

## LIMNOLOGICAL STUDIES OF CONSERVED MAN-MADE LAKE DURGASAGAR AT BARISHAL IN BANGLADESH AND ANGIOSPERMIC FLORAL DIVERSITY OF THE ADJACENT AREA

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### Abstract

Limnological aspects Durgasagar (lake) and angiospermic floral diversity of the adjacent area were investigated during the year in 2019. A total of 153 angiosperms species belonging 127 genera and 63 families including exotic, wilds, cultivated and planted were recorded. Among the families, Asteraceae was the largest contributed family and represented 11 species followed by Solanaceae and Moraceae respectively. A total of 116 tree species and 126 terrestrial species were recorded. 38% of the recorded species has ethnomedicinal and pharmacological properties. Besides this, 29 fruits yielding species were also found in the survey. Physico-chemicals quality of air and water such as air temperature, humidity, water temperature, Secchi depth, pH, electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO), Biological oxygen demand (BOD), alkalinity, PO<sub>4</sub>-P and NO<sub>3</sub>-N were studied and mean values of these are 24.63°C, 64 % , 23.80°C, 88.31 cm, 8.41, 66.72 µS/cm, 22.37 mg/l, 6.64 mg/l, 1.14 mg/l, 0.63 meq/l, 4.36 µg/l and 0.17 µg/l respectively. Frequent entrance of local people, tourists and weak infrastructure of boundary wall cause major damages to the vegetation of the area. Protection of biodiversity of this lake and adjacent area is essential to conserve this historically and man-made ecologically important lake.

**Keywords:** Limnology, Floral diversity, Physico-chemicals properties, Durgasagar and Barishal.

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## **Introduction**

Geographical location blesses Bangladesh with adequate freshwater reserve as a deltaic country and these include rivers, haors, baors, beels, lagoons, natural lakes, man-made lakes, ponds, floodplains and reservoirs. Among man-made lakes, Durgasagar locally known as Madhabpasha Dighi in Barishal is notable one and located at Madhabpasha under Babuganj upazilla in Barishal Sadar, existed between 22°76'N to 90°28'E having total area of about 2,500 hectares (Fig. 1). The lake is about 11 kilometers away from north of Barishal city. Besides this, in Bangladesh there are some artificial lake named Ramsagar in Dinajpur, Nilsagar in Nilphamari, Joysagar in Sirajganj and Dharmasagar in Cumilla. The words 'Sagar' (= sea) are the characteristic features of the aquatic ecosystems in many areas of Bangladesh and generally means large sized, perennial, pond-like water body and is a legendary of the Hindu landlord of the then Bengal under British India that has been purposefully dug-out for storing freshwater to meet the needs of domestic water use by the local people (Islam et al., 2012). Soil fertility, pH and humidity enrich the floral diversity of catchment areas of these lakes.

These aquatic ecosystems are legendary through their history, sustains age old and its interesting biodiversity makes it as a tourist spots. Due to increasing tendency of tourists and anthropogenic pressures, biodiversity of these protected areas like national parks, botanical gardens and eco-parks are decreasing rapidly (Rahman et al., 2012; Chowdhury et al., 2014). In order to conserve biodiversity of these protected areas, it is prerequisite to have precise data of present status of it. Taking into account of this prerequisite, Rahman and Hasan (1995); Uddin and Hassan (2010); Arefin et al., (2011); Dutta et al., (2014) and Rahaman et al., (2017) studied the angiospermic floral diversity of national parks named Bhawal (Gazipur), Lawachara (Maulvibazar), Satchari (Habiganj), Sitakunda (Chattogram) and Kuakata (Patuakhali) in Bangladesh respectively whereas Rimi et al., (2013) assessed out the diversity of flora and fauna of Ramsagar at Dinajpur districts. But floral diversity particularly angiosperm diversity of remaining other conserved man-made lake is not check listed still. Furthermore, different exotic plant species has been planted for beautification purpose in the catchment area and these were listed (Hossain and Pasha, 2004).

