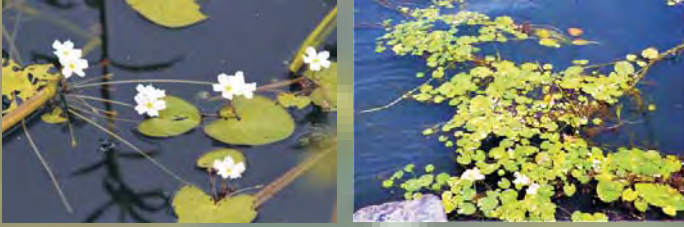
Synonyms: *Menyanthes hydrophylla* Lour, *Nymphoides cristatum* (Roxb.) O. Kuntze

Family: Menyanthaceae

English name: Crested Floating Heart.

Local name: Not known.

Description: A floating, rhizomatous, annual or sometimes perennial herb, with long stolons, which reach the surface of the water, producing a node from which start a tuft of roots and a cluster of flowers. Leaves petiolate, blades orbicular, base deeply cordate, purplish. Inflorescence of umbel-like cluster of 10-20 flowered. Flowers bisexual, distylic, pedicellate, pure white or with a yellow or orange base, borne below a floating leaf; calyx lobes 5, ovate lanceolate, margins hyaline; corolla tubes up to 2 mm long with a



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ring of glandular hairs above, lobes 5-7, linear-lanceolate to oblong-lanceolate, inner surface and margins densely fimbriate. Capsules broadly ovoid or subglobose, 10-20 seeded. Seeds globose, strongly muriculate, pale yellowish-brown, smooth or shining.

Habitat: Fresh water lakes, ponds, beels and haors.

Distribution: Tropical Asia and China. In Bangladesh, it occurs throughout the country.

Uses: The leaves are used medicinally for the treatment of ulcer. It is feed to the cattle to increase yield of milk.

Propagation: By seeds and fragments of suckers.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Nymphaea nouchali

Description: A perennial, rhizomatous, aquatic herb. Leaves long petiolate, floating on the surface of water, blades elliptic-orbicular to round, peltate, margins irregularly repand-dentate. Flowers emergent, showy, polypetalous, long pedunculate, scented, open during day and close at night; calyx green or sometimes dull red, often marked with darker dots; petals light blue, dull yellowish-white, rose or purplish. Fruit a spongy berry, ripening under water. Seeds ellipsoid enclosed by fleshy saccate aril.

Habitat: Stagnant inland water bodies.

Distribution: India, Sri Lanka, Myanmar, Malaysia, Indonesia, Thailand, Laos,

Cambodia, Vietnam, the Philippines, New Guinea and Taiwan. In Bangladesh, blue water lily is common throughout the country.

Uses: Fruits are eaten raw by children. Fried seeds produce tasty puffed grains that are eaten. The rhizome and peduncles are eaten as vegetable. Rhizomes powder is used in piles, dysentery and dyspepsia. Flowers are astringent and used as cardiac tonic. Seeds are employed in cutaneous diseases.

Propagation: By rhizomes and seeds.

State of occurrence in TH area: Rare.

National conservation status: Least Concern (lc).

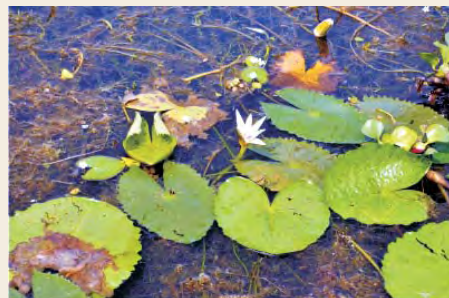
Scientific name: *Nymphaea nouchali* Burm. f.

Synonyms: *Nymphaea malabarica* Poir., *Nymphaea stellata* Willd.

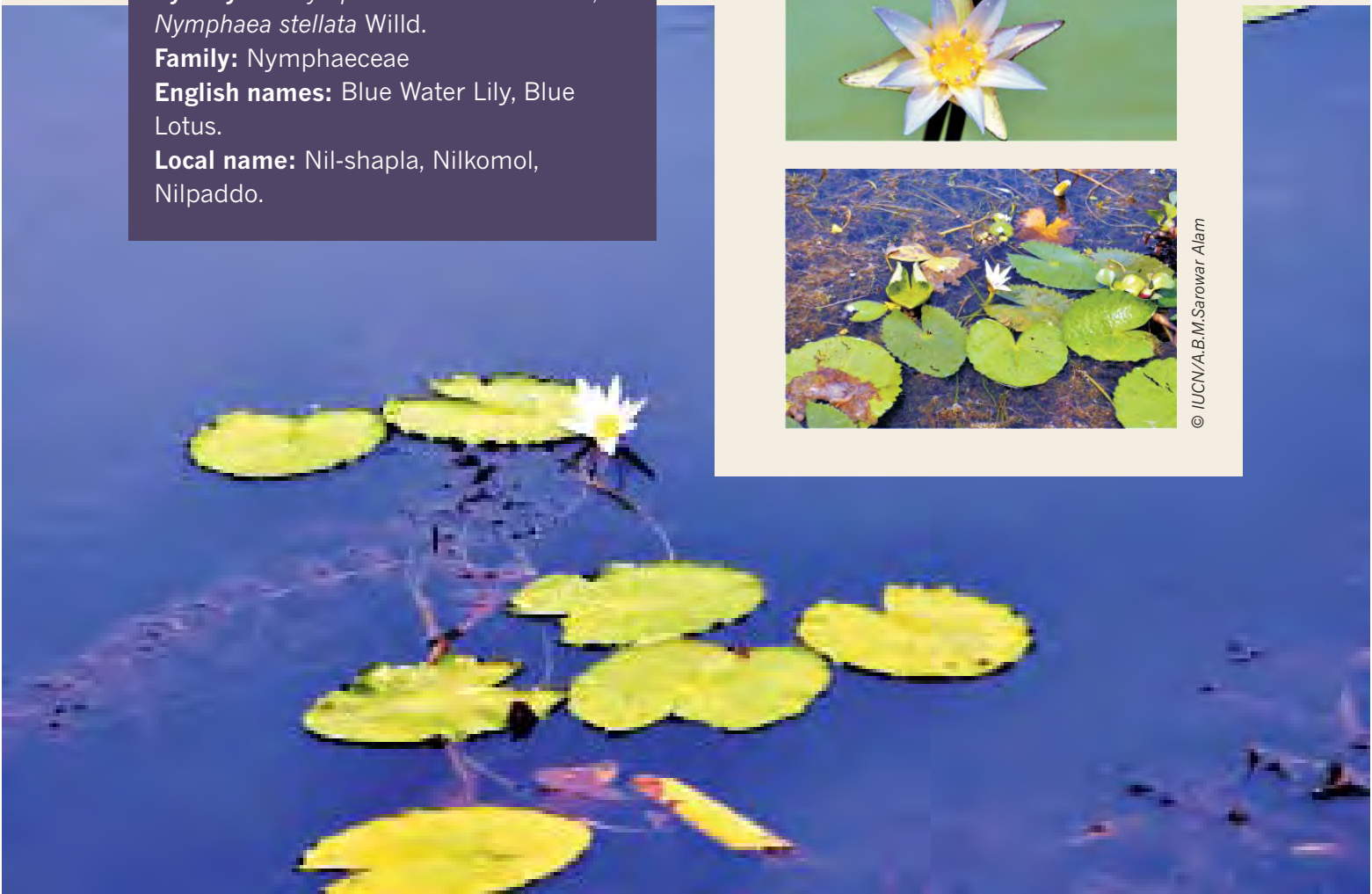
Family: Nymphaeaceae

English names: Blue Water Lily, Blue Lotus.

Local name: Nil-shapla, Nilkomol, Nilpaddo.



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Nymphaea capensis

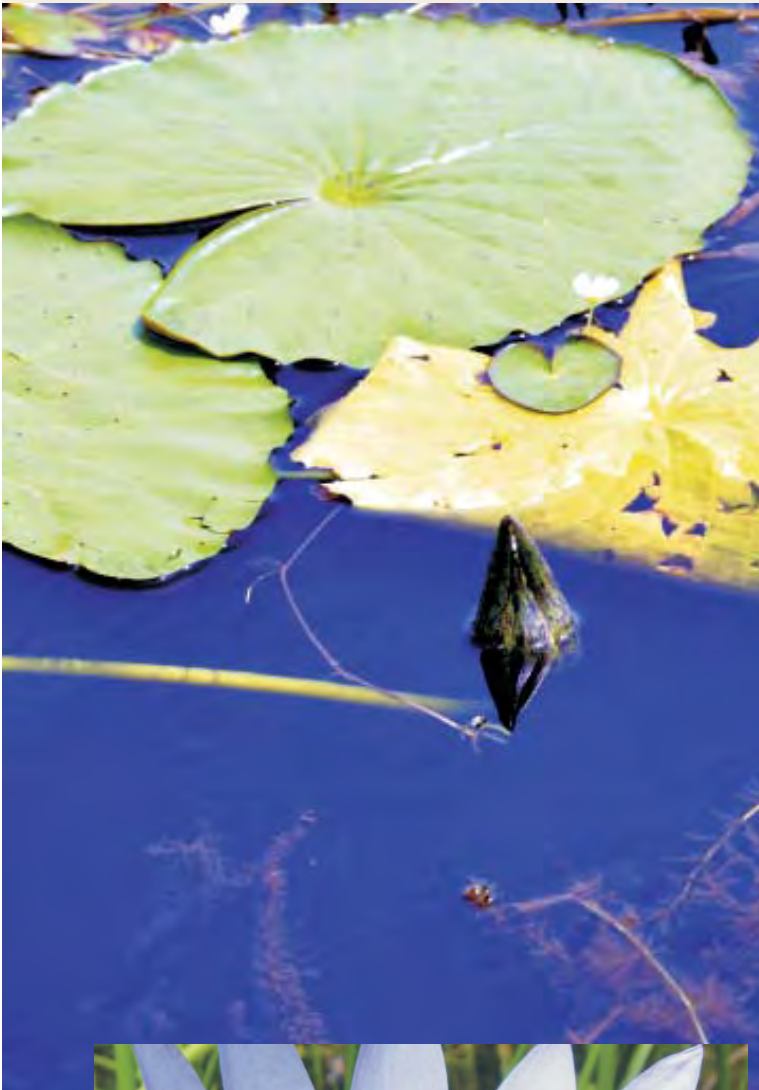
Scientific name: *Nymphaea capensis* Thunb.

