Investigation of aquatic vascular flora at Sadullapur Upazila of Gaibandha District, Bangladesh

Monira Akter Ame, Lima Khatun, Sonia Khatun, Shamima Afroj Sumona and AHM Mahbubur Rahman*

Plant Taxonomy Laboratory, Department of Botany, Faculty of Biological Sciences, University of Rajshahi, Bangladesh.

GSC Biological and Pharmaceutical Sciences, 2022, 21(01), 175–187

Publication history: Received on 09 September 2022; revised on 12 October 2022; accepted on 15 October 2022

Article DOI: https://doi.org/10.30574/gscbps.2022.21.1.0395

Abstract

The present article focused on aquatic vascular plants diversity and their conservation status in natural and manmade wetlands habitats of Sadullapur Gaibandha. The study was conducted in between May 2019 to June 2020. A total of 52 aquatic plant species was recorded from Sadullapur Gaibandha in the present study. These are assigned to 35 genera under 30 families. For each species scientific name, local name, family, division, habit, habitat, use and status are provided. Ecological habitats analysis of aquatics shows variations. Among them, 37% species prefers to grow near the edge of water, 13% submerged, 11% as emergent, 11% as free floating and 28% as rooted floating in the aquatic habitat. In case of submerged species, they produce flowers on surface of the water. After pollination fruits remain under water up to maturation. Among them, 49% species used as fodder, 22% as medicinal, 4% as aquarium purpose, 9% as vegetable, 6% as edible, 10% as fish food in the study area. The population number of different aquatic plant species in habitats is not uniform. Overall analysis showed that 46% aquatic plant species in the study area found to be rare, 44% species found common and 10% species found as abundant. This status of aquatic plant species is very preliminary. Based on field observations and discussion with local people we are able to identify a good number of rare aquatic plants and also pointed some conservation measures for them in future. The investigation recorded a number of rare aquatic plant species from the study area. These are *Trapa bispinosa* (Singara), *Nelumbo nucifera* (Paddo), *Nymphaea pubescens* (Sada shapla), *Oenanthe javanica* (Panidhone), *Nymphaea rubra* (Lal shapla), *Ottelia alismoides* (Panikola), *Enhydra fluctuans* (Titidata) and *Centrostachys aquatica* (Thuash). Populations of such species in the wild are very rare because of local demand for the use. These species need to be cared for conservation.

Keywords: Species diversity; Aquatic vascular plants; Gaibandha district; Bangladesh

1. Introduction

The majority of our terrestrial ecology relies on plant variety. We are all completely reliant on plant diversity, both directly and indirectly, for not only food energy but also for all of our everyday needs. Humans employ tens of thousands of higher plant species and a few hundred lower plant species for a range of reasons, including food, fuel, fiber, oil, herbs, spices, industrial crops, and pasture and fodder for domesticated animals. People in tropical areas have employed between 25000 and 30000 plant species, with up to 25000 species being used in traditional remedies [70]. Thousands of species are also cultivated for decorative purposes in parks, public and private gardens, as avenue trees, and for shade and shelter. Plant variety also plays a vital part in ecosystem services, such as providing a clean environment, protecting watersheds, stabilizing slopes, improving soils, regulating climate, and providing habitat for most of our wild wildlife. Currently, humans are posing a significant danger to plant variety across the planet. Urbanization, commercial agriculture, tree plantations, logging and timber extraction, mining and transportation, pollution, overharvesting, tourism, biological invasion, and alien monoculture plantings are all examples of human-caused concerns. Natural catastrophes and other natural occurrences have an influence on plant diversity in various ecosystems.

*Corresponding author: AHM Mahbubur Rahman
Plant Taxonomy Laboratory, Department of Botany, Faculty of Biological Sciences, University of Rajshahi, Bangladesh.

Copyright © 2022 Author(s) retain the copyright of this article. This article is published under the terms of the Creative Commons Attribution License 4.0.
The study of aquatic plant diversity is critical because it offers a baseline for comparison following habitat alteration and for tracking changes in biodiversity over time. The results of the survey can be used to identify uncommon, imperiled, foreign, native, pest, and therapeutic plant species. The survey results are now being utilized to assess the possible impact of proposed projects and to inform management programs in order to make biodiversity protection decisions. Students, researchers, biodiversity management planners, social foresters, NGOs, District gazetteers, and other enthusiastic plant enthusiasts want data on water plant variety.

Plant diversity exploration and documentation in various forests, protected areas, districts, and upazilas has already begun [2], [3], [5-6], [9-16], [19-65], [71-72], [74-91], [93-94] and [96-106]. The South Asian subcontinent has a large number of publications on water plants [66], [67], [68], [69], [92], [95]. In Bangladesh, researches on aquatic plants have been identified for the districts of Kishoregonj and Noakhali, as well as the Rajshahi university campus [48], [67] and [76]. However, for the Gaibandha district, no comparable aquatic plant survey and documentation activity has been discovered. Dams and diversion, modern agriculture, irrigation, pollution, and biological invasion are all contributing to the fragility of aquatic environments. Species are fast becoming extinct due to a lack of scientific record.

2. Material and methods

2.1. Study area

Sadullapur is an upazila of Gaibandha District in the Division of Rangpur, Bangladesh. Sadullapur is located at 25.3833°N 89.4667°E. It has 47,102 homes and a total area of 227.97 km². As of the 1991 Bangladesh census, Sadullapur has a population of 243,012. Males constitute 50.4% of the population, and females 49.6%. The upazila’s adult population, over 18 years, is 117,347. Sadullapur has an average literacy rate of 25.1% (7+ years), below the national average of 32.4%. The literacy rate of this upazila is 89.3. Sadullapur Upazila is divided into 11 union parishads: Bongram, Damodorpur, Dhaperhat, Faridpur, Idilpur, Jamalpur, Kamarpara, Khodkomor, Noldanga, Rasulpur, and Vatgram. The union parishads are subdivided into 166 mauzas and 169 villages [4].

