E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2018; 6(3): 01-05

www.fisheriesjournal.com
Received: 01-03-2018
Accepted: 02-04-2018

Abu Saleh Md. Arif
Department of Aquaculture, Sylhet Agricultural University, Sylhet, Bangladesh

Md. Shahab Uddin
Professor, Department of Aquaculture, Sylhet Agricultural University, Sylhet, Bangladesh

Md. Shahidul Islam
Professor, Department of Coastal and Marine Fisheries, Sylhet Agricultural University. Sylhet, Bangladesh

Sadia Nusrat
Department of Aquaculture, Sylhet Agricultural University, Sylhet, Bangladesh

Poly Rani Das
Department of Aquaculture, Sylhet Agricultural University, Sylhet, Bangladesh

Mithila Biswas
Department of Coastal and Marine Fisheries, Sylhet Agricultural University, Sylhet, Bangladesh

Correspondence
Abu Saleh Md. Arif
Department of Aquaculture, Sylhet Agricultural University, Sylhet, Bangladesh

Seasonal variation of aquatic weeds at Dekar *haor* under Sunamganj district, Bangladesh

Abu Saleh Md. Arif, Md. Shahab Uddin, Md. Shahidul Islam, Sadia Nusrat, Poly Rani Das and Mithila Biswas

Abstract
A study was conducted to assess the seasonal variation and present status of aquatic weeds diversity in Dekar *haor* under Sunamganj district for the period of nine months from December 2016 to August 2017. The Shannon-Weiner diversity, Margalef richness and Pielou's evenness index were 1.32±1.19, 3.16±0.94 and 0.42±0.39, respectively. Values of different indices were high in monsoon. Shannon diversity value was the highest (2.95) in August. Species richness value was mostly similar in winter and summer. Margalef species richness was the highest (4.58) in July and the lowest (2.41) was in March. In the species evenness index, a slight variation was observed among the seasons. The highest value (0.96) of species evenness was found in July while the lowest (0.09) was in April. Diversity indices were lower during summer owing to flash flood that occurred in early April. A total of 35 species of aquatic weeds as 13 floating species, 16 emergent and 6 submerged were recorded from the study area. Nymphaeaceae, Araceae and Hydrocharitaceae were the dominant families which contributed 3 species in each. It was observed that emergent weeds were abundant compared to submerged weeds. It was also found that aquatic weeds have both positive and negative aspects. It reveals from the study that aquatic weeds diversity changes from season to season. This study therefore, provides new baseline information on the diversity of aquatic weeds based on seasonal changes. So it is extremely important to conserve these aquatic weeds for human, aquatic organisms, soil health, productivity and friendly environment of the *haor*.

Keywords: Aquatic weeds, diversity indices, weeds species, seasonal variation

1. Introduction
Bangladesh is endowed with a vast expanse of inland open waters characterized by rivers, canals, floodplains, *haors*, *beels*, natural and man-made lakes, freshwater marshes, estuaries, brackishwater impoundments, etc. [8]. The vegetation's of *haors*, *beels*, lakes and ponds are rich in aquatic flora and constitute very important resources of food and medicine for the rural population. But these natural resources, especially in the larger waterbodies of the northern and eastern region of the country have hardly been given due attention for scientific studies, and thus their potentialities remain still untapped. The importance of these water floras in agriculture, fish culture and as a source of food and medicine can hardly be emphasized [14]. Aquatic weeds are aquatic photosynthetic organisms, large enough to see with the naked eye, that actively grow permanently or periodically submerged below, floating on or growing up through the water surface [4]. Aquatic plants are the most important component of the closed and open waterbodies. These are used as producers and phytoplankton in the closed and open waterbodies. Aquatic plants also produce carbohydrate with the help of sunlight, chlorophyll, carbon dioxide and water. These plants are as follows: *Azolla, Ceratophyllum, Eichhornia, Hydrilla, Lemna, Nymphaea, Ottelia, Pistia, Potamogeton, Scirpus, Ludwigia, Spirodella, Vallianeria, Wolffia,* etc. Aquatic weeds increase productivity of aquatic ecosystem and thus help to maintain ecosystem balance [15]. *Haors* (saucer or bowl shaped shallow depressions) cover about 25% of the North-eastern part of Bangladesh [9]. It is a mosaic of aquatic habitats including rivers, streams and irrigation canals, large area of seasonally flooded cultivated plains and combination of hundreds of inter-connected *beels* [9]. In greater Sylhet, the most prominent *haors* are Saneer *haor*, Hail *haor*, Hakaluki *haor*, Dekar *haor*, Maker *haor*, Chayer *haor*, Tanguar *haor* and Kawadighi *haor* [8]. Dekar *haor* is one of the most important *haors* in Sunamganj. It is the home of many species of freshwater fishes and thousands of indigenous

birds. It is also a harbor of non-fish organisms like snails, mussels and different types of aquatic vegetation. Limited numbers of swamp trees are present in this area [5]. There is a great importance of this *haor* in production, maintaining biodiversity, meeting local and regional demand and it also serves as a good source of local fish seed supply for other adjacent water bodies [5]. Aquatic weeds (emergent, floating and submerged) interfere with the static and flow water system. They cause tremendous loss of water from waterbodies like lakes and dams through evapo-transpiration. In flowing water system, aquatic weeds impede the flow of water in irrigation canals and drainage channels thereby increasing evaporation damage structures in canals and dams, clog gates, siphons, valves, bridge piers, pump, etc. Impediment in flow of water may result in localized floods in neighboring areas. Village ponds and tanks get infested with floating and submerged weeds, which results in reducing the capacity of the water storage and therefore effecting efficient irrigation. Therefore, considering the losses caused, it is essential to keep aquatic weeds under control in waterbodies, flow water systems, ponds and tanks so that these systems can be utilized to best of their efficiency [11]. However very little information is available regarding aquatic weeds of Dekar *haor*. Considering the above facts, this work was therefore undertaken to document aquatic weeds diversity of the *haor* on the basis of seasonal variation.

2. Materials and methods

2.1 Selection and description of the study site and study period

Dekar *haor* was selected for the present study because it is one of the largest and most important *haor* in Bangladesh. It lies between latitude 24°46´N to 24°57´N and longitude 91°20´E to 91°31´E. It is a seasonal-perennial *haor*. Data were collected from four sites namely Joykalash, Sunamganj Dakshin, Purbo pagla and Paschim pagla under Daksin Sunamganj upazila. The primary criterion for the selection of the study area was a suitable geographical coverage of *haor* as far as possible. At first, primary information was collected from Dakshin Sunamganj Upazila Fisheries Officer regarding concentration of aquatic weeds in the study area. On the basis of preliminary survey the final decision was taken for the study of this locality. The study was conducted for a period of 9 months covering three seasons namely winter, summer and monsoon from December 2016 to August 2017.

2.2 Collection of data

Several sampling methods are used for studying the structure of sociological order in any plant community *viz* quadrate method, transect method, loop method and point method. For the present study, randomized quadrate method for sampling was used. The quadrate is a square sample plot or unit for a detailed analysis of vegetation. A plastic frame quadrate (1×1 m^2) was laid at the specific sampling spots with minimum three replications and average abundance was expressed as No./quadrat. During data collection, both primary and secondary sources were strongly considered.

2.3 Sample Collection

Aquatic weed samples were collected from the *haor* on each sampling day. Samples were collected from various sites of the *haor*. Monthly sampling was done and data were recorded. Weeds were manually collected from the sampling spots and then brought to the laboratory immediately and preserved in 7-10% formalin for further classification and identification.

2.4 Identification

Samples of weeds were placed on a table for the easy contrast of vision for the identification. Weeds were identified using standard available literature [18]. Identification was done up to genus and species level. Data of research were finally tabulated.

2.6 Determination of indices of species diversity

In the present study, aquatic weeds diversity evaluated by dint of Shannon-Wiener index (H′) [17], Species richness by Margalef index (d) [12] and Evenness by Pielou's index (J′) [13].
Shannon-Weiner diversity index (H′):

$$H' = - \Sigma \, pi \log pi$$

Where, H′ = Shannon Weiner index,
Pi = ni/N,
ni = no. of individuals of a species,
N = Total number of individuals

Margalef species richness (d):

$$d = (S - 1) / \ln N$$

Where, S = Total species,
N = Total individuals

Pielou's evenness index (J'):
Evenness or equitability of the species in the study sites was calculated using Margalef's equation:

$$(J') = H(s) / H(max.)$$

Where, H(s) = the Shannon-Weiner information function
H (max.) = theoretical maximum value for H(s) if all species in the sample were equally abundant

3. Results and Discussion

3.1 List of aquatic weeds

Several types of weeds are found round the year in Dekar *haor*. Aquatic weeds of the *haor* as recorded are mainly classified as floating, emergent and submerged based on different characteristics. These are displayed in Table 1, 2 and 3.