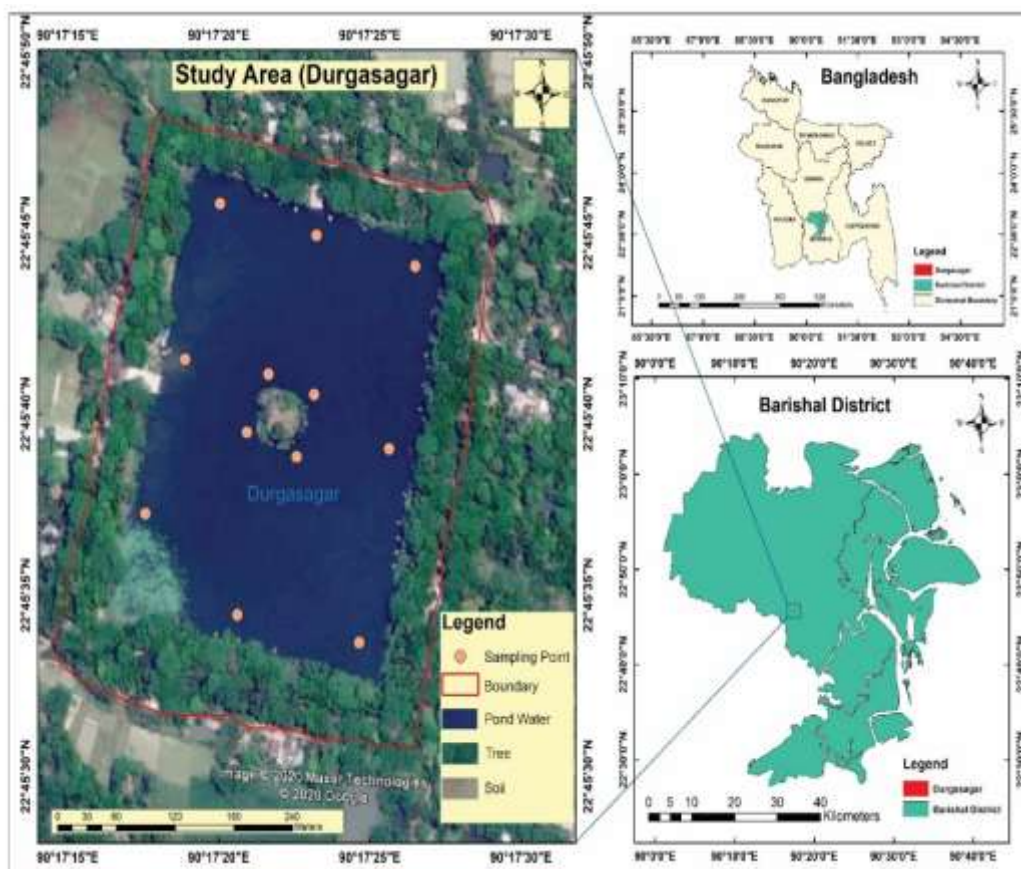
Soil and water quality has a direct impact on both aquatic and terrestrial floral diversity of each area. In addition most of these man-made lakes are vulnerable so strongly by releasing excessive nutrients from decomposition of both liquid and solid wastes from tourists and local people that make the lakes eutrophic (Rahman et al.,

2017). Because of fresh water as an essential part of daily life, conservation of these freshwater resources is now national issue. For conservation and management strategy, a number of limnological investigations were carried out for Joysagar (Sirajganj), Nilsagar (Nilphamari), Ramsagar (Dinajpur) and Dharmasagar (Cumilla) by Nahar et al., (2010); Islam et al., (2012); Khondker et al., (2012); Bhuyan and Khondker (2017) respectively. But limnological aspects of Durgasagar in Barishal is still not analyzed. Therefore, this study was conducted at Durgasagar and its adjacent area in Barishal with the following objectives: to assess physico-chemical qualities of water, to list angiospermic floral diversity, to evaluate the contribution of biodiversity to the local community and finally to depict a comprehensive management structure of ecotourism to protect the biodiversity.

### **Materials and Methods**

**Limnological study:** The samples were collected mostly between 10:00 and 11:30 A.M. all the year round dividing it into four season named pre-monsoon, monsoon, post-monsoon and winter. Different portable field meters and chemicals purchased from Hanna Instruments, (Romania) were used to measure temperature (Model-HI98509), pH (Model-HI98107), electrical conductivity (Model-HI98304), alkalinity (Model-HI755), dissolved oxygen (Model-100T), humidity (Model-HI9564), total dissolved solids (Model-HI98301), PO<sub>4</sub>-P (Model-50T) and NO<sub>3</sub>-N (Model-100T) *in-situ*. A Secchi disc was used to measure the depth of transparency. All physicals and chemicals analyses were performed according to mild modification of Khondker (1997).

**Floral survey:** The angiospermic floral survey was conducted during January to December, 2019 and twelve visits were done in each season of the year mentioned. The survey has covered all habitats of the study area including terrestrial and aquatic body. Maximum identification of the species observed was done at the field site and in case of confusion in authentic identification plant specimens were collected for herbarium preparation and photograph of each species was taken. Voucher specimens (Hyland, 1972) and photographs for species were preserved. Identification of the collected specimens were confirmed by consulting different floras such as Siddiqui et al., (2007); Ahmed et al., (2008-2009); Pasha and Uddin (2013). The updated nomenclature of the species was done according to Siddiqui et al., (2007) and Ahmed et al., (2008-2009).