2.2. Methodology

The work is based on fresh materials collected during twenty six visits to Sadullapur upazila of Gaibandha district, Bangladesh from May 2019 to June 2020 to cover the seasonal variations. The visits covered aquatic habitats in the study area. Plant parts with either flowers or fruits were collected using traditional herbarium techniques to make voucher specimens for documentation [73].

2.3. Identification

Collected aquatic species were authentically identified with the help of various books [1], [7] and [18]. For the current name and up-to-date nomenclature [8] and [17] were also consulted.

3. Results

A total of 52 aquatic plant species were discovered during the current investigation of Sadullapur Gaibandha’s aquatic habitats. These species are divided into 35 genera, which are divided into 30 families (Table 1). Aside from these, the research region also had other water-tolerant tree species. Hijal [Barringtonia acutangula (L.) Gaertn.], Koranja [Pongamia pinnata (L.) Pierre], Pidali [Trewia nudiflora L.], Dumur [Ficus hispida L. f.]. Jalibet [Calamus guruba Buch.-Ham.]. Shitalpati [Schumannianthus dichotomus (Roxb.). During the monsoon, they can withstand water logging.

| Categories | Dicotyledons | Monocotyledons | Pteridophytes | Total |
|------------|--------------|----------------|---------------|-------|
| Number of families | 17 | 12 | 01 | 30 |
| Number of genera | 16 | 18 | 01 | 35 |
| Number of species | 29 | 21 | 02 | 52 |

The scientific name, local name, family, division, habit, habitat, usage, and status of each species are listed (Table 2). The findings are preliminary, and future research might lead to an increase in the number of aquatic plant species in the
Variations in aquatic plant species' ecological environments have been discovered. In the aquatic habitat, 37 percent like to grow along the water's edge, 13 percent as submerged, 11 percent as emergent, 11 percent as free floating, and 28 percent as rooted floating (Figure 3). Flowers are produced on the water's surface by submerged species. Fruits are kept under water until they reach maturity after pollination. Aquatic plant species have a wide range of life forms. Herbs account for 94% of all species, while shrubs account for the remaining 6% (Figure 2).

In my research, I documented the utilization of a variety of aquatic plant species. In the research region, 49 percent of the species were utilized as fodder, 22 percent as medicinal, 4% as aquarium plants, 9% as vegetables, 6% as edible, and 10% as fish food (Figure 4). Monocots make up 41 percent of the species, Dicots make up 55 percent, and Pteridophytes make up 4% (Figure 1). Poaceae and Cyperaceae (monocot) have the most species (3 and 4), followed by Hydrocharitaceae, Pontederiaceae (three species), Araceae (one species), and the rest (one species) (Figure 6).

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 Convolvulaceae contains 2 species and rest families contains 1 species (Figure 7) 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 46% aquatic plant species in the study area found to be rare, 44% species found as common and 10% 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 Sadullapur Gaibandha.
Figure 5 Pie chart showing the status of the aquatic plant species

Figure 6 An analytical data showing dominant monocot families along with genera and species

Figure 7 An analytical data showing dominant dicot families along with genera and species

