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Vegetation Assessment of Inland Wetland of Central Gujarat (Pariej Irrigation Reservoirs)

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ABSTRACT

Wetlands are one of the most productive and fertile ecosystems on earth. Those wetlands which are located in the transitional zone between permanently aquatic and terrestrial (upland) ecosystems have properties common to land and water both. Gujarat has a variety coastal and inland wetland systems. The inland wetlands include floodplains, freshwater ponds and lakes, rivers, irrigation reservoirs, marshes and waterlogged areas while the coastal wetlands include salt marshes and salt-pans, creeks, mudflats, estuaries, mangrove swamps and coral reefs. Many of these wetlands have potential to get designation of international significance due to their high diversity/population and/or other criteria. Pariej is one of the eight wetlands in Gujarat that has been declared by the Central Government as wetland of national importance. The purpose of the present study is to observe the flora of the pariej wetland and to determine the changes by each season. In a wetland ecosystem these biotic factors are mostly dependent on the season and hydrology. Thus wetland being an integrated system is affected by the changes in the physical as well as chemical parameters of hydrosphere at the catchment scale.

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I. INTRODUCTION

Wetlands are eco-transitional regions which inhabit a transitional position between dry land and open water (Tatu *et. al.,* 2007). The penetration of wetland never exceeds six meters as defined in the text of convention report of wetlands which are globally important particularly as Water birds habitat known as the Ramsar site. Wetlands are extremely valuable pools of biodiversity and genetic resources, but unmaintainable development is intimidating the bio-wealth and even initiating species extinction (Burlakova *et al,* 2009). Wetlands are supportive to a varied range of flora and fauna and inhabit many ecological, climatic and biological roles. Wetlands provides food, shelter and breeding platforms for

aquatic birds and animals(Turner *et. al.,* 2000). It has a variety of aquatic habitats such as a long Arabian seacoast, rivers, streams, ponds, puddles, lakes, backwater creeks etc., which support characteristic types of vegetation of their own (Callaway *et. al.,* 2007). Pariej is one of the eight wetlands in Gujarat that has been declared by the Central Government as wetland of national importance. It offers a variety of habitats –from the ponds and marshes ,to patches of open grasslands and scrub and its proximity of the Gulf of Khambhat as given its wealth of birdlife.

II. MATERIALS AND METHODS

Study Area

Prioritized wetland site from Gujarat**.** One of the eight wetlands of National Importance identified in Gujarat state by the Ministry of Environment and Forests, Govt. of India. The wetland well known as 'Mahi- Pariejyojna' that stores and supply water to Saurashtra region. This is also an Important Bird Area (IBA) Site of India. Also, a proposed Ramsar Site by SACON (Source: SACON's Atlas for Wetland Conservation). Commercial fishing is practiced.

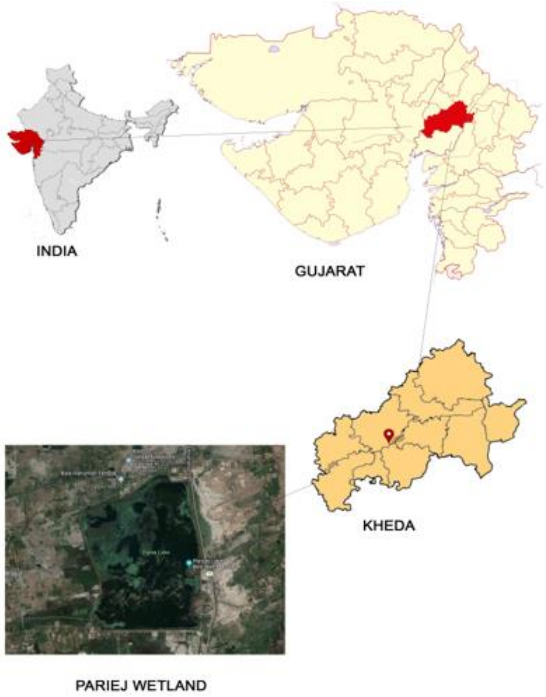


Figure 1 : Satellite image of Pariej Wetland (Source: Google Map)

Location: Pariej Irrigation Reservoir is located in Limbasi taluka at 22˚33'00" N latitudes and 72˚38'00" E longitudes. It is situated at the distance of just 7 km north of Tarapur on Tarapur-Kheda State highway. The big lake of Pariej is approximately 2.5 kms. in area with depth varying between 4 ft to 10 ft.

