

Checklist, Taxonomic Diversity, and Ecological Documentation of Wetland Macrophytes in Ranchi District, Jharkhand, India

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Abstract: Wetlands are ecologically significant ecosystems that support high biodiversity, regulate hydrological cycles, and provide multiple ecosystem services. Macrophytes, as structural and functional components of these systems, play essential roles in productivity, nutrient cycling, and habitat provision. This study aimed to prepare a comprehensive checklist of macrophytes and assess their ecological distribution across 15 representative wetlands in Ranchi district, Jharkhand. Field surveys were carried out from 2020 to 2024, with intensive sampling during the monsoon to post-monsoon seasons. Sampling was conducted using randomly placed 1 m × 1 m quadrats. Plant specimens were identified following standard floras and validated with global taxonomic databases. They were analyzed to determine species richness, dominant families, and growth-form composition. A total of 136 species belonging to 78 genera and 39 families were documented, comprising dicots (64 species), monocots (62), pteridophytes (7), and charophytes (3). Emergent macrophytes were dominant (66.91%), followed by submerged (18.38%), rooted floating-leaved (8.82%), and free-floating forms (5.88%). Cyperaceae (21 species), Poaceae (12), and Hydrocharitaceae (9) emerged as the most speciose families. Species richness varied widely among wetlands, ranging from 20 species at Umedanda Talab to 44 species at Patratoli Bara Talab, with smaller ponds often supporting greater diversity than larger reservoirs such as Rukka Dam. These patterns indicate that local catchment conditions, nutrient inflow, and anthropogenic pressures influence macrophyte distribution more significantly than wetland size alone. This study is important as it provides the first district-level baseline of macrophyte diversity in Ranchi wetlands and will inform conservation strategies for protecting and managing these ecologically valuable wetlands.

Key words: Macrophytes; Wetlands; Species richness; Taxonomic data; Growth forms; Ranchi

1 Introduction

Wetlands are transitional ecosystems, sitting between land and water, and are recognized worldwide for their ecological and economic value. They provide crucial ecosystem services such as water purification, flood control, carbon storage, and biodiversity conservation [1, 2]. In the Indian context, wetlands sustain agriculture and fisheries, recharge groundwater, and hold deep cultural importance while acting as biodiversity reservoirs at both regional and national levels [3].

Among wetland components, macrophytes are central to ecosystem functioning. These large aquatic plants, including emer-

gent, submerged, floating-leaved, and free-floating forms, act as ecological engineers. They enhance productivity, cycle nutrients, trap sediments, and offer habitat for fish, invertebrates, and microorganisms [4, 5]. By absorbing excess nutrients and pollutants, macrophytes help maintain water quality [6]. Their utility extends beyond ecology to human use: they contribute to carbon storage, renewable bioenergy, and even traditional medicine [7]. This wide range of functions underscores their role as indicators of wetland health and as valuable resources in nature-based solutions for sustainability.

However, wetlands in India are under stress. Rapid urban expansion, agricul-

tural intensification, pollution, and invasive species collectively alter hydrology and nutrient regimes, reshaping macrophyte communities [8, 9]. Much of India's aquatic plant research has focused on floristic documentation, with relatively fewer efforts to quantify abundance, community structure, or functional roles [10, 11]. This imbalance limits our understanding of how ecological gradients and human pressures shape macrophyte assemblages across landscapes.

In Jharkhand, particularly within Ranchi district, such gaps are even more evident. Previous works have described species diversity in individual wetlands such as Ranchi Lake and Kanke Dam [12] or listed them in broader regional checklists [13, 14]. Yet, comparative assessments across multiple wetlands linking species composition to physical and anthropogenic gradients remain scarce.

Ranchi's wetlands, including Bundu Lake, Rukka Dam, and Raja Bandh, represent a mosaic of ecosystems that differ in size, altitude, and use. Urban sites receive untreated sewage and solid waste, while rural ponds are used for irrigation and aquaculture. These pressures have begun to alter species composition and reduce native macrophyte richness. Similar patterns have been observed in other tropical wetlands of Southeast Asia and Africa, where nutrient enrichment and pollution favour fast-growing, invasive species over native communities [15, 16], suggesting a comparable developmental pattern for Ranchi's wetlands.

Documenting and monitoring macrophyte diversity thus becomes more than an academic exercise. It provides a baseline for identifying rare or threatened taxa, tracking invasive alien plant species (IAPS), and informing management under the Ramsar Convention and India's National Wetland Conservation Programme (NWCP). It also helps quantify ecosystem services such as carbon sequestration, nutrient cycling, and water purification, offering direct insights into wetland resilience under

climate stress.