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  |
|----------------------------------|------------|-------------|----------|-------|--------------------------|-----------|---------|
| Actinoscirpus grossus (L. f.)    | Kasura     | Cyperaceae  | Monocot  | Herb  | Near the edge of water  | Fodder    | Common  |
| Goetgh. & D.A Simpsonay           |            |             |          |       |                          |           |         |
| Aeschynomene indica L.            | Bhathsola  | Fabaceae    | Dicot    | Shrub | Near the edge of water  | Fodder    | Rare    |
| Alloteropsis cimicina (L.) Stapf | Unknown    | Poaceae     | Monocot  | Herb  |Emergent                 | Fodder    | Common  |
| Scientific Name | Common Name | Family | Type | Life Form | Habitat | Medicinal Use | Abundance |
|----------------|-------------|--------|------|-----------|---------|---------------|-----------|
| *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. | Hainsashak | Amaranthaceae | Dicot | Herb | Emergent | Medicinal | Common |
| *Ammannia alternifolia* H.Perrier. | Red Ammannia | Lythraceae | Dicot | Herb | Submerged | Aquarium plant | Rare |
| *Ammannia gracilis* Guill. & Perr. | Red Ammannia | Lythraceae | Dicot | Herb | Submerged | Aquarium plant | Rare |
| *Azolla filiculoides* Lamarck | Lal Khudipana | Azollaceae | Pteridophytes | Herb | Free floating | Fish food | Abundant |
| *Azolla pinnata* R. Br. | Lal Khudipana | Azollaceae | Pteridophytes | Herb | Free floating | Fish food | Abundant |
| *Brachiaria distachya* (L.) Stapf | Cori ghas | 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. | Kanta jhangi | Ceratophyllaceae | Dicot | Herb | Submerged | Fodder | Rare |
| *Colocasia esculenta* (L.) Schoott | Kachu | Araceae | Monocot | Herb | Near the edge of water | Vegetable | Common |
| *Commelina benghalensis* L. | Dholpata | Commelinaceae | Monocot | Herb | Emergent | Fodder | Rare |
| *Cyperus alopecuroides* Rottb. | Chancha | Cyperaceae | Monocot | Herb | Near the edge of water | Fodder | Common |
| *Cyperus laxus* Lamk. | Unknown | Cyperaceae | Monocot | Herb | Near the edge of water | Fodder | Common |
| *Eichhornia crassipes* (Mart.) Solms | Kachoripana | Pontederiaceae | Monocot | Herb | Free floating | Fodder | Abundant |
| *Enhydrilla fluctuans* Lour. | Titidata | Asteraceae | Dicot | Herb | Near the edge of water | Vegetable | Rare |
| *Hydrilla verticillata* (L. f.) Royle | Kanjal | Hydrocharitaceae | Monocot | Herb | Submerged | Fodder | Rare |
| Common Name                      | Scientific Name                  | Family         | Life Form | Habitat                  | Use               | Availability |
|---------------------------------|----------------------------------|----------------|-----------|--------------------------|-------------------|--------------|
| Hygrophila erecta               | (Burm. f.) Hochr                 | Acanthaceae    | Herb     | Near the edge of water   | Fodder            | Common       |
| Hygrophila phlomoides Nees      |                                  | Acanthaceae    | Herb     | Rooted floating          | Fodder            | Common       |
| Ipomoea aquatica                | Forssk.                          | Convolvulaceae | Herb     | Near the edge of water   | Vegetable         | Common       |
| Ipomoea fistulosa               | Mart. ex Choisy                   | Convolvulaceae | Herb     | Near the edge of water   | Medicinal         | Common       |
| Kyllinga microcephala           | Steud.                           | Cyperaceae     | Herb     | Emergent                 | Fodder            | Common       |
| Lemna perpusilla                 | Torrey                           | Lemnaceae      | Herb     | Free floating            | Fish food         | Common       |
| Limnocharis flava (L.) Buchen.   | pani kala                        | Limnocharitaceae | Herb     | Near the edge of water   | Fodder            | Abundant     |
| Limnophila heterophylla         | (Roxb.) Benth.                    | Scrophulariaceae | Herb     | Near the edge of water   | Fodder            | Rare         |
| Ludwigia adscendens             | (L.) Hara                        | Onagraceae     | Herb     | Emergent                 | Medicinal         | Common       |
| Ludwigia hyssopifolia           | (G. Don) Exell                    | Onagraceae     | Herb     | Rooted floating          | Medicinal         | Common       |
| Ludwigia perennis L.            |                                  | Onagraceae     | Herb     | Rooted Floating          | Medicinal         | Rare         |
| Ludwigia prostrata              | Roxb.                            | Onagraceae     | Herb     | Rooted Floating          | Medicinal         | Rare         |
| Monochoria hastata              | (L.) Solms                       | Pontederiaceae | Herb     | Rooted floating          | Fodder            | Common       |
| Monochoria vaginalis            | (Burm. f.) C.Presl               | Pontederiaceae | Herb     | Rooted floating          | Fodder            | Common       |
| Myriophyllum tetrandrum          | Roxb.                            | Haloragaceae   | Herb     | Free floating            | Fodder            | Common       |
| Najas gracillima (A. Br. ex Engelm.) Magnus |                      | Najadaceae     | Herb     | Submerged                | Fish food         | Rare         |
| Nechamandra alternifolia        | (Roxb. ex Wight) Thw.            | Hydrocharitaceae | Herb     | Submerged                | Fish food         | Rare         |
| Nelumbo nucifera                | Gaertn.                          | Nelumbonaceae  | Herb     | Rooted Floating          | Medicinal         | Rare         |
4. Discussion
The wetlands in Gaibandha district yielded a total of 52 aquatic plant species, divided into 35 genera and 30 families. Magnoliopsida (Dicots) has 17 families, 17 genera, and 29 species, while Liliopsida (Monocots) has 12 families, 18 genera, and 21 species, and Pteridophytes has 1 family, 1 genus, and 2 species, which is higher than Magnoliopsida (Dicots). [76] Discovered 22 species in Bangladesh's Noakhali Sadar, divided into 16 families and 21 genera. The greatest families in Magnoliopsida are Nymphaeaceae and Onagraceae, which have 2 and 4 species each, whereas the largest families in Liliopsida are Cyperaceae and Poaceae, which contain 4 and 3 species each, comparable to [90]. Asteraceae (7 species) in Magnoliopsida and Poaceae (7 species) in Liliopsida are the two biggest families, according to [90]. In Magnoliopsida, [94] identified the biggest Fabaceae family (23 species) and Poaceae (16 species) in Liliopsida.

| Species                                      | Habitat          | Description        | Family   | Genus  | Common Usage    | Habitat  |
|----------------------------------------------|------------------|--------------------|----------|--------|-----------------|----------|
| Nymphaea nouchali Burm. f.                   | Nilpaddo         | Nymphaeaceae       | Dicot    | Herb   | Rooted floating | Edible   |
| Nymphaea rubra Roxb. ex Andr.                | Lal shapla       | Nymphaeaceae       | Dicot    | Herb   | Rooted floating | Edible   |
| Nymphoides hydrophylla (Lour.) Kuntze        | Panchuli         | Menyanthaceae      | Dicot    | Herb   | Rooted floating | Fodder   |
| Nymphoides indicum (L.) Kuntze               | Chandmalla       | Menyanthaceae      | Dicot    | Herb   | Rooted floating | Fodder   |
| Oenanthe javanica (Blume) DC.                | Panidhone        | Apiaceae           | Dicot    | Herb   | Near the edge of water | Vegetable |
| Persicaria glabra (Willd.) M. Gomez          | Lal-kukri        | Polygonaceae       | Dicot    | Herb   | Near the edge of water | Medicinal |
| Persicaria hydropiper (L.) Delarbre          | Bishkaatali      | Polygonaceae       | Dicot    | Herb   | Near the edge of water | Medicinal |
| Pistia stratiotes L.                         | Topapana         | Araceae            | Monocot  | Herb   | Near the edge of water | Fish food |
| Potamogeton crispus L.                       | Unknown          | Potamogetonaceae   | Monocot  | Herb   | Near the edge of water | Fodder   |
| Sagittaria guayanensis Kunth                 | Kaowathukri      | Alismataceae       | Monocot  | Herb   | Rooted floating | Fodder   |
| Trapa bispinosa Roxb.                        | Singara          | Trapaceae          | Dicot    | Herb   | Free floating   | Edible   |
| Utricularia aures Lou.                       | Jhangi           | Lentibulariaceae   | Dicot    | Herb   | Rooted floating | Fodder   |
| Utricularia inflexa Forssk.                  | Panijhangi       | Lentibulariaceae   | Dicot    | Herb   | Rooted floating | Fodder   |
| Utricularia scandens Benj.                   | Panijhangi       | Lentibulariaceae   | Dicot    | Herb   | Rooted floating | Fodder   |

181
Emergent (Emergent plants grow in shallow waters and situations near water bodies where water recedes), free floating (Floating plants are found on the surface of large, deep, and shallow depths of water bodies), and aquatic (Aquatic plants are found in the surface of large, deep, and shallow depths of water bodies. Some plants in this environment float freely and travel large distances, while others float on the water’s surface but attach to soil beneath the water’s surface), submerged (species germinate, sprout, develop, and reproduce beneath the water’s surface).