Table 1: List of floating weeds of Dekar *haor* during the study period.

SL.	Local name	Family	Common name	Scientific name
1	Kachuripana	Pontederiaceae	Water hyacinth	*Eichhornia crassipes*
2	Topapana	Araceae	Water lettuce	*Pistia stratiotes*
3	Khudipana	Lemnaceae	Duck weed	*Lemna minor*
4	Edurkanipana	Araceae	Rootless duckweed	*Wolffia arhiza*
5	Kutipana	Salviniaceae	Mosquito fern	*Azolla pinnata*
6	Kowai	Aponogetonaceae	Drifting sword plant	*Aponogeton nutans*
7	Nil-shapla	Nymphaeaceae	Blue water lily	*Nymphaea nouchali*

8	Lal Shapla	Nymphaeaceae	Red water lily	*Nymphaea rubra*
9	Sada shapla	Nymphaeaceae	Water lily	*Nymphaea pubescens*
10	Panchuli	Menyanthaceae	White water fringe	*Nymphoides indicum*
11	Paniphal	Solanaceae	Water chest nut	*Trapa maximowiczii*
12	Padmo	Nelumbonaceae	Lotus	*Nelumbo nucifera*
13	Janglidhan	Poaceae	Water stargrass	*Hygroryza aristata*

Table 2: List of emergent weeds of Dekar *haor* during the study period.

SL.	Local name	Family	Common name	Scientific name
1	Dhol kolmi	Convolvulaceae	Gloria-d la manana	*Ipomea carnea*
2	Helencha	Asteraceae	Water cress	*Enhydra fluctuans*
3	Bishkatali	Polygonaceae	Polygonum	*Polygonum glabrum*
4	Gechu	Aponogetonaceae	Aponogeton vlvaecus	*Aponogeton* sp.
5	Kolmi	Convolvulaceae	Water spinach	*Ipomea aquatica*
6	Malancha	Asteraceae	Alligator weed	*Enhydra* sp.
7	Keshore dam	Onagraceae	Water primrose	*Ludwigia adscendens*
8	Kanai bashi	Commelinaceae	Dayflower	*Commerlina bengalensis*
9	Amrul Shak	Oxalidaceae	Oxalis	*Oxalis corniculata*
10	Pani kocu	Alismataceae	Arrowhead	*Sagittaria* sp.
11	Susni Shak	Marsileaceae	Water clover	*Marsilea quadrifolia*
12	Kanidoga	Commelinaceae	Day flowers	*Commelina appendiculata*
13	Arail	Poaceae	Cutgrasses	*Leersia hexandra*
14	Kachu	Araceae	Elephant-ear	*Colocasia esculenta*
15	Chesra	Cyperaceae	Chinese water chestnu	*Eleocharis dulcis*
16	Mutha	Cyperaceae	Coco-grass	*Cyperus rotundus*

Table 3: List of submerged weeds of Dekar *haor* during the study period.

SL.	Local name	Family	Common name	Scientific name
1	Hydrilla	Hydrocharitaceae	Water thyme	*Hydrilla verticilata*
2	Pata jhanji	Hydrocharitaceae	Eel-grass	*Vallisneria spiralis*
3	Najas	Hydrocharitaceae	Minor naiad	*Najas minor*
4	Not known	Potamogetonaceae	Curly-leaf pondweed	*Potamogeton crispus*
5	Sheola	Ceratophyllaceae	Con's tail	*Ceratophyllum demersum*
6	Myriophyllum	Holoragidaceae	Water milfoil	*Myriophyllum* sp.

In the study, there were 35 species of aquatic weeds and macrophytes identified from the *haor*, which belonged to 23 families (Fig. 1). Among 35 aquatic weeds, 13 species were floating, 16 were emergent and the rest 6 were submerged. Basak *et al.* [3] found only 10 aquatic weeds species in the *haor* of Kishoregonj district. Kaisar *et al.* [10] found a total of 22 species of 16 families, 12 orders and 21 genuses in Noakhali Sadar, Bangladesh. The findings of above researchers are lower than the findings of the present study. It was observed that the emergent aquatic weeds were abundantly found compared to submerged weeds. Shailaja and Aruna [16] also observed less amount of submerged weeds compared to emergent weeds, which is quite similar to the findings of the present study. The species composition varied from time to time. The families Nymphaeaceae, Araceae and Hydrocharitaceae were most dominant among 23 families of collected weeds.

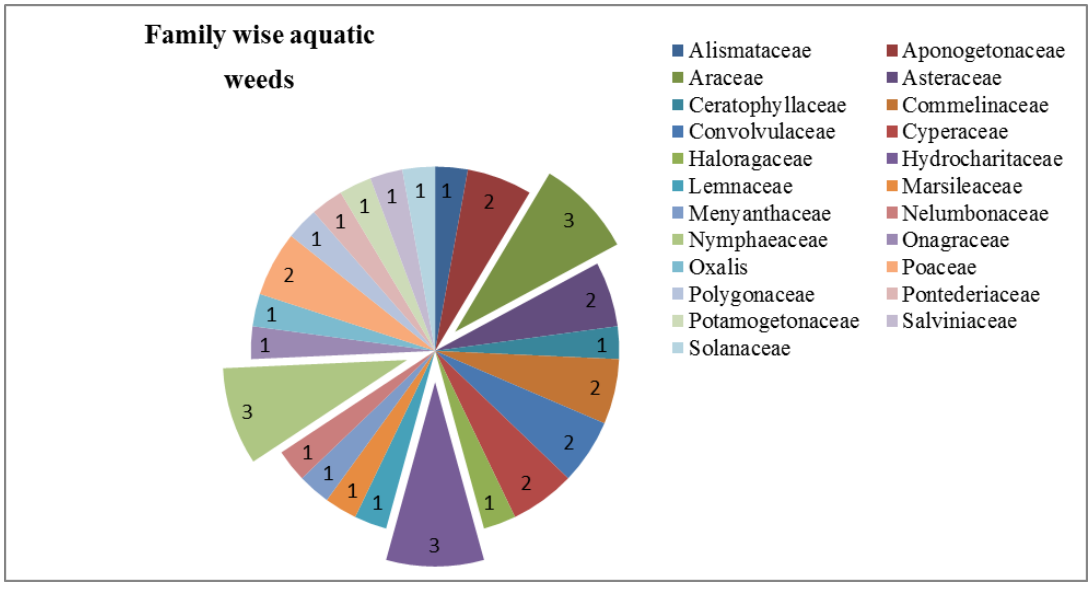

Fig 1: Showing families of aquatic weeds in the studied *haor*.

3.2 Seasonal variation of abundance of aquatic weeds

Number and abundance of aquatic weeds varied from season to season. There was a significant seasonal variation in number of aquatic weeds. In winter season, 26 aquatic weeds were identified from Dekar *haor* and among them 16 species were emergent, 6 floating and 4 submerged. During summer, 25 species were found where 15 species were emergent, 6 floating and 4 submerged (Fig. 2). Species composition of summer was more or less similar with the species of winter. But there was a remarkable variation of species composition in monsoon compared to winter and summer seasons. In monsoon only 22 weeds were identified as 9 emergent, 4 submerged and 9 floating species (Fig. 2).

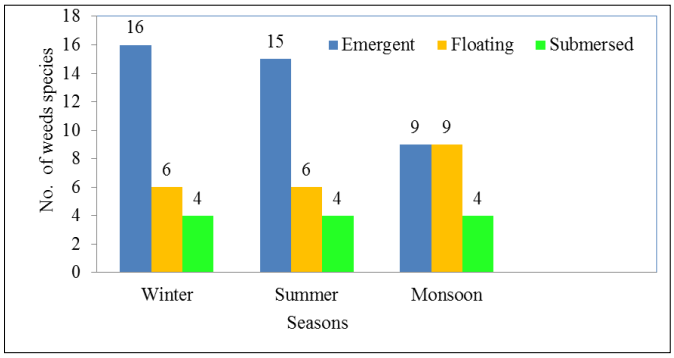

Fig 2: Weeds species composition in different seasons.

3.3 Seasonal variation in diversity indices of aquatic weeds of the study site

In the present study, Shannon-Weiner diversity, Margalef richness and Pielou's evenness indices were found to be 1.32±1.19, 3.16±0.94 and 0.42±0.39, respectively during the study period.

3.3.1 Seasonal variation in Shannon diversity value

The highest value (2.95) of Shannon diversity was obtained in August followed by July during monsoon period and the lowest value (0.28) was in April followed by May during summer (Fig. 3). Goswami *et al.* [7] recorded the highest value of Shannon's diversity index in monsoon season. Dutta *et al.* [6] analyzed Shannon-Weiner diversity index of summer and winter and maximum value (3.14) found during the summer season and minimum (2.45) in winter season. These findings are supported the findings of the present study. Ahmad *et al.* [1] found Shannon-Wiener index values for aquatic macrophytes from 1.04 to 2.12, which is coincided with the findings of the present study. Banerjee and Ghosh [2] recorded Shannon-Wiener index values from 0.03 to 1.75, which is lower than the results of the present study.

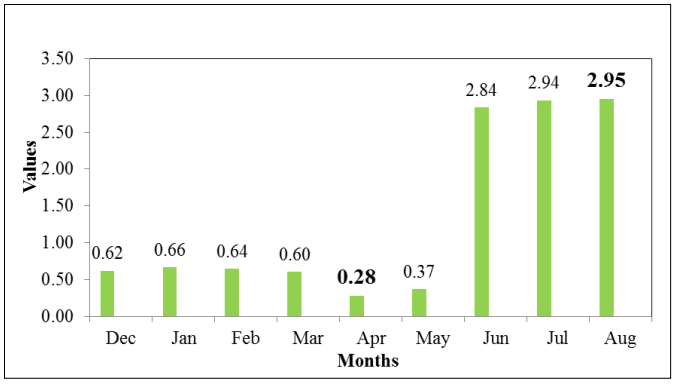

Fig 3: Seasonal variation in Shannon-Weiner index.

3.3.2 Seasonal variation in Species richness value

Data revealed that the species richness was the highest during pre-monsoon and monsoon period. The highest richness (4.58) of weeds was found in July followed by August (4.39) and June (4.27). On the other hand, species richness was lower in winter season. Richness was lowest (2.41) in March followed by December and February (Fig. 4). Goswami *et al.* [7] found the highest richness of wetland weeds in July and the lowest in winter, which is consistent with the results of the present study. Banerjee and Ghosh [2] found the value of Margalef diversity index as 3.75 to 4.85, which is similar with the present findings. Ahmad *et al.* [1] found Species richness for aquatic macrophytes from 0.30 to 1.22, which is much lower than the present findings.

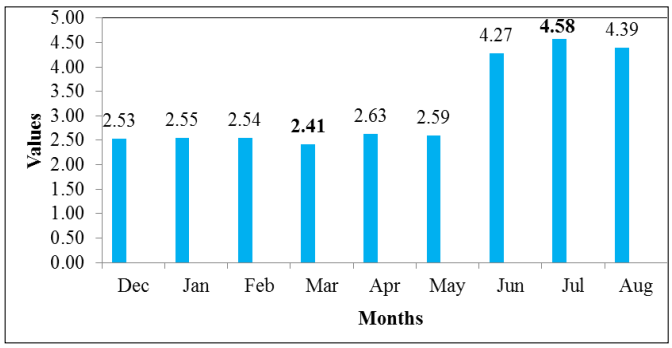

Fig 4: Seasonal variation in Species richness index.

3.3.3 Seasonal variation in Species evenness value

There was a little bit change in species evenness among the seasons. The lowest value (0.09) was recorded in April while the highest (0.96) was in July during monsoon (Fig. 5), which agrees with the result of evenness as stated by Goswami *et al.* [7]. Ahmad *et al.* [1] found maximum value of evenness as 0.99. Banerjee and Ghosh [2] reported evenness values ranging from 0.02 to 0.50, which is lower than the present findings.