Field Survey

The field survey was started with reconnaissance survey of Pariej Wetlands located at Khambhat District of Gujarat state, India. Further, data collection was carried out in each of the season i.e., Summer, Monsoon and Winter. Types of vegetations like Submerged vegetation, Rooted Plants with Floating Leaves, Unrooted Submerged Plant, Free-floating Plants, Emergent vegetation have been covered during study. Belt- transects methods was employed for fulfilment of the objectives.

Belt-Transect

Belt- Transect method for wetlands ringed with vegetation around large central deep water, a better strategy might be establishing a baseline around the perimeter of the wetland running transect toward the Centre. A length of the transect was 100 m. On each transect, quadrates were laid down at regular distance (i.e.,10m). Quadrates size was fixed as per habit of plants, 5m x 5m for the Shrub and 1m x 1m for the herbs. Each species occurring in the first three quadrate was counted for determination of species density, frequency, abundance, percentage composition and remaining quadrate only Percent cover and frequency percentage was taken because these aquatic species which could not be counted as individual number. Longitude and Latitude were also recorded for each transect & quadrates by using GPS (Global Positioning System).

Quantitative Data Analysis

Enumeration of vegetation was carried out using quadrates method. The quantitative assessment was

carried out for all species. Various measurable attributes i.e., density, frequency, abundance, percentage composition, species richness and evenness were used for the assessment of plants in the all selected areas of wetland. Following formulas were being applied for calculation.

Density

Density is an expression number of the individual per unit area. Density is calculated by the equation.

$$\text{Density} = \frac{\text{Total number of individual of particular species}}{\text{Total number of quadrates studied} \times \text{Area of quadrat(ha)}}$$

Frequency

Frequency refers to the degree of dispersion of individual species in an area and usually expressed in term of percentage cover and it can be calculated by equation.

$$\text{Frequency} = \frac{\text{Number of quadrates in which species occurred}}{\text{Total number of quadrates studied}} \times 100$$

Abundance

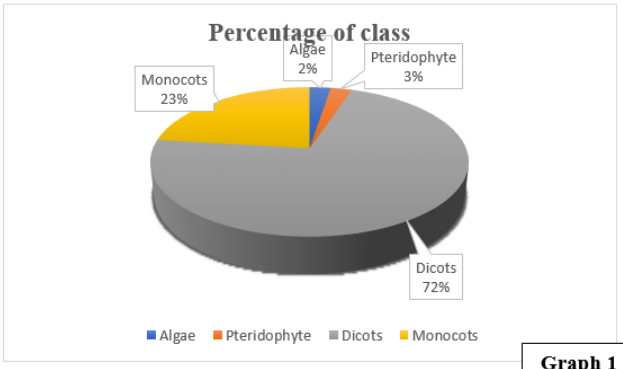
Abundance refers the number of individual of different species in community unit per area. By quadrates methods, sampling is made random at several places and the number of individual of each species was summed up for all quadrates divided by total number of quadrates in which the species occurred. It can be represented by an equation.

$$\text{Abundance} = \frac{\text{Total number of individual in all quadrates}}{\text{Total number of quadrates in which individual occures} \times \text{Area of quadrat(ha)}}$$

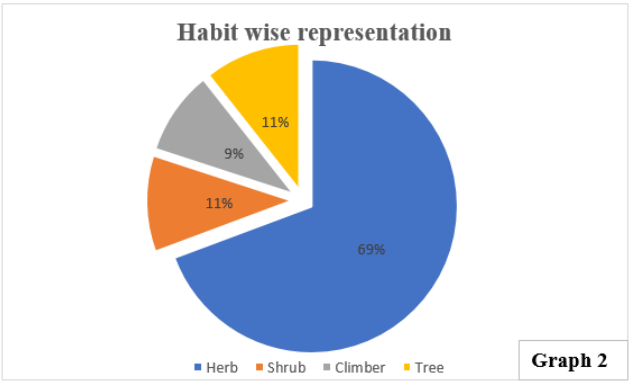
III. RESULTS AND DISCUSSION

Qualitative analysis

During the present study, a total of 74 species belonging to 39 families and 63 genera of flowering plants and 2 non-flowering i.e. *Chara* sp. (Algae) as well as *Marsilea quadrifolia L.* (pteridophyte) have been recorded from the in and around the Pariej wetland. Dicots represented by 48 species belongs to 41 genera and 29 families while Monocots represented by 26 species belongs to 20 genera and 9 families (Graph 1). Graph 2 showed habit wise analysis of plants i.e., tree, shrubs, climber, herbs, etc. Moreover, plant checklist was prepared based on the visual observation in the quadrats as well transects (Table 6). Graph 1 representing percentage of Dicot, Monocot, Algae, Pteridophyte and graph 2 representing habit percentage.