This study was designed to: (i) compile a comprehensive checklist of macrophytes from selected Ranchi wetlands; (ii) assess their taxonomic richness and distribution across growth forms and families; (iii) compare richness among wetlands varying in altitude, size, and human use; and (iv) interpret the ecological implications for conservation and management. We hypothesize that wetlands exposed to greater anthropogenic stress will exhibit lower macrophyte richness and altered dominance patterns, for example, increased prevalence of invasive or pollution-tolerant species at the expense of native taxa, compared to less-disturbed systems.

2 Materials and Methods

2.1 Study Area

The study was conducted in Ranchi district, the capital of Jharkhand, India ($23^{\circ}21' - 23^{\circ}87' \text{ N}$, $85^{\circ}15' - 85^{\circ}23' \text{ E}$). The district covers 7,698 km² of undulating terrain in the southern Chotanagpur Plateau. It is bordered by Ramgarh, Hazaribagh, and Chatra to the north; Khunti to the south; Latehar, Lohardaga, and Gumla to the west; and Saraikela and Purulia (West Bengal) to the east. Ranchi has a humid subtropical climate, with summer temperatures ranging from 20 to 40 °C and winter temperatures from 1 to 25 °C. The area receives both monsoonal and occasional cyclonic rainfall [17]. The Subarnarekha River and its tributaries form the principal drainage system of the district.

2.2 Selection and Inventorization of Wetlands

Fifteen freshwater wetlands were identified across Ranchi district, seven in the east (RCH-E01 to RCH-E07) and eight in the west (RCH-W01 to RCH-W08) (Figure 1). Selection followed ecological and hydrological criteria:

- i minimum area of 5 acres,

- ii gradual depth increase up to about 6 m with saturated or inundated banks, and
- iii sufficient macrophyte cover.

These parameters were adapted from Ramsar (1975) [18], Mitsch and Gosselink (1986) [19], and Williams (1990) [20], consistent with U.S. Fish and Wildlife Service (Circular 39) and Cook (1996) [11] guidelines.

Geographical coordinates, elevation, and surface area were recorded using GPS. Elevation ranged from 189.46 m (Tamar Bada Talab, RCH-E06) to 644.54 m (Jamtoli Dam, RCH-W01), with an average of 438 m. Surface areas varied from 2.02 ha (Kita Uparbandh, RCH-E05) to 10,199.77 ha (Rukka Dam, RCH-E07).

2.3 Selected Wetland Sites

The eastern zone includes Bundu Lake, Hindalco Pond, Choga Bada Talab, Raja Bandh, Kita Uparbandh, Tamar Bada Talab, and Rukka Dam; the western zone covers Jamtoli Dam, Dolaicha Bandh, Jagannathpur Talab, Kamati Talab, Khelari Dam, Patratoli Bara Talab, Pithoria Jora Talab, and Umedanda Talab (RCH-W08) (Figure 1). These sites encompass a range of ecological and cultural settings, community-managed systems (e.g., Jamtoli Dam), sacred ponds (e.g., Kamati Talab, Umedanda Talab), semi-urban multipurpose waterbodies (e.g., Khelari Dam, Patratoli Talab), and extensive riverine systems (e.g., Rukka Dam). Of the fifteen sites, four are urban, two semi-urban, eight rural, and one riverine. Most remain perennial, except Kamati Talab (RCH-W04), which is seasonal.

2.4 Rationale for Site Selection

A stratified ecological approach was used to capture hydrological variation and human influence. The design facilitates comparison between the industrially affected eastern sites and the more rural western

ones. Urban and industrial stress is represented by Jagannathpur Talab, Bundu Lake, and Hindalco Pond, while transitional systems like Patratoli Bara Talab show moderate disturbance. Large water bodies such as Rukka and Jamtoli Dams illustrate managed hydrological conditions. Inclusion of the seasonal Kamati Talab allows cross-regime comparison, and rural ponds like Choga Bada Talab, Tamar Bada Talab, and Dolaicha Bandh ensure adequate representation of agricultural landscapes.

2.5 Plant Identification and Voucher Preparation

Macrophytes were identified using standard taxonomic keys provided in *Aquatic and Wetland Plants of India* [11], *Wetland Flora of West Bengal* [21], *Flora of Bihar: Analysis* [22], and *Botany of Bihar and Orissa* [23]. Species names were verified through Plants of the World Online [24] and World Flora Online [25]. Voucher specimens were prepared following Jain and Rao (1977) [26].

