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Vascular plants diversity in Satajan Beel in the Lakhimpur District of Assam in Northeast India

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ABSTRACT

Satajan Beel (wetland) is situated in the North Lakhimpur District of Assam in Northeast India and is located between 27° 12' 23.7" to 27° 12' 40.00" N latitude and 94° 03' 08.5" to 94° 03' 08.8" E. longitude in the flood-plain of Ranganadi (Ranga River) at an altitude of 94 m. A survey during 2018 – 2019 led to the record of 262 species of vascular plants from this wetland area. The flora is dominated with annual herbs (54.2 % spp.) and Therophytes (58.4 % spp.). Through the functional classification of plants 153 or 75.19 % species were recognised as Simulated and Wet-Marginal plants. The Biological Spectrum of this wetland flora is not matching with the Normal Spectrum and expresses many limitations and disturbances in the vegetation. However, a good proportion of the flora is useful in numerous ways.

Key words: Satajan wetland, Lakhimpur, Assam, Vascular Flora, Life-form, Distribution

INTRODUCTION

'Wetland' is a generic term used to define all types of wet habitats like marshes, swamps, bogs, fens and similar areas (Tiner, 1999). Such areas are considered as ecotonal habitats as those are laying on the transitional zone between two or more communities with rich biota, mainly terrestrial and aquatic (Clark, 1954; Odum, 1959; Mitsch & Gosselink, 1986 & 1993). Traditionally wetlands have been treated as useless wastelands and used mainly for the dumping and disposal of muck, urban sewage, household garbage etc. In folktales, such areas are expressed as dirty, murky places full of hidden dangers. All kinds of water bodies, including oceanic areas, where the depth of water is less than 6 m, are generally considered as a wetland. The soil of such habitat is generally very rich in micro- and macro-nutrients, and is rich in diverse floral, faunal and microbial inhabitants. After the Ramsar Convention of IUCN in Iran in 1971, wetlands have attracted high attention for conservation and scientific exploration. In India, wetlands formed a diverse ecosystem in various climatic zone and support around 20 % of the country's total biodiversity (Deepa & Rmachandra, 1999; Chowdhury, 2015). Gopal (1995) prepared a list of over 1200 species of plants and a shortlist of animals inhabiting in Indian wetland systems. Cook (1996) provided one detailed account of wetland plants of India. The flood-plain lakes are generally biologically very rich and are considered to be the most productive ecosystems and become a continuous source of resources for the local people (Mitsch & Gosselink, 1986; Jhingram & Pathak, 1987; Chowdhury, 2015).

Studies on aquatic and marshland plants of India are well documented by many authors including Biswas & Calder (1937), Mirashi (1954), Pattnaik & Pattanaik (1956), Sen & Chatterjee (1959), Maheshwari (1960), Chavan & Sabnis (1961), Subramanyam (1962), Vyas (1964), Majumdar (1965), Unni (1967), Bhaskar & Razi (1973), Kachroo (1984), Lavania *et al*. (1990), Cook (1996), and Bhowmik *et al*. (2008). In the nearby area, in the northern part of West Bengal bordering Assam two important wetlands, namely Rasik Beel (Biswas *et al*. 2013) and on Gossaihat Beel (Biswas *et al.* 2012; Chowdhury *et al.* 2014) were recorded with very high floristic diversity including endemic elements.

NWAA (2010) recorded 92 oxbow lakes and cut-off meanders from the Lakhimpur district of Assam, covering a total of 1038 ha that is 3.8 % of the total wetland area of the district. Mostly due to the shifting of the courses of different rivers oxbow lakes are formed and from such leftover patches, numerous sub-Himalayan wetlands have been produced in nearby places to the Himalayas. This is very common in Northeast India, especially with the river Brahmaputra ('Siang' in Arunachal Pradesh) and its numerous contributors and distributaries. Ranganadi (*Ranga* = coloured; *Nadi* = river) is contributory to the Brahmaputra, flowing through the Lakhimpur district of Assam, India. In 1950 due to one severe earthquake, a wetland was produced from Ranganadi that is now named as Satajan Beel (*Beel* = wetland).

Not much information about aquatic and wetland macrophytes from Assam is available. Some broad-spectrum works like Hooker (1872 – 1897), Kanjilal *et al.* (1934 – 1940), Bor (1940), Satyanarayana (1962), Rao & Verma (1969), Barua (1992), Pal & Dutta 2010; Das, 2013), with terrestrial plants also recorded the hydrophytes. Some fragmentary works like Satyanarayana (1962), Pathak (1990), Malakar (1995) and Sarkar *et al.* (2008) are available on hydrophytic vegetation in different parts of Assam. Recently Sarmah *et al*. (2013)

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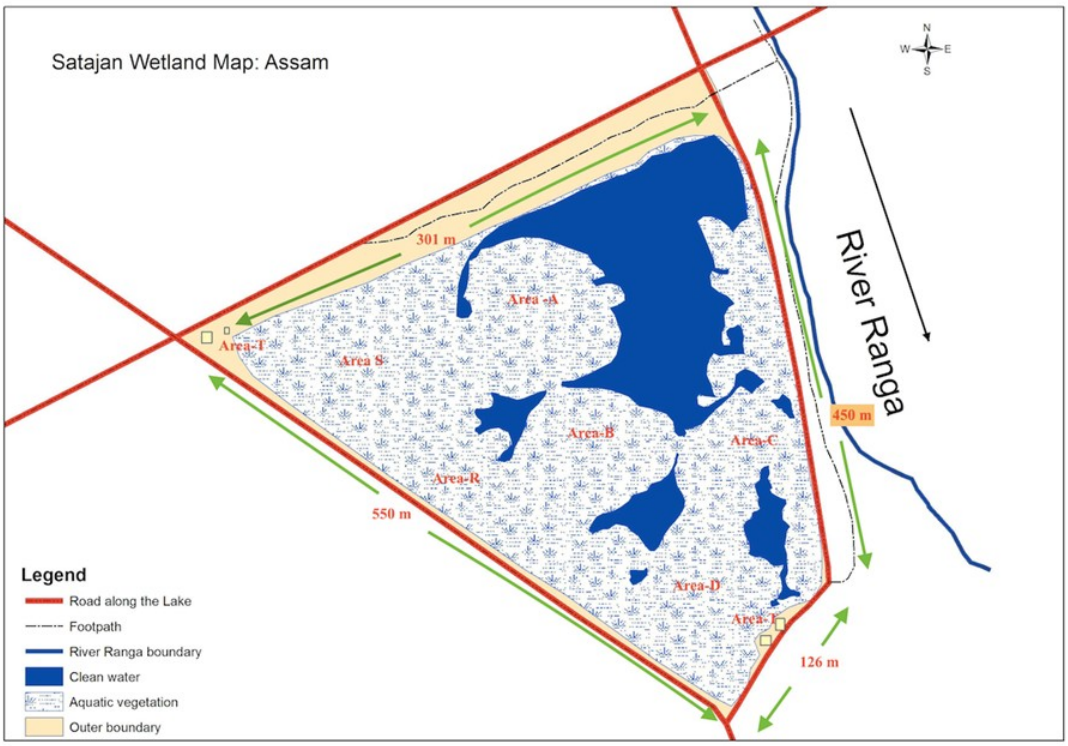

Figure 1. **Map of the study area, Satajan Beel (wetland) in Lakhimpur, Assam, India.**

recorded 65 species of semi-aquatic and aquatic species of medicinal plants from the areas near to the downstream of Subansiri and Ranga rivers in Lakhimpur district. Gogoi *et al*. (2016) studied the fishes of Dulakhojia Beel. However, all these works are sporadic and are quite insufficient against the wide areas of Assam's wetland cover, distributed throughout the state. There are at least 151 medium and small wetlands present only in Lakhimpur district (Boruah & Riba, 2015). Though some works have already done on Satajan Beel to study its birds (Ahmed, 2019), Physicochemical properties of soil (Hazarika, 2013), ichthyofauna (Kaushik & Bordoloi, 2016) and geo-ecological status (Hussain, 2019) but, even today, no work has been conducted to record the botanical wealth of this wetland. The present dissertation was taken to record the vascular flora of Satajan Beel of North Lakhimpur district of Assam in Northeast India.