Their reproductive organs and roots stay in the soil at the bottom of the water body, rooted floating (species that float on the top but are rooted on the bottom), and certain species that grow along the water’s edge. During the study period, 6 species were emergent, accounting for 11% of all plant species, 6 species were free floating, accounting for 11% of all plant species, 7 species were submerged, accounting for 13% of all plant species, 15 species were rooted floating, accounting for 28% of all plant species, and 19 species were found near the edge of water bodies, accounting for 37% of all plant species, which is higher than Basak et al [67] Four species are floating, four are emergent, and two are submerged, according to the data. Some species are economically significant and have a positive impact on the local community.

*Ipomoea aquatica* (Kalmi shak) is one of them, and it is utilized as a vegetable. Locals grow it in a swamp and sell it near the market. It was given the name *Schumannianthus dichotomus* in the area. Patipata, a water-tolerant plant, can be seen growing around the edges of ponds and other bodies of water. The plant is worth a lot of money. It was first planted by the Bangladesh Forest Department on a commercial plot of wet forest lands. The peel of the plant’s stem is used to make a fine mat. Mats are used as a bed cover, a wall mat, and a material for handicrafts. The plant is flourishing despite its lack of attention. It has the ability to regenerate through sprouting. It will continue to grow from generation to generation after you have planted it. The juice of the leaves is used by the locals to treat ear ache. Sheetolpati is well-known in the broader Sylhet region, as you are all aware. *Nelumbo nucifera* (padma) is a plant that is used to treat hair problems and is known as takpata by the locals. The species’ blossom is particularly huge and spectacular. Diabetic patients love the seeds of such plants. *Helencha Alternanthera philoxeroides* is a vegetable that is also used as cow feeding. *Oenanthe javanika* (Panidhane) is a plant that is used as a vegetable and is commercially significant.

Aquatic *Centrostachys Thuash*, as it is known locally, is also commercially significant and is grown as a vegetable by men in marshes. Stems are offered as a vegetable at the local market. It was utilized by the locals to boost appetizers. It contains therapeutic characteristics that can help with coughs, cold, and stomach problems. The stem paste is highly useful in cases of constipation. I also hypothesized that the stem of such a plant may help to lower blood sugar levels in humans. To prove the local claim of therapeutic capabilities, phytochemical and pharmacognosy studies are required. Ducks consume *Azolla pinnata* and *Azolla filiculoides* (Lal khudipana). Cows consume a variety of plants from the Cyperaceae and Poaceae families, including *Hygroryza aristata* (Jangli dhan), *Actinoscirpus grossus* (Kansa), and others.

In this location, uncommon species such as *Trapa bispinosa* (Singara), *Nymphaea rubra* (Lal shapla), *Nelumba nucifera* (paddo), *Oenanthe javanica* (panidhane) and *Ottelia alismoides* may be found. Only one location in the area has *Nymphaea rubra* (Lal shapla) and *Nelumba nucifera* (Padma). This species grows in an undisturbed environment; if any disturbances, such as fishing or farming, occur in the marsh, they will go extinct in the near future.

Only this location grows *Ammannia alternifolia*, *Ammannia gracilis*, *Centrostachys aquatica* (Thuash), *Oenanthe javanica* (Panidhone), and *Ottelia alismoides* (Shamakola). These species have a very limited range; throughout my field investigation, I only discovered them in one site. These factories are vital to the economy. *Centrostachys aquatica*, often known as Thuash, is a plant whose stems are marketed as vegetables in the local market. *Oenanthe javanica*, also known as Panidhane, is an aquatic herb that grows near water’s edge. The plant’s shoot is sold as a vegetable in the local market. The juice of the leaves is used to treat jaundice. In the research region, the species is quite uncommon. I discovered it in nature and also saw it at the market. The fruits of *Ottelia alismoides*, also known as Shamakola, are consumed as vegetables. Because of local demand for their use, these species’ populations are extremely scarce. These animals require special attention to ensure their survival. Otherwise, the species will be extinct in the near future.

**5. Conclusion**

Aquatic plants are the major components of wetland ecosystems. All aquatic life other than plants directly and indirectly depends on green products. Any change in the species and population composition of aquatic ecosystem may fail to maintain ecological balance in which many organisms interact with each other for their survival. The preliminary survey in Sadullapur Gaibandha resulted in recording of total 52 aquatic plant species. They are belonging to 35 genera under 30 families. Among them, Dicotyledons is represented by 17 families whereas Monocotyledons are represented by 12 families and Pteridophytes represented by 1 family. In Magnoliopsida, Nymphaeaceae and Onagraceae are the largest family each of them contain2 and 4 species, whereas in Liliopsida the largest families are Cyperaceae and Poaceae.
contains 4 and 3 species. The investigation recorded a number of rare aquatic plant species from the study area. These are *Trapa bispinosa* (Singara), *Nelumbo nucifera* (Padma), *Nymphaea pupeescens* (Sada shapla), *Oenanthe javanica* (Panidhone), *Nymphaea rubra* (Lal shapla), *Ottelia alismoides* (Shamakola), *Enhydra fluctuans* (Helencha) and *Centrostachys aquatica* (Thuash). Population of such species in the wild is very rare because of local demand for the use. These species need to be cared for conservation. Otherwise, the species will be eliminated from the wild very soon. Based on the preliminary survey in Sadullapur Gaibandha, it is very difficult to make sound conclusion on the status of aquatic flora. The results of present study showed that aquatic habitats of Gaibandha district is floristically rich in terms of area and the district is also the home for many rare aquatic plant species of Bangladesh. To make a complete inventory of the aquatic flora of Sadullapur Gaibandha further long term survey is necessary.