Special preservation techniques were used for species unsuitable for conventional herbarium mounting. Macroscopic algae, carnivorous taxa such as *Utricularia* sp., and delicate floating species (*Spirodela* sp., *Lemna* sp., *Wolffia* sp.) were preserved in 40% formalin and also mounted for reference [26]. All field data, including site coordinates, quadrat positions, ecological observations, and photographs, were logged in field notebooks and archived at SKBU.

2.6 Sampling Methodology

Field surveys were carried out from September 2020 to March 2024, covering both post-monsoon and winter seasons across the Ranchi district's 18 administrative blocks. Sampling was carried out during the post-monsoon period at one-month intervals to capture variation across hydrological phases. In each wetland, ten to fourteen 1 m × 1 m quadrats were

positioned along transects extending from the shoreline to a depth of up to about 2 m. Samples were hand-collected within or touching each quadrat, and all macrophyte species were recorded [27–31].

2.7 Data Analysis

Data from all 15 wetlands were compiled in Microsoft Excel for organization and analysis. Descriptive statistics were used

to summarize macrophyte abundance and richness across sites. One-way ANOVA was applied to test for significant differences in macrophyte abundance among wetlands, followed by post-hoc comparisons where relevant.

The dominance of macrophyte families was determined by calculating the percentage contribution of each family to the total species pool using the formula:

$$\text{Percentage of Family} = \frac{\text{Number of Species in a Particular Family}}{\text{Total Number of Species across all Families}} \times 100$$

Families with the highest percentage values were designated as dominant, as they contributed more species relative to others. This approach enabled clear identification

and comparison of the relative importance of different families within the macrophyte community [31].

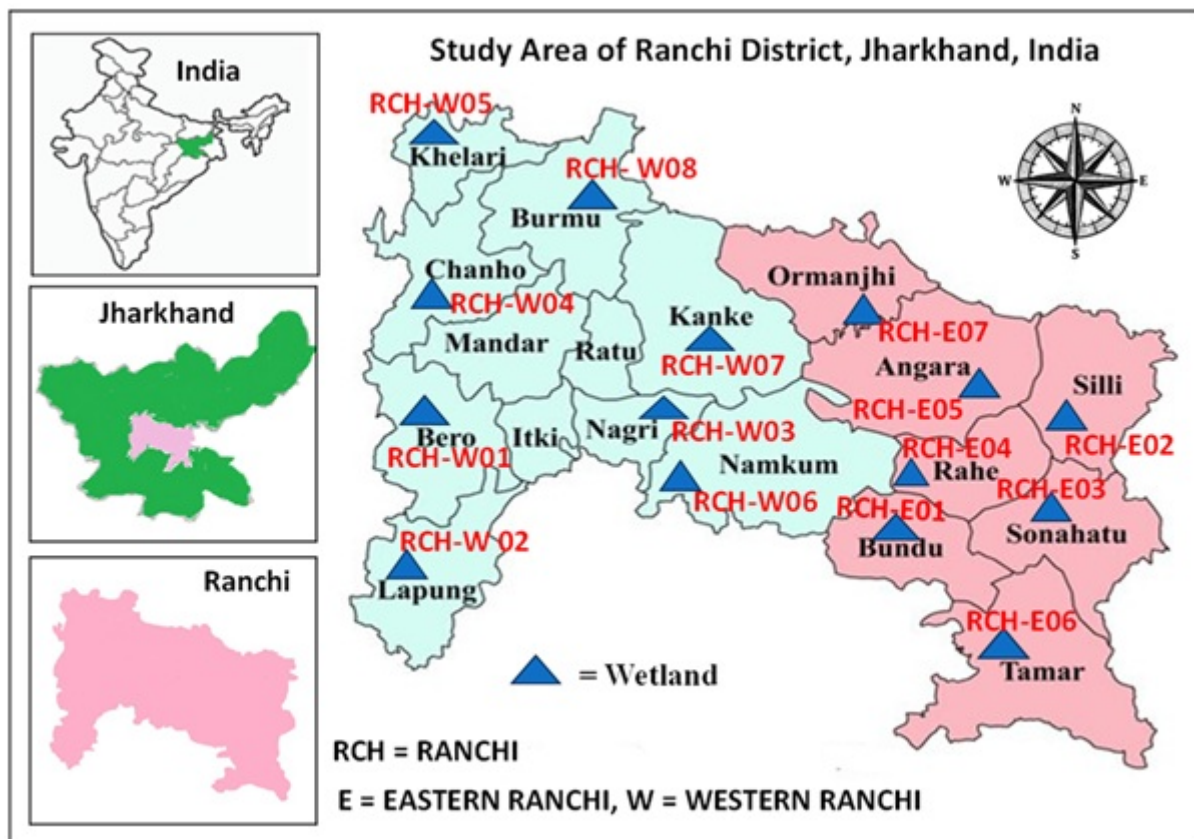


Figure 1: Study area of Ranchi district, Jharkhand, showing surveyed wetlands (RCH-E01–E07 and RCH-W01–W08). Wetlands are marked with blue triangles.