Study area

Satajan Beel is a small wetland situated in the North Lakhimpur District of Assam in Northeast India and is located between 27° 12' 23.7" to 27° 12' 40.00" N latitude and 94° 03' 08.5" to 94° 03' 08.8" E. longitude in the floodplain of Ranganadi (Ranga River) at an altitude of 94 m (Figure 1). This beel was created by a devastating earthquake in 1950 (Hazarika, 2013; Ahmed, 2019). Its connection with Ranganadi is blocked by a small earthen dam (near the river bridge). The area of the protected part of the beel is only 39 acres and the maximum depth of water remain in winter is around 6.5 m (Mohammed, 2013; Boruah & Riba, 2015). The mean annual rainfall of the district is 300 cm and experiences 31° C and 7° C maximum and minimum temperature, respectively, in the district (NWAA, 2010).

Structure: The structure of the wetland is roughly quadrangular, situated parallel to the Ranganadi and is slightly obliquely placed. Measurements of its four arms are SE = 126 m; SW = 550 m; NW = 301 m and NE = 450 m (Hussain, 2019) (Figure 1). The major part of the clear water part is situated in the NE and SE areas. The central part is with an elevated area that represents some floating islands/ pits (Hazarika, 2013). A major part of the area is vegetation-covered.

Vegetation: The entire wetland is thickly vegetated. Mostly immerged, free-floating and rooted-floating plants are found in the clear-water region. Submerged amphibian plants are dominating in the remaining area of the partial water-filled area. The SW part of the island part is covered with many tree-species, the other part is with a thick growth of *Alpinia nigra*.

METHODOLOGY

The vascular plants growing in Satajan Beel area was explored from August 2018 to July 2019. Plant specimens were collected at random in different seasons of the year and were processed into mounted herbarium sheets following Jain & Rao (1977) and Das (2018). Plants were identified using available literature (Hooker, 1972 – 1897; Kanjilal *et al.,* 1934 – 1940; Hajra *et al.,* 1996; Giri *et al.,* 2008; Chowdhery *et al.,* 2009) and e-floras. For updated nomenclature www.theplantlist.org and www.worldfloraonline.org were consulted and APG-IV (APG, 2016) system of classification was followed for family delimitation, keeping the basic structure of classes Magnoliopsida and Liliopsida intact. All the families under the classes, genera under the families and species under a genus are arranged alphabetically. Voucher

PLATE - I: Plants of Satajan Wetland. **A.** The signboard; **B.** Part of wetland; **C.** *Alpinia nigra* formation (inset: single flower); **D.** *Salvinia cucullata*; **E.** *Salvinia natans*; **F.** *Potamogeton nodosus*; **G.** *Rotala cordifolia*; **H.** *Utricularia bifida*; **I.** *Ludwigia adscendens*; **J.** *Spharanthus indica*; **K.** *Hibiscus tiliaceus*; **L.** *Enydra fluctuans*; **M.** *Azolla pinnata*; **N.** *Hygrophila polysperma*; **O.** *Heliotropium indicum*; **P.** *Hypericum japonicum*.

Figure 2. Some of the plant species collected from Satajan Beel (wetland) of Lakhimpur, Assam, India

specimens will be deposited in the Herbarium of the Rajiv Gandhi University (AUH) after the project is over.

Following Boutin & Keddy (1993) recorded hydrophytes are classified into (i) Free Floating; (ii) Rooted with Floating Leaves; (iii) Submerged; (iv) Suspended; (v) Emerged; (vi) Amphibian; (vii) Wet Marginal; and (viii) Simulated. And, for Life Form classification, the system of Raunkiaer (1934) has been used.

For understanding the occurrence of different species in different sections of the wetland, the region have been recognized as A, B, C, D, R, S & T areas (Figure 1).

RESULTS AND DISCUSSION

The present floristic survey in the Satajan Beel (wetland) in the Lakhimpur district of Assam in NE India led to the record of a total of 262 Species of vascular plants. All the recorded species are presented in Table 1 along with their habit groups, life forms, type on hydrophytic nature, and distribution in the study area. Some of the recorded plant species from the study cite are shown in Figure 2.

***Taxonomic classification*:** Out of the recorded 262 species of vascular plants, only 7 are Pteridophytes (6 genera from 5 families) and the remaining 255 are angiosperms (Magnoliophytes) that are again represented by 190 species of Magnoliopsida (136 genera from 64 families) and 65 species of Liliopsida (51 genera from 16 families).

***Habit Groups*:** To understand vegetation covering permanent waterfront, island areas that often partially go underwater during high downpours, a transitional area between a marsh and the high land etc. it is essential to understand the distribution of different habit groups represented by the recorded flora is important. The result has been presented in Table 2. Annual herbs (136 spp.) are dominating the flora, followed by 55 spp. of perennial herbs and 26 spp. of trees. If all types of annuals (AHC, ASC, HA, SA) are taken together then the total number become 142 (or 54.2 %) species. Similarly for perennial herbs, if Geophytic climbers (GC) are taken then it will be 60 species. Again, all types of the climber (AHC, ASC, GC, SC) together present a good number of 20 species. Representation of other habit groups is quite less. So, the flora represents vegetation that faces some adverse situation in some part of the year.

Types of Hydrophytes: In a marshy area different types of habitat conditions develops and different species select their habitats as per their adoptive suitability. A classification of the flora of Satajan wetland, following Boutin & Keddy (1993), showed the clear dominance of Simulated plants represented by 104 or 39.69 % species. Plants of Wet Marginal type are also well represented by 93 or 35.5 % species. And, these two types together [Sim + WM] represent 75.19 % species. This, in turn, shows that majority of the species are grown either in the transitional region or on wet margins near water. Amphibian plants also grow in low water depth and those can also grow in WM areas and is represented by 17 or 6.49 % species. The over dominance of all these three groups of species in Satajan wetland expresses a poof flora in the deep-water region. This indicates the disturbances take place in clear waterfront where large number RFL, FF, Sbm and Ssp types of species are expected to grow

***Area-wise Distribution of Species*:** Numerical distribution of plant species in different sections of the wetland has been presented in Figure 3. The highest number of 114 species found to occur in the southern side (area-D) that has a narrow belt of the marshy area after the clear waterfront and the increasingly high dry land. A motorable road is passing through the south-western side, opposite to the river (area-R) and that is also attached to the little more elevated portion of the island where some tree species are also occurring and a total of 81 species has been recorded from that area. Some tree species like *Lagerstroemia speciosa, Hibiscus tilliaceus* and *Terminalia arjuna* are planted along the road-side. Also, the area towards the river (area-S) is the habitat for 62 species where some individuals of *Hibiscus tilliaceus* are planted. The area-T or the village side represent the smallest area and the least number of 26 species recorded from the area. Dense formation of *Alpinia nigra* might be the other reason. The species composition of the central island part (area-B) is also very poor and that can be ascribed to the same reason, i.e. the dense and almost uninterrupted formation of *Alpinia nigra*. No doubt, this species is occupying the largest area and the most dominating species in this wetland.

From the Waterfront (area-A) the recorded number of species is only 47. The expectation was more as in this region of Assam most of the wetlands, water front's remain covered with free-floating and rooted-floating plants and also with many submerged and suspended species. But in Satajan wetland the waterfront is completely clear and no such plants found there except very few detached individuals of *Trapa natans*. That may be due to visits of numerous water-fowls or for fishing activities. Recorded such species (e.g. *Nymphoides indica, Nymphaea* spp*., Nelumbo nucifera, Eichhornia crassipes, Pistia stratiotes, Salvinia* spp. etc.) are found only near the margin or in short duration water-covered areas along with amphibian grasses and sedges. So, the population structure of these plants is extremely poor though the expectations were just the reverse.

Lastly, only 39 species have been recorded from the flat area between the river and wetland (area-C). This is a much-disturbed area with unstable river-bank, submergence by flood-water, presence of a regularly used kachcha road, etc. Plants like *Eleusine indica, Chrysopogon aciculatus, Desmodium triflorum* etc. are trying to colonize there along with few other species only.

***Life-Form Classification*:** The representation of different Raunkiaer (1934) Life-Forms has been presented in Table 3. As for the habit-group analysis discussed above, annual plants are distinctly dominating over other habit groups with 153 species and are representing the Therophytes. Out of the recognized 48 Phanerophytes, there are 20 spp. of Microphanerophytes, 3 spp. of Megaphanerophytes, 12 spp. of Nanophanerophytes and 13 spp. of Mesophanerophytes. Of the recorded 31 Cryptophytes, there are 9 Hydrophytes, 15 Geophytes and 7

Table 1. The list of vascular plants recorded in Satajan Beel (wetland) in Lakhimpur, Assam, India.