**Fig 1.** Location of study area of Durgasagar at Barishal, Bangladesh.

## Results and Discussion

**Limnological properties:** All the physico-chemicals quality of water measured in present study are depicted in Table 1. Temperature of water plays a potential role on aquatic flora and fauna. Warm water contains less oxygen than that of cold water which may have fatal impact on aquatic flora and fauna. Mean water and air temperature were recorded 23.80°C and 24.63°C respectively (Table 1). Water temperature was found to be almost closed to the air temperature as desired with mild exceptions. Durve and Bal (1961); Oppenheimer et al., (1978); Chowdhury and Mazumder (1981) also found almost similar results in their previous study. During summer, a tendency of soaring up water temperature over surrounding air temperature was observed and this may be because of

thermal properties of water and air (Bhuiyan and Khondker, 2017). In this study, water temperature was slightly lower than that of air. In addition, Bhuiyan and Khondker (2017) also found same evidence in their study (Table 1). The mean of Secchi depth was recorded 88.31 cm (Table 1) which was highest among 5 man-made conserved lake in Bangladesh (Table 1). Total dissolved solids (TDS) represents the amount of total dissolved material in aquatic ecosystem and change in the runoff rate of surface chemicals from catchment area. High value of TDS makes the water turbid and results

**Table 1. Comparative accounts of different physico-chemical parameters of five man-made lakes of Bangladesh (mean value).**

Parameters	Unit	Name of the lake				
		Durgasagar (Present study)	Ramsagar (Khondker et al., 2012)	Nilsagar (Islam et al., 2012)	Joysagar (Nahar et al., 2010)	Dharmasagar (Bhuiyan and Khondker, 2017)
Air temp.	(°C)	24.63	20.48	19.27	29	32.58
Water temp.	(°C)	23.80	22.50	20.20	27.4	31.78
Secchi depth	(cm)	88.31	75	53	14.10	48
TDS	(mg/l)	22.37	10.66	32	-	130.44
Conductivity	(µS/cm)	66.72	73.66	126.33	109.20	502.50
p <sup>H</sup>		8.41	6.73	6.96	7.4	7.67
DO	(mg/l)	6.64	7.99	11.64	-	7.59
BOD <sub>5</sub>	(mg/l)	1.14	-	-	-	-
Alkalinity	(meq/l)	0.63	0.50	0.60	0.66	0.19
Humidity	(%)	64	-	-	-	-
NO <sub>3</sub> -N	(µg/l)	0.17	0.007	0.19	97.5	41.95
PO <sub>4</sub> -P	(µg/l)	4.36	3.16	6.80	79.87	4.61

- Represents not available

a fluctuation in abundance of aquatic flora and fauna. Average TDS was recorded 22.37 mg/l (Table 1) which is about two times more than Ramsagar (Khondker et al., 2012), but

about 1.5 times and 5.5 times lower than that of Nilsagar (Islam et al., 2012) and Dharmasagar (Bhuiyan and Khondker, 2017) respectively (Table 1).

In addition, Electrical conductivity (EC) indicates the concentration of electrolytes in the water body. The mean of EC was recorded 66.72  $\mu\text{S}/\text{cm}$  (Table 1) which was lowest than those reported for Nilsagar (Islam et al., 2012), Ramsagar (Khondker et al., 2012), Joysagar (Nahar et al., 2012) and Dharmasagar (Bhuiyan and Khondker, 2017) (Table 1). pH of water describe the nature of water whether it is acidic, basic or neutral (Hasan and Bhuiyan, 2013). It regulates the biological environment and a sharp increase or decrease in pH of water body exerts a fatal impact on aquatic life. The average of pH of Durgasagar was 8.41 (Table 1). Compared to other studied water bodies it was found that Durgasagr is moderately alkaline in nature and just across of all the previous studies related to Nilsagar (Islam et al., 2012), Ramsagar (Khondker et al., 2012), Joysagar (Nahar et al., 2012) and Dharmasagar (Bhuiyan and Khondker, 2017) (Table 1). Dissolved oxygen (DO) is a regulator of metabolic process in aquatic ecosystem and an indicator of organic pollution (Hasan and Bhuiyan, 2013). Runoff of surface water with solid and/or liquid waste affects the DO of waterbody. The mean DO concentration recorded was 6.64 mg/l (Table 1) and lowest among the other compared lakes named Nilsagar (Islam et al., 2012), Ramsagar (Khondker et al., 2012), Joysagar (Nahar et al. 2012) and Dharmasagar (Bhuiyan and Khondker, 2017) (Table 1).

**Taxonomic inventory and documentation of plant species:** A total of 153 angiosperm species belonging to 127 genera and 63 families were recorded from the Durgasagar area (Table 2 and Table 4).