3 Results

3.1 Inventory of Wetlands and Macrophytes

Fifteen wetlands were surveyed across Ranchi district, Jharkhand, India, to document macrophyte diversity and community structure (Table 1). These included four urban, two semi-urban, eight rural, and one riverine system (RCH-E07). Except for Kamati Talab (RCH-W04), which was seasonal, all were perennial. Wetlands varied widely in elevation (189.46–644.54 m), size (2.02–10,199.77 ha), and catchment type.

Species richness ranged from 20 species at Umedanda Talab (RCH-W08) to 44 species at Patratoli Bara Talab (RCH-W06), averaging 30.6 species per wetland. The eastern wetlands supported 25–39 species, while western sites exhib-

ited broader variation, including the most and least diverse systems. Richness was not strictly related to size. For instance, Rukka Dam, the largest wetland, had 39 species, while smaller ones such as Patratoli Bara Talab (2.02 ha) and Kamati Talab (2.02 ha) supported 44 and 36 species, respectively.

Ecological contrasts were evident across catchments. Rural wetlands were mostly influenced by agricultural runoff, while urban and semi-urban systems, such as Patratoli Bara Talab and Jagannathpur Talab, received sewage and domestic inputs. Larger perennial wetlands, including Rukka Dam, Bundu Lake, and Jamtoli Dam, supported higher species diversity. Smaller or degraded sites such as Pithoria Jora Talab and Umedanda Talab had lower richness, reflecting spatial and ecological heterogeneity across Ranchi's wetland mosaic.

Table 1: Inventory of Selected Wetlands in Ranchi District with Location, Size, and Species Richness.

Wetland Code	Name of Wetland (Block)	Latitude (N)	Longitude (E)	Altitude (m)	Size (ha)	Size (ac)	Existing Species
RCH-E01	Bundu Lake (Bundu)	23.1614	85.586489	259.47	40.47	100.0	31
RCH-E02	Hindalco Pond, Muri (Silli)	23.38126	85.867212	198.63	2.43	6.0	25
RCH-E03	Choga Bada Talab, Choga (Sonahatu)	23.21299	85.7433049	190.09	10.93	27.0	27
RCH-E04	Raja Bandh, Rahe (Rahe)	23.24986	85.6375088	251.66	9.41	23.25	27
RCH-E05	Kita Uparbandh, Kita (Angara)	23.36492	85.765632	251.55	2.02	5.0	25
RCH-E06	Tamar Bada Talab (Tamar)	23.05430	85.65870	189.46	5.67	14.0	29
RCH-E07	Rukka Dam (Ormanjhi–Rukka portion)	23.43663	85.462674	596.00	10199.77	25203.0	39
RCH-W01	Jamtoli Dam (Bero)	23.27983	85.01791	644.54	4.05	10.0	35
RCH-W02	Dolecha Bandh (Lapung)	23.18998	84.96339	602.08	5.67	14.0	31
RCH-W03	Jagannathpur Talab (Nagri)	23.31328	85.28193	619.26	4.05	10.0	32
RCH-W04	Kamati Talab (Chanho)	23.514623	85.02523	641.93	2.02	5.0	36
RCH-W05	Khelari Dam (Khelari)	23.64871	85.00544	389.00	4.05	10.0	34
RCH-W06	Patratoli Bara Talab (Namkum)	23.327127	85.386732	561.54	2.02	5.0	44
RCH-W07	Pithoriya Joda Talab (Kanke)	23.514874	85.29060	597.31	7.26	17.95	24
RCH-W08	Umedanda Talab (Burmu)	23.62334	85.16310	580.74	2.67	6.6	20

Note: **RCH** = Ranchi; **E** = Eastern Ranchi, **W** = Western Ranchi. Altitude is given in meters (**m**). Size is given in both hectares (**ha**) and acres (**ac**) (**1 acre = 0.4047 ha**).