S No.	Name of the plants	Field No.	Habit	Flower/fruit	Type	Life Form	Location	Use
	MAGNOLIOPSIDA							
	ACANTHACEAE							
01	*Hygrophila erecta* (Burm.f.) Hochr.	035	HA	Oct – Mar	Amp	T	D	
02	*Hygrophila phlomoides* Nees	027	HA	Jan – Mar	Amp	T	D	
03	*Hygrophila polysperma* (Roxb.) T.Anderson	082	HA	Jan – Mar	Em	T	D	
04	*Justicia procumbens* L.	028	HP	Jul – Oct	Sim	H	S	
05	*Phaulopsis imbricata* (Forssk.) Sweet	087	HA	Nov –Mar	Sim	T	S	
06	*Rungia pectinata* (L.) Nees	243	HA	Nov – Apr	Sim	T	R, S	
	ACTINIDIACEAE							
07	*Saurauia roxburghii* Wall.	101	T	May –Aug	Sim	Pi	D	
	AMARANTHACEAE							
09	*Achyranthes bidentata* Blume	258	HA	Sep – Feb	Sim	T	D	
10	*Alternanthera sessilis* (L.) R.Br. ex DC.	204	HP	Jan – Dec	Sim	H	D,C	Edible, medicinal
11	*Amaranthus blitum* L.	244	HA	May –Nov	Sim	T	C,D,T	Edible
12	*Amaranthus viridis* L.	223	HA	Jan – Dec	Sim	T	C,D,T	Edible
13	*Cyathula prostrata* (L.) Blume	270	HA	Sep –Apr	Sim	T	D	
14	*Deeringia amaranthoides* (Lam.) Merr.	102	SC	Aug – Sep	Sim	Pi	T	Medicinal
15	*Dysphania ambrosioides* (L.) Mosyakin & Clemants	170	HA	Jul – Sep	Em	T	D	
	APIACEAE							
16	*Centella asiatica* (L.) Urb.	088	HA	Jul – Aug	Sim	T	S,D	Edible, medicinal
17	*Oenanthe javanica* (Blume) DC.	030	HA	Jul – Sep	Em	T	A,B,D	
	APOCYNACEAE							
18	*Alstonia scholaris* (L.) R. Br.	103	T	Dec – Mar	Sim	Ps	R,D	Medicinal
19	*Ichnocarpus frutescens* (L.) W. T.Aiton	143	SC	Aug – Dec	Sim	Ps	R	
	ARALIACEAE							
20	*Schefflera pubigera* (Brongn. ex Planch.) Frodin	260	E	NR	Sim	Pi	D	
21	*Hydrocotyle sibthorpioides* Lam.	089	HA	Mar –Sep	WM	T	T,D	
	BALSAMINACEAE							
22	*Impatiens tripetala* Roxb. ex DC.	104	HA	Jul –Dec	WM	T	D	Medicinal
	BIGNONIACEAE							
23	*Oroxylum indicum* (L.) Kurz	084	T	Jun – Sep	Sim	Ps	R	
	BORAGINACEAE							
24	*Heliotropium indicum* L.	237	HA	Sep –Mar	WM	T	D,C	
25	*Heliotropium strigosum* Willd.	090	HA	Jan – Oct	WM	T	D	
26	*Cynoglossum lanceolatum* Forssk.	268	HP	Jun – Aug	Sim	H	R	
	BRASSICACEAE							
27	*Rorippa benghalensis* (DC.) H. Hara	079	HA	Mar – May	WM	T	D	
28	*Cardamine hirsuta* L.	245	HA	Nov –Jan	WM	T	D	
	CAMPANULACEAE							
29	*Lobelia terminalis* C. B. Clarke	122	HA	Dec – Feb	WM	T	D,S	
30	*Wahlenbergia marginata* (Thunb.) A.DC.	083	HA	Jan – Mar	WM	T	D,S	

continued

	CANNABACEAE							
31	*Trema orientalis* (L.) Blume	105	T	Sep – Dec	Sim	Pi	D	
	CARYOPHYLLACEAE							
32	*Drymaria cordata* (L.) Willd. ex Schult.	145	HA	Jan – Dec	WM	T	C,D,T	Medicinal
33	*Stellaria wallichiana* Haine	081	HA	Feb – Aug	WM	T	D	
34	*Stellaria uliiginosa* Murray	144	HA	May –Jul	WM	T	C,D	
	CERATOPHYLLACEAE							
35	*Ceratophyllum demersum* L.	171	HP	Oct – Jan	Ssp	Cd	A	
	CLEOMACEAE							
36	*Cleome houtteana* Schltdl.	078	HA	Feb – Apr	WM	T	D,R,S	
37	*Cleome rutidosperma* DC.	080	HA	May – Nov	Sim	T	R	
38	*Cleome viscosa* L.	148	HA	Mar – Jul	WM	T	R,D	
	COMBRETACEAE							
39	*Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.	206	T	May – Jun	WM	Ps	T	Medicinal
	COMPOSITAE							
40	*Acmella uliginosa* (Sw.) Cass.	093	HA	Nov – Feb	WM	T	D	Edible
41	*Ageratum conyzoides* (L.) L.	032	HA	Aug – Dec	WM	T	D,S	Medicinal
42	*Ageratum houstonianum* Mill.	236	HA	Sep – Mar	WM	T	D,S	
43	*Bidens pilosa* L.	085	HA	Oct – Apr	Sim	T	D	
44	*Blumea membranacea* DC.	240	HA	Aug – May	WM	T	C,S	
45	*Chromolaena odorata* (L.) R.M.King & H.Rob.	211	Sf	Dec – May	Sim	Ch	S,R	
46	*Crassocephalum crepidioides* (Benth.) S.Moore	146	HA	Aug – Dec	WM	T	D	
47	*Cyanthillium cinereum* (L.) H.Rob.	208	HA	Jan – Dec	WM	T	D	
48	*Eclipta prostrata* (L.) L.	091	HA	Aug – Dec	WM	T	D,S	
49	*Emilia sonchifolia* (L.) DC. ex DC.	246	HA	Jul – Dec	WM	T	C,D,S	
50	*Enydra fluctuans* DC.	276	HP	Oct – Feb	Amp	H	D	
51	*Erigeron canadensis* L.	278	HA	Jul – Nov	WM	T	C,D,S	
52	*Grangea maderaspatana* (L.) Poir.	285	HA	Mar – Jul	WM	T	D,C	
53	*Helichrysum indicum* (L.) Grierson	172	HA	Jun – Sep	WM	T	D,R	
54	*Laphangium affine* (D. Don) Tzvelev	273	HA	Jan – Dec	WM	T	R	
55	*Mikania micrantha* Kunth	034	SC	Feb –Apr	WM	Pi	D,R,B	Medicinal
56	*Sonchus asper* (L.) Hill	128	HA	Jul - Apr	WM	T	D,R	
57	*Sonchus oleraceus* (L.) L.	272	HA	Jul – Oct	Sim	T	R	
58	*Sphaeranthus indicus* L.	092	HA	Nov –Jan	WM	T	S	
59	*Xanthium strumerium* L.	147	HA	Aug –Sep	Sim	T	S	
60	*Youngia japonica* (L.) DC.	207	HA	Oct –Apr	WM	T	R,S,T	