**Table 2. List of angiospermic flora recorded from Durgasagar, Barishal**

Serial	Scientific name	Local name	Family	Habitat	Habit	Medicinal value	Status
1.	<i>Abelmoscus moschata</i> (L.) Medic	Muskadana	Malvaceae	Terrestrial	Herb	No	Wild
2.	<i>Acacia auriculiformis</i> A. Cunn. ex Benth.& Hook.	Akashmoni	Mimosaceae	Terrestrial	Tree	No	Planted
3.	<i>Achyranthes aspera</i> L.	Apang	Amaranthaceae	Terrestrial	Herb	Yes	Wild
4.	<i>Acmella ciliata</i> (Kunth) Cass	Nakful	Asteraceae	Terrestrial	Herb	Yes	Wild
5.	<i>Actinoscirpus grossus</i> (L.f.) Goetgh & D.A. Simpson	Kesur	Cyperaceae	Amphibian	Herb	No	Wild
6.	<i>Aegle marmelos</i> (L.) Correa	Bell	Rutaceae	Terrestrial	Tree	Yes	Planted
7.	<i>Ageratum conyzoides</i> (L.) L.	Mukhra	Asteraceae	Terrestrial	Herb	Yes	Wild
8.	<i>Albizia lebbek</i> (L.) Benth.	Kalo sirish	Mimosaceae	Terrestrial	Tree	No	Planted
9.	<i>Albizia procera</i> (Roxb.) Benth.	Sada sirish	Mimosaceae	Terrestrial	Tree	No	Planted
10.	<i>Albizia richardiana</i> (Voigt) King & Prain	Gagon sirish	Mimosaceae	Terrestrial	Tree	No	Planted
11.	<i>Albizia saman</i> (Jacq.) Merr.	Raintree	Mimosaceae	Terrestrial	Tree	No	Planted
12.	<i>Alocasia acuminata</i> (Schott.) G. Don	Bonkochu	Araceae	Amphibian	Herb	Yes	Wild
13.	<i>Alstonia scholaris</i> (L.) R. Br.	Chatim	Apocynaceae	Terrestrial	Tree	Yes	Planted
14.	<i>Alternanthera phyloxeroides</i> (Mart.) Griseb.	Helenchna	Amaranthaceae	Amphibian	Herb	No	Wild
15.	<i>Amaranthus tricolor</i> L.	Lalshak	Amaranthaceae	Terrestrial	Herb	No	Cultivated
16.	<i>Annona reticulata</i> L.	Nona	Annonaceae	Terrestrial	Tree	No	Planted
17.	<i>Aphanamixis polystachya</i> (Wall.) R. Parker	Raina	Meliaceae	Terrestrial	Tree	Yes	Wild
18.	<i>Aponogeton crispus</i> Thunb	Gechu	Aponogetonaceae	Aquatic	Herb	No	Wild
19.	<i>Ardisia solanacea</i> (Poir.) Roxb.	Bonjam	Primulaceae	Terrestrial	Shrub	No	Wild
20.	<i>Areca catechu</i> L.	Supari	Arecaceae	Terrestrial	Tree	No	Planted
21.	<i>Artocarpus heterophyllus</i> Lam.	Kathal	Moraceae	Terrestrial	Tree	No	Planted
22.	<i>Artocarpus lakoocha</i> Buch.-Ham.	Deuya	Moraceae	Terrestrial	Tree	No	Planted
23.	<i>Averrhoa carambola</i> L.	Kamranga	Oxalidaceae	Terrestrial	Tree	No	Planted
24.	<i>Axonopus compressus</i> (Sw.) P.Beauv.	Balla ghash	Poaceae	Terrestrial	Herb	No	Wild
25.	<i>Azadirachta indica</i> A. Juss.	Neem	Meliaceae	Terrestrial	Tree	Yes	Planted
26.	<i>Bambusa bambos</i> (L.) Voss	Katabash	Poaceae	Terrestrial	Herb	No	Planted
27.	<i>Bischofia javanica</i> Blume	Kainjal	Euphorbiaceae	Terrestrial	Tree	Yes	Wild
28.	<i>Blumea lacera</i> (Burm.f.) DC.	Baro-Kuksim	Asteraceae	Terrestrial	Herb	No	Wild
29.	<i>Bombax ceiba</i> L.	Shimul	Bombacaceae	Terrestrial	Tree	No	Planted