3.2 Taxonomic Composition

Across all sites, 136 macrophyte species were identified, distributed among 78 genera and 39 families (Table 2). Dicots were the most diverse group with 64 species, followed by monocots with 62 species. Pteridophytes and macroalgae

contributed 7 and 3 species, respectively (Figure 2). Pteridophytes were represented mainly by *Marsilea* and *Salvinia* species, while macroalgae comprised *Chara braunii* S.G. Gmel., *Chara fibrosa* (Agardh ex Bruzelius) R.D. Wood, and *Chara globularis* Thuill.

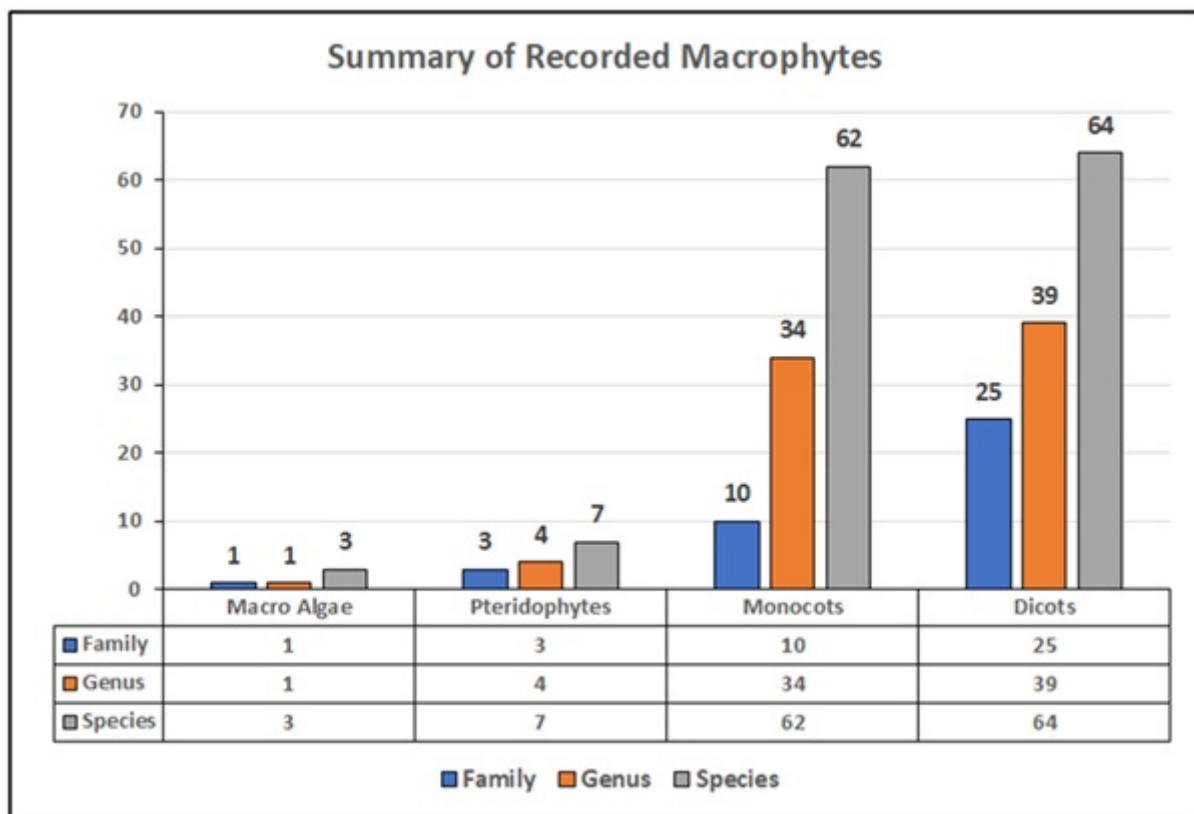


Figure 2: Taxonomic composition of recorded macrophytes in Ranchi wetlands, showing numbers of families, genera, and species across macroalgae, pteridophytes, monocots, and dicots.

3.3 Growth-Form Distribution

The species pool was dominated by emergent macrophytes (91 species; 66.91%), followed by submerged forms (25 species; 18.38%), rooted floating-leaved plants (12 species; 8.82%), and free-floating species (8 species; 5.88%) (Table 2; Figure 3).

Emergent taxa were widespread, with *Cyperus iria* L. abundant in RCH-W05, *Paspalum distichum* L. common in RCH-E03 and RCH-E05, and *Echinochloa*

colonum (L.) Link frequent in RCH-E04, RCH-E05, and RCH-E07. Western wetlands (RCH-W01–RCH-W08) showed high abundance of *Alternanthera sessilis* (L.) DC. and *Panicum repens* L.

Rooted floating-leaved macrophytes included *Nymphaea pubescens* Willd., