DISCOVERY

Aquatic vascular flora at Sadar Upazila of Chapai Nawabganj district, Bangladesh

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ABSTRACT

The current study concentrated on the aquatic plants and their conservation status in both naturally occurring and artificially created wetlands across Chapai Nawabganj Sadar Upazila. The research was done from October 2021 to September 2022. In the current study, a total of 35 species of aquatic plants were discovered in Chapai Nawabganj Sadar Upazila. These belong to 28 families and 32 genera. Scientific names, local names, families, divisions, habits, habitats, uses and status are all given for each species. Aquatic ecological habitat analysis reveals variances. Among them 34.78% of the species prefer to grow close to the edge of the water, followed by 8.70% that grow underwater, 10.87% that emerge, 13.04% that float freely and 32.61% that grow rooted in the water. When it comes to submerged species, they bloom on the water's surface. Fruits are submerged in water until they reach maturity after pollination. Of these, 50% of the species are used as fodder, 23.91% are used medicinally, 2.17% are used in aquariums, 6.52% are used as vegetables, 6.52% are edible and 10.87% are used as fish food in the study area. Varied aquatic plant species have different densities in their habitats. According to analysis, there were 10.87% species that were abundant, 43.48% common and 45.65% rare aquatic plant species in the research region. From the research region, the investigation identified several rare aquatic plant species was recorded. These are *Ottelia alismoides* (Panikola), *Enhydra fluctuans* (Titidata), *Centrostachys aquatica*, *Trapa bispinosa* (Singara), *Nelumbo nucifera* (Paddo), *Nymphaea pubescens* (Sadashapla), *Oenanthe javanica* (Panidhone) and *Nymphaea rubra* (Lal shapla). Due to local demand for use, there are relatively few of these species left in the wild. Conservation efforts must be made to protect these species. If not, the species will eventually disappear entirely from the wild. A preliminary survey conducted in Chapai Nawabganj Sadar Upazila revealed that making informed judgments about the state of aquatic plants is exceedingly challenging. The findings of the current study demonstrated that Chapai Nawabganj Sadar Upazila's water habitats are floristically abundant in terms of area and that the district is also the home to numerous endangered aquatic plant species in Bangladesh. Further long-term study is required to create a comprehensive inventory of the aquatic flora in Chapai Nawabganj Sadar Upazila.

Keywords: Species diversity, vascular aquatic flora, Chapai Nawabganj district, Bangladesh

DISCOVERY
SCIENTIFIC SOCIETY

1. INTRODUCTION

Our terrestrial ecology largely depends on the diversity of plants. We are all totally dependent on plant diversity for all of our daily requirements, including food and energy, both directly and indirectly. For a variety of purposes, including food, fuel, fiber, oil, herbs, spices, industrial crops, pasture for domesticated animals and fodder, humans use tens of thousands of higher plant species and a few hundred lower plant species. Between 25,000 and 30,000 plant species have been used by tropical people, with up to 25 000 species being used in traditional medicines (Heywood, 1993). Additionally, plant diversity is essential for ecosystem functions like maintaining a clean environment, safeguarding watersheds, reducing erosion, enhancing soil quality, controlling climate and providing habitat for the majority of our wild animals. Humans are currently posing a serious threat to the world's diverse plant species. Examples of problems created by humans include urbanization, commercial agriculture, tree plantations, logging and timber exploitation, mining and transportation, pollution, overharvesting, tourism, biological invasion and foreign monoculture plantings. The diversity of plants in different environments is influenced by natural disasters and other occurrences.

In order to compare changes in biodiversity through time and to establish a baseline for comparison after habitat changes, the study of aquatic plant variety is essential. The survey's findings can be utilized to identify rare, endangered, alien, indigenous, pest, and therapeutic plant species. The survey results are now being used to evaluate potential project impacts and to provide information to management programs so that decisions about biodiversity protection may be made. Data on water plant variety is needed for students, researchers, biodiversity management planners, social foresters, NGOs, District gazetteers and other passionate plant aficionados.