Synonym: *Not known.*

Family: Nymphaeaceae

English name: Cape-blue Waterlily.

Local name: Beguni shapla.



Description: A perennial aquatic herb. Leaves narrowly peltate to orbicular-ovate, margins strongly sinuate-dentate, angle of lobes acuminate. Flowers sweet scented, open almost throughout the day. Sepals acute, pure green outside, purplish-blue within. Petals narrowly elliptic, sky blue. Stamens numerous in many series, appendages dark blue, anthers dark crimson-violet. Carpels with 20-30 stigmatic rays. Fruits ripening under water and enclosed by persistent sepals. Seeds arillate.

Habitat: Fresh water ponds, lakes, tanks etc. but sometimes can grow in brackish water also.

Distribution: Native of South America but now widespread in the tropics. In Bangladesh, it is found all over the country.

Uses: Planted as an ornamental aquatic herb in pond gardens.

Propagation: By seeds and rhizomes.

State of occurrence in TH area: Common.

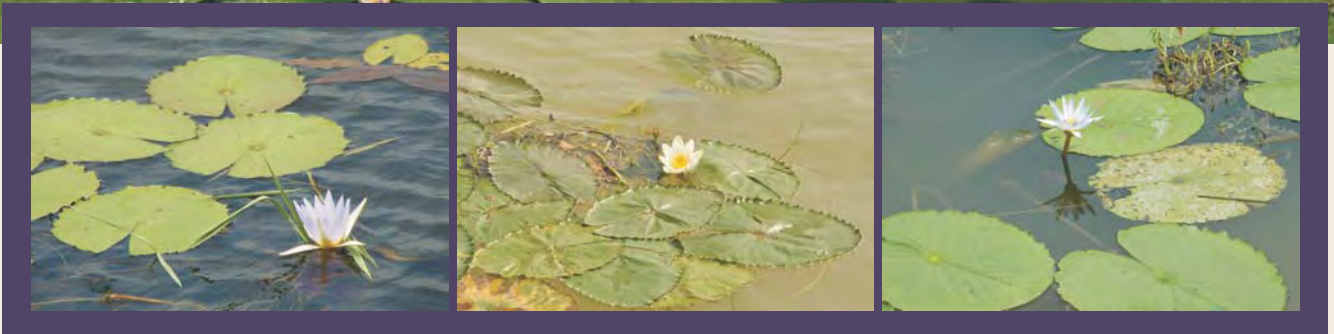
National conservation status: Conservation Dependent (cd).



Nymphaea pubescens



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Description: A perennial, rhizomatous, stoloniferous, aquatic herb. Leaves broadly ovate-elliptic, or reniform to orbicular, margin repand to spinous-dentate, dark green, glabrous and often pustulate above, green or dull purplish-green and velutinous pubescent beneath. Flowers large, slightly fragrant, white on long peduncle. Sepals 4, usually ovate-lanceolate, apex subacute or obtuse, outside green with 5-9 prominent white veins, white inside. Petals linear-oblongate, apex obtuse or subacute, white. Stamens yellow. Ovary 13-22 loculate. Fruit a globose berry. Seeds ellipsoid.

Habitat: Stagnant inland water bodies.

Distribution: South and South-east Asia. In Bangladesh, it is found all over the country.

Uses: Rhizomes are used for treatment of piles, diarrhoea, dysentery and dyspepsia. Flowers are refrigerant and astringent and act

as a cardiac tonic. Rhizomes and peduncles are eaten as vegetable. Seeds are fried and eaten as puffed grain.

Propagation: By seeds and tuberous rhizomes.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Scientific name: *Nymphaea pubescens* Willd.

Synonyms: *Nymphaea nouchali* auct. non Burm. f., *Nymphaea esculenta* Roxb.

Family: Nymphaeaceae

English names: Water Lily, White Water Lily.

Local names: Sada shapla, Shaluk.



Nymphaea rubra

Description: A perennial, rhizomatous aquatic herb. Leaves long, petioled, peltate, lamina reniform to orbicular, margin repand to dentate, greenish and glabrous above, purple and pubescent beneath. Flowers large, showy, crimson-red. Sepals 4, ovate-lanceolate, green with 5-9 prominent white veins outside, red inside. Petals linear-oblongate, red. Stamens yellow with dark purplish band at base. Ovary 19-21 loculate, oblong, crimson. Fruit a globose berry. Seeds ellipsoid.

Habitat: Stagnant inland water bodies, ponds and lakes.

Distribution: South and South-east Asia. In Bangladesh, it is found all over the country.

Uses: Planted as an ornamental plant. Peduncles are eaten as vegetable. Flowers are used in the treatment of piles and blood dysentery.

Propagation: By seeds, stolons and vegetative buds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

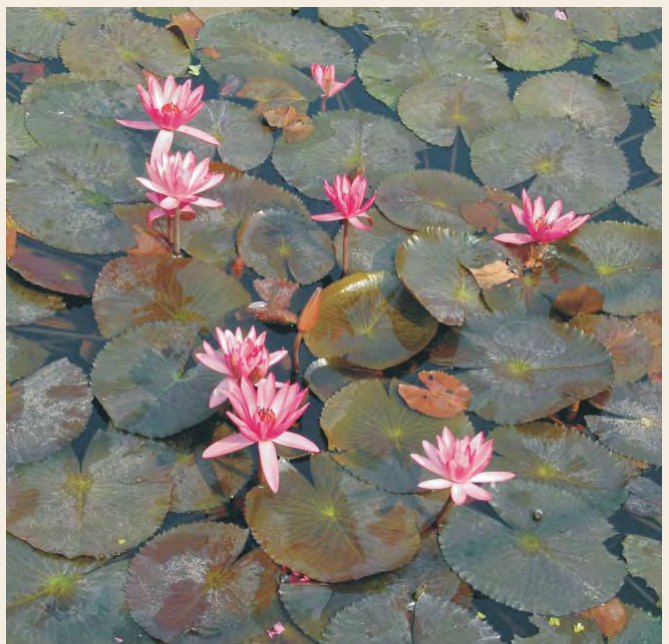
Scientific name: *Nymphaea rubra* Roxb. ex Andr.

Synonym: *Nymphaea pubescens* auct. non Willd.

Family: Nymphaeaceae

English name: Red Water Lily.

Local name: Lal Shapla.



Ludwigia octovalvis

Scientific name: *Ludwigia octovalvis* (Jacq.)
Raven

Synonyms: *Oenothera octovalvis* Jacq.,
Jussiaea suffruticosa sensu Clarke

Family: Onagraceae

English name: Willow Primrose.

Local names: Bhuikura, Bunlong, Labanga
Lang.



Description: A much-branched, woody, tomentose herb or undershrub. Leaves lanceolate, apex acute to acuminate, base acute, margins entire. Flowers axillary, solitary, yellow. Calyx lobes 4, ovate or lanceolate, green. Petals 4, obovate or cuneate, emarginate, yellow. Ovary inferior, 4-celled, many-ovuled. Fruit a capsule, cylindrical, terete, brown with 8 darker ribs, ribs persistent after dehiscence. Seeds reddish-brown, rounded.

Habitat: Marshy places, grasslands, cultivated fields, sides of ditches and water courses.

Distribution: Tropical America, Africa, Asia and Australia. In Bangladesh, it is found all over the country.

Uses: The plant in the paste form with turmeric is applied for the treatment of eczema and other skin diseases for one week.

Propagation: By seeds and vegetative parts like runners.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Ludwigia perennis

Scientific name: *Ludwigia perennis* L.

Synonyms: *Jussiaea parviflora* Roxb., *Jussiaea perennis* (L.) Brenan

Family: Onagraceae

English name: Not known.

Local name: Not known.



Description: An erect, annual herb, up to 1 m tall. Stem glabrous to minutely puberulent on younger parts. Leaves simple, narrowly elliptic to lanceolate, sometimes linear, base narrowly cuneate, apex subacute, margins entire. Flowers yellow, pedicellate. Sepals 4, deltoid, green. Petals 4, elliptic, yellow. Stamens usually 4, rarely 5. Fruit a capsule, cylindrical, terete, pale brown, irregularly loculicidal. Seeds ellipsoid-rounded, pluriseriate in each locule, brown.

Habitat: Usually grows in open and wet places in fallow lands, ricefields, cultivated lands, sometimes occurs along ditches, river and water courses.

Distribution: Tropics of the World. In Bangladesh, it is found all over the country.

Uses: Sometimes used as a forage.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).



Merremia gemella

Scientific name: *Merremia gemella* (Burm. f.) Hallier f.

Synonyms: *Convolvulus gemellus* Burm. f., *Merremia hederacea* sensu Prain non Burm. f.

Family: Convolvulaceae

English name: Indian Jalap.

Local name: Halud Kalmi.



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Description: A twiner, sometimes prostrate. Stem appressed to patently hairy. Leaves ovate to broadly ovate, base broadly cordate or sagittate, base acute to acuminate, rarely

broadly rounded, margins entire or coarsely crenate to dentate, sometimes 3-lobed, glabrous or sometimes pilose mostly on the nerves. Flowers in axillary cymes, yellow, campanulate. Fruit a capsule, depressed-globose. Seeds dark grey or brownish, trigonous or globose, puberulent.

Habitat: Thickets, roadsides and waste lands.

Distribution: Southeast Asia to tropical Australia. In Bangladesh, it is found in Dhaka, Netrakona, Sunamganj and Sylhet districts.

Use: The seeds are laxative, used for curing inflammation, abdominal diseases, headache, joint pain, liver and spleen complaint.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).



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Coccinia grandis

Scientific name: *Coccinia grandis* (L.) Voigt

Synonyms: *Bryonia grandis* L., *Coccinia cordifolia* Cogn.

Family: Cucurbitaceae

English name: Ivy Gourd, Scarlet Fruited Gourd.

Local name: Telakucha.

Description: A perennial, dioecious climber. Stem slender, angular, tendrils simple, filiform. Leaves entire to palmately lobed, glistening glands present on the lower surface. Male flowers peduncle filiform, calyx campanulate, corolla white or slightly yellow. Female flowers peduncle slender. Fruits subglabrous, round at both ends, pulp red, juicy. Seeds yellowish, oblong, base with two deep marks.

Habitat: Grasslands, roadsides, hedges and forests.

Distribution: Africa, China, India, Japan, Malaysia and Pakistan. In Bangladesh, this species is common throughout the country.

Uses: Tender shoots are used as vegetable. Plant is used in the treatment of skin diseases, bronchitis and diabetes.

Propagation: By stem cuttings and seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).



Senna tora

Description: A perennial, erect herb or undershrub, about 100 cm tall. Leaves paripinnately compound, stipulate, leaflets 3 pairs, obovate-oblong, finely pubescent or glabrous, apex cuneate to broadly rounded, base oblique. Inflorescence of axillary racemes. Flowers yellow, pentamerous. Fruit a pod, linear-oblong, terete to sub-tetragonous, dehiscent. Seeds dark brown, glossy, rhomboidal.

Habitat: Fallow lands, roadsides, and village thickets.

Distribution: Bhutan, India, Malaysia, Nepal, Pakistan, the Philippines and Thailand. In Bangladesh, the species is commonly found all over the country.

Uses: Leaves are laxative, antiperiodic, aspirant and anthelmintic. Seeds are used as tonic and stomachic. Leaves and seeds are recommended for the treatment of skin diseases like ringworm, scabies, itch and leprosy.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Scientific name: *Senna tora* (L.) Roxb.

Synonyms: *Cassia tora* L., *Cassia humilis* Colladon.

Family: Caesapiniaceae

English names: Sickle Senna, Foetid Cassia, Metal Seed.

Local names: Teraj, Araj, Chakunda, Kalkasham.



Ipomoea aquatica

Scientific name: *Ipomoea aquatica* Forssk.

Synonym: *Ipomoea reptans* Poir.

Family: Convolvulaceae

English names: Swamp Cabbage, Water Spinach, Swamp Morning-glory.

Local name: Kalmi shak.

Description: A perennial, glabrous, trailer on mud or floating on water. Stem usually hollow, rooting at the nodes. Leaves variable in shape, ovate, ovate-oblong, deltoid, lanceolate or linear, apex acute, base cordate, sagittate or hastate. Flowers 1 to few, in axillary cymes. Calyx lobes subequal. Corolla funnel-shaped, pink or pale lilac with deeper throats. Fruit a capsule, with persistent calyx, ovoid to globose. Seeds grey-pubescent or glabrous.

Habitat: Wet lowlands, tanks or ditches.

Distribution: In Bangladesh, it is found all over the country.

Uses: The leaves and stems constitute a good vegetable, beneficial for nervous and general debility in females. Juice is given in fever complaints as an emetic. Buds are used in the treatment of ringworm, leprosy, leucoderma and fever.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).



Plant description: A diffuse or erect, annual herb; stem reddish or brick red. Leaves elliptic-lanceolate, acute or shortly acuminate, attenuate at the base, margin sub-entire to entire or faintly crenate-serrate, lateral veins obscure. Inflorescence a subglobose capitulum, peduncles 0.5-3.0 cm long. Bracts ovate, rarely obovate, acute or shortly acuminate, covered with appressed hispid hairs. Flowers white. Fruit a cypsela having narrow wings, 1.5-2.0 mm long, compressed, pappus of a few minute, scaly teeth.

Habitat: Grows commonly in moist places as a weed.

Distribution: Cosmopolitan in all warm countries. In Bangladesh, it is found all over the country.

Propagation: By seeds.

Uses: The plant is principally used as a tonic and deobstruent, in hepatic and spleen enlargement, various chronic skin diseases, jaundice and fever. Traditionally leaves are using for stop bleeding, snake bite, scorpion stings, eczema and dermaties. It is also used as a cure for asthma and bronchitis, as pectoral and antiasthmatic. The plant is said to purify blood, and is also considered as a cooling agent. Its application promotes growth of hair on the shaved scalp and turning hair black.

Status in Tangour Haor: Common.

Conservation status: Least concern (lc).

Eclipta alba



Scientific name: *Eclipta alba* (L.) Hassk.

Synonym: *Eclipta prostrata* (L.) Mant.

Family: Asteraceae

English/ common name: False Daisy

Local name: Kesaraj, Kesuti, Kalokeshi, Bhimraj

Enhydra fluctuans

Scientific name: *Enhydra fluctuans* Lour.

Synonyms: *Enhydra phaseoloides* Merrill.,
Enhydra. pursaetha DC

Family: Asteraceae

English names: Water Cress, Marsh Herb.

Local names: Helencha, Harhach, Hinchashak.



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Description: A trailing marsh herb, also floating on water; branches up to 60 cm long, rooting at the nodes. Leaves opposite, elliptic, linear to oblong, obtuse-subacute, margin distantly dentate, base narrowed down, glabrous on both surfaces. Inflorescence a sessile capitulum, axillary and terminal.

Involucral bracts globose or broadly obovate. Flowers brownish yellow. Fruit a cypsela, 3-angled with many hyaline ribs, with few hairs at the tip.

Habitat: Aquatic in ditches, ponds and Beels.

Uses: Leaves are regarded as laxative and useful in the diseases of skin and nervous system. They are considered as antibilious and applied as demulcent in gonorrhoea and also described as a cooling agent. The plant is also prescribed for torpidity of the liver.

Distribution: India, tropical Africa and Asia up to Malaysia. In Bangladesh, it is found all over the country.

Propagation: By seeds and nodal segments of stem.

Status of occurrence in TH area: Rare.

Conservation status: Least Concern (lc).



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Trewia nudiflora

Scientific name: *Trewia nudiflora* L.

Synonyms: *Trewia macrophylla* Roxb., *Mallotus cardiophyllus* Merr.

Family: Euphorbiaceae

English name: False White Teak.

Local names: Bhetul, Meragota, Pithapura.

Description: A medium-sized dioecious tree, bark pale grey, young parts greyish-tomentose. Leaves triangular-ovate to ovate, apex acuminate, base cordate to truncate, 3-5 nerved from the base. Male inflorescence 12-20 cm long, lax-flowered; female inflorescence 1-4 flowered. Male flowers yellowish; female flowers greenish, ovary ellipsoid-subglobose. Fruits globose, tomentose, reddish-tinged. Seeds black, smooth.

Habitat: Forests and near water bodies.

Distribution: South and South-east Asia including China. In Bangladesh, it is found all over the country.

Uses: Timber is used for making packing boxes and fuel wood. The plant is cooling and tonic, and is used to cure bile and phlegm.

Propagation: By seeds.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).

Millettia pinnata



Scientific name: *Millettia pinnata* (L.) Panigrahi

Synonyms: *Cytisus pinnatus* L., *Pongamia glabra* Vent.

Family: Fabaceae

English names: Indian Beach, Poongan Oil Plant.

Local names: Karanja, Karach, Kaamz.



Description: An evergreen tree, bark greyish-brown or greenish, smooth or tubercled, with bad smell. Leaves alternate, imparipinnate, leaflets 5-9, opposite, ovate-oblong or elliptic, terminal one largest, glossy-green, glabrous, shortly acuminate, base sub-cuneate or rounded. Flowers in lax, axillary racemes, pink. Calyx campanulate, truncate. Corolla much exserted, pink. Stamens 10, monadelphous, anthers uniform. Ovary subsessile, ovules 2, styles incurved, bearded,



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stigmas capitate. Fruit a pod, flattened, obliquely oblong, beaked, indehiscent. Seed reniform, white.

Habitat: Village thickets, marshy lands and forests.

Distribution: India, Pakistan, Sri Lanka, Myanmar, North Australia, Polynesia and Mascarene Island. In Bangladesh, it is found all over the country.

Uses: An orange-coloured oil obtained from the seeds is used for soap making, varnish, in lamps, and for treatment of rheumatism.

Propagation: By seeds and stem cuttings.

State of occurrence in TH area: Common.

National conservation status: Least Concern (lc).