**Compliance with ethical standards**

**Acknowledgments**

The authors are grateful to the local people at Sadullapur upazila of Gaibandha district, Bangladesh for their cooperation and help during the research work. The authors are also grateful to the Ministry of Science and Technology (MoST), Government of the Peoples Republic of Bangladesh for financial support to complete this research work.

**Disclosure of conflict of interest**

The authors declare that there are no conflicts of interests.

**References**

[1] Ahmed ZU, Begum ZNT, Hassan MA, Khondker M, Kabir SMH, Ahmad M, Ahmed ATA, Rahman AKA, Haque EU(Eds). *Encyclopedia of Flora and Fauna of Bangladesh*. Vols. 6-10. Publisher: Asiatic Society of Bangladesh, Dhaka. 2008-2009.

[2] Ara T, Khokan EH, Rahman AHMM. Taxonomic Studies on the Family Solanaceae in the Rajshahi University Campus. *Journal of Biodiversity and Environmental Sciences*, 2011; 4(1): 29-34.

[3] Bakar S, Faria LA, Rani R, Rahman AHMM. Diversity of vascular weeds species in six selected crop fields of Chuadanga district, Bangladesh. *Species*. 2021; 22(69): 36-42.

[4] Bangladesh Population Census (BPC). Bangladesh Bureau of Statistics; Cultural survey report of Gobindaganj Upazila 2007.

[5] Debnath A, Rahman AHMM. A Checklist of Angiosperm Taxa at the Village Pandit Para under Palash Upazila of Narsingdi District, Bangladesh with Special Importance to Medicinal Plants. *Species*. 2017; 18(58): 23-41.

[6] Easmin MF, Faria LA, Rani R, Rahman AHMM. Asteraceae: A Taxonomically and Medicinally Important Sunflower Family. *American International Journal of Biology and Life Sciences*. 2021; 3(1):1-17.

[7] Hooker JD. *Flora of British India*. Vols.1-7. L. Reeve and Co. Ltd. London, U.K. 1877.

[8] Huq AM. Plant Names of Bangladesh. *Bangladesh National Herbarium, BARC, Dhaka, Bangladesh*. 1986.

[9] Islam M, Rahman AHMM. A Preliminary Taxonomic Account of the Family Araceae in Rajshahi District of Bangladesh. *Discovery*. 2017; 53(253): 30-48.

[10] Islam MJ, Rahman AHMM. An Assessment of the family Asteraceae at Shadullapur Upazila of Gaibandha District, Bangladesh with Particular Reference to Medicinal Plants. *Journal of Progressive Research in Biology*. 2016; 2(2): 108-118.

[11] Ismail M, Rahman AHMM. Taxonomic Study and Traditional Medicinal Practices on Important Angiosperm Plant Species in and around Rajshahi Metropolitan City. *International Journal of Botany Studies*. 2016; 1(3): 33-39.

[12] Kona S, Rahman AHMM. An Assessment of Angiosperm Diversity at Mahadebpur Upazila of Naogaon District, Bangladesh. *International Journal of Advanced Research*. 2015; 3(10): 1067-1086.

[13] Keya MA, Rahman AHMM. Angiosperm Diversity at the Village Sabgram of Bogra, Bangladesh with Emphasis on Medicinal Plants. *American Journal of Plant Biology*. 2017; 2(1): 25-34.

[14] Khatun MA, Rahman AHMM. Angiosperm Weeds Diversity and Medicinal Uses in Seven Selected Maize Fields at Puthia Upazila of Rajshahi District, Bangladesh. *Plant Environment Development*. 2018; 7(1): 1-9.
[15] Nahar J, Rahman AHMM. Floristic Diversity of Naogaon Sadar, Bangladesh with Special Reference to Medicinal Plants. Discovery, 2016; 52(252): 2352-2368.

[16] Nahar J, Rahman AHMM. Study of Angiosperm Plant Species at Sadar Upazila of Naogaon District, Bangladesh. Discovery. 2016; 52(250): 1963-1978.

[17] Pasha MK, Uddin SB. Dictionary of Plant Names of Bangladesh (Vascular Plants). Janokalyan Prokashani. Chittagong, Dhaka, Bangladesh. 2013.

[18] Prain D. Bengal Plants. Vols.1-2. Botanical Survey of India. Calcutta, India. 1903.

[19] Rahman AHMM, Khatun MA. Leafy Vegetables in Chapai Nawabganj District of Bangladesh Focusing on Medicinal Value. Bangladesh Journal of Plant Taxonomy. 2020; (2): 359-375.

[20] Rahman AHMM, Akter M. Taxonomy and Medicinal Uses of Euphorbiaceae (Spurge) Family of Rajshahi, Bangladesh. Research in Plant Sciences. 2013; 1(3): 74-80.

[21] Rahman AHMM, Debnath A. Angiosperm Diversity of Pandit Para Village under Pashal Upazila of Narsingdi District, Bangladesh. Frontiers of Biological & Life Sciences. 2014; 2(4): 98-105.

[22] Rahman AHMM, Gulshana MIA. Taxonomy and Medicinal Uses on Amaranthaceae Family of Rajshahi, Bangladesh. Applied Ecology and Environmental Sciences. 2014; 2(2): 54-59.

[23] Rahman AHMM, Keya MA. Assessment of Angiosperm Flora at the Village Sabgram under Sadar Upazila of Bogra District, Bangladesh. International Journal of Advanced Research. 2014; 2(11): 443-458.

[24] Rahman AHMM, Jamila M. An Assessment of Angiosperm Taxa at the village Jamtala under sadar Upazila of Chapai Nawabganj District, Bangladesh. Research & Reviews: Journal of Botanical Sciences. 2015; 4(4): 13-22

[25] Rahman AHMM, Jamila M. Angiosperm Diversity at Jamtala Village of Chapai Nawabganj District, Bangladesh with Emphasis on Medicinal Plants. Research in Plant Sciences. 2016; 4(1): 1-9.

[26] Rahman AHMM, Mahfuza A. Taxonomy and Traditional Medicinal Uses of Apocynaceae (Dogbane) Family of Rajshahi District, Bangladesh. Research & Reviews: Journal of Botanical Sciences. 2015; 4(4): 1-12.

[27] Rahman AHMM, Mamun MAA. Investigation and Taxonomic Studies of Angiosperm Weed Flora in the Mulberry Field of Rajshahi University Campus. Species. 2017; 18(58): 42-56.

[28] Rahman AHMM, Parvin MIA. Taxonomic Studies on the family Fabaceae (Weeds) at Rajshahi University Campus. Plant. 2015; 3(3): 20-25.

[29] Rahman AHMM, Rahman MM. An Enumeration of Angiosperm weeds in the Paddy field of Rajshahi, Bangladesh with emphasis on medicinal Plants. Journal of Applied Science And Research. 2014; 2(2): 36-42.

[30] Rahman AHMM, Rojonigondha. Taxonomy and Traditional Medicine Practices on Malvaceae (Mallow Family) of Rajshahi, Bangladesh. Open Journal of Botany. 2014; 1(2): 19-24.

[31] Rahman AHMM. A Checklist of Common Angiosperm Weeds of Rajshahi District, Bangladesh. International Journal of Agricultural and Soil Science. 2013; 1(1): 1-6.

[32] Rahman AHMM. Angiospermic flora of Rajshahi district, Bangladesh. American Journal of Life Sciences. 2013; 1(3): 105-112.

[33] Rahman AHMM. Assessment of Angiosperm Weeds of Rajshahi, Bangladesh with emphasis on medicinal plants. Research in Plant Sciences. 2013; 1(3): 62-67.

[34] Rahman AHMM. Study of Species Diversity on Cucurbitaceae family at Rajshahi Division, Bangladesh. Journal of Plant Sciences. 2013; 1(2): 18-21.

[35] Rahman AHMM. Systematic studies on Asteraceae in the northern region of Bangladesh. American Journal of Life Sciences. 2013; 1(4): 155-164.

[36] Rahman AHMM. Systematic studies on Cucurbitaceae family at Rajshahi division, Bangladesh. Plant. 2013; 1(2): 10-15.

[37] Rahman AHMM. Annotated List in the Graveyards Trees of Rajshahi City, Bangladesh. Discovery. 2017; 53(254): 107-116.

[38] Rahman AHMM. A Preliminary Assessment of Angiospermic Flora in and around Rajshahi metropolitan city, Bangladesh. Applied Ecology and Environmental Sciences. 2021; 9(4): 440-449.
Rahman AHMM, Afsana MW, Islam AKMR. Taxonomy and Medicinal Uses on Acanthaceae Family of Rajshahi, Bangladesh. Journal of Applied Science And Research. 2014; 2(1): 82-93.

Rahman AHMM, Ferdous Z, Islam AKMR. A Preliminary Assessment of Angiosperm Flora of Bangladesh Police Academy. Research in Plant Sciences. 2014; 2(1): 9-15.

Rahman AHMM, Hossain MM, Islam AKMR. Taxonomy and Medicinal Uses of Angiosperm weeds in the wheat field of Rajshahi, Bangladesh. Frontiers of Biological and Life Sciences. 2014; 2(1): 8-11.

Rahman AHMM, Ferdows Z, Nitu SK, Islam AKMR. Herbaceous Plant Species in and around Rajshahi Metropolitan City, Bangladesh. International Journal of Advanced Research. 2015; 3(5): 1002-1018.

Rahman AHMM, Akter S, Rani R, Islam AKMR. Taxonomic Study of Leafy Vegetables at Santahar Pouroshova of District Bogra, Bangladesh with Emphasis on Medicinal Plants. International Journal of Advanced Research. 2015; 3(5): 1019-1036.

Rahman AHMM, Sultana Z, Rani R, Islam AKMR. Taxonomic Studies of the Family Commelinaceae at Rajshahi, Bangladesh. International Journal of Advanced Research. 2015; 3(5): 978-989.

Rahman AHMM, Alam MS, Hossain MB, Nesa MN, Islam AKMR, Rahman MM. Study of Species Diversity on the family Asteraceae (Compositae) of the Rajshahi Division. Research Journal of Agriculture and Biological Sciences. 2008; 4(6): 794-797.

Rahman AHMM, Alam MS, Khan SK, Ahmed F, Islam AKMR, Rahman MM. Taxonomic Studies on the family Asteraceae (Compositae) of the Rajshahi Division. Research Journal of Agriculture and Biological Sciences. 2008; 4(2): 134-140.

Rahman AHMM, Islam AKMR, Naderuzzaman ATM. Studies on the herbaceous plant species in the graveyard areas of Rajshahi city. Plant Environment Development. 2007; 1(1):57-60.

Rahman AHMM, Islam AKMR, Naderuzzaman ATM, Hossain MD, Afza R. Studies on the Aquatic Angiosperms of the Rajshahi University Campus. Research Journal of Agriculture and Biological Sciences. 2007; 3(5): 474-480.

Rahman AHMM, Anisuzzaman M, Ahmed F, Zaman ATMN, Islam AKMR. A Floristic Study in the Graveyards of Rajshahi City. Research Journal of Agriculture and Biological Sciences. 2007; 3(6): 670-675.

Rahman AHMM. Graveyards angiosperm diversity of Rajshahi city, Bangladesh with emphasis on medicinal plants. American Journal of Life Sciences. 2013; 1(3): 98-104.

Rahman AHMM. Angiospermic flora of Rajshahi district, Bangladesh. American Journal of Life Sciences. 2013; 1(3): 105-112.