Graph 1



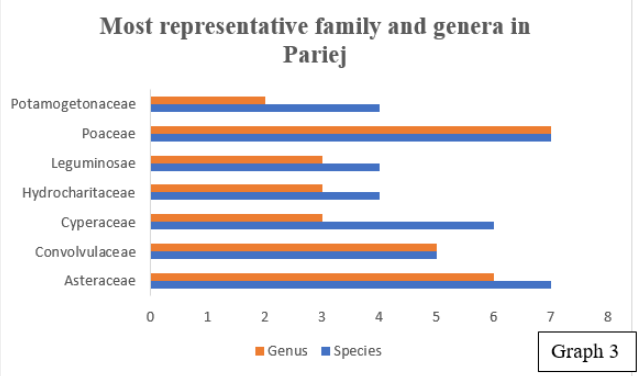
Graph 2

Out of 49 families, 48 genera are represented by single species of each genus. Convolvulaceae is largest families among the dicot while Poaceae and

Cyperaceae are largest among the monocots which are poorly represented. A total of 74 species of flowering plants, 51 species are herbs, 8 species are shrubs, 7 species are climbers and 8 species are trees and 1 non-flowering plant *Marsilea* (pteridophyte). This study show that herbaceous plants are dominating in the wetland and its surrounding areas.

Most representative family and genera in Pariej Wetland

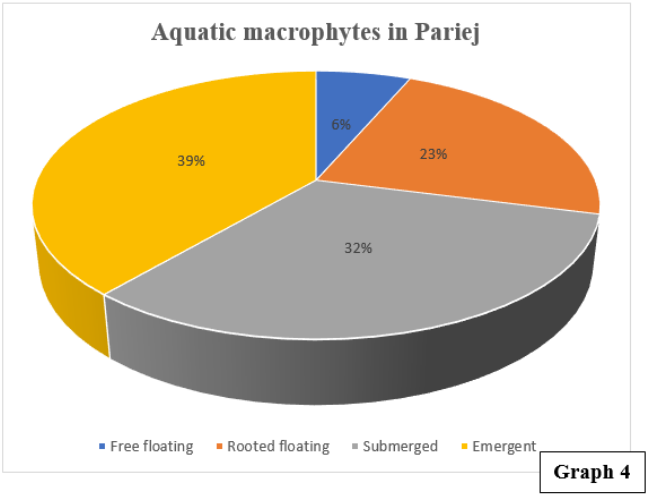
Most representative family, genera and species of Pariej are Asteraceae (7 species) followed by Poaceae (7 species), Cyperaceae (6 species), Convolvulaceae (5 species), Hydrocharitaceae (4 species) etc. as given in graph 3.



Graph 3

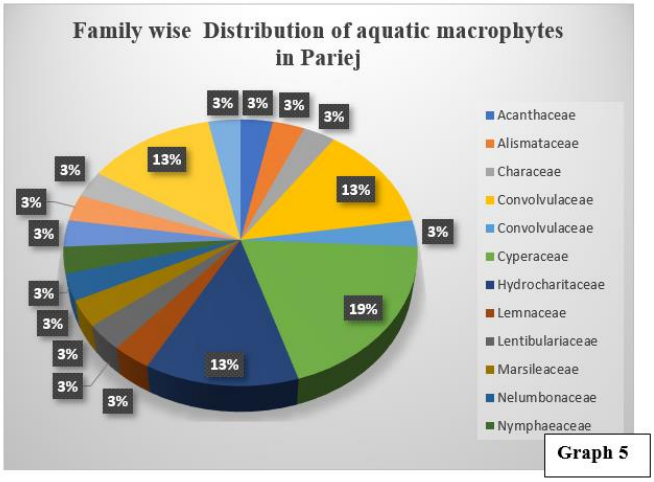
Aquatic macrophytes

The macrophytes are classified into submerged, free floating, rooted floating and emergent vegetation. Total 32 species recorded under this study belonged to 18 families. Majority of the species are recorded from emergent (13 species) vegetation followed by submerged (10 species), Rooted floating (7 species) and Free floating (2 species) Vegetation, etc. (graph 3)



Graph 4

Majority of the species are recorded from Cyperaceae family (6 species) followed by Convolvulaceae (4 species), Hydrocharitaceae (4 species), and Potamogetonaceae (4 species). Other Family wise Distribution of aquatic macrophytes in Pariej wetland. (graph 4)



Graph 5

During fieldwork at Pariej wetland 32 species of aquatic macropytes were identified and listed based on the visual observation in the quadrats as well transects by using Cook (1996) and Shah (1978). The given table show list of aquatic macrophytes with their indicator statuses, habit, family, class etc.(table1)

Table 1 : List of recorded aquatic macrophytes and their indicator status.