Serial	Scientific name	Local name	Family	Habitat	Habit	Medicinal value	Status
30.	<i>Borassus flabellifer</i> L.	Tal	Arecaceae	Terrestrial	Tree	No	Planted
31.	<i>Breynia vitis-idaea</i> (Burm.f.) C. E. C. Fisher	Juli	Phyllanthaceae	Terrestrial	Shrub	Yes	Wild
32.	<i>Capsicum annuum</i> L.	Langka	Solanaceae	Terrestrial	Herb	Yes	Cultivated
33.	<i>Cardiospermum halicacabum</i> L.	Latafutki	Menispermaceae	Terrestrial	Climber	Yes	Wild
34.	<i>Carica papaya</i> L.	Pepe	Caricaceae	Terrestrial	Herb	Yes	Cultivated
35.	<i>Cassia fistula</i> L.	Badorlathi	Caesalpiniaceae	Terrestrial	Tree	Yes	Planted
36.	<i>Senna occidentalis</i> L.	Kolkasunda	Caesalpiniaceae	Terrestrial	Herb	Yes	Wild
37.	<i>Centella asiatica</i> (L.) Urb.	Thnakuni	Apiaceae	Terrestrial	Herb	Yes	Wild
38.	<i>Ceratophyllum demersum</i> L.	Sheola	Ceratophyllaceae	Aquatic	Herb	No	Wild
39.	<i>Ceratophyllum submersum</i> L.	Katajhanji	Ceratophyllaceae	Aquatic	Herb	No	Wild
40.	<i>Chromolaena odorata</i> (L.) King & Robinson	Assamlata	Asteraceae	Terrestrial	Herb	No	Wild
41.	<i>Chrysopogon aciculatus</i> (Retz.) Trin.	Premkata	Poaceae	Terrestrial	Herb	No	Wild
42.	<i>Citrus aurantifolia</i> (Christm.) Sw.	Patilebu	Rutaceae	Terrestrial	Shrub	No	Cultivated
43.	<i>Citrus grandis</i> Merr.	Batabilebu	Rutaceae	Terrestrial	Shrub	Yes	Cultivated
44.	<i>Clerodendrum viscosum</i> Vent.	Vait	Verbenaceae	Terrestrial	Herb	Yes	Wild
45.	<i>Coccinea grandis</i> (L.) Voigt	Telakucha	Cucurbitaceae	Terrestrial	Climber	Yes	Wild
46.	<i>Cocos nucifera</i> L.	Narikal	Arecaceae	Terrestrial	Tree	No	Cultivated
47.	<i>Codiaeum variegatum</i> (L.) A. Juss.	Patabahar	Euphorbiaceae	Terrestrial	Shrub	No	Planted
48.	<i>Coix lacryma-jobi</i> L.	Kaich	Poaceae	Amphibian	Herb	No	Wild
49.	<i>Colocasia esculenta</i> (L.) Schott	Janglikachu	Araceae	Amphibian	Herb	Yes	Wild
50.	<i>Commelina bengalensis</i> L.	Kanshira	Commelinaceae	Amphibian	Herb	No	Wild
51.	<i>Cordia myxa</i> L.	Bahubora	Boraginaceae	Terrestrial	Tree	No	Wild
52.	<i>Coriandrum sativum</i> L.	Dhonia	Apiaceae	Terrestrial	Herb	No	Cultivated
53.	<i>Costus speciosus</i> (Koenig ex Retz.) Smith	Keumul	Costaceae	Terrestrial	Herb	Yes	Wild
54.	<i>Cucurbita maxima</i> Duchesne	Kodu	Cucurbitaceae	Terrestrial	Herb	No	Cultivated
55.	<i>Curcuma longa</i> L.	Haldi	Zingiberaceae	Terrestrial	Herb	Yes	Cultivated
56.	<i>Curcuma zedoaria</i> (Christm.) Rosc.	Shati	Zingiberaceae	Terrestrial	Herb	Yes	Wild
57.	<i>Cynodon dactylon</i> (L.) Pers.	Durbaghash	Poaceae	Terrestrial	Herb	Yes	Wild
58.	<i>Cyperus rotandus</i> L.	Muthagash	Cyperaceae	Amphibian	Herb	No	Wild
59.	<i>Dalbergia sissoo</i> Roxb. ex DC.	Sisso	Fabaceae	Terrestrial	Tree	No	Cultivated
60.	<i>Delonix regia</i> (Hook.) Raf.	Krisnochura	Caesalpiniaceae	Terrestrial	Tree	No	Cultivated