Rahman AHMM, Ferdous Z, Islam AKMR. A Preliminary Assessment of Angiosperm Flora of Bangladesh Police Academy. Research in Plant Sciences. 2014; 2(1):9-15.

Roy TR, Rahman AHMM. Inventory of Angiosperm Diversity in Ishwardi Pouroshova of Pabna District, Bangladesh, Discovery Science. 2018; 14: 9-22.

Roy TR, Sultana RS, Rahman AHMM. Taxonomic study and Medicinal Uses of Verbenaceae Family of Rajshahi District, Bangladesh. Journal of Progressive Research in Biology. 2016; 3(1): 160-172.

Sarker AK, Rahman AHMM. A Preliminary Checklist of Angiosperm Flora at Katakhali Pouroshova of Rajshahi, Bangladesh. Discovery. 2016; 52(251): 2127-2140.

Sarker P, Rahman AHMM. Angiosperms in Gobindaganj Upazila of Gaibandha District, Bangladesh. Bangladesh Journal of Plant Taxonomy. 2016; 26(2): 285-298.

Sarker U, Rahman AHMM. Diversity of Weed Species in Mustard Fields of Manda Upazila of Naogaon District, Bangladesh. Species. 2017; 18(59): 133-145.

Sultana R, Rahman AHMM. Convolvulaceae: A Taxonomically and Medicinally Important Morning Glory Family. International Journal of Botany Studies. 2016; 1(3): 47-52.

Uddin K, Rahman AHMM, Islam AKMR. Taxonomy and Traditional Medicine Practices of Polygonaceae (Smartweed) Family at Rajshahi, Bangladesh. International Journal of Advanced Research. 2014; 2(11): 459-469.

Uddin MZ, Alam MF, Rahman MA, Hassan MA. Diversity in Angiosperm Flora of Teknaf Wildlife Sanctuary, Bangladesh. Bangladesh Journal Plant Taxonomy. 2013; 20(2): 145-162.
[61] Zahra F, Rahman AHMM. Documentation of Angiosperm Weed Flora in and around Rajshahi Metropolitan City, Bangladesh. Discovery Agriculture. 2018; 4: 33-46.

[62] Akter A, Zuberi MI. Invasive alien species in northern Bangladesh: Identification, inventory and impacts. International journal of biodiversity and conservation. 2009; 1(5): 129-134.

[63] Alam S, Uddin MZ, Hassan MA. A Preliminary Checklist of the Angiospermic Flora of Ghagotia Union under Kapasia Upazila in Gazipur district, Bangladesh. Bangladesh J. Plant Taxon. 2006; 13(2): 155-170.

[64] Ara H, Khan B, Uddin SN(Eds.). Red data book of vascular plants of Bangladesh, Vol. 2. Bangladesh National Herbarium, Dhaka. 2013.

[65] Aziz A. Azolla filiculoides Lam. and A. Pinnata R. Brown to measure arsenic pollution in groundwater. Bangladesh J. Bot. 2001; 30(1): 17-24.

[66] Balick MJ, Anderson AB, Silva MF. Plant taxonomy in Brazilian Amazonia: The state of systematic collection in regional herbaria. Brittonia. 1982; 14: pp. 463-477.

[67] Basak SK, Ali MM, Islam MS, Shaha PR. Aquatic weeds of haor area in Kishoregonj district, Bangladesh: Availability, Threats and Management Approaches. International Journal of Fisheries and Aquatic Studies. 2015; 2(6): 151-156.

[68] Chakraborty R, Mondal MS, Mukherjee SK. Ethnobotanical information on some aquatic plants of South 24 Parganas, West Bengal. Plant Science Today. 2016; 3(2): 109-114.

[69] Goldsmith FB, Harrison CM. Description and Analysis of Vegetation. In: Chapman, S.B. (Ed.), Methods of plant Ecology. Blackwall, Oxford, 1976; pp. 85-155.

[70] Heywood V. Flowering plants of the world. B.T. Batsford Ltd., London, UK, 1993.

[71] Hossain MK, Pasha MK. An account of the exotic flora of Bangladesh. Journal of forestry and environment. 2004; 2: 99-115.

[72] Hoque MM, Hassan MA, Khan, MR. Studies on the antibacterial activity of plants in Bangladesh 1. Polygonum L. J. asiat. Soc. Bangladesh Sci. 1986; 12: 72-82.

[73] Hyland BPM. A technique for collecting botanical specimens in rain forest. Flora Malesiana Bulletin, 1972; 26: pp. 2038-2040.

[74] Islam MM, Amin RASM, Sarker SK. Invasive alien species in South Southeast Asia National Reports and Director of Resources. 2003.

[75] Islam A, Aziz N. Najas Gracillima (A. Br.) Morong.- a new record for Bangladesh. Bangladesh J. Bot. 1983; 12(1): 90-92.

[76] Kaisar MI, Adhikary RK, Dutta M, Bhowmik S. Diversity of Aquatic weeds at Noakhali sadar in Bangladesh. American Journal of Scientific and Industrial Research. 2016; 7(5): 117-128.

[77] Khan MS, Halim M. Aquatic angiosperms of Bangladesh. BNH, BARC. 1987; 120pp.

[78] Khan MS, Nahar S. Onagraceae. In: Khan, M.S. (Ed.), Flora of Bangladesh, No. 6. Bangladesh National herbarium, Bangladesh Agricultural Research Council, Dhaka, Bangladesh, 1977; p. 10.

[79] Khan MS, Rahman MM, Ali MM (Eds.). Red Data Book of Vascular Plants of Bangladesh. Bangladesh J. Plant Taxon. 2001; 8(1): 47-64.

[80] Khan MS, Huq AM. The vascular flora of Chunati wildlife sanctuary in south Chittagong, Bangladesh. Bangladesh J. Plant. Taxon. 2001; 8(1): 47-64.