continued

	CONVOLVULACEAE							
61	*Ipomoea aquatica* Forssk.	077	HP	Nov – Mar	Amp	H	A	Edible
62	*Ipomoea carnea* Jacq.	150	S	Jan – Dec	Amp	Pn	C,S,A	
63	*Ipomoea eriocarpa* R. Br.	086	HA	Oct – Jan	Sim	T	A	
64	*Cuscuta reflexa* Roxb.	076	P	Oct –Mar	Sim	T	C,R,S	
65	*Cuscuta monogyna* Vahl	036	P	Jun – Sep	Sim	T	R	
	CORNACEAE							
66	*Alangium barbatum* (R.Br. ex C.B.Clarke) Baill. ex Kuntze	247	T	Jun –Aug	Sim	Pi	D	
	CUCURBITACEAE							
67	*Luffa cylindrica* (L.) M.Roem.	229	ASC	Feb – Dec	Sim	T	T	Edible
68	*Momordica dioica* Roxb. ex Willd.	209	GC	Jul – Dec	Sim	T	T	Edible
69	*Trichosanthes lepiniana* (Naudin) Cogn.	248	GC	Apr – Nov	Sim	Cg	T	
	ELATINACEAE							
70	*Bergia ammannioides* Roxb. ex Roth	274	HA	Aug – Mar	Em	T	D	
	EUPHORBIACEAE							
71	*Croton bonplandianus* Baill.	228	HA	Jan – Jun	Sim	T	R	
72	*Euphorbia hirta* L.	106	HA	Jan – Dec	WM	T	R,D	
73	*Euphorbia heyniana* Spreng.	210	HA	Jan – Dec	WM	T	C,T	
74	*Euphorbia hypericifolia* L.	255	HA	Jul – Dec	WM	T	C,R,S	
75	*Macaranga denticulata* (Blume) Mull.Arg.	212	T	Apr – Oct	Sim	Pi	R	
76	*Mallotus nudiflorus* (L.) Kulju & Welzen	271	T	May – Nov	Sim	Ps	R,T	
	GENTIANACEAE							
77	*Exacum teres* Wall.	249	HA	Dec– Feb	WM	T	B,S	
	HYDROLEACEAE							
78	*Hydrolea zeylanica* (L.) Vahl	107	HA	Nov – Aug	Em	T	D	Edible
	HYPERICACEAE							
79	*Hypericum japonicum* Thunb.	075	HA	Jan – Dec	WM	T	D	
	ICACINACEAE							
80	*Natsiatum herpeticum* Buch.-Ham. ex Arn.	213	SC	Dec – Feb	Sim	Pn	R	
	LAMIACEAE							
81	*Clerodendrum infortunatum* L.	151	Sf	Dec – Feb	Sim	Ch	D,T	
82	*Hyptis suaveolens* (L.) Poit.	173	HA	Sep – Feb	Sim	T	C	
83	*Leucas zeylanica* (L.) W.T.Aiton	037	HA	May – Jul	WM	T	D,S	Edible, medicinal
84	*Orthosiphon incurvus* Benth.	043	HA	Aug – Nov	Em	T	B,S	
85	*Pogostemon andersonii* (Prain) Panigrahi	048	HA	Aug – Nov	Em	T	B,S	
	LAURACEAE							
86	*Litsea glutinosa* (Lour) C. B. Rob.	214	T	Apr – May	Sim	Pi	D	
87	*Litsea monopetala* (Roxb.) Pers.	**152**	T	Mar – May	Sim	Ps	D	
	LEGUMINOSAE : CAESALPINI-OIDEAE							
88	*Cassia fistula* L.	038	T	Apr – Dec	Sim	Pi	R,T	
89	*Senna occidentale* (L.) Link	178	HA	Jul – Dec	WM	T	D	
90	*Senna tora* (L.) Roxb.	108	HA	Aug – Dec	WM	T	D	

continued

	LEGUMINOSAE : MIMOSOIDEAE						
91	*Albizia chinensis* (Osbeck) Merr.	251	T	Mar – Jul	Sim	Ps	R
92	*Albizia lucidior* (Steud.) I.C. Nielsen	073	T	Apr – Jan	Sim	Pm	R,D
93	*Leucaena leucocephala* (Lam.) de Wit	215	T	Apr – Oct	Sim	Ps	R
94	*Mimosa pudica* L.	039	US	Jul – Jan	Sim	T	R,S
	LEGUMINOSAE : PAPILION-OIDEAE						
95	*Cajanus scarabaeoides* (L.) Thouars	109	AHC	Sep – Jan	Sim	T	D
96	*Crotalaria pallida* Aiton	174	HA	Sep – Jan	WM	T	R,S
97	*Desmodium heterophyllum* (Willd.) DC.	072	HP	Jul – Dec	Sim	H	D
98	*Desmodium laxiflorum* DC.	054	HP	Sep – Jan	Sim	Ch	D,R,S
99	*Desmodium triflorum* (L.) DC.	160	HP	Jul – Dec	WM	H	D
100	*Erythrina stricta* Roxb.	216	T	Jan – May	Sim	Ps	R
101	*Indigofera atropurpurea* Hornem.	220	S	Jul – Sep	Sim	Pn	D
102	*Smithia grandis* Baker	094	HA	Nov – Mar	Em	T	D,S
103	*Vigna pilosa* (Klein ex Willd.) Baker	153	AHC	Oct – Dec	Sim	T	T
104	*Vigna unguiculata* (L.) Walp.	177	AHC	NR	Sim	T	T
	LENTIBULARIACEAE						
105	*Utricularia bifida* L.	040	HA	Jul – Sep	Ssp	T	A,B
106	*Utricularia stellata* L.F.	154	HA	Jul – Sep	Ssp	T	A,B
	LINDERNIACEAE						
107	*Lindernia anagallis* (Burm.f.) Pennell	074	HA	Jul – Dec	WM	T	D,A
108	*Lindernia antipoda* (L.) Alston	041	HA	Aug – Nov	WM	T	D
109	*Lindernia ciliata* (Colsm.) Pennell	200	HA	Jun – Oct	WM	T	D
110	*Lindernia crustacea* (L.) F.Muell.	175	HA	Aug – Nov	WM	T	D,A
111	*Lindernia parviflora* (Roxb.) Haines	071	HA	Aug – Dec	Em	T	D
112	*Lindernia hookeri* Wettst.	031	HA	Aug – Jan	WM	T	D,R
113	*Torenia cordifolia* Roxb.	042	HA	Sep – Nov	WM	T	D
	LORANTHACEAE						
114	*Scurrula SP.*	179	P	Nov – Feb	Sim	Pi	R
	LYTHRACEAE						
115	*Cuphea carthagenensis* (Jacq.) J.F.Macbr.	044	HA	Jan – Dec	WM	T	D,C,S
116	*Duabanga grandiflora* (DC.) Walp.	095	T	Dec – Mar	Sim	Pm	R
117	*Lagerstroemia speciosa* (L.) Pers.	096	T	May – Jun	Sim	Ps	R,T
118	*Rotala cordata* Koehne	239	HA	Feb – Jun	Amp	T	D,S
119	*Rotala rotundifolia* (Buch.-Ham. ex Roxb.) Koehne	250	HA	Jan – Mar	Amp	T	D,S
120	*Trapa natans* L.	230	HP	Sep – May	RFL	Cd	B

continued

	MALVACEAE							
121	*Bombax ceiba* L.	045	T	Jan – May	Sim	Pm	R	
122	*Grewia serrulata* DC.	199	T	Aug – Nov	Sim	Pi	R	
123	*Hibiscus tiliaceus* L.	176	T	May – Oct	Sim	Pi	R,S	Cordage
124	*Melochia corchorifolia* L.	218	HA	Jul – Apr	WM	T	R	
125	*Sida acuta* Burm.f.	097	HA	Aug – Oct	WM	T	R,S	
126	*Sida rhombifolia* L.	110	US	Sep – Dec	Sim	Ch	R,S	
127	*Triumfetta rhomboidea* Jacq.	257	HA	Oct – Jan	WM	T	D	
128	*Urena lobata* L.	159	SA	Jan – Apr	Sim	T	R,S	Medici-nal
	MELASTOMATACEAE							
129	*Melastoma malabathricum* L.	001	S	Feb – Dec	Sim	Ch	R,B	Dye
130	*Osbeckia chinensis* L.	252	US	May – Nov	WM	Ch	R	
131	*Osbeckia nepalensis* Hook. *f.*	254	US	Aug – Dec	WM	Ch	R	
	MENYANTHACEAE							
132	*Nymphoides indica* (L.) Kuntze	231	HP	Jan – Dec	RFL	Cd	A,B	
	MENISPERMACEAE							
133	*Stephania glandulifera* Miers	046	GC	Nov – May	Sim	Cg	R	
134	*Stephania japonica* (Thunb.) Miers	098	SC	Mar – Dec	Sim	Cg	R	
135	*Tinospora sinensis* (Lour.) Merr.	111	SC	Feb – Jun	Sim	Pi	R,T	
	MOLLUGINACEAE							
136	*Glinus lotoides* L.	265	HA	Apr – May	WM	T		
137	*Glinus oppositifolius* (L.) DC.	070	HA	Feb – Apr	WM	T	D	
138	*Mollugo nudicaulis* Lam.	205	HA	Jan –Mar	WM	T	C	
	MORACEAE							
139	*Broussonetia kurzii* (Hook.f.) Corner	266	T	NR	Sim	Pi	B,R	
140	*Ficus hispida* L.f.	219	T	Jan – Dec	Sim	Pi	R	
141	*Ficus racemosa* L.	047	T	Feb – May	Sim	Ps	R	
	NELUMBONACEAE							
142	*Nelumbo nucifera* Gaertn.	002	HP	Jul – Dec	RFL	Cl	B	
	NYMPHAEACEAE							
143	*Nymphaea alba* L.	068	HP	Apr – Oct	RFL	Cl	B	Edible
144	*Nymphaea nouchali* Burm.f.	049	HP	Aug – Sep	RFL	Cl	B	Edible
	ONAGRACEAE							
145	*Ludwigia adscendens* (L.) H.Hara	156	HP	Jan – Dec	Em	T	A	
146	*Ludwigia octovalvis* (Jacq.) P.H.Raven	155	HA	May – Nov	Em	T	A,D	
147	*Ludwigia perennis* L.	003	HA	Jan – Dec	Em	T	A,D	
	OXALIDACEAE							
148	*Oxalis corniculata* L.	004	HA	Jun – Oct	WM	T	T,R	Edible
	PAPAVERACEAE							
149	*Fumaria indica* (Hausskn.) Pugsley.	180	HA	Dec – Mar	WM	T	B	
	PENTAPHYLACACEAE							
150	*Eurya acuminata* DC.	050	T	Sep – Dec	Sim	Pi	B,R	
	PHRYMACEAE							
151	*Mazus pumilus (Burm.f.) Steenis*	279	HA	Aug – Dec	WM	T	D,A	