Several districts and upazilas, forests, protected areas have already started to explore and document their local plant diversity (Khan et al., 1994; Rahman and Hassan 1995; Uddin et al., 1998; Uddin and Rahman, 1999; Khan and Huq, 2001; Uddin et al., 2002; Uddin et al., 2003; Alam et al., 2006; Moniruzzaman et al., 2012; Rahman et al., 2013; Rahman and Alam, 2013; Uddin et al., 2005; Rafiqul, 2009; Tutul, 2010; Uddin and Hassan, 2004; Zahra and Rahman, 2018; Uddin and Hassan, 2010; Uddin et al., 2013; Uddin et al., 2014; Sultana and Rahman, 2016; Sarker and Rahman, 2016, 2017, 2019; Roy and Rahman, 2018; Rahman et al., 2014; Rahman et al., 2007, 2007; Rahman et al., 2008; Rahman, 2021; Debnath and Rahman, 2017; Rahman and Mamun, 2017; Islam and Rahman, 2017; Rahman, 2017; Nahar and Rahman, 2016, 2016; Roy and Rahman, 2018; Roy et al., 2016; Rahman and Jamila, 2015; Rahman et al., 2015; Rahman et al., 2015; Rahman et al., 2015; Rahman and Parvin, 2015; Uddin et al., 2014; Rahman and Gulshana, 2014; Rahman and Rahman, 2014; Rahman et al., 2014; Rahman et al., 2014; Rahman and Rojonogondha, 2014; Rahman and Keya, 2014; Kona and Rahman, 2015; Keya and Rahman, 2017; Rahman and Akter, 2013; Uddin et al., 2016).

Numerous articles on water plants have been published in South Asian countries (Swamy et al., 2016; Chakraborty et al., 2016; Rasingam Ladan, 2010). In Bangladesh, the districts of Kishoregonj and Noakhali, as well as the campus of Rajshahi University, have been chosen for aquatic plant study (Basak et al., 2015, Kaiser et al., 2016; Rahman et al., 2007). However, no comparable aquatic plant survey and documentation activity has been found for the Chapai Nawabganj district. The vulnerability of aquatic habitats is exacerbated by biological invasion, irrigation, industrial agriculture, dams and diversion and pollution. Because of a lack of scientific documentation, species are rapidly going extinct.

2. MATERIALS AND METHODS

Study area

Chapainawabganj sadar is located at 24.6000°N 88.2667°E. It has 65158 households and total area 451.8 km^2. Chapainawabganj sadar upazila is bounded by Shibganj, Chapainawabganj and Nachole Upazilas on the north, Tanore and Godagari Upazilas, in Rajshahi district, on the east, Samserganj, Suti I, Suti II, Raghunathganj II and Lalgola CD Blocks, in Murshidabad district, West Bengal, India, all across the Ganges/Padma, on the south and Shibganj upazila, Chapainawabganj on the west. There are four rivers in Chapainawabganj Padma, Mohananda, Pagla & Punarbhaba. The soil all around the Chapainawabganj sadar upazila is alluvium the texture of the soil is sandy loam. The soil pH of Chapainawabganj sadar upazila is 7.5. Chapainabganj is very close to the big city Rajshahi and the climates of both districts are very close. The maximum mean temperature observed is about during the months of April, May, June and July and the minimum temperature recorded in January is about 7 to 16°C (45 to 61°F). The highest rainfall is observed during the months of monsoon. The annual rainfall in the district is about 1,448 millimetres (57.0 in) (BPC, 2001).

Methodology

The work is based on fresh materials collected during seventeen visits to Sadar Upazila of Chapai Nawabganj district, Bangladesh from October 2021 to September 2022 to cover the seasonal variations. The visits covered eight crop fields in the study area. To

make voucher specimens for documentation the traditional herbarium techniques were used to collect plant parts with either flowers or fruits.

Identification

Collected vascular aquatic plant species were authentically identified with the help of various journals (Hooker, 1877; Prain, 1903; Ahmed et al., 2008-2009). For up-to-date nomenclature and current name were also consulted (Huq, 1986; Pasha and Uddin, 2013).

3. RESULTS AND DISCUSSION

During the current examination of Chapai Nawabganj Sadar, Chapai Nawabganj's aquatic habitats, a total of 46 aquatic plant species were found. The 32 genera that make up these species are further classified into 28 families (Table 1). In addition to these, there were several water-tolerant tree species in the study area. Jalibet (*Calamus guruba* Buch-Ham.), Shitalpati (*Schumannianthus dichotomus* Roxb.), Koranja (*Pongamia pinnata* L. Pierre), *Trewia nudiflora* L., Dumur (*Ficus hispida* L. f.), Hijal (*Barringtonia acutangula* L. Gaertn.) and Pidali. They can survive water logging during the monsoon.

Table 1 Total number of Monocotyledons and Dicotyledons and Pteridophytes in case of wetlands in Chapainawabganj Sadar Upazila, Chapainawabganj**.**

Categories	Dicotyledons	Monocotyledons	Pteridophytes	Total
Number of families	16	11	01	28
Number of genera	16	15	01	32
Number of species	27	17	02	46

Each species is listed along with its scientific name, local name, family, division, habit, habitat, use and status (Table 2). The results are preliminary and further study may enhance the variety of aquatic plant species in the area. It has been found that the ecological conditions of aquatic plant species vary. 34.78 percent of aquatic plants like to grow close to the water's edge, followed by 8.70 percent of submerged plants, 10.87 percent of emergent plants, 13.04 percent of free-floating plants and 32.61 percent of rooted floating plants (Figure 3). Submerged species grow flowers on the water's surface. Fruits are maintained submerged in water until they are fully developed after pollination. A variety of life forms can be found in aquatic plant species. 94% of all species are herbs, with shrubs making up the remaining 6% (Figure 2).

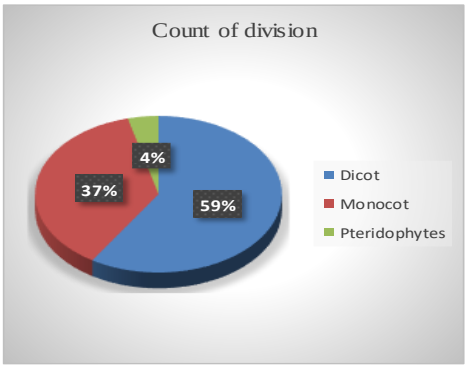
I found evidence of the use of numerous aquatic plant species during my research. In the study area, 50 percent of the species were used as fish food, 10.87% as vegetables, 6.52% as medicinal plants, 2.17% as aquarium plants and 23.91 percent as fodder (Figure 4). 37 percent of the species are monocots, 59 percent are dicots and 4 percent are Pteridophytes (Figure 1). The two monocot families of Poaceae and Pontederiaceae have the most species (three each), followed by Hydrocharitaceae (two), Araceae (two) and the rest (one species) (Table 2).

In Magnoliopsida (dicot) the largest families are Onagraceae and Nymphaeaceae contains 4 and 2 species, Lentibulariaceae, Amaranthaceae contains 3 and 2 species, Lythraceae, Polygonaceae, Menyanthaceae, Acanthaceae and Convulvulaceae contains 2 species and rest families contains 1 species and pteridophytes contains 1 family Azollaceae contains 2 species. The population number of different aquatic plant species in habitats is not uniform. My overall analysis showed that 45.65% aquatic plant species in the study area found to be rare, 43.48% species found as common and 10.87% species found as abundant (Figure 5). The present inventory of aquatic plant species is very preliminary. Further long-term survey is necessary to make complete list of aquatic plant species of Sadar Upazila, Chapai Nawabganj District, Bangladesh.

Table 2 Aquatic plant species with scientific name, local name, family name, division, habit, habitat, use and status.

Scientific Name	Local Name	Family Name	Division	Habit	Habitat	Use	Status
Aeschynomene indica L.	Bhath sola	Fabaceae	Dicot	Shrub	Near the edge of water	Fodder	Rare
Alloteropsis cimicina (L.) Stapf	-	Poaceae	Monocot	Herb	Emergent	Fodder	Common
Alpinia nigra (Gaertn.) Burtt.	Tara	Zingiberaceae	Monocot	Shrub	Near the edge of water	Medicinal	Rare
Alternanthera philoxeroides (Mart.) Griseb.	Helencha	Amaranthaceae	Dicot	Herb	Emergent	Medicinal	Common
Alternanthera sessilis (L.) R. Br. ex Roem. & Schult.	Hainsa shak	Amaranthaceae	Dicot	Herb	Emergent	Medicinal	Common
Ammannia alternifolia H.Perrier.	RedAmmannia	Lythraceae	Dicot	Herb	Submerged	Aquarium plant	Rare
Azolla filiculoides Lamarck	LalKhudipana	Azollaceae	Pteridophytes	Herb	Free floating	Fish food	Abundant
Azolla pinnata R.Br.	LalKhudipana	Azollaceae	Pteridophytes	Herb	Free floating	Fish food	Abundant
Brachiaria distachya (L.) Stapf	Corighas.	Poaceae	Monocot	Herb	Near the edge of water	Fodder	Common
Brachiaria mutica (Forssk.) Stapf	Nardul	Poaceae	Monocot	Herb	Near the edge of water	Fodder	Common
Ceratophyllum demersum L.	Kantajhangi	Ceratophyllacae	Dicot	Herb	Submerged	Fodder	Rare
Colocasia esculenta (L.) Schoott	Kachu	Araceae	Monocot	Herb	Near the edge of water	Vegetable	Common
Commelina benghalensis L.	Dhol pata	Commelinaceae	Monocot	Herb	Emergent	Fodder	Rare
Cyperus laxus Lamk.	-	Cyperaceae	Monocot	Herb	Near the edge of water	Fodder	Common
Eichhornia crassipes (Mart.) Solms	Kachori pana	Pontederiaceae	Monocot	Herb	Free floating	Fodder	Abundant
Hygrophila phlomoides Nees	-	Acanthaceae	Dicot	Herb	Rooted floating	Fodder	Common
Hydrilla verticillata (L. f.) Royle	Kanjal	Hydrocharitaceae	Monocot	Herb	Submerged	Fodder	Rare
Hygrophila erecta (Burm. f.) Hochr	-	Acanthaceae	Dicot	Herb	Near the edge of water	Fodder	Common
Ipomoea aquatica Forssk.	Kalmi Shak	Convulvulaceae	Dicot	Herb	Near the edge of water	Vegetable	Common
Ipomoea fistulosa Mart. ex Choisy	Dhol kolmi	Convulvulaceae	Dicot	Shrub	Near the edge of water	Medicinal	Common
Lemna perpusilla Torrey	Khudi pana	Lemnaceae	Monocot	Herb	Free floating	Fish food	Common
Limnocharis flava (L.) Buchen.	Pani kala	Limnocharitaceae	Monocot	Herb	Near the edge of water	Fodder	Abundant
Limnophila heterophylla (Roxb.) Benth.	-	Scrophulariaceae	Dicot	Herb	Near the edge of water	Fodder	Rare
Ludwigia adscendens (L.) Hara	Kesardum	Onagraceae	Dicot	Herb	Emergent	Medicinal	Common

Ludwigia hyssopifolia (G.Don) Exell	Molsi shak	Onagraceae	Dicot	Herb	Rooted floating	Medicinal	Common
Ludwigia prostrate Roxb.	-	Onagraceae	Dicot	Herb	Rooted floating	Medicinal	Rare
Ludwigia perennis L.	-	Onagraceae	Dicot	Herb	Rooted floating	Medicinal	Rare
Monochoria hastata (L.) Solms	Bara nukha	Pontederiaceae	Monocot	Herb	Rooted floating	Fodder	Common
Monochoria vaginalis (Burm.f.) C.Presl	Sarka chu	Pontederiaceae	Monocot	Herb	Rooted floating	Fodder	Common
Myriophyllum tetrandrum Roxb.	-	Haloragaceae	Dicot	Herb	Free floating	Fodder	Common
Nechamandra alternifolia (Roxb. exWight) Thw.	Rasna jhangi	Hydrocharitaceae	Monocot	Herb	Submerged	Fish food	Rare
Nelumbo nucifera Gaertn.	Padma	Nelumbonaceae	Dicot	Herb	Rooted floating	Medicinal	Rare
Nymphaea nouchali Burm.f.	Nil paddo	Nymphaeaceae	Dicot	Herb	Rooted floating	Edible	Rare
Nymphaea rubra Roxb.ex Andr.	Lal shapla	Nymphaeaceae	Dicot	Herb	Rooted floating	Edible	Rare
Nymphoides hydrophylla (Lour.) Kuntze	Pan chuli	Menyanthaceae	Dicot	Herb	Rooted floating	Fodder	Common