Sr. No.	Botanical Name	Family	Status	Habit	Indicator status	Class
1	*Ammannia baccifera* L.	Lythraceae	Emergent	Herb	FAC	Dicot
2	*Coix lacryma-jobi* L.	Poaceae	Emergent	Herb	FACW	Monocot

3	*Cyperus difformis* L.	Cyperaceae	Emergent	Herb	FACW	Monocot
4	*Cyperus iria* L	Cyperaceae	Emergent	Herb	FACW	Monocot
5	*Cyperus rotundus* L.	Cyperaceae	Emergent	Herb	FACW	Monocot
6	*Cyperus bulbosus* Vahl	Cyperaceae	Emergent	Herb	FACW	Monocot
7	*Eichhornia crassipes* (Mart.) Solms	Pontederiaceae	Free Floating	Herb	OBL	Monocot
8	*Fimbristylis aestivalis* Vahl	Cyperaceae	Emergent	Herb	FACW	Monocot
9	*Hydrilla verticillata* (L.f.) Royle	Hydrocharitaceae	Submerged	Herb	OBL	Monocot
10	*Hygrophila auriculata* (Schum.) Heine	Acanthaceae	Emergent	Herb	FACW	Dicot
11	*Ipomoea aquatica* Forssk.	Convolvulaceae	Rooted Floating	Climber	FACW	Dicot
12	*Ipomoea carnea* Jacq.	Convolvulaceae	Emergent	Climber	FACW	Dicot
13	*Ipomoea marginata* (Desr.) Verdc.	Convolvulaceae	Rooted Floating	Climber	FACW	Dicot
14	*Ipomoea triloba* L.	Convolvulaceae	Rooted Floating	Climber	FACW	Dicot
15	*Lemna minor* L.	Lemnaceae	Free Floating	Herb	OBL	Monocot
16	*Limnophyton obtusifolium* (L.) Miq.	Alismataceae	Emergent	Herb	FACW	Monocot
17	*Ludwigia adscendens* (L.) Hara	Onagraceae	Emergent	Herb	FACW	Dicot
18	*Najas marina* L.	Hydrocharitaceae	Submerged	Herb	OBL	Monocot
19	*Najas minor* All.	Hydrocharitaceae	Submerged	Herb	OBL	Monocot
20	*Nelumbo nucifera* Gaertn.	Nelumbonaceae	Rooted Floating	Herb	OBL	Dicot
21	*Nymphaea nouchali* Burm.f.	Nymphaeaceae	Rooted Floating	Herb	OBL	Dicot
22	*Persicaria glabra* (Willd.) M.Gómez	Polygonaceae	Emergent	Herb	FACW	Dicot
23	*Potamogeton crispus* L.	Potamogetonaceae	Submerged	Herb	OBL	Monocot
24	*Potamogeton nodosus* Poir.	Potamogetonaceae	Submerged	Herb	OBL	Monocot
25	*Potamogeton perfoliatus* L.	Potamogetonaceae	Submerged	Herb	OBL	Monocot
26	*Scirpus littoralis* Schrad.	Cyperaceae	Emergent	Herb	FACW	Monocot
27	*Stuckenia pectinata* (L.) Börner	Potamogetonaceae	Submerged	Herb	OBL	Monocot
28	*Typha domingensis* Pers.	Typhaceae	Emergent	Herb	FACW	Monocot
29	*Utricularia inflexa* Forssk.	Lentibulariaceae	Submerged	Herb	OBL	Dicot
30	*Vallisneria spiralis* L.	Hydrocharitaceae	Submerged	Herb	OBL	Monocot

31	*Chara* sp.	Characeae	Submerged	-	OBL	Algae
32	*Marsilea quadrifolia* L.	Marsileaceae	Rooted Floating	Herb	OBL	Pteridophyte

* Obligate Wetland Plants (OBL), Facultative Wetland Plants (FACW), Facultative Plants(FAC), Facultative Upland Plants (FACU), Obligate Upland Plants (UPL).

Wetland indicator status

The National List of Plant Species that Occur in Wetlands is a list of wetland plants and their assigned indicator statuses. The five indicator statuses are: Obligate Wetland Plants (OBL), Facultative Wetland Plants (FACW), Facultative Plants (FAC), Facultative Upland Plants (FACU), Obligate Upland Plants (UPL). Based on these indicator statuses total of 76 species of plants were categories and represented. Out of these, 38 species belong to Obligate Upland Plants, 16 Facultative Wetland Plants, 15 Obligate Wetland Plants, 6 Facultative Upland Plants and 1naturalized, 1 Facultative Plants. (graph 5)

Quantitative analysis

Percent Cover

32 species of macrophytes were recorded in the Pariej wetland. Out of these, 11species of macrophytes were recorded in the quadrats laid along with transects. The study reveals that the maximum Percent Cover was found of *Hydrilla verticillata* (L.f.) Royle (45.15%) follow by *Eichhornia crassipes* (Mart.) Solms (41.42%), *Stuckenia pectinata* (L.) Börner (38.33%), *Najas minor* All (33.75%) in winter season etc. (Table 2).

Table 2 : Percent cover of macrophytes

SN	Species Name	Common name	% Cover		
			Summer	Monsoon	Winter
1	*Chara* sp.	-	10	0	10
2	*Eichhornia crassipes* (Mart.) Solms	-	20	20	41.42
3	*Hydrilla verticillata* (L.f.) Royle	-	44.83	26	45.15
4	*Lemna minor* L.	-	23.33	10	25
5	*Marsilea quadrifolia* L.		15	10	10
6	*Najas marina* L.		21.81	23.63	26.66
7	*Najas minor* All.		30.43	26.92	33.75
8	*Nymphaea nouchali* Burm.f.	Poynu	22.85	20	28.57
9	*Potamogeton crispus* L.	-	26.47	24.7	25
10	*Stuckenia pectinata* (L.) Börner	-	23.33	10	38.33
11	*Vallisneria spiralis* L.	-	36.66	20	30

Frequency

An analysis of the study showed that the maximum frequency was found of *Hydrilla verticillata* (L.f.) Royle (94.29%) in winter follow by *Najas minor* All (74.29%) in monsoon, *Potamogeton crispus* L. (51.43%) in winter, *Najas marina* L. (34.29%) in winter season etc. (Table 3).

Table 3 : Frequency of macrophytes

SN	Species Name	Common name	Frequency %		
			Summer	Monsoon	Winter
1	*Chara* sp.	-	2.86	0.00	2.86
2	*Eichhornia crassipes* (Mart.) Solms	-	22.86	22.86	20.00
3	*Hydrilla verticillata* (L.f.) Royle	-	88.57	85.71	94.29
4	*Lemna minor* L.	-	8.57	2.86	5.71
5	*Marsilea quadrifolia* L.		5.71	2.86	2.86
6	*Najas marina* L.		31.43	31.43	34.29
7	*Najas minor* All.		65.71	74.29	68.57
8	*Nymphaea nouchali* Burm.f.	Poynu	20.00	17.14	20.00
9	*Potamogeton crispus* L.	-	48.57	48.57	51.43
10	*Stuckenia pectinata* (L.) Börner	-	8.57	2.86	17.14
11	Vallisneria spiralis L.	-	8.57	11.43	11.43

Density

The study reveals that the maximum density was found of *Typha domingensis* Pers., (9.80 Indi/m) in winter follow by *Polygonum plebeium* R.Br. (3.27 indi/m) in winter, Eclipta prostrata (L.) L. (2.07indi/m) in summer, *Ipomoea carnea* Jace. (2.0 Indi/m) in summer season etc. (Table 4)

Frequency

In pariej wetland, the maximum frequency was found of Typha domingensis Pers. (93.33%) in monsoon, *Polygonum plebeium* R.Br. (46.67 %) in monsoon, Eclipta prostrata (L.) L. (33.33%) in winter, *Ipomoea carnea* Jace. (33.33) in winter etc. (Table 4)

Abundance

An abundance of different species in the present study were Typha domingensis Pers.(12.25indi/m) in winter followed by *Polygonum plebeium* R.Br. (8.16 indi/m) in winter, Ammannia baccifera L.(6.00 indi/m) in winter, Ipomoea carnea Jace. (5.2 indi/m) in winter season etc. (Table 4)

Percentage composition

The percentage compositions of dominant species were Typha domingensis Pers. (53.26%) in winter followed by *Polygonum plebeium* R.Br. (17.75 %) in winter, Ipomoea carnea Jace. (9.42%) in winter, Eclipta prostrata (L.) L. (6.90%) in monsoon season etc. (Table 4)

Table 4 : Density, frequency, abundance and Percentage composition of Upland plant in Pariej wetland

Sr. No.	Scientific Name	Local Name	Density per sq. meter			Abundance sq. meter			% of Frequency			% of Composition		
			Summer	Monsoon	Winter	Summer	Monsoon	Winter	Summer	Monsoon	Winter	Summer	Monsoon	Winter
1	*Alternanthera sessilis* (L.) R.Br. ex DC.	-	0.47	0.27	0.27	2.33	2.00	2	20.00	13.33	13.33	2.80	1.72	1.45
2	*Cyperus iria* L.		0.47	0.40	0.47	3.50	2.00	2.33333	13.33	20.00	20.00	2.80	2.59	2.54
3	*Cyperus rotundus* L.	Dilo	0.60	0.47	0.47	3.00	2.33	2.33333	20.00	20.00	20.00	3.60	3.02	2.54
4	*Eclipta prostrata* (L.) L.	-	2.07	1.07	1.27	6.20	3.20	3.8	33.33	33.33	33.33	12.40	6.90	6.88
5	*Ipomoea aquatica* Forssk.	Vel	0.33	0.20	0.20	2.50	1.50	1.5	13.33	13.33	13.33	2.00	1.29	1.09
6	*Ipomoea carnea* Jace.	Bush Morning Glory	2.00	1.53	1.73	7.50	4.60	5.2	26.67	33.33	33.33	12.00	9.91	9.42
7	*Ammannia baccifera* L.	Jal agiyo	0.40	0.40	0.40	6.00	6.00	6	6.67	6.67	6.67	2.40	2.59	2.17
8	*Launaea procumbens* (Roxb.) Ramayya & Rajagopal	Gadjepi	0.13	0.13	0.13	2.00	2.00	2	6.67	6.67	6.67	0.80	0.86	0.72
9	*Ludwigia adscendens* (L.) Hara	-	0.27	0.27	0.27	4.00	4.00	4	6.67	6.67	6.67	1.60	1.72	1.45
10	*Polygonum plebeium* R.Br.		2.40	2.53	3.27	7.20	5.43	8.16667	33.33	46.67	40.00	14.40	16.38	17.75
11	*Typha domingensis* Pers.	Gha Bajariu	7.53	8.07	9.80	9.42	8.64	12.25	80.00	93.33	80.00	45.20	52.16	53.26
12	*Commelina benghalensis* L.		-	0.13	-	-	2.00	-	-	6.67	-	-	0.86	-
13	*Rungia repens* (L.) Nees		-	-	0.13	-	-	2	-	-	6.67	-	-	0.72

IV. CONCLUSION

Wetlands are most productive ecosystem. Vegetation plays important role in wetland ecosystem. It acts as primary producer who makes food. Vegetation takes part vital chain like energy flow, food web, carbon cycle, Nitrogen cycle, phosphate cycle. It acts as basic trophic level for biomass production, which further passes to another trophic levels.

In the present study, a total of 74 species belonging to 39 families and 63 genera of flowering plants and 2 non-flowering i.e. Chara sp. (Algae) as well as Marsilea quadrifolia L. (pteridophyte) have been recorded in and around the Pariej wetland. Dicots represented by 48 species belongs to 41 genera and 29 families while Monocots represented by 26 species belongs to 20 genera and 9 families.

The macrophytes are classified into submerged, free floating, rooted floating and emergent vegetation. A total 32 aquatic macrophytes species recorded under this study belonged to 18 families. Majority of the species are recorded from emergent (13 species) vegetation followed by submerged (10 species),

Rooted floating (7 species) and Free floating (2 species) Vegetation.

Based on the National List of wetland plants and their assigned indicator statuses a total of 76 species of plants were categories. Out of these, 38 species belong to Obligate Upland Plants, 16 Facultative Wetland Plants, 15 Obligate Wetland Plants, 6 Facultative Upland Plants and 1 naturalized, 1 Facultative Plants.
Thus wetlands require collaborated research involving natural, social and inter disciplinary study aimed at understanding the various components such as monitoring of water quality, socio economic dependency, bio diversity and other activities as an indispensable tool for formulating long term conservation strategies.

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