continued

	PHYLLANTHACEAE							
152	*Antidesma acidum* Retz.	051	S	Apr – Dec	Sim	Pi	R	Edible
153	*Bischofia javanica* Blume	099	T	Mar – Oct	Sim	Ps	R	
154	*Phyllanthus amarus* Schumach. & Thonn.	005	HA	May – Aug	WM	T	D,S	
155	*Phyllanthus urinaria* L.	198	HA	Feb – Jun	WM	T	R	
	PIPERACEAE							
156	*Peperomia pellucida* (L.) Kunth	056	HA	Jun – Dec	Sim	T	T	Edible, medicinal
	PLANTAGINACEAE							
157	*Dopatrium junceum* (Roxb.) Buch.-Ham. ex Benth.	283	HA	Aug – Oct	WM	T	A	
158	*Limnophila heterophylla* (Roxb.) Benth.	100	HA	Aug – Dec	Amp	T	A,B	
159	*Limnophila indica* (L.) Druce	057	HA	Sep – Dec	Amp	T	A,B	
160	*Mecardonia procumbens* (Mill.) Small	181	HA	Oct – Dec	Sim	T	D	
161	*Microcarpaea minima* (K.D. Koenig ex Retz.) Merr.	253	HA	Aug – Oct	WM	T	D,S	
162	*Scoparia dulcis* L.	006	HP	Jan – Dec	Sim	H	S	Medici-nal
	POLYGALACEAE							
163	*Polygala chinensis* L.	267	HP	Apr – Dec	Sim	T	C	
	POLYGONACEAE							
164	*Persicaria barbata* (L.) H.Hara	007	HA	Aug – Mar	Em	T	A	
165	*Persicaria decipiens* (R.Br.) K.L.Wilson	201	HA	Aug – Nov	Em	T	D,T	
166	*Persicaria hydropiper* (L.) Delarbre	113	HA	Apr – Sep	Em	T	T,D	
167	*Persicaria orientalis* (L.) Spach	157	HA	Feb – May	WM	T	A,D	
168	*Persicaria strigosa* (R.Br.) Nakai	008	HP	Aug – Mar	Em	H	A,C	
169	*Polygonum plebeium* R.Br.	197	HA	Mar – Apr	WM	T	D	
170	*Polygonum pubescens* Blume	009	HA	Sep – Oct	WM	T	A,C	
171	*Rumex maritimus* L.	182	HA	Feb – May	WM	T	R,S	
	PORTULACACEAE							
172	*Portulaca oleracea* L.	221	HA	Jun – Sep	WM	T	A	
	PRIMULACEAE							
173	*Maesa indica (*Roxb.*)* A. DC.	284	S	Dec – Jul	Sim	Pi	R	
	RANUNCULACEAE							
174	*Ranunculus sceleratus* L.	256	HA	Jan – Mar	WM	T	B	
	RHAMNACEAE							
175	*Ziziphus zujuba* Mill.	141	T	Oct – Nov	Sim	Ps	S,R	Edible
	ROSACEAE							
176	*Duchesnea indica* (Jacks.) Focke	058	HA	Mar – Oct	WM	T	C,S	Edible
	RUBIACEAE							
177	*Dentella repens* (L.) J.R.Forst. & G.Forst.	139	HA	Mar – Apr	WM	T	D	
178	*Oldenlandia biflora* L.	059	HA	Jan – Dec	Em	T	S,D	Medici-nal
179	*Oldenlandia corymbosa* L.	158	HA	Jan – Dec	WM	T	S,D	Medici-nal
180	*Mussaenda roxburghii* Hook.f.	222	S	May – Aug	Sim	Pn	R	
181	*Mitracarpus hirtus* (L.) DC.	114	HA	Jul – Dec	WM	T	D	

continued

	SOLANACEAE							
182	*Solanum torvum* Sw.	060	S	Aug – Oct	Sim	Pn	S	Edible
183	*Solanum anguivi* Lam.	066	S	Aug – Nov	Sim	Pn	D	Edible
184	*Solanum americanum* Mill.	135	HA	Mar – Nov	Sim	T	S	Edible
	TAMARICACEAE							
185	*Tamarix dioica* Roxb. ex Roth	161	S	Apr – Dec	WM	Pi	C	
	URTICACEAE							
186	*Pilea microphylla* (L.) Liebm.	264	HA	Aug – Nov	WM	T	R,S,T	
187	*Pouzolzia zeylanica* (L.) Benn.	115	HA	Aug – Dec	WM	T	D	
	VERBENACEAE							
188	*Stachytarpheta indica* (L.) Vahl	224	US	Aug – Nov	Sim	Pn	D	
	VITACEAE							
189	*Cayratia pedata* (Lam.) Gagnep.	137	SC	Mar – Aug	Sim	Pn	B,R	
190	*Tetrastigma dubium* (Lawson) Planch	183	SC	Jul – Dec	Sim	Pn	B,R	
	LILIOPSIDA							
	ALISMATACEAE							
191	*Sagittaria guayanensis* Kunth	033	HA	Aug – Oct	Em	Cl	D	
	APONOGETONACEAE							
192	*Aponogeton crispus* Thunb.	010	HA	Sep – Mar	RFL	Cd	B	
	ARACEAE							
193	*Colocasia esculenta* (L.) Schott	067	HP	May – Oct	WM	Cg	D,R	Edible
194	*Lemna minor* L.	012	HP	Sep – Nov	FF	T	A,B	
195	*Pistia stratiotes* L.	011	HP	Jun – Sep	FF	T	A,B	
	ARECACEAE							
196	*Calamus tenuis* Roxb.	134	SC	Sep – Feb	Sim	Pn	R	Edible
	COMMELINACEAE							
197	*Commelina benghalensis* L.	065	HP	Jan – Dec	WM	H	A	
198	*Commelina diffusa* Burm.f.	013	HP	Jul – Sep	WM	H	A	
199	*Commelina suffruticosa* Blume	190	HP	Jun – Dec	Sim	H	C,R	
200	*Cyanotis axillaris* (L.) D.Don ex Sweet	133	HA	Aug – Dec	WM	T	D	
201	*Murdannia nudiflora* (L.) Brenan	196	HA	Sep – Nov	WM	T	D,A	
	CYPERACEAE							
202	*Cyperus compressus* L.	226	HA	Jan – Dec	WM	T	S	
203	*Cyperus cuspidatus* Kunth	061	HA	Jul – Nov	Em	T	C	
204	*Cyperus dubius* Rottb.	064	HP	Aug – Dec	WM	T	D,S	
205	*Cyperus laxus* Lam.	193	HA		WM	T	A	
206	*Cyperus rotundus* L.	189	HP	Jul – Feb	Sim	Cg	A,C,D	
207	*Cyperus squarrosus* L.	184			Em	T	C,D	
208	*Fimbristylis aestivalis* Vahl	014	HA	Jan – Apr	WM	T	C,S	
209	*Fimbristylis dichotoma* (L.) Vahl	130	HP	Mar – Dec	WM	T	A,D	
210	*Fuirena umbellata* Rottb.	166	HP	Jul – Dec	WM	T	C	

continued

	DIOSCOREACEAE							
211	*Dioscorea laurifolia* Wall. Ex Hook. f.	127	GC	NR	Sim	Cg	R	
212	*Dioscorea pentaphylla* L.	116	GC	Sep – Dec	Sim	Cg	R,T	
	ERIOCAULACEAE							
213	*Eriocaulon cinereum* R.Br.	202	HA	Oct – Mar	Em	T	B	
	HYDROCHARITACEAE							
214	*Blyxa octandra* (Roxb.) Planch. ex Thwaites	052	HA	Oct – Mar	Sbm	T	A	
215	*Hydrilla verticillata* (L.f.) Royle	165	HP	Sep – Mar	Sbm	Cl	A	
216	*Najas*	235	HA	Nov – Feb	Sbm	T	A	
217	*Ottelia alismoides* (L.) Pers.	232	HP	Jul – Mar	Sbm	Cl	B	
218	*Vallisneria spiralis* L.	053	HP	Oct – Mar	Sbm	Cl	A	
	MARANTACEAE							
219	*Schumannianthus dichotomus* (Roxb.) Gagnep.	117	S	Sep – Apr	Amp	Cg	A	Basketry
	POACEAE							
220	*Arundinella bengalensis* (Spreng.) Druce	015	HP	Nov – Jan	Amp	Pn	A,D	
221	*Arundo donax* L.	132	HP	Aug – Dec	Amp	Pn	R	
222	*Axonopus compressus* (Sw.) P. Beauv.	026	HP	Jan – Dec	WM	H	S,R,D	
223	*Brachiaria reptans* (L.) C.A. Gardner & C.E. Hubb.	062	HA	Jul – Nov	WM	T	S	
224	*Calamagrostis elatior* (Griseb.) A.Camus	191	HA	Sep – Oct	Em	T	A	
225	*Chrysopogon aciculatus* (Retz.) Trin.	163	HP	Jun – Oct	Sim	H	R,S,C	
226	*Cynodon dactylon* (L.) Pers.	016	HP	Mar – Oct	Sim	H	D,R	
227	*Dichanthium annulatum* (Forssk.) Stapf	188	HP	Jun – Dec	WM	H	C	
228	*Digitaria sanguinalis* (L.) Scop.	063	HA	Apr – Nov	WM	T	S	
229	*Echinochloa colona* (L.) Link	185	HA	Jan – Dec	WM	T	D	
230	*Echinochloa crus-galli* (L.) P.Beauv.	118	HA	Mar- Sep	Amp	T	A,D	
231	*Eleusine indica* (L.) Gaertn.	131	HP	Jan – Dec	Sim	H	R,S	Medicinal
232	*Eragrostis atrovirens* (Desf.) Trin. ex Steud.	164	HA	Jan – Dec	Sim	T	S,D	
233	*Eragrostis gangetica* (Roxb.) Steud.	125	HA	Jun – Dec	WM	T	D,C	
234	*Eragrostis minor* Host	192	HA	May – Sep	WM	T	C	
235	*Eragrostis unioloides* (Retz.) Nees ex Steud.	195	HA	Jan – Dec	Sim	T	D,S	
236	*Hygroryza aristata* (Retz.) Nees ex Wight & Arn.	194	HA	Oct – Feb	RFL	T	A	
237	*Hymenachne amplexicaulis* (Rudge) Nees	263	HP		EM	H	C,R	
238	*Imperata* cylindrica (L.) Raeusch.	023	HP	Mar – Jul	Sim	Cg	R	
239	*Leersia hexandra* Sw.	022	HP	Aug – Feb	Sim	H	A,D,S	
240	*Microstegium ciliatum* (Trin.) A.Camus	120	HA	Dec – Feb	WM	T	D,S,C	
241	*Oplismenus burmanni* (Retz.) P.Beauv.	123	HA	Sep – Nov	Sim	T	S,C	
242	*Oryza rufipogon* Griff.	233	HA	Sep – Mar	RFL	T	R,T	
243	*Panicum repens* L.	167	HP	Jul – Sep	Amp	H	D,S	
244	*Paspalidium punctatum* (Burm.) A. Camus	225	HP	Aug – Mar	Sim	H	S	
245	*Paspalum scrobiculatum* L.	259	HP	Jul – Oct	Sim	H	C,S	
246	*Phragmites karka* (Retz.) Trin. ex Steud.	234	HP	Apr – Dec	Amp	Cg	B,R	
247	*Saccharum ravennae* (L.) L.	121	HP	Apr – Jun	Sim	Cg	C	
248	*Saccharum spontaneum* L.	129	HP	Nov – Feb	Sim	Cg	D	
249	*Sacciolepis indica* (L.) Chase	169	HA	Jun – Feb	WM	T	D	

continued

	PONTEDERIACEAE							
250	*Eichhornia crassipes* (Mart.) Solms	021	HP	Jun – Sep	FF	H	A,B	
251	*Monochoria hastata* (L.) Solms	025	HP	Mar – Jun	Em	Cd	C,A,B	
	POTAMOGETONACEAE							
252	*Potamogeton nodosus* Poir.	186	HP	Jun – Sep	RFL	Cd	B	
	SMILACACEAE							
253	*Smilax sp.*	203	S	May – Jun	Sim	Pi	R	
	STEMONACEAE							
254	*Stemona tuberosa* Lour.	126	HC	NR	Sim	Cg	R,D	
	ZINGIBERACEAE							
255	*Alpinia nigra* (Gaertn.) Burtt	017	HP	Jun – Aug	Amp	Cg	D	
	PTERIDOPHYTA							
	ATHYRIACEAE							
256	*Diplazium esculentum* (Retz.) Sw.	119	HP	Sep – May	Sim	Ch	C,S,R	Edible
	EQUISETACEAE							
257	*Equisetum diffusum* D. Don	162	HP	Aug – Feb	Sim	Cg	D,T	
	MARSILEACEAE							
258	*Marsilea minuta* L.	018	HA	Dec – Mar	Amp	T	A,D	
	PTERIDACEAE							
259	*Ceratopteris thalictroides* (L.) Brongn.	029	HA	Aug – Feb		T	A,B	
	SALVINIACEAE							
260	*Azolla pinnata* R. Br.	024	HA	Dec – Feb	FF	Cd	A	
261	*Salvinia cucullata* Roxb.	020	HP	NR	FF	Cd	A	
262	*Salvinia natans* (L.) All.	019	HP	NR	FF	Cd	A	

Notes:

Habit groups: AHC = Annual Herbaceous Climber- 4; ASC = Annual Shrubby Climber- 1; E = Epiphyte- 1; GC = Geophytic Climber- 5; HA = Annual Herb- 136; HP = Perennial Herb- 55; P = Parasite- 3; S = Shrub- 11; SA = Shrubby Annual- 1; SC = Shrubby Climber-9; Sf = Suffrutescent plant- 2; T = Tree- 25; US = Under-Shrub- 5; HC = Herbaceous climber- 1.

Life Form: Phanerophytes [Pi = Microphanerophyte- 20; Pm = Megaphanerophyte- 3; Pn = Nanophanerophyte- 12; Ps = Mesophanerophyte- 13]; Ch = Chamaephyte- 7; H = Hemicryptophyte- 23; Cryptophyte (Cd = Hydrophyte- 9; Cg = Geophyte- 15; Cl = Helophyte- 7); T = Therophyte- 151; E = Epiphyte- 0.

Location: A = Water front; B = Vegetated Island; C = Land between Ranganadi & main wetland; D = Marginal areas; R = Road side – opposite to river; S = Beside road to bridge; T = Beside the village.

Helophytes. Remaining two categories, Chamaephytes and Hemicryptophytes are represented by 7 and 23 species respectively.

In Table 3 the Life-form spectrum of Satajan wetland area is compared with the Normal Spectrum of Smith (1913) and Raunkiaer (1934). When the Life-Form distribution is compared with Smith's (1913) Normal Spectrum it is found that except for MM no other category is matching. And, when compared with Raunkiaer's (1934) spectrum, not a single category is matching. That indicates the existence of a special type of vegetation in the study area that is quite different from the mesophytic vegetation. Presence of 58.4% Therophytes in Satajan wetland is very much significant and that indicates the presence of extremities in the habitat and prevailing climate. Reduction of Phanerophytic, Chaemephytic and Hemicryptophytic species indicates the reduction in terrestrial fronts and the present picture for these categories is due to the presence of wide island/ elevated region at the middle. So, from Life-form analysis, the vegetation can easily be recognised as wetland vegetation that is connected to terrestrial surroundings.