Serial	Scientific name	Local name	Family	Habitat	Habit	Medicinal value	Status
61.	<i>Desmodium gangeticum</i> (L.) DC.	Shalpani	Fabaceae	Terrestrial	Herb	Yes	Wild
62.	<i>Dillenia indica</i> L.	Chalta	Dilleniaceae	Terrestrial	Tree	No	Planted
63.	<i>Dioscorea bulbifera</i> L.	Bonalu	Dioscoreaceae	Terrestrial	Climber	No	Wild
64.	<i>Diospyros peregrina</i> (Gaertn.) Gurke	Deshigab	Ebnaceae	Terrestrial	Tree	No	Wild
65.	<i>Dolichos lablab</i> L.	Sheem	Fabaceae	Terrestrial	Climber	No	Cultivated
66.	<i>Eclipta prostrata</i> (L.) L.	Kalokeshi	Asteraceae	Terrestrial	Herb	Yes	Wild
67.	<i>Eichhornia crassipes</i> (Mart.) Sloms	Kachuripana	Pontederiaceae	Aquatic	Herb	No	Wild
68.	<i>Enhydra fluctuans</i> Lour.	Helencha	Asteraceae	Aquatic	Herb	No	Wild
69.	<i>Ficus benghalensis</i> L.	Jhuribot	Moraceae	Terrestrial	Tree	No	Wild
70.	<i>Ficus hispida</i> L.f.	Kakdumur	Moraceae	Terrestrial	Tree	No	Wild
71.	<i>Ficus racemosa</i> L.	Jaggodumur	Moraceae	Terrestrial	Tree	Yes	Wild
72.	<i>Ficus religiosa</i> L.	Aswath	Moraceae	Terrestrial	Tree	Yes	Wild
73.	<i>Ficus rumphii</i> Blume	Gai Aswath	Moraceae	Terrestrial	Tree	No	Wild
74.	<i>Garcinia cowa</i> Roxb. ex Dc.	Kowa	Ebnaceae	Terrestrial	Tree	No	Planted
75.	<i>Glycosmis arborea</i> (Roxb.) DC.	Matkila	Rutaceae	Terrestrial	Shrub	Yes	Wild
76.	<i>Hibiscus rosa-sinensis</i> L.	Roktajaba	Malvaceae	Terrestrial	Shrub	No	Planted
77.	<i>Holarrhena antidysenterica</i> (L.) Wall. ex Decne.	Kurchi	Apocynaceae	Terrestrial	Tree	Yes	Planted
78.	<i>Ipomoea aquatica</i> Forssk.	Kalmi	Convolvulaceae	Amphibian	Herb	No	Wild
79.	<i>Ipomoea fistulosa</i> Mart. ex Choisy	Dholkalmi	Convolvulaceae	Terrestrial	Herb	Yes	Wild
80.	<i>Ixora coccinea</i> L.	Lalraggon	Rubiaceae	Terrestrial	Shrub	No	Planted
81.	<i>Justicia gendarussa</i> Burm.	Jagatmadan	Acanthaceae	Terrestrial	Herb	Yes	Wild
82.	<i>Lagenaria vulgaris</i> Ser.	Laow	Cucurbitaceae	Terrestrial	Herb	No	Cultivated
83.	<i>Lagerstroemia speciose</i> (L.) Pers.	Katajarul	Lythraceae	Terrestrial	Tree	No	Planted
84.	<i>Leea guineensis</i> G. Don	Phupharia	Vitaceae	Terrestrial	Shrub	No	Wild
85.	<i>Lepisanthes rubiginosa</i> (Roxb.) Leenh	Kakjam	Sapindaceae	Terrestrial	Shrub	No	Wild
86.	<i>Leucas aspera</i> (Willd.) Link	Dondokalas	Lamiaceae	Terrestrial	Herb	Yes	Wild
87.	<i>Lippia alba</i> (Mill.) N. E. Br. ex Britton & P. Wilson	Bonpisach	Verbenaceae	Terrestrial	Herb	No	Wild
88.	<i>Ludwigia adscendens</i> (L.) H. Hara	Kesordam	Onagraceae	Aquatic	Herb	No	Wild
89.	<i>Ludwigia octovalvis</i> (Jacq.) P. H. Raven	Bhuikura	Onagraceae	Amphibian	Herb	No	Wild
90.	<i>Ludwigia perennis</i> L.	Bonlobongo	Onagraceae	Amphibian	Herb	No	Wild
91.	<i>Luffa cylindrica</i> (L.) M. Roem.	Dhundal	Cucurbitaceae	Terrestrial	Climber	No	Cultivated
92.	<i>Lycopersicon esculentum</i> Mill.	Begoon	Solanaceae	Terrestrial	Herb	No	Cultivated

Serial	Scientific name	Local name	Family	Habitat	Habit	Medicinal value	Status
93.	<i>Malvaviscus arboreus</i> Cav.	Morichjoba	Malvaceae	Terrestrial	Shrub	No	Planted
94.	<i>Mangifera indica</i> L.	Aam	Anacardiaceae	Terrestrial	Tree	No	Planted
95.	<i>Melia azedarach</i> L.	Ghoraneem	Meliaceae	Terrestrial	Tree	Yes	Planted
96.	<i>Mikania cordata</i> (Burm.f.) B. L. Rob.	Rayotlata	Asteraceae	Terrestrial	Climber	Yes	Wild
97.	<i>Musa sapientum</i> L.	Kancha Kola	Musaceae	Terrestrial	Herb	No	Cultivated
98.	<i>Mussaenda erythrophylla</i> Scumach. & Thonn.	Nagballi	Rubiaceae	Terrestrial	Shrub	No	Planted
99.	<i>Nelumbo nucifera</i> Gaertn.	Poddmo	Nelumbonaceae	Aquatic	Herb	No	Planted
100.	<i>Neolamproloma cadamba</i> (Roxb.) Bosser	Kodom	Rubiaceae	Terrestrial	Tree	No	Planted
101.	<i>Nymphaea rubra</i> Roxb. ex Andr.	Lalshapla	Nymphaeaceae	Aquatic	Herb	No	Planted
102.	<i>Nymphoides cristata</i> (Roxb.) Kuntze	Chandmala	Menyanthaceae	Aquatic	Herb	No	Wild
103.	<i>Oroxylum indicum</i> (L.) Kurz	Kanaidhingi	Bignoniaceae	Terrestrial	Tree	Yes	Wild
104.	<i>Otella alismoides</i> (L.) Pers.	Panikola	Hydrocharitaceae	Aquatic	Herb	No	Wild
105.	<i>Oxalis corniculata</i> L.	Aamrul	Oxalidaceae	Terrestrial	Herb	Yes	Wild
106.	<i>Peperomia pellucida</i> (L.) H. B. & K.	Luchipata	Piperaceae	Terrestrial	Herb	No	Wild
107.	<i>Persicaria hydropiper</i> (L.) Spach	Bishkatali	Polygonaceae	Amphibian	Herb	Yes	Wild
108.	<i>Phoenix sylvestris</i> (L.) Roxb.	Khejur	Arecaceae	Terrestrial	Tree	No	Planted
109.	<i>Phyllanthus reticulatus</i> Poir. In Lamn.	Pankushi	Phyllanthaceae	Terrestrial	Shrub	No	Wild
110.	<i>Physalis minima</i> L.	Bontepari	Solanaceae	Terrestrial	Herb	No	Wild
111.	<i>Pilea microphylla</i> (L.) Liebrn.	Lotamorich	Urticaceae	Terrestrial	Herb	No	Wild
112.	<i>Piper longum</i> L.	Pipul	Piperaceae	Terrestrial	Herb	Yes	Wild
113.	<i>Piper nigrum</i> L.	Golmorich	Piperaceae	Terrestrial	Climber	Yes	Wild
114.	<i>Piper sylvestre</i> Lam.	Rupali pipul	Piperaceae	Amphibian	Herb	No	Wild
115.	<i>Polyalthia longifolia</i> (Sonn.) Thwaites	Debdaru	Annonaceae	Terrestrial	Tree	No	Planted
116.	<i>Potamogeton crispus</i> L.	Kokra	Potamogetonaceae	Aquatic	Herb	No	Wild
117.	<i>Pouzolzia zeylanica</i> (L.) Benn.	Kullaroki	Urticaceae	Amphibian	Herb	No	Wild
118.	<i>Raphanus sativus</i> (L.) Domin	Mula	Brassicaceae	Terrestrial	Herb	No	Cultivated
119.	<i>Rorippa indica</i> (L.) Hiern.	Bonsorisha	Brassicaceae	Amphibian	Herb	No	Wild
120.	<i>Rosa involucrata</i> Roxb. ex Lindl.	Golap	Rosaceae	Terrestrial	Shrub	No	Cultivated
121.	<i>Saccharum spontaneum</i> L.	Kashful	Poaceae	Terrestrial	Herb	No	Wild
122.	<i>Salvia plebeia</i> R. Br.	-	Lamiaceae	Terrestrial	Herb	No	Wild
123.	<i>Scoparia dulcis</i> L.	Bondhone	Scrophulariaceae	Terrestrial	Herb	Yes	Wild
124.	<i>Sida cordifolia</i> L.	Berella	Malvaceae	Terrestrial	Herb	Yes	Wild

Serial	Scientific name	Local name	Family	Habitat	Habit	Medicinal value	Status
125.	<i>Sida rhombifolia</i> L.	Sadaberella	Malvaceae	Terrestrial	Herb	No	Wild
126.	<i>Smilax macrophylla</i> Roxb.	Kumarilata	Smilacaceae	Terrestrial	Climber	Yes	Wild
127.	<i>Solanum americanum</i> Mill.	Titbegoon	Solanaceae	Terrestrial	Herb	No	Wild
128.	<i>Solanum indicum</i> L.	Katabegoon	Solanaceae	Terrestrial	Shrub	Yes	Wild
129.	<i>Solanum melongena</i> L.	Begoon	Solanaceae	Terrestrial	Herb	No	Cultivated
130.	<i>Solanum nigrum</i> L.	Unresolved	Solanaceae	Terrestrial	Herb	Yes	Wild
131.	<i>Solanum torvum</i> Sw.	Bunobegoon	Solanaceae	Terrestrial	Shrub	No	Wild
132.	<i>Solanum xanthocarpum</i> Schard. H & Wendl.	Kantikari	Solanaceae	Terrestrial	Herb	Yes	Wild
133.	<i>Spondias pinnata</i> (L.f.) Kurz	Aamra	Anacardiaceae	Terrestrial	Tree	No	Planted
134.	<i>Stephania japonica</i> (Thunb.) Miers	Akondilata	Menispermaceae	Terrestrial	Climber	Yes	Wild
135.	<i>Streblus asper</i> Lour.	Sheora	Moraceae	Terrestrial	Tree	Yes	Wild
136.	<i>Swietenia mahagoni</i> Jacq.	Mehogani	Meliaceae	Terrestrial	Tree	No	Planted
137.	<i>Symplocos racemosa</i> Roxb.	Loodpipul	Symplocaceae	Terrestrial	Tree	Yes	Wild
138.	<i>Synedrella nodiflora</i> (L.) Gaertn.	Sindrella	Asteraceae	Terrestrial	Herb	Yes	Wild
139.	<i>Syngonium podophyllum</i> Schott.	Hongsapod	Araceae	Terrestrial	Climber	No	Wild
140.	<i>Syzygium cumini</i> (L.) Skeels	Kaloram	Myrtaceae	Terrestrial	Tree	No	Planted
141.	<i>Syzygium fruticosum</i> DC.	Phutijam	Myrtaceae	Terrestrial	Tree	No	Wild
142.	<i>Syzygium jambos</i> (L.) Alston	Golabjam	Myrtaceae	Terrestrial	Tree	No	Planted
143.	<i>Syzygium malaccense</i> (L.) Merr. & L. M. Perry	Jamrul	Myrtaceae	Terrestrial	Tree	No	Planted
144.	<i>Tagetes erecta</i> L.	Gadha	Asteraceae	Terrestrial	Herb	Yes	Cultivated
145.	<i>Tamarindus indica</i> L.	Tetul	Caesalpinaceae	Terrestrial	Tree	Yes	Planted
146.	<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Arjun	Combretaceae	Terrestrial	Tree	Yes	Planted
147.	<i>Tiliacora acuminata</i> (Lam.) Hook.f. & Thom.	Bhaglata	Menispermaceae	Terrestrial	Climber	Yes	Wild
148.	<i>Typha elephantiana</i> Roxb.	Hogla	Typhaceae	Amphibian	Herb	No	Wild
149.	<i>Urena lobata</i> L.	Bonokra	Malvaceae	Terrestrial	Herb	No	Wild
150.	<i>Vernonia cinerea</i> (L.) Less.	Shiallata	Asteraceae	Terrestrial	Herb	Yes	Wild
151.	<i>Vigna unguiculata</i> var. <i>sesquipedalis</i> (L.) Verdc.	Barboti	Fabaceae	Terrestrial	Climber	No	Cultivated
152.	<i>Wedelia chinensis</i> (Osbeck) Merr.	Bhimraj	Asteraceae	Terrestrial	Herb	Yes	Wild
153.	<i>Xanthosoma violaceum</i> Schott.	Dudhkachu	Araceae	Amphibian	Herb	Yes	Wild