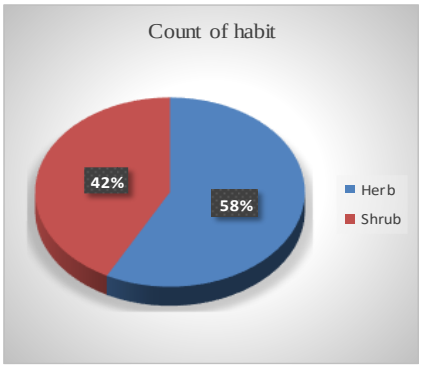
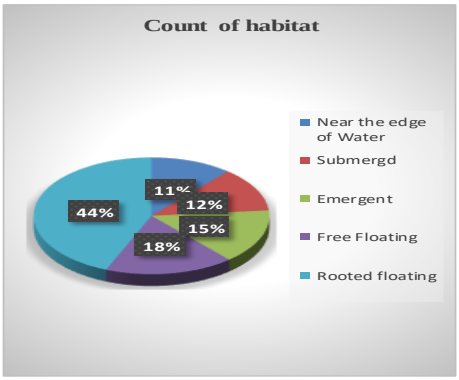


Figure 1 Percentage of plant species in Monocot, Dicot and Pteridophytes. **Figure 2** Vegetation analysis of the species based on habit.



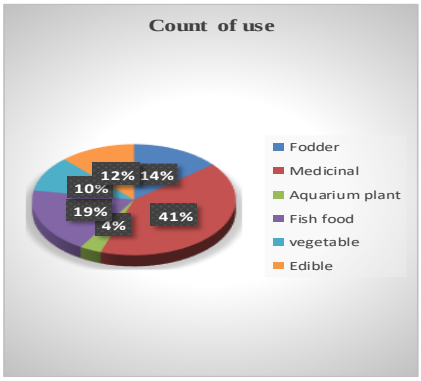


Figure 3 Pie chart showing the percentage of plant species in different habitats **Figure 4** Pie chart showing the uses of the species

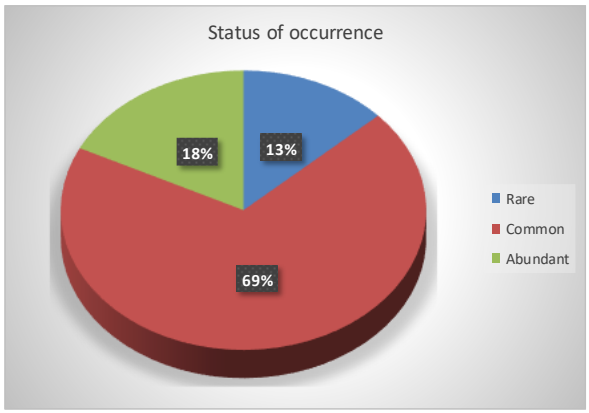


Figure 5 Pie chart showing the status of the aquatic plant species

There are 46 aquatic plant species in the Chapai Nawabganj district's wetlands, which are broken down into 30 genera and 26 families. Liliopsida (Monocots) has 10 families, 14 genera, and 16 species, while Pteridophytes has 1 family, 1 genus and 2 species, which is higher than Magnoliopsida, which has 15 families, 15 genera and 25 species (Dicots). The largest families in Liliopsida are Cyperaceae and Poaceae, which include 4 and 3 species each, comparable to Rahman and Debnath, while the largest families in Magnoliopsida are Nymphaeaceae and Onagraceae, which have 2 and 4 species respectively (2014). According to Rahman and Debnath, (2014), the two largest families are Asteraceae (7 species) in the Magnoliopsida and Poaceae (7 species) in the Liliopsida. Sajib et al., (2014) recognized Liliopsida as having the largest Fabaceae family (23 species) and Poaceae (16 species) within Magnoliopsida. Acanthaceae, Lythraceae, Menyanthaceae each have two species, whereas Polygonaceae, Fabaceae and Convolvulaceae each have one species. Nymphaeaceae, Onagraceae (2 and 4 species), Lentibulariaceae and Amaranthaceae each have three and two species. The five major monocotyledon families are Cyperaceae, Poaceae, Pontederiaceae, Hydrocharitaceae and Zingiberaceae.

A couple of instances of plant life include shrubs and herbs. The research area has three shrub species and 49 herb species, which is fewer than Sajib et al., (2014). According to Sajib et al., (2014) there were 174, 53, 96 and 22 species of climbers, shrubs, trees, and herbs, respectively. Sarker et al., (2013) detected 58% of the plant species in Manikganj Sadar Upazila. The most common plant species include *Alloteropsis cimicina*, *Alternanthera philoxeroides*, *Alternanthera sessilis, Azolla filiculoides* and *Azolla pinnata*. The most common shrubs are *Actinoscirpus grossus, Ipomoea fistulosa*, *Hygrophila phlomoides* and others. Less individuals belong to the Dicotyledons and Monocotyledons categories than Alam et al., (2006), Rahman and Debnath and other researchers (2006, 2014). Alam et al., (2006) discovered a total of 187 species, 133 dicots and 54 monocots in the angiospermic flora of the Ghagotia Union under the Kapasia Upazila in the Gazipur region. Rahman and Debnath, (2014) discovered 12 Liliopsida (Monocotyledones) families, 24 genera and 26 species of Liliopsida in Pandit Para Village, Palash Upazila, Narsingdi District. They also discovered 53 Magnoliopsida (Dicotyledones) families, 112 genera and 136 species.

Free floating plants are found on the surface of big, deep and shallow water bodies, aquatic plants are located in the surface of large, deep and shallow water bodies and emergent plants grow in shallow waters and conditions near water bodies where water recedes. While some plants in this ecosystem float freely and travel great distances, others float on the water's surface while adhering to the soil below the water's surface. Other plant species in this environment are submerged, where they grow, develop, and reproduce below the water's surface.

These include rooted floating species (species that float on the top but have roots on the bottom), species that develop along water's edge and species whose reproductive organs and roots remain in the soil at the bottom of the water body. Six species emerged during the study period, making up 11% of all plant species; six species were free-floating, making up 11% of all plant species; seven species were submerged, making up 13% of all plant species; fifteen species were rooted floating, making up 28% of all plant species; and nineteen species were found close to water bodies, making up 37% of all plant species, which is higher than Basak et al., (2015). The statistics show that two species are submerged, four emerging species and four floating species. Certain species are economically significant and benefit the neighborhood.

One of them, *Ipomoea aquatica* (Kalmi Shak), is consumed as a vegetable. It is grown by locals in a wetland and sold nearby. In the vicinity, it was given the name *Schumannianthus dichotomus*. Water-tolerant patipata is a plant that grows on the periphery of ponds and other bodies of water. The plant is very expensive. On a commercial tract of wet forest land, the Bangladesh Forest Department initially planted it. The plant's stem peel is used to create a delicate mat. Mats can be used as a wall mat, a bed cover,

and a crafting item. Despite the lack of care, the plant is thriving. It has the capacity to sprout and rejuvenate. After you plant it, it will keep growing from one generation to the next. Locals in the area use the leaf juice to cure ear pain. Sheetolpati is highly recognized in the greater Sylhet area. Locals refer to the herb *Nelumbo nucifera* (Padma), also known as takpata, as a remedy for hair issues. The blossom of the species is especially impressive and large. Patients with diabetes enjoy eating these plants' seeds. A vegetable called Helencha (*Alternanthera philoxeroides)* is also used as cow feeding. *Oenanthe javanika* (Panidhone) is a commercially important plant that is grown for use as a vegetable.

Centrostachys aquatic men cultivate Thuash, as it is known locally, as a vegetable in marshes. It is also important commercially. At the neighborhood market, stems are available as a vegetable. The natives used it to enhance appetizers. It has medicinal qualities that can treat gastrointestinal issues, colds and coughs. When someone has constipation, the stem paste is really helpful. I also proposed that the stem of such a plant could aid in lowering people's blood sugar levels. Studies on phytochemicals and pharmacognosy are needed to support the indigenous belief that certain plants have therapeutic properties. *Azolla pinnata* and *Azolla filiculoides* are consumed by ducks (Lal khudipana). Cows eat a range of plants from the Cyperaceae and Poaceae families, including *Actinoscirpus grossus* (Kasura), *Hygroryza aristata* (Jangli dhan) and others. *Nelumba nucifera* (Paddo), *Trapa bispinosa* (Singara), *Nymphaea rubra* (Lal shapla), *Oenanthe javanica* (Panidhone) and *Ottelia alismoides* are just a few of the unusual species that could be discovered here. *Nelumba mucifera* and *Nymphaea rubra* (Lal shapla) are only found in one place in the region (Padma). This species needs an undisturbed environment to thrive; if the marsh is disturbed by activities like farming or fishing, they will soon become extinct.

Ammannia alternifolia, *Ammannia gracilis*, *Centrostachys aquatica* (Thuash), *Oenanthe javanica* (Panidhone) and *Ottelia alismoides* are all unique to this locality (Shamakola). These species have a very small geographic range; for the course of my fieldwork, I only found them at one location. The economy depends on these factories. The stems of a plant called *Centrostachys aquatica*, also referred to as Thuash and are sold in the neighborhood market as vegetables. Aquatic plants called *Oenanthe javanica* and Panidhane grow close to the water. The plant's shoot is marketed in the neighborhood market as a vegetable. Jaundice is treated using the leaf juice. The species is relatively rare in the study area. Both in the natural world and in the market, I witnessed it. Shamakola, another name for *Ottelia alismoides*, is a plant whose fruits are eaten as vegetables. These species are highly rare because of local demand for their use. To ensure their life, these creatures need specific care. Otherwise, the species will soon become extinct.

4. CONCLUSION

The primary elements of wetland ecosystems are aquatic plants. Other than plants, all aquatic life is directly and indirectly dependent on green products. If the species and population makeup of the aquatic ecosystem changes, the delicate ecological balance required for numerous organisms to coexist will likely be lost. In Chapai Nawabganj Sadar Upazila, a preliminary survey led to the identification of 35 different kinds of aquatic plants. They are divided into 28 families and 32 genera. Dicotyledons are among them, represented by 16 families, whereas Monocotyledons are represented by 11 and Pteridophytes are represented by 1. While the greatest families in Liliopsida are Pontederiaceae and Poaceae, which respectively comprise 3 and 3 species, the largest families in Magnoliopsida are Nymphaeaceae and Onagraceae. Numerous unusual aquatic plant species were found during the inquiry in the study region. These include *Ottelia alismoides* (Shamakola), *Enhydra fluctuans* (Helencha), *Centrostachys aquatica*, *Nelumbo nucifera* (Padma), *Nymphaea pubescens* (Sada shapla), *Oenanthe javanica* (Panidhone), *Nymphaea rubra* (Lal shapla), and *Trapa bispinosa* (Singara). Due to local demand for use, there are relatively few of these species left in the wild. These species require preservation and care. If not, the species will eventually disappear entirely from the wild. On the basis of the initial survey in Chapai Nawabganj Sadar, it is quite challenging to draw reliable conclusions about the condition of aquatic flora. The findings of the current study demonstrated that the aquatic habitats in the Chapai Nawabganj district are abundant in aquatic plant species from Bangladesh, many of which are rare. Additional long-term investigation is required to create a comprehensive account of the aquatic vascular flora in Chapai Nawabganj Sadar Upazila.

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Ethical approval

Aquatic vascular flora from Sadar Upazila of Chapai Nawabganj district, Bangladesh was observed in the study. The ethical guidelines for plants & plant materials are followed in the study for sample collection & identification.

Informed consent
Not applicable.

Conflicts of interests
The authors declare that there are no conflicts of interests.

Funding
The study has not received any external funding.

Data and materials availability
All data associated with this study are present in the paper.

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