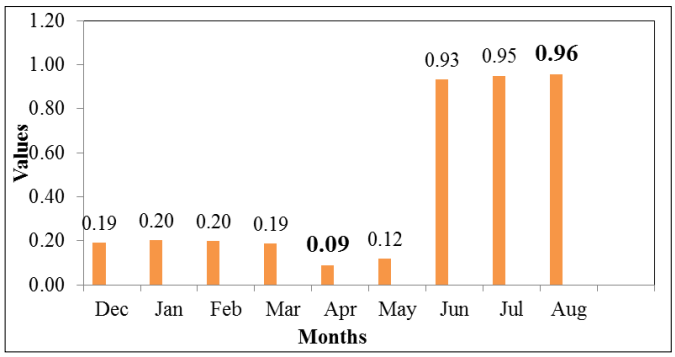

Fig 5: Seasonal variation in Species evenness index.

4. Conclusion

Wetland weeds are an important component of aquatic ecology. Weeds of Dekar *haor* are found to be diversified. Diversity of weeds of the *haor* changes with the changes of season. Weeds are found to have both positive and negative sides. These weeds should be properly managed and preserved for the purposes of human consumption, fodder, fish feed, fish shelter, breeding and friendly environment of *haor* ecosystem.

5. Acknowledgements

Authors would like to thank to Krishi Gobeshona Foundation (KGF), Farmgate, Dhaka, Bangladesh for financial support to carry out the present study.

6. References

1. Ahmad U, Parveen S, Hasan T, Bhat BN. Diversity of aquatic macrophytes of Aligarh, UP India. International Journal of Current Microbiological Applied Science. 2015; 4(4):494-505.
2. Banerjee R, Ghosh AR. Identification and Quantification of Aquatic Macrophytes with Ecological Indices in the Damodar River. International Journal of Scientific Research in Science, Engineering and Technology. 2016; 2(6):275-281.
3. 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; 5(6):151-156.
4. Chambers PA, Lacoul P, Murphy KJ, Thomaz SM. Global diversity of aquatic macrophytes in freshwater. Hydrobiologia. 2008; 595(1):9-26.
5. CNRS (Center for Natural Resource Studies).Management of Aquatic Ecosystems through Community Husbandry. Feasibility Report on MACH (Management of Aquatic Ecosystems through Community Husbandry) Outreach Program. 2004, 10.
6. Dutta T, Deka U, Rabha PK. Diversity of aquatic macrophytes of Kapla beel (wetland) of Barpeta district, Assam, India. Annals of Biological Research. 2014; 5(12):41-45.
7. Goswami G, Pal S, Palit D. Studies on the physico-chemical characteristics, macrophyte diversity and their economic prospect in Rajmata Dighi: a wetland in Cooch Behar district, West Bengal, India. NeBIO. 2010, 1(3).
8. Hossain MAR. An Overview of Fisheries Sector of Bangladesh. Research in Agriculture, Livestock and Fisheries. 2015; 1(1):109-126.
9. Hussain MG, Salam. Basic Service Delivery Advocacy: Review Report, Development Wheel (Dew), Dhaka. 2007, 35.
10. 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.
11. Kevin MK, Lancar ML. Aquatic weeds and their management. International Commission on Irrigation and Drainage. 2002; 12(1-2):15-64.
12. Margalef R. Information theory in ecology. International Journal of General Systems. 1958; 3:36-71.
13. Pielou EC. The measurement of diversity in different types of biological collections. Journal of Theoretical Biology. 1966; 13:131-144.
14. 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.
15. Rahman MS. Environmental Science and Biogeography, Abosar Publication Ltd. Dhaka- 1100, Bangladesh. 2005, 126-135.
16. Shailaja A, Aruna M. Diversity of Aquatic Macrophytes in Kamanpoor Pond & Agraharam Pond of Karimnagar District, Telangana. Advances in Bioresearch. 2017; 8(5):47-50.
17. Shannon CE, Weiner W. The mathematical theory of communication. Urbana: University of Illinois Press, 1963.
18. Sobhan I, Alam ABMS, Chowdhury MSM. Biodiversity of Tanguar Haor: A Ramsar Site of Bangladesh. Volume II: Flora. IUCN Bangladesh Country Office, Dhaka, Bangladesh, 2012, 92-195.