[81] Khan MS, Huq AM. Flora of Bangladesh, No. 30. Bangladesh National Herbarium, Dhaka, 1975.

[82] Khan MS, Yusuf M. New angiospermic records for Bangladesh-13: Limnocharis flava (L.) Buch. J. Asiat. Soc. Bangladesh, Sci. 1979; 5(1): 77-80.

[83] Khan MS, Rahman MM, Huq AM, Mia MMK, Hassan MA. Assessment of Biodiversity of Teknaf Game Reserve in Bangladesh Focussing on economically and ecologically important plant species. Bangladesh J. Plant Taxon. 1994; 1(1): 21-33.

[84] Khan MS, Rahmanand MM, Ali MM(Eds.). Red Data Book of Vascular Plants of Bangladesh. Bangladesh National Herbarium. 2002; 179pp.
[85] Moniruzzaman M, Hasan MA, Rahman M, Layla S, Islam MR. A Preliminary Checklist of the Angiospermic Flora Asiat. Soc. Bang. Sci. 2012; 38(1): 53-65.

[86] Rafiqul MI, Uddin MZ, Hassan MA. An assessment of the angiospermic flora of Ramgarh Upazila in Khagrachhari district, Bangladesh. Bangladesh J. Plant Taxon. 2009; 16(2): 115-140.

[87] Rahman MO, Begum M, Ullah MW. Angiospermic Flora of Sadar Upazila of Munshiganj District, Bangladesh, Bangladesh J. Plant Taxon. 2013; 20(2): 213-231.

[88] Rahman AHMM, Debnath A. Angiosperm diversity of Pandit Para Village under Palash upazila of Narsingdi district, Bangladesh. Frontiers of Biological and Life Science. 2014; 2(4): 98-105.

[89] Rahman AHMM, Naderuzzaman ATM, Islam AKM, Afza R. Studies on the aquatic angiosperms of the Rajshahi university campus. J. Agriculture and Biological Science. 2007; 3(5): 474-480.

[90] Rahman MO, Alam MT. A Taxonomic Study on the Angiospermic Flora of Trishal Upazila, Mymensingh.Dhaka Univ. J. Biol. Sco. 2013; 22(1): 63-74.

[91] Rahman MO, Hassan MA. Angiospermic flora of Bhawal National Park, Gazipur, Bangladesh. Bangladesh J. Plant Taxon. 1995; 2(1&2): 47-79.

[92] Rasingam L. Aquatic and wetland plants of little Andaman Island, India. Journal of Basic and Applied Biology. 2010; 4 (3): 52-59.

[93] Sajib NH, Uddin SB, Islam MM. Angiospermic plant diversity of Subarnachar upazila in Noakhali, Bangladesh. J. Assiat. Soc. Bangladesh, Sci. 2014; 40 (1): 39-60.

[94] Sarker, K., Uddin, M.Z., Islam, M.R., and Hasan, M.A. Angiospermic Flora of Manikganj Sadar Upazila, Bangladesh, J. Asiat. Soc. Bangladesh, Sci. 2013; 39(2): 147 166.

[95] Swamy J, Chandramohan K, Bhadraiah B. An Inventory of Aquatic and Wetland Plants of Pocha ram lake, Medak District, Telangana, India. Asian Journal of Plant Science and Research. 2016; 6(3): 87-91.

[96] Tutul E, Uddin MZ, Rahman MO, Hassan MA. Angiospermic flora of Runctia Sal forest, Bangladesh. 1 Liliopsida (Monocots). Bangladesh J. Plant Taxon. 2009; 16 (1): 83-90.

[97] Tutul E, Uddin MZ, Rahman MO, Hassan MA. Angiospermic flora of Runctia Sal forest, Bangladesh II. Magnoliopsida (Dicots). Bangladesh J. Plant Taxon. 2010; 17 (1): 33-53.

[98] Uddin MZ, Hassan MA. Flora of Rema-Kalenga Wildlife Sanctuary. IUCN Bangladesh Country Office, Dhaka, Bangladesh. 2004; 120pp.

[99] Uddin MZ, Hassan MA. Angiosperm diversity of Lawachara National Park (Bangladesh): a preliminary assessment. Bangladesh J. Plant Taxon. 2010; 17 (1): 9-22.

[100] Uddin MZ, Hassan MA, Hosen MM. A checklist of angiospermic flora of Lalmai Hills, Comilla, Bangladesh. Bangladesh J. plant Taxon. 2005; 12 (2): 85-96.

[101] Uddin MZ, Hassan MA, Khan MS. An annotated checklist of angiospermic flora of Rema-Kalenga wildlife sanctuary (Habiganj) in Bangladesh-1. Liliopsida (Monocots). Bangladesh J. Plant Taxon. 2002; 9 (2): 57-66.

[102] Uddin MZ, Hassan MA, Khan MS. An annotated checklist of angiospermic flora of Rema-Kalenga wildlife sanctuary (Habiganj) in Bangladesh-11a. Magnoliopsida (Dicots). Bangladesh J. plant Taxon. 2003; 10(1): 79-94.

[103] Uddin MZ, Alam MS, Hassan MA. A preliminary checklist of the angiospermic flora of Ghagotia Union under Kapasia Upazila in Gazipur district, Bangladesh. Bangladesh J. Plant Taxon. 2006; 13(2): 155-170.

[104] Uddin SB, Rahman MA. Angiospermic flora of Himchari National Park. Cox's Bazar. Bangladesh J. Plant Taxon. 1999; 6(1): 31-68.

[105] Uddin SN, Khan MS, Hassan MA, Alam MK. An annotated checklist of angiospermic flora of Sitapahar at Kaptai in Bangladesh. Bangladesh J. Plant Taxon, 1998; 5(1):13-46.

[106] Uddin MZ, Abiabdullah M. Taxonomic study on the angiosperms of Char Kukri Mukri Wildlife Sanctuary, Bhola District. J. Asiat. Soc. Bangladesh, Sci. 2016; 42(2): 153-168.