- Represents not available

Among the families, Asteraceae contributed highest number of species (11 species) followed by Solanaceae (9 species), Moraceae (8 species), Malvaceae (6 species) and remaining other 119 angiosperm species were from different families (Table 2 and Table 3). Rimi et al., (2013) found 232 angiosperm species from Ramasagar area of Dinajpur among which Asteraceae contributed highest number of species (11 species) followed by Poaceae (29 species) (Table 3).

**Table 3. List of comparative dominant families of two man-made lakes.**

Family	Name of the lake	
	Durgasagar (Present study)	Ramsagar (Rimi et al., 2013)
Asteraceae	11	11
Solanaceae	9	9
Moraceae	8	6
Malvaceae	6	5
Poaceae	6	29
Mimosaceae	5	9
Araceae	4	3
Arecaceae	4	-
Caesalpiniaceae	4	8
Cucurbitaceae	4	1
Fabaceae	4	5
Meliaceae	4	5
Myrtaceae	4	6
Piperaceae	4	1
Rutaceae	4	3

- Represents not available

Moreover, among 153 species, 126 species are terrestrial in habitat, followed by amphibian and aquatic (Table 4). Plant species were classified into four different habit groups and among these 77 belong to herb, 48 to tree, 16 to shrub and 12 to climber. Rimi et al., (2013) also found that herb contributed maximum number (81 species) among 232 angiosperms followed by trees, shrubs and climbers consecutively (Table 5).

**Table 4. Over view of angiospermic floral diversity of Duragasagar.**

Categories	Investigated	Categories	Investigated
Number of family	63	Tree	48
Number of genus	127	Medicinal	58
Number of species	153	Nonmedicinal	95
Terrestrial	126	Timbers	13
Amphibian	16	Fruits	29
Aquatic	11	Ornamental	21
Climber	12	Cultivated and planted	61
Herb	77	Wild	92
Shrub	16	Weeds	83

Furthermore, about 38% of the 153 angiosperms species have ethnomedicinal and pharmacological potentiality (Table 2 and Table 6), whereas Rimi *et al.*, (2013) found nearly 32% of the total angiospermic species as ethnomedicinal and pharmacological (Table 6)

**Table 5. Comparative plant species distribution of two man-made lakes area according habit.**

Habit	Name of the lake	
	Durgasagar (Present study)	Ramsagar (Rimi <i>et al.</i> , 2013)
Herb	77	81
shrub	16	61
Tree	48	78
Climber	12	12

**Table 6. Comparative diversity (angiosperms) distribution of two man-made lake areas.**

Categories	Name of the lake	
	Durgasagar (Present study)	Ramsagar (Rimi <i>et al.</i> , 2013)
Timber plants	13	28
Fruits plants	29	19
Medicinal plants	58	75
Ornamental plants	21	6
Cultivated and planted plant	61	18
Wild plants	92	-
Weeds	83	57

- Represents not available

In the category of timber yielding species, Ramsagar contributed nearly 1.5 times than Durgasagar, but in case of fruit yielding species Durgasagar contributed almost 2.5 times than Ramsagar (Table 6). The reason for this difference may be that in Durgasagar about 3.5 times more planted species were found than that of found in Ramsagar. In addition, almost 3.5 times more ornamental and 1.6 times more weeds were recorded than that of Ramsagar (Table 6).

Study of physico-chemical quality of water and angiospermic floral diversity of adjacent area of Durgasagar is very important step for conservation and management. There is no significance of conservation of the biological resources including flora and fauna without assessment and documentation. The contribution of floral and faunal diversity to the local people in the study area was mainly for fruits, ethnomedicinal purpose and fodder. But increasing population pressure initiates the deforestation and deterioration. It is time to conserve this aquatic catchment treasure through increasing surveillance, annual development work and management plan, constructing well established demarcation boundary and miscellaneous works.

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