Floral Conservation in Tanguar Haor

Chapter

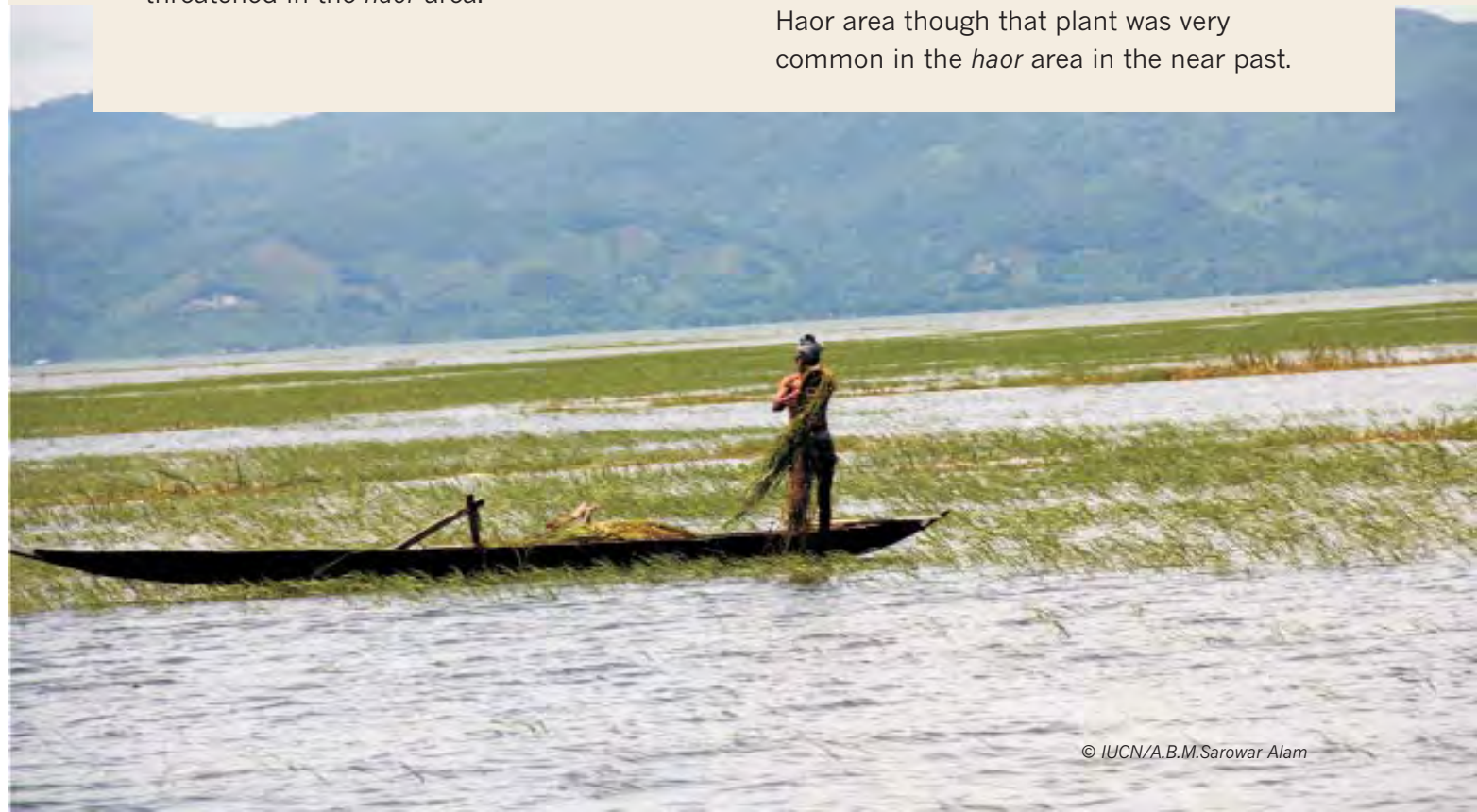
6



6.1. Conservation Status

Over exploitation of plant resources is a common phenomenon in Tanguar Haor area. Population of the *haor* area has increased in many folds within last few decades. Those increased population are depending more and more on the natural resources for their livelihood. Many plant species are disappearing from the area to meet the ever growing demand for fuel wood and building materials for houses. Some people are also involved in illicit wood trading that exerts a great threat to the tree species. That enhanced many species to become threatened in the *haor* area.

Barringtonia acutangula (Hijal) and *Millettia pinnata* (Koroch) are two vital components of the swamp forest in the *haor* area. This two species are now under a great threat in the area. The upper part of the plant is cut down for fuel wood. This activity has greatly reduced the propagation and growth of these two plant species. Such activity also adversely affected on the habitation of the birds and other wildlife which used to rely on them for food and shelter. Another tree species, *Salix tetrasperma* (Panijab) is also a very rare plant in Tanguar Haor. This plant is being cleared for fuel wood and for furniture making. The population of *Crataeva magna* (Barun) has also decreased significantly in the Tanguar Haor area though that plant was very common in the *haor* area in the near past.



The shrubby and herbaceous plants are mainly being cleared for fuel material and also for making fence and roof materials. This type of over exploitation, in a nonsense manner, exerts dangerous threat to the undergrowth vegetation. Many *kanda* regions are now converted to grass land due to the destructive consumption of other species. Many valuable medicinal plant species [i.e. *Asparagus racemosus*, *Vitex negundo*, *Cardiospermum halicacabum*, *Hydrocotyle sibthorpioides*] are becoming rare for over exploitation. The wild rose of Bengal (*Rosa clinophylla*) is also becoming threatened due to fuel wood collection and for using as a stalk plant for cultivated rose development. Plants like *Schumannianthus dichotomus* (morta or shital Pati) and *Calamus longisetus* (bet) are becoming rare in the Haor area for being used in making mat and binding materials. *Duchesnea indica* is becoming threatened due to the destruction of its habitat. *Phragmatis kakra* (*Nol khagra*) a very important species of reed swamp forest is

also under a consistent threat. This is now being cleared unwisely by the local people for fuel and other house building materials. Such destruction of vegetation will give rise to a total bare or a poorly diversified grass land. As a result, the fauna of that region will face a great threat of extinction in near future as their habitat and food supplying plant community are being destroyed.

A number of aquatic plants are becoming rarer due to the over collection of under ground rhizomes/tubers for food (i.e. *Nymphaea pubescens*, *Potamogeton crispus*, *Potamogeton mucronatus*). In the same way, *Trapa maximowiczii* is becoming rare due to the over exploitation of its fruits. On the other hand, submerged plant species are not facing a threat in the *haor* area yet. For example, *Hydrilla verticillata* and *Vallisneria spiralis* are growing so vigorously that can block the movement of fishes in the water. Hence, they should be monitored properly as their density and frequency can affect aquatic fauna.





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6.2. Importance of Conservation

Conservation of nature in its natural state is solely important for someone who depends on them. The depending community of Tanguar Haor is not aware of the conservation of the plant genetic resources. A number of economically important plant species occur in the *haor* area. *Rosa clinophylla* (*Jongli golap*) is the basic material for the modern rose cuttings. Buds of better quality rose are grafted to the young twigs of wild rose for developing cultivated rose.



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Bet and *Morta* are two important fiber yielding plants. These are used for making various kinds of furniture and handicrafts. *Asparagus racemosus* (*Satomuli*) is an important medicinal plant. Once it was found abundantly in the study area but now it has become scarce due to over harvesting.

Conservation of flora is necessary for the conservation of all other associated things e.g. fauna, ecological balances and natural beauty. Tanguar Haor is a famous ground for the migratory birds. Few rare local birds and some globally threatened birds are also found here. Plant community provides food, shelter, breeding ground to the associated fauna. This *haor* is also a large reserve for fresh water fishes and meets a significant part of fish demand of the country. Aquatic plants provide food, oxygen and shelter to those fishes. So conservation of these plants diversity is important for the integrated welfare of the total biodiversity.



6.3. Some Recommendations for Conservation and Sustainable Management

Involvement of community people is vital for any conservation and sustainable management practice. Without involving local people no conservation and management program can be made successful in the *haor* area. Some of such activities can be undertaken for the management of the *haor* biodiversity is given below:

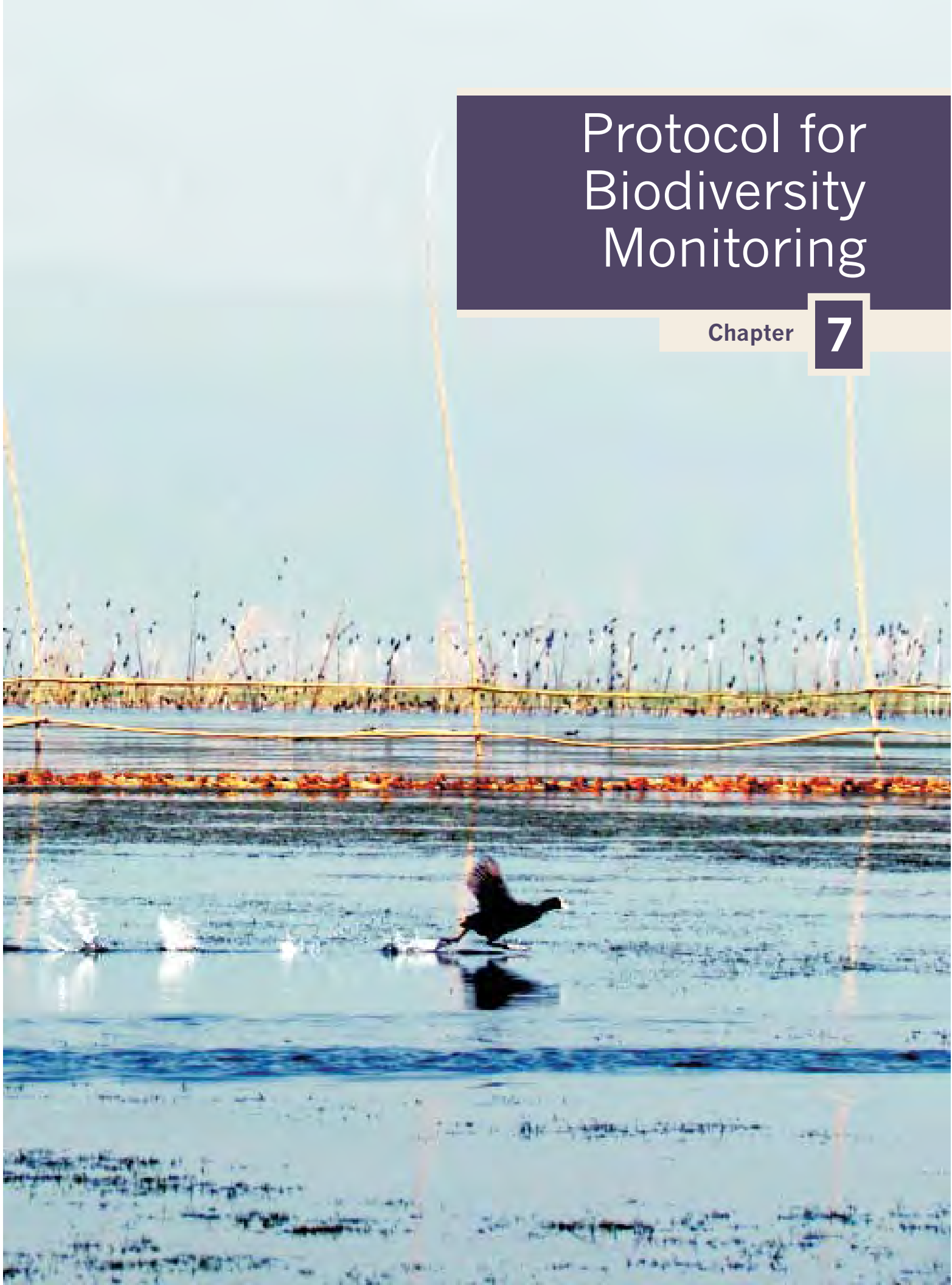
- ▶ Programme like 'social forestry' can be implemented in the *haor* area by involving community people.
- ▶ All collection programmes (for example fuel, medicine, food, timber) should be brought under a scientific observation scheme for confirming sustainable conservation.
- ▶ A number of sites representing different types of habitats should be brought under strict conservation where public entrance should be limited.
- ▶ Threatened, important medicinal, economical and woody plants should be conserved at a mono-conservation site by involving community people.
- ▶ Different programmes should be taken to raise awareness among the local people on the importance of diversity conservation.



Protocol for Biodiversity Monitoring

Chapter

7



Biodiversity monitoring systems help us contribute to the improved conservation and sustainable use of forests, freshwater and marine wetlands. Monitoring can show whether the biodiversity of an area is being maintained in accordance with the existing acts and provisions and if management interventions in the area are effective in addressing biodiversity conservation issues.

7.1 Community Based Biodiversity Monitoring

This monitoring format will be used by the groups consisting of experts, project staff and local volunteers such as committee members,

school teachers or students from colleges and schools. As the monitoring format will be finalized by a comprehensive discussion with the community people there is a good possibility to incorporate them in future monitoring processes such as survey time or data analysis for example. Enthusiastic and potential people from local community having interest in biodiversity conservation will be selected as 'local volunteers'. Central Committee with the help of management authority will select the local volunteers. A biodiversity monitoring team will be formed with above mentioned people. Four monitoring teams will be formed and they will work in four *Unions*.





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At the initial stage, the monitoring procedure is being endorsed by the experts where the project staff and community people will be a part of the system. They would have learnt the full procedure practically from the experts. The project staff and the community people in this process can acquire the knowledge on survey procedure, data compilation, data analysis and status of the haor ecosystem. Indicator species have already been selected by the experts and community people become skilled at these species by knowing their identifying characteristics. This will assist them to learn the process to identify the indicator species, their habitats, impact on the wetland ecosystem and finally to make decisions about further intervention in respect of biodiversity conservation and its management.

7.2 Biodiversity Monitoring Indicators and Format for Tanguar Haor



Biodiversity monitoring articulates the status of species in and around the Tanguar Haor which ultimately reflect the accomplishment of the ecosystem management. Sustainability of the monitoring mechanism after completion of the study largely depends on local volunteers. They will take over the whole biodiversity monitoring procedure and undertake it continuously throughout the year. Monitoring tools are generally used to evaluate the impact of current and past activities to a certain set of activities.

7.2.1 Indicator species for biodiversity monitoring in Tanguar Haor

The most important event of community based biodiversity monitoring activities is setting up indicators. Indicators will be selected by consulting literature, talking to recognized experts on biodiversity conservation and management, local people and assessing relevance of the information gathered. The following biological indicators could be used in biodiversity monitoring:

- ▶ Dominant plant species (for Tanguar Haor i.e. *Hijal*, *Singra*, *Nal* etc.)
- ▶ Bird species (for Tanguar Haor Purple Swamphen, Pallas's Fish Eagle, Ferruginous Pochard, Oriental Darter etc.).
- ▶ Fish (Rohu fish)
- ▶ Freshwater mollusks (Apple Snail)
- ▶ Frogs (Marbled toad)
- ▶ Turtle (Indian peacock softshell turtle)

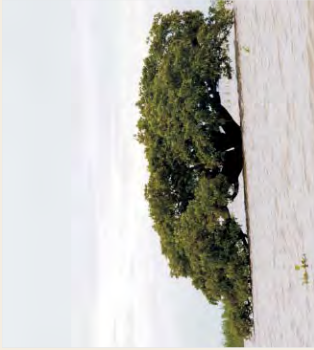
These species are being selected as indicators for variety of reasons. Indicator species are taken from different ecological strata which will ultimately depict a picture of a whole

ecosystem. As the ecosystem is an inter and intra relationship between the living and nonliving organisms the indicators are carefully chosen to include all aspects of the *haor*. As an example, Purple Swamphen depends on reed land vegetation, so degradation of such vegetation would affect the population of this bird. Tall *Hijal*, *Karoch*, Barun trees are suitable for Pallas's Fish Eagle nesting, so decline of these plant species would be alarming for the existence of this globally vulnerable species. Fishes are integral part of the wetland, as are reptiles and amphibians. In considering all these issues, the species mentioned here are preferred as indicators for biodiversity monitoring of Tanguar Haor.



Table 7.1: Identification of indicator species for biodiversity monitoring

7.1.1.1. Floral species monitoring: Few species have been selected as indicator species for monitoring purpose. The following table shows the community based floral species monitoring matrix.

Species name	Monitoring aspects	Monitoring time	How to monitor	Distribution of Monitoring Responsibility (village-wise)	Remarks	Photo for identification
<i>Barringtonia acutangula</i> [Indian Oak (English); HijoI (Local name)]	Number of trees and area of occupancy	February	Following the monitoring information collection form (see table-6.2.1)	Foliar beel adjacent forest: Mandiata (East side) and Binodpur (West side) Lachuamara beel adjacent forest: Paniakhali Noal beel adjacent forest: Ramshinghapur (Northwest side) and Jaypur (East side) Kajjori beel adjacent forest: Silan Tahirpur Rongchi forest: Rongchi	Different species of birds depends on this tree for nesting and roosting, branches of this tree have been used as food staff for the fishes. Increase of both the number of trees and the area of occupancy will have positive impacts on haor biodiversity.	
<i>Milletia pinnata</i> [Indian Beach (English); Karoch Local name]]	Number of trees and area of occupancy	February	Following the monitoring information collection form (see table-6.2.1)	Noal beel adjacent forest: Amtorpur Naindar garden: Indrapur Purangaon forest: Sriargaon (North side) and Golabari (South side) Kaillartok forest: Lamagaon Annar beel adjacent forest: Lamagaon (East side) and Makordi (West side) Berberia beel adjacent forest: Isamari Bank forest of Patlai river (east of Alamdor): Chriargaon (North side) and Tahirpur (South side) Hatirgata beel adjacent forest: Indrapur (North side) and Lamagaon (South side)	Different species of birds depends on this tree for nesting and roosting. Increase of both the number of trees and the area of occupancy will have positive impacts on haor biodiversity.	

Species name	Monitoring aspects	Monitoring time	How to monitor	Distribution of Monitoring Responsibility (village-wise)	Remarks	Photo for identification
<i>Trapa Maximowiczii</i> [Water Chestnut (English); Shingara (Local name)]	Area of occupancy by this species in different beels	February/ March	Following the monitoring information collection form (see table-6.2.1)	Lechuamara beel, Rupaboi, Rowa beel, Tekunna beel, Hatirgata beel and Berberia beel	Small fishes and fries get nutrition from submerged portion of this species. Pheasant tailed Jacana lays their eggs on leaves of this species. Local people collect it's fruit as food stuff.	
<i>Phragmites karka</i> [Tropical Reed (English); Nal (Local name)]	Number of <i>Nalbans</i> and area of occupancy by this species	February/ March	Following the monitoring information collection form (see table-6.2.1)	Kandas of Lechuamara beel, Rupaboi, Rowa beel, Tekunna beel, Hatirgata beel and Berberia beel	Reeds directly support fishes for breeding, grazing, protection etc. They also support birds for protection, food and breeding of local wetland birds. So, increasing reeds both in terms of coverage, height and density would be beneficial for fish production, birds and other wildlife	
<i>Rosa clinophylla</i> [The Bengal Rose (English); Gujjiakata (Local name)]	Number of individuals	February/ March	Following the monitoring information collection form (see table-6.2.1)	Kanda of north side of Rowa beel Purangaon adjacent kanda (West side of Patlai river): Sriargaon Kanda of west side of Eraillkona beel: Binodpur Kanda of north side of Lechuamara beel: Binodpur Kanda of Naindar beel: Indrapur	Villagers used to take these as fuel. This species is occurred only in <i>Tanguar haor</i> and in a part of Mymensingh district.	

Species name	Monitoring aspects	Monitoring time	How to monitor	Distribution of Monitoring Responsibility (village-wise)	Remarks	Photo for identification
<i>Hydrilla verticillata</i> [Whorled-leaved Hydrilla (English); Jhangj (Local name)]	Area of occupancy by this species in different beels	February/ March	Following the monitoring information collection form (see table-6.2.1)	Lechuamara beel, Rupaboi, Rowa beel, Tekunna beel, Hatirgata beel and Berberia beel South side of Hatirgata beel and East side of Ballarduba beel: Lamagaon	Fishes get nutrition and shelter from this submerged species. However, vigorous growth of the plant may cause adverse effects on aquatic fauna.	
<i>Vallisneria spiralis</i> [Eel Grass (English); Patseola (Local name)]	Area of occupancy by this species in different beels	February/ March	Following the monitoring information collection form	Lechuamara beel, Rupaboi, Rowa beel, Tekunna beel, Hatirgata beel and Berberia beel	Fishes get nutrition and shelter from this submerged species. However, vigorous growth of the plant may cause adverse effects on aquatic fauna.	

7.1.2 Faunal species monitoring: Few species have been selected as indicator species for monitoring purpose. The following table shows the community based faunal species monitoring matrix

Code: E- English name; S- Scientific name; L-Local name

Name of the Indicator bird species	Food and habitat	Identification Characteristics	Status	Bird's Calling	Census time	Status without this species (red line)	Photo for identification
E-Pallas's Fish Eagle S- <i>Haliaeetus leucorophus</i> L-Kura/Kurol/ Bo-wol	-Mainly come in winter for food and breeding in Tanguar haor. -Normally live on catching large fish from the water surface. - Need tall trees to build their nests.	-Easily identifiable. -Largest Eagle in Bangladesh.	Threatened all over the world, mostly seen in Tanguar Haor in Bangladesh	It can be easily identified its frequent very loud species specific calls	Winter season	-Decreasing of this species indicates reducing the number of large fish in the haor. -Decreasing the number of large trees inside and surrounding the haor.	
E-Ferruginous Pochard S- <i>Aythya nyroca</i> L- Bhuti Hans	-Come in winter for food in the haor -Lives on aquatic tender leaves of the plants -It is the representative of the migratory duck	Easily identifiable	-Threatened all over the world, -Mostly found in Tanguar Haor from all over the world	Difficult to identify by their calling	Winter season	Decreasing of this species indicates reducing the aquatic herbs and shrubs which are essential not only for birds but also for the survival of the fish.	

Name of the Indicator bird species	Food and habitat	Identification Characteristics	Status	Bird's Calling	Census time	Status without this species (red line)	Photo for identification
E- Oriental Darter S-Anhinga melanogaster L- Goyar/Shapapaksi	-Resident bird of Bangladesh -Feed on hunting small fish by diving under water like a cormorant -They need large trees to build their nests.	Easily identifiable	Threatened all over the world, mostly found in Tanguar Haor, Bangladesh	Difficult to identify by their calling. As it is virtually silent.	All around the year	-Decreasing of this species indicates reducing the small fish of the haor which are essential for the wolfish such as Striped Snakehead, Freshwater Shark, Giant Snakehead, etc. - The number of large trees inside and surrounding the haor is decreasing. -Water pollution is increasing.	
E-Purple Swamphen S-Porphyrion porphyrio L- Kalim/Kayem	-Resident bird of Bangladesh -Largely feed on aquatic vegetation insects, small fishes and larvae -Builds nests inside the reed of the elevated land of the haor	Easily identifiable	-Once it was widely found in most of the wetlands of Bangladesh. -Hard to be seen anywhere except in the haor	Can be easily identified by its calling	All around the year	-Decreasing of this species indicates reducing the reeds of the haor -Not only Purple swamphen but also other birds, small mammals, frog, turtle/tortoise and fish will be reduced in numbers as it is suitable for their breeding	

Name of the Indicator bird species	Food and habitat	Identification Characteristics	Status	Census time	Status without this species (red line)	Photo for identification
E-Peacock Soft-shelled Turtle <i>S-Nilssoniahurum</i> L-Dhum Kasim	-Both water and upland area are important for their survival. -Feed on aquatic plants and small fish -Keep the water clean by eating aquatic waste materials	Easily identifiable	Threatened in Bangladesh but can be easily seen in Tanguar Haor.	Winter and rainy season	-Decreasing of this species indicates reducing the aquatic plants and small fish. -Increase of water pollution. - Hunting increasing	
E-Marbled Toad <i>S-Bufo stomaticus</i> L-Khoshkhoshey Bang	-Important food item for birds and snakes.	Easily identifiable	Can be easily identified by its calling	Rainy season	-Decrease the number of birds and snakes -Acts as an important indicator of climate change.	

7.1.3 Fish species monitoring: Few species have been selected as indicator species for monitoring purpose. The following table shows the community based fish species monitoring matrix

Fish	Food and habitat	Status without this species	Photo for identification
E- Rohi or Rohu S- <i>Labeo rohita</i> L-Rou	-Natural breeding center. -Rapidly growing -Survival of this fish is interlinked with the depth of water -Thousands of fishermen sustain their livelihoods by Rohu fishing.	-If this fish decreases in the Tanguar Haor area, Bangladesh's most prosperous breeding centre, the whole biodiversity of this area would be affected. - Living standards of the fishermen will decline - Protein crisis might occur	
E-Freshwater Shark L-Boal S - <i>Wallago attu</i>	-It's a predatory fish - Maintains an equilibrium among the fish species by eating some fishes - Survivability of this fish is interlinked with the depth of water -Thousands of fishermen live on fishing	- If this fish decreases in the Tanguar Haor area, Bangladesh's most prosperous breeding centre, the whole biodiversity of this area would be affected. - Living standards of the fishermen will decline - Protein crisis might be noticed	
E- Reba carp S- <i>Cirrhinus reba</i> L-Laacho	- This fish of the haor is unique. - In fact thousands of fishermen live on catching this fish.	- If this fish decreases in the Tanguar Haor area, Bangladesh's most prosperous breeding centre, the whole biodiversity of this area would be affected. - Living standards of the fishermen will decline - Protein crisis might be felt	

7.2.2 Biodiversity Monitoring Format for Tanguar Haor

A species monitoring format (Table 7.2) after being designed by the researchers will be sent to the field level for analyzing. At this stage, a species monitoring format will be finalized discussing with the local people and then field work will be started following the format.

Who will monitor?

Several teams (each comprising of three educated local people interested in

birds/nature conservation from villages/union) will be formed for the monitoring task. Local school teachers or even the students of schools and colleges can be considered for the team.

Who will scrutinize the monitoring format?

After receiving field information researchers will examine the data of the baseline survey and will submit a comparative report to the authority and accordingly they will take the necessary steps.



7.3 Monitoring Format for Indicator Plant, Bird, Turtle Species, Hunting, Hunter and other Indicators

Table 7.2.1 Plant Monitoring Format

1. Hijal (*Barringtonia acutangula*)

Sl. no.	Present status of old/mature forest			Sl. no.	Count of newly cultivated gardens and plants		
	Name/location	Area coverage	Tree number		Name/location	Area coverage	Tree number
Total				Total			

2. Karoch Plant (*Millettia pinnata*)

Sl. no.	Present status of old/mature forest			Sl. no.	Count of newly cultivated gardens and plants		
	Name/location	Area coverage	Tree number		Name/location	Area coverage	Tree number
Total				Total			

3. Singara (*Trapa maximowiczii*)

Sl. no.	Present status of old/mature Singara vegetation		Sl. no.	Count of newly regenerated Singara vegetation	
	Name/location	Area coverage		Name/location	Area coverage
Total			Total		

4. Nalbon (*Phragmites karka*)

Present status of old/mature nalbon			Count of newly accreted nalbon		
Sl. no.	Name/location	Area coverage	Sl. no.	Name/location	Area coverage
Total			Total		

5. Guijjakata (*Rosa clinophylla*)

Present status of old/mature Guijjakata			Count of newly regenerated Guijjakata		
Sl. no.	Name/location	Individual number	Sl. no.	Name/location	Individual number
Total			Total		

6. Jhangi (*Hydrilla verticillata*)

Sl. no.	Present status of old/mature Jhangi vegetation		Sl. no.	Count of newly regenerated Jhangi vegetation	
	Name/location	Area coverage		Name/location	Area coverage
Total			Total		

7. Patseola (*Vallisneria spiralis*)

Present status of old/mature Patseola vegetation			Count of newly regenerated Patseola vegetation		
Sl. no.	Name/location	Area coverage	Sl. no.	Name/location	Area coverage
Total			Total		

Table 7.2.2 Wildlife Monitoring Format

Bird's name	Number	Obtained marks
Pallas's Fish Eagle	Census data:	Marks:.....
Marking guidelines:0%=1,1-40%=2,41-60%=3,61-79%=4,80>=5		
Formula of result calculation:20*100/40=50%=if 10 birds seen in one census, Marks=3		
Pallas's Fish Eagle=40 seen=100%=No management is required in case of scored more than 80% (5) marks If scored 4 management is going well If scored 3 management is required If scored 2 management is going down In case of not seen Red Line's causes are clear		

Bird's name	Number	Obtained marks
Nest of Pallas's Fish Eagle	Census data:	Marks:.....
Marking guidelines:0%=1,1-40%=2,41-60%=3,61-79%=4,80>=5		
Formula of result calculation:10*100/20=50%=if 5 nests seen in one census, Marks=3		
Pallas's Fish Eagle Nesting =20 =100%= No management is required in case of scored more than 80% (5) marks If scored 4 management is going well If scored 3 management is required If scored 2 management is going down In case of not seen Red Line's causes are clear		

Bird's name	Number	Obtained marks
Ferruginous Pochard	Census data:	Marks:.....
Marking guidelines:0%=1, 1-40%=2, 41-60%=3, 61-79%=4, 80>=5		
Formula of result calculation:7500*100/15000=50%=if 7500birds seen in one census, Marks=3		
Ferruginous Pochard= if 30,000 individuals are seen=100%= No management is required in case of scored more than 80% (5) marks If scored 4 management is going well If scored 3 management is required If scored 2 management is going down In case of not seen Red Line's causes are clear		

Bird's name	Number	Obtained marks
Oriental Darter	Census data:	Marks:.....
Marking guidelines:0%=1,1-40%=2,41-60%=3,61-79%=4,80>=5		
Formula of result calculation:40*100/60=66.66%=if 40 birds seen in one census, Marks=4		
Oriental Darter=60 seen=100%= No management is required in case of scored more than 80% (5) marks If scored 4 management is going well If scored 3 management is required If scored 2 management is going down In case of not seen Red Line's causes are clear		

Bird's name	Number	Obtained marks
Purple Swampfen	Census data:	Marks:.....
Marking guidelines:0%=1,1-40%=2,41-60%=3,61-79%=4,80>=5		
Formula of result calculation:7000*100/10,000=70%=if 7,000 birds seen in one census, Marks=3		
Purple Swampfen= If 10,000 individuals are seen=100%= No management is required in case of scored more than 80% (5) marks If scored 4 management is going well If scored 3 management is required If scored 2 management is going down In case of not seen Red Line's causes are clear		

Bird's Nesting	Number	Obtained marks
Purple Swampfen (Nesting)	Census data:	Marks:.....
Marking guidelines:0%=1,1-40%=2,41-60%=3,61-79%=4,80>=5		
Formula of result calculation:60*100/100=60%=if 60 birds seen in one census, Marks=3		
Purple Swampfen (Nesting)=100=100%= No management is required in case of scored more than 80% (5) marks If scored 4 management is going well If scored 3 management is required If scored 2 management is going down In case of not seen Red Line's causes are clear		

Hunting**Number****Obtained marks****Bird's Hunted****Census data:****Marks:.....**

Marking guidelines: 0%=1, 1-40%=2, 41-60%=3, 61-79%=4, 80>=5

Formula of result calculation: $40 \times 100 / 100 = 40\%$ = if 40 birds seen in one census, Marks=2

If Hunting 100 individuals = 100% = Management is required if the number is over 20% (2)

Score 3 indicates to regular hunting

Score 4 indicate that hunters are desperate or there is no monitoring from the authority

Score 5 indicates very poor management

Hunter**Number****Obtained marks****Bird hunter****Census data:****Marks:.....**

Marking guidelines: 0%=1, 1-40%=2, 41-60%=3, 61-79%=4, 80>=5

Formula of result calculation: $20 \times 100 / 50 = 40\%$ = if 20 birds seen in one season, Marks 2

Bird Hunter=If 50 Bird hunters are seen=100%= Management is required if the number is over 20% (2)

Score 3 indicates to regular hunting

Score 4 indicates that hunters are desperate or there is no monitoring from the authority

Score 5 indicates very poor management

Turtle**Number****Obtained marks****Peacock Soft-shelled Turtle****Census data:****Marks:.....**

Marking guidelines: 0%=1, 1-40%=2, 41-60%=3, 61-79%=4, 80>=5

Formula of result calculation: $30 \times 100 / 50 = 60\%$ = if 40 Turtles seen in one season, Marks=3

Turtle=50=100%= No management is required in case of scored more than 80% (5) marks

If scored 4 management is going well

If scored 3 management is required

If scored 2 management is going down

In case of not seen Red Line's causes are clear

Hunting	Number	Obtained marks
Turtles hunted	Census data:	Marks:.....
Marking guidelines: 0%=1, 1-40%=2, 41-60%=3, 61-79%=4, 80%>=5		
Formula of result calculation: $10 \times 100 / 20 = 50\%$ = if 10 Turtles seen in one season, Marks=3		
Turtle hunting=If 20 individuals are hunted=100%= Management is required if the number is over 20% (2) Score 3 indicates to regular hunting Score 4 indicate that hunters are desperate or there is no monitoring from the authority Score 5 indicates very poor management		

Hunter	Number	Obtained marks
Turtle hunter	Census data:	Marks:.....
Marking guidelines: 0%=1, 1-40%=2, 41-60%=3, 61-79%=4, 80%>=5		
Formula of result calculation: $5 \times 100 / 10 = 50\%$ = if 5 Turtle hunters found in one season, Marks=3		
Turtle hunting=10 turtle hunters found=100%= Management is required if the number is over 20% (2) Score 3 indicates to regular hunting Score 4 indicate that hunters are desperate or there is no monitoring from the authority Score 5 indicates very poor management		

Census	Number	Obtained marks
Scientific Bird Census	Census data:	Marks:.....
Marking guidelines: 0%=1, 1-50%=3, 100 >=5		
Formula of result calculation: 50%=1 time census, Marks=3		
Scientifically bird census=2 times every year=100%=If score 5, research works are going on regularly Score 3 indicates that research is going on but not regular Score 1 indicates no research is going on		

Festival	Number	Obtained marks
Bird Festival	Census data:	Marks:.....

Marks guidelines: 0% = 1, 99% = 5

Formula of result calculation: If biodiversity conservation festival organize once in a = 100% = Marks 5

Festival on bird conservation = once in every year = 5 marks, Awareness works is going on Score 1 indicates that there is no mass awareness on biodiversity conservation

Committee	Number	Obtained marks
Biodiversity conservation committee	Census data:	Marks:.....

Marks guidelines: 0% = 1, 1-50% = 2, 51% >= 5

Formula of result calculation: committee in 4 villages = 100% = Marks = 5, committee in two villages = 50% = 3 marks

Biodiversity conservation Committee = committee in four villages every year = 100% = Marks 5, Biodiversity conservation committee is working well
Biodiversity conservation committee = 2 committees in 2 villages per year = 50% = Marks 2, biodiversity conservation committee is working slowly

7.4 How Community Benefit from Sustainable Resource Management?

The natural resources of Tanguar Haor are immensely important to the local community as the people are extremely dependent on *haor* resources. The sustainable management of the wetlands flora and fauna needs detailed understanding of species composition, distribution patterns, estimates of productivity and direct and indirect values.

Sustainable forest (swamp forest and reed beds) management will help local people to continue collecting their variety of products and services and also assist in fish breeding. These are both of considerable benefit to the community.

Conservation of fish in the *haor* would increase fish production in the floodplains of Bangladesh and subsequently directly effect the economy of *haor* community as a vast proportion of the population in Tanguar Haor are connected to fishery.

In Tanguar haor, local people are mainly engaged in agriculture. Conservation of fauna will help increase fertility of agricultural land, e.g., wetland waterfowls, turtle and tortoises and indirectly help increase the fertility of agricultural land through their faecal deposition.

A thorough combination of biodiversity and sustainable management will represent a healthy ecosystem in Tanguar Haor and therefore will help to protect the biodiversity of this *haor* for future benefits. Accordingly, it will directly or indirectly help the economy and livelihood of the Tanguar Haor local community.







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APPENDICES

Appendix 1. Checklist of Flora in Tanguar Haor

Sl. No.	Scientific Name	Family	Common Name		Habitat	Present status
			English	Bengali		
1.	<i>Alternanthera ficoidea</i>	Amaranthaceae	Not known	Not known	Dry land	Rare
2.	<i>Alternanthera philoxeroides</i>	Amaranthaceae	Alligator weed	Hycha	Wet land	Common
3.	<i>Alternanthera sessilis</i>	Amaranthaceae	Alligator weed	Hycha	Wet land	Common
4.	<i>Aniseia martinicensis</i>	Convolvulaceae	White Jacket	Rada lota	Cosmopolitan	Rare
5.	<i>Aponogeton undulatus</i>	Aponogetonaceae	Not known	Not known	Aquatic	Rare
6.	<i>Aponogeton nutans</i>	Aponogetonaceae	Not known	Not known	Aquatic	Common
7.	<i>Asparagus racemosus</i>	Liliaceae	Wild Asparagus	Satamuli.	Cosmopolitan	Rare
8.	<i>Azolla pinnata</i>	Azollaceae	Feathered mosquito fern	Khode pana	Aquatic	Rare*
9.	<i>Barringtonia acutangula</i>	Lecythidaceae	Indian Oak	Hijol	Wetland	Very Common
10.	<i>Calamus longisetus</i>	Arecaceae	Rattan palms	Bet	Cosmopolitan	Rare
11.	<i>Cardiospermum halicacabum</i>	Sapindaceae	Balloon Vine	Phutka	Dry land	Rare
12.	<i>Centella asiatica</i>	Apiaceae	Indian pennywort.	Thankuni	Wet land	Common
13.	<i>Ceratophyllum demersum</i>	Ceratophyllaceae	Hornwort	Not known	Aquatic	Rare



Sl. No.	Scientific Name	Family	Common Name		Habitat	Present status
			English	Bengali		
14.	<i>Chenopodium album</i>	Amaranthaceae	Pigweed	Beley shak.	Dry land	Common
15.	<i>Chylocalyx perfoliatus</i>	Polygonaceae	Thorny Smartweed.	<i>Kanta Tokpata</i>	Dry land	Rare
16.	<i>Cissampelos pareira</i> var. <i>hirsuta</i>	Menispermaceae	Not known	Akanadi	Cosmopolitan	Rare
17.	<i>Cleome hassleriana</i>	Capparaceae	Fringed spider flower	Not known	Dry land	Very Common
18.	<i>Clerodendrum indicum</i>	Verbenaceae	Not known	Not known	Dry land	Rare
19.	<i>Coccinia grandis</i>	Cucurbitaceae	Ivy Gourd	Telakucha	Dry land	Common
20.	<i>Coix lacryma-jobi</i>	Poaceae	Job's Tears	Kaich Gota	Wet land	Common
21.	<i>Commelina benghalensis</i>	Commelinaceae	Dew Flower	Kanshira	Wet land	Common
22.	<i>Cotula hemispherica</i>	Asteraceae	Not known	Babuni	Cosmopolitan	Common
23.	<i>Crateva magna</i>	Capparidaceae	Three-leaved Caper	Barun	Wet land	Rare
24.	<i>Crotalaria pallida</i>	Fabaceae	Rattle pod	Jhunjuni	Dry land	Common
25.	<i>Cryptocoryne retrospiralis</i> subsp. <i>albida</i>	Araceae.	Not known	Basori.	Wetland	Common
26.	<i>Cynodon dactylon</i>	Poaceae	Dog's Tooth Grass	Durbagass.	Cosmopolitan	Very common
27.	<i>Cyperus compressus</i>	Cyperaceae	Poor land Flat sedge	Not known	Wet land	Common
28.	<i>Cyperus rotundus</i>	Cyperaceae	Nut sedge	Vedha grass.	Wet land	Common
29.	<i>Duchesnea indica</i>	Rosaceae	Indian Strawberry	<i>Jongli Strawberry</i>	Dry land	Very Rare
30.	<i>Echinochloa crusgalli</i>	Poaceae	Water grass	Shama ghas	Wetland	Common
31.	<i>Eclipta alba</i>	Asteraceae	False Daisy	Kalokashi	Wet land	Common
32.	<i>Eichhornia crassipes</i>	Pontederiaceae	Water Hyacinth	Kochuri pana	Aquatic	Common
33.	<i>Eleocharis dulcis</i>	Cyperaceae	Chinese Water Chestnut	Chechra	Wet land	Very Common
34.	<i>Enhydra fluctuans</i>	Asteraceae	Water Cress	Helencha	Aquatic	Rare
35.	<i>Ficus heterophylla</i>	Moraceae.	Not known	Not known	Wet land	Abundant



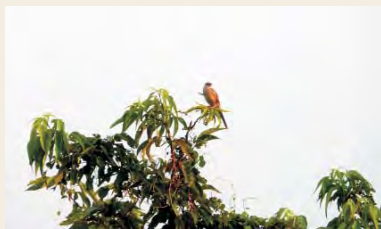
Sl. No.	Scientific Name	Family	Common Name		Habitat	Present status
			English	Bengali		
36.	<i>Fimbristylis aestivalis</i>	Cyperaceae	Summer fimbristylis	Not known	Wet land	Common
37.	<i>Glinus oppositifolius</i>	Molluginaceae	Indian Chickweed	<i>Gima-sak</i>	Wet land	Common
38.	<i>Gnaphalium luteo-album</i>	Asteraceae	Common cudweed	Bara Kamra	Bara Kamra	Common
39.	<i>Hedyotis corymbosa</i>	Rubiaceae	Diamond flower	Khet Papra	Cosmopolitan	Common
40.	<i>Heliotropium indicum</i>	Boraginaceae	Indian heliotrope	Hatisur	Dry land	Common
41.	<i>Hemarthria protensa</i>	Poaceae	Not known	Not known	Wet land	Very common
42.	<i>Hydrilla verticillata</i>	Hydrocharitaceae	Hydrilla	Pata Jhaji	Aquatic	Abundant
43.	<i>Hydrocotyle sibthorpioides</i>	Apiaceae	Lawn marsh pennywort	Not known	Wetland	Very Rare
44.	<i>Hygroryza aristata</i>	Poaceae	Water Star Grass	Phutki	Aquatic	Rare
45.	<i>Ipomoea aquatica</i>	Convolvulaceae	Swamp Morning-glory	Kalmi shak	Wet land	Common
46.	<i>Ipomoea fistulosa</i>	Convolvulaceae	Pink morning glory	Dholkolmi	Cosmopolitan	Very common
47.	<i>Lemna perpusilla</i>	Lemnaceae	Common Duckweed	Khodepana	Aquatic	Common
48.	<i>Leucas indica</i>	Lamiaceae	Leucas	Setodrone	Dry land	Common
49.	<i>Limnophila heterophylla</i>	Scrophulariaceae	Dwarf Ambulia	Kashordham	Aquatic	Common
50.	<i>Lindernia antipoda</i>	Scrophulariaceae	Sparrow false pimpernel	Not known	Wet land	Common
51.	<i>Lippia alba</i>	Verbenaceae	Bushy Lippia	Potpoti	Cosmopolitan	Common
52.	<i>Ludwigia adscendens</i>	Onagraceae	Water Primrose	Kesardam,	Aquatic	Very Common
53.	<i>Ludwigia octovalvis</i>	Onagraceae	Willow Primrose	Bunlong	Wet land	Common
54.	<i>Ludwigia perennis</i>	Onagraceae	Not known	Not known	Wet land	Common
55.	<i>Marsilea quadrifolia</i>	Marsileaceae	Water clover	Shusni shak	Wet land	Rare
56.	<i>Mazus pumilus</i>	Scrophulariaceae	Japanese Mazus	Not known	Wet land	Rare
57.	<i>Merremia gemella</i>	Convolvulaceae	Indian Jalap	Halud Kalmi	Cosmopolitan	Common



Sl. No.	Scientific Name	Family	Common Name		Habitat	Present status
			English	Bengali		
58.	<i>Najas minor</i>	Najadaceae	Brittle Waternymph	Jhaudham	Aquatic	Very common
59.	<i>Nechamandra alternifolia</i>	Hydrocharitaceae	Not known	Not known	Aquatic	Common
60.	<i>Nymphaea capensis</i>	Nymphaeaceae	Cape-blue Waterlily	<i>Beguni shapla</i>	Aquatic	Common
61.	<i>Nymphaea nouchali</i>	Nymphaeaceae	Water lily	Nilsapla.	Aquatic	Rare
62.	<i>Nymphaea pubescens</i>	Nymphaeaceae	White Water Lily	Sada shapla	Aquatic	Common
63.	<i>Nymphaea rubra</i>	Nymphaeaceae	Red Water Lily	Lal Shapla	Aquatic	Common
64.	<i>Nymphoides hydrophylla</i>	Menyanthaceae	Crested Floating Heart	Not known	Aquatic	Common
65.	<i>Nymphoides indicum</i>	Menyanthaceae	White Water Fringe	Not known	Aquatic	Rare
66.	<i>Ottelia alismoides</i>	Hydrocharitaceae	Duck Lettuce	Panikola	Aquatic	Common
67.	<i>Oxystelma secamone</i>	Asclepiadaceae	Rosy Milkweed Vine	Dudhialata	Wet land	Common
68.	<i>Panicum paludosum</i>	Poaceae	Not known	Barti, Kalam	Wet land	Common
69.	<i>Persicaria glabra</i>	Polygonaceae	Smooth Smartweed	<i>Lal-kukri</i>	Wet land	Very Common
70.	<i>Persicaria lanata</i>	Polygonaceae	Silver Knotweed	<i>Shet-panimarich</i>	Wet land	Common
71.	<i>Persicaria lapathifolia</i>	Polygonaceae	Pale Smartweed	<i>Panimorich</i>	Wet land	Common
72.	<i>Persicaria orientalis</i>	Polygonaceae	Gate Knotweed	<i>Bara Panimorich</i>	Wet land	Very Common
73.	<i>Persicaria viscosa</i>	Polygonaceae	Sticky Knotweed	<i>Athalo Bishkatali</i>	Wet land	Common
74.	<i>Phragmites karka</i>	Poaceae	Common reed	Nolkhagra	Wet land	Very common
75.	<i>Phyla nodiflora</i>	Verbenaceae	Frogfruit	Koyerar pata	Dry land	Common
76.	<i>Phyllanthus reticulatus</i>	Euphorbiaceae	Roast Potato Plant	Chitki	Cosmopolitan	Very common
77.	<i>Physalis angulata</i>	Solanaceae	Cape Goose Berry	Futka	Dry land	Common
78.	<i>Pistia stratiotes</i>	Araceae	Water lettuce	Topa pana.	Aquatic	Rare*
79.	<i>Polygonum plebeium</i>	Polygonaceae	Knotweed	Not known	Wet land	Common



Sl. No.	Scientific Name	Family	Common Name		Habitat	Present status
			English	Bengali		
80.	<i>Milletia pinnata</i>	Fabaceae	Indian Beech	Koroch	Wet land	Common
81.	<i>Potamogeton crispus</i>	Potamogetonaceae	Curly-leaf Pondweed	Not known	Aquatic	Common
82.	<i>Potamogeton mucronatus</i>	Potamogetonaceae	Bog Pondweed	Not known	Aquatic	Rare
83.	<i>Pteris vittata</i>	Pteridaceae	Sunfern	Dhakishak	Dry land	Common
84.	<i>Ricinus communis</i>	Euphorbiaceae	Castor	Verenda	Dry land	Common
85.	<i>Rorippa heterophylla</i>	Brassicaceae	Yellow Cress	Not known	Dry land	Rare
86.	<i>Rosa clinophylla</i>	Rosaceae	Wild rose	Jongligolap	Cosmopolitan	Common
87.	<i>Rumex dentatus</i>	Polygonaceae	Not known	Bon palong	Cosmopolitan	Common
88.	<i>Saccharum munja</i>	Poaceae	Tall cane	Binna	Cosmopolitan	Very Common
89.	<i>Sagittaria sagittifolia</i>	Alismatacea	Arrow-head	Gacho	Wet land	Very Common
90.	<i>Salix tetrasperma</i>	Salicaceae	Indian willow	Panibaj	Wet land	Rare
91.	<i>Salvinia cucullata</i>	Salviniaceae	Salvinia	Indurkani	Aquatic	Rare*
92.	<i>Schoenoplectus juncooides</i>	Cyperaceae	Bulrush	Chechra	Wet land	Common
93.	<i>Schumannianthus dichotomus</i>	Marantaceae	Cool Mat	Murta	Wet land	Rare
94.	<i>Senna tora</i>	Caesalpiniaceae	Sickle Senna	Teraj, Araj	Dry land	Common
95.	<i>Sida rhombifolia</i>	Malvaceae	Not known	Not known	Dry land	Common
96.	<i>Solanum americanum</i>	Solanaceae.	Not known	Tit begun.	Dry land	Common
97.	<i>Trapa maximowiczii</i>	Trapaceae	Water Chestnut	Singra	Aquatic	Very Common
98.	<i>Trewia nudiflora</i>	Euphorbiaceae	False White Teak	Meragota	Cosmopolitan	Common
99.	<i>Utricularia aurea</i>	Lentibulariaceae	Bladderworts.	Not known	Aquatic	Common
100.	<i>Vallisneria spiralis</i>	Hydrocharitaceae	Tape-grass	Baicha	Aquatic	Abundant
101.	<i>Vetiveria zizanioides</i>	Poaceae	Vetiver Grass	Gandha bena	Cosmopolitan	Common
102.	<i>Vicia sativa</i>	Lythraceae	Common vetch	Ankari, Hatka	Dry land	Common
103.	<i>Vitex negundo</i>	Verbenaceae	Five-leaved chaste tree	Nishinda	Cosmopolitan	Very rare
104.	<i>Xanthium indicum</i>	Asteraceae	Common Cocklebur	Ghagra	Dry land	Common



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