Useful plants: Scrutiny of the recorded flora shows the

Table 2. Habit-group distribution of the recorded vascular flora in Satajan wetland

Herbs	**193**	**Shrubs**	**17**	**Climbers**	**20**	**TOTAL**
HA	144	Perennial	11	AHC	4	262
HP	49	SA	1	ASC	1	
		US	5	GC	6	
				SC	9	
Trees	26	Suffrutescent	2	Parasite	3	
Epiphyte	1					

Table 3. Life-Form analysis of Satajan Beel (wetland) flora

		S	E	MM	M	N	Ch	H	G	HH	T
Normal spectrum (Smith, 1913)	%	1	3	6	17	20	9	27	3	1	13
Normal spectrum (Raunkiaer 1934)	%	-	-	46			9	26	6		13
Satajan wetland	No.	0	0	16	20	12	7	23	15	16	153
	%	0	0	6.11	7.63	4.58	2.67	8.78	5.73	6.11	58.4

[**Abbreviations:** S = Stem succulents; E = Epiphytes; MM = Mega- & Mesophenerophytes; M = Microphanerophytes; N = Nanophanerophytes; Ch = Chamaephytes; H = Hemicryptophytes; HH = Hydro- & Helophytes; T = Therophytes]

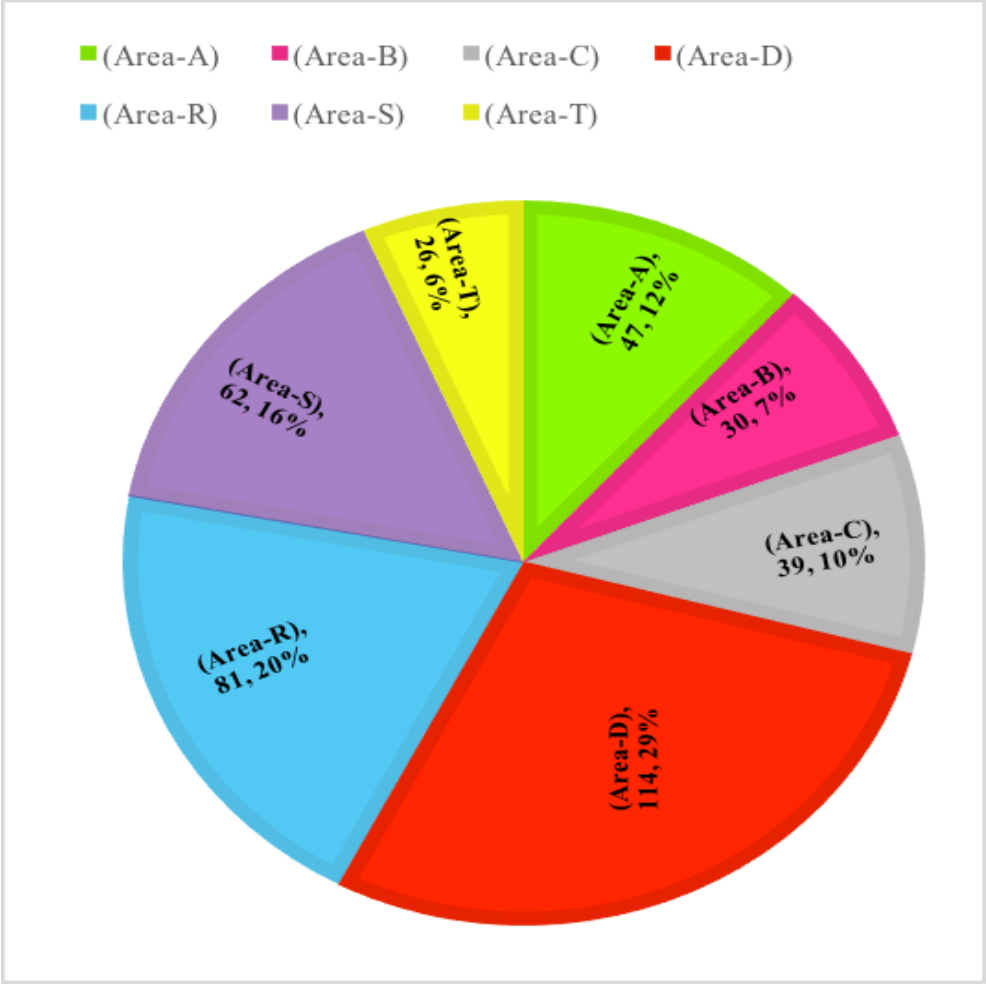

Figure 3. Numerical representation of species of vascular plants in different areas of Satajan Beel

presence of many useful species. There are 44 species of medicinal plants, 38 species of edible plants, 9 species of potential ornamentals, and 9 species of assorted (floss, cordage, basketry, thatching, dye yielding, etc.). The population of wild rice, *Oryza rufipogon* is also good. Besides, a good proportion of these plants can be used as fodder for different domesticated animals like cows, goats and pigs. The dominant *Alpinia nigra* could be exploited for essential oil extraction for therapeutic uses.

CONCLUSION

The Satajan wetland was created only in 1950, i.e. only about 70 years old. From the results of the present floristic survey, related observations and the discussion above it is now clear that the flora of Stajan wetland is quite rich but the high representation of annuals and Therophytes and the poor representation of true hydrophytes indicate towards its juvenile status. The regular and periodic disturbances to the wetland by factors like extreme climate, submergence during monsoon months, anthropogenic disturbances due to contiguity with the terrestrial fronts within short distance in all sides might have resulted to the high species diversity in the area which also holds true according to the intermediate level hypothesis (Wilkinson, 1999). The dense formation of *Alpinia nigra* vegetation in most of the areas shows the dominant nature of the species that can overcome the regular disturbances occur in the wetland. Despite the rich species diversity, the presence of clear-water areas towards the centre of the wetland suggest the rich concentration of aquatic fauna or ichthyofauna near the centre of the wetland protecting themselves from the human reach.

The richness of the ichthyofauna makes the wetland as one of the preferred habitat for a good number of migratory birds. The recorded ichthyofauna of this region is quite high and that must be linked with the avifauna of the region including exotics. Therefore, Satajan wetland presents one important ecosystem in the area that houses a good and diversified flora and associated fauna and needs to be protected by suitable agencies for its important services to the environment including local human residents.

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REFERENCES

Ahmed, F. 2019. Number of winged visitors declining in Satajan. *The Assam Tribune*, Guwahati. January 10, 2019.

APG [Angiosperm Phylogeny Group] 2016. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. *Botanical Journal of the Linnean Society*, 181: 1 – 20.

Barua, I.C. 1992. *Systematic studies of the angiosperms of Kamrup District, Assam*, Ph.D. Thesis, Gauhati University, Guwahati.

Bhaskar, V. and Raji, B.A. 1973. Hydrophytes and marsh plants of Mysore city. *Prasaranga*, University of Mysore, Mysore, India

Bhowmik, S., Saha, R. and Datta, B.K. 2008. Aquatic and marshland plants in West Tripura, India. *Pleione* 2(1): 3 – 11.

Biswas, K and Calder, C. 1937. Handbook of common water and marsh plants of India and Burma. Bishen Singh & Mahendra Pal singh, Dehradun (Reprint).

Biswas, R., Chowdhury, A. and Das, A.P. 2012. Macrophytic flora of Gossaihat Beel, Jalpaiguri Forest Division, West Bengal, India: I. Magnoliopsida. *Pleione*, 6(1): 217 – 237.

Biswas, R.; Paul, T.K. and Das, A.P. 2013. Floristic diversity of Rasik Beel and its adjoining areas in Coochbehar district of West Bengal, India. *Pleione* 7(2): 501 – 507.

Bor, N.L. 1940. *Flora of Assam* Vol. 5 (Gramineae). Assam Govt of Press, Shillong.

Boruah, B. and Riba, T. 2015. A Study on Bordoibaam Wetland of Assam, India. Environmentalism 1: 15 – 21.

Boutin, C. and Keddy, P.A. 1993. A functional classification of Wetland plants. *Journal of Vegetation Science*. 4(5): 591 – 600.

Chavan, A.R. and Sabnis, S.D. 1961. A study of hydrophytes of Baroda and environs. *J. Ind. Bot. Soc.* 40: 121 – 130.

Chowdhury, A. 2015. *Studies on the Diversity and Ethnic Uses of Wetland Vascular Plants in Terai and Duars of West Bengal*. PhD thesis, North Bengal University, Siliguri.

Chowdhury, A., Biswas, R. and Das, A.P. 2014. Macrophytic flora of Gossaihat Beel, Jalpaiguri Forest Division, West Bengal, India: II. Pteridophyta and Liliopsida. *Pleione* 8(2): 293 – 310.

Chowdhery, H.J., Giri, G.S. and Pramanik, A. 2009. *Materials for the Flora of Arunachal Pradesh*. Vol. III. Botanical Survey of India, Calcutta.

Clark, G.L. 1954. Elements of ecology. John Wiley & Sons, Inc., New York.

Cook, C.D.K. 1996. Aquatic and Wetland Plants of India. Oxford University Press,Oxford. Pp. 385.

Das, A.P. 2018. Herbarium Techniques. In: J.B. Bhandari & Cyria Gurung (eds.), *Instrumentation Mannual*. Narosha, New Delhi. [in press]

Das, K.K. 2013. Diversity of aquatic and wetland angiospermic macrophytes in the Kamrup District, Assam, India. *Pleione* 7(1): 8 – 17.

Deepa, R.S. and Ramachandra, T.V. 1999. Impact of Urbanization in the Interconnectivity of wetlands. Paper presented at the *National Symposium on Remote Sensing Applications for Natural Resources: Retrospective and Perspective (XIX-XXI 1999*), Indian Society of Remote Sensing, Bangalore

Giri, G.S., Pramanik, A. and Chowdhery, H.J. 2008. *Materials for the Flora of Arunachal Pradesh*. Vol. II. Botanical Survey of India, Kolkata.

Gogoi, B., Das, R., Abujam, S.K. and Das, D.N. 2016. Enumeraton of Fish from Dulakhojiya Beel

(wetland) of Lakhimpur District, Assam, India. Journal of FisheriesSciences.com 10(4): 37 – 42.

Gopal, B. 1995. *Biodiversity in Freshwater Ecosystems including wetlands, Biodiversity and Conservation in India, A Status Report.* Vol. 4. Zoological survey of India, Calcutta

Hajra, P.K., Verma, D.M. and Giri, G.S. 1996. *Materials for the Flora of Arunachal Pradesh*. Vol. I. Botanical Survey of India, Calcutta.

Hazarika, L.P. 2013. A study of certain physico-chemical characteristics of Satajan wetland with special reference to fsh diversity indices, Assam, India. European Journal of Experimental Biology 3 (4): 173−180. http://pelagiaresearchlibrary.com/european-journalof-experimental-biology/vol3-iss4/EJEB-2013-3-4-173-180.pdf

Hooker, J.D. 1872-1897. Flora of British India, Vols. 1-7. L. Reeve & Co Ltd, Ashford, Kent. London.

Hussain, S. 2019. *Geo- ecological status of Satajan Wetland, Lakhimpur, Assam*. M.Phil. Dissertation, Rajiv Gandhi University.

Jain, S.K. and Rao, R.R. 1977. A Handbook of Field and Herbarium Methods. Today & Tomorrow's Printers and Publishers, New Delhi.

Jhingram, A.G. and Pathak, V. 1987. Ecology and Management of beels in Assam-A case study of Dhir beel. Workshop. Dev. Beel Fisheries, Assam, Assam Agricultural University, Khanapara, Assam pp: 16-28.

Kachroo, P. 1984. *Aquatic Biology in India*. Bishen Singh Mahendra Pal Singh, Dehra Dun.

Kanjilal, U.N., Kanjilal, P.C. and Das, A. 1938. Flora of Assam, Vol. 2, Assam Govt. Press, Shillong.

Kanjilal, U.N., Kanjilal, P.C., Das. A. and Dey, R.N. 1939. Flora of Assam, Vol. 3, Assam Govt. Govt. Press, Shillong.

Kanjilal, U.N., Kanjilal, P.C, Das, A. and Dey, R.N. 1940. Flora of Assam, Vol. 4, Assam Govt. Govt. Press, Shillong.

Kanjilal, U.N., Kanjilal, P.C, Das. A. and Purkaystha, C. 1934. Flora of Assam, Vol. 1, Assam Govt. Press, Shillong.

Kaushik, G. and Bordoloi, S. 2016. Ichthyofauna of Ranganadi River in Lakhimpur, Assam, India. *Check List* 12(2): 1871, 17 April 2016 doi: http://dx.doi.org/10.15560/12.2.1871.

Lavania, G.S., Paliwal, S.C. and Gopal, B. 1990. Aquatic vegetation of the Indian subcontinent. In: (Ed.) Brij Gopal, *Ecology and Management of Aquatic vegetation in the Indian subcontinent*. Kluwer Academic Publishers, Dordsecht Boston/London. Pp. 29 – 76.

Maheshwari, J.K. 1960. The Origin and Distribution of the naturalized plants of Khandwa Plateau, Madhya Pradesh. *J. Biol. Sci*. 3: 9 – 19.

Majumdar, N.C. 1965. *Aquatic and semiaquatic flora of Calcutta and adjacent localities*. *Bull. Bot. Soc. Beng.* 19: 10 – 17.

Malakar, N.C. 1995. *The systematic studies on the aquatic angiosperm of Cachar district of Assam*, Ph.D. Thesis, Gauhati University.

Mirashi, M.V. 1954. Studies in the hydrophytes of Nagpur 1. A preliminary survey. *J. Indian Bot. Soc.* 33: 299 – 308.

Mitsch, W.I. and Gosselink, I. G. 1986. *Wetlands*. Van Nostrand Reinhold, New York. 198.

Mitsch, W.J. and Gosselink, J.G. 1993. Wetlands. Van Nostrad Reinhold. New York. Pp. 722.

Mohammed, T. 2013. Lakhimpur: A geographical Review. *Damphi Journal*. Pp, 72 – 76.

NWAA 2010. *National Wetland Atlas: Assam.* SAC/RESA/AFEG/NWIA/ATLAS/18/2010, Indian Space Research Organisation (ISRO), Ahmedabad.

Odum, E.P. 1959. *Fundamentals of Ecology*, 2nd ed. W.B. Saunder Co. Philadelphia and London. Pp. 546.

Pal, H. and Dutta C.M. 2010. New records of some sedges from southern Assam. *Pleione* 4(1): 143 – 147.

Pathak, K.C. 1990. *Detailed study on Hydrophytic flora of Gawahati and its vicinity*. Ph.D. Thesis, Gauhati University.

Pattnaik, H. and Pattanaik, N.K. 1956. The hydrophytes of Cuttack. *J. Indian Bot. Soc*. 35: 167 – 170.

Rao, A.S. and Verma, D.N. 1969 (1972). Contribution to the Botany of North Lakhimpur Subdivision, Assam. *Bull. Bot. Surv. India* 11: 403 – 413.

Raunkiaer, C. 1934. *The Life-forms of plants and Statistical Plant Geography*. Oxford University Press, Oxford. p. 632.

Sarkar, S., Deka, D. and Devi, N. 2008. Studies on some medicinally important wetland angiosperms used by Boro tribe of Kamrup district in Assam, India. *Pleione* 2(1): 20 – 26.

Sarmah, B.P., Baruah, D. and Bakalial, B. 2013. Wetland medicinal plants in floodplains of Subansiri and Ranga river of Lakhimpur district, Assam, India. *Asian Journal of Plant Science and Research*, 3(3): 54 – 60.

Satyanarayana, G. 1962. Hydrophytic vegetation of Jalukbari. *Bull. Bot. Surv. India*. 4 (1-4): 217 – 218.

Sen, D.N. and Chatterjee, U.N. 1959. Ecological studies on aquatic and swampy vegetation of Gorakhpur. *Agra Univ. J. Res. (Sci.)* 8(1): 17 – 29.

Smith, W.G. 1913. Raunkiaer's "Life-Forms" and statistical methods. *J. Ecol*. 1(1): 16 – 26.

Subramanyam, K. 1962. *Aquatic angiosperms: a systematic accounts of common Indian aquatic angiosperm,* New Delhi.

Tiner, W.L. 1999. Wetland Indicators: A Guide to Wetland Identification, Delineation, Classification, and Mapping. Lewis Publishers, New York.

Unni, K.S.1967. Studies on the vegetation of ponds, swamps and river banks in Raipur, M.P. J. Bomb. Nat. Hist. Soc. 64: 95 – 102.

Vyas, L. N. 1964. A study of hydrophytes and marsh plants of Alwar and environs. *J. Indian Bot. Soc.* 43: 7 – 30.

Wilkinson, D. M. (1999). The Disturbing History of Intermediate Disturbance. *Oikos,* 84(1), 145-147. doi:10.2307/3546874. Wiley, Nordic Society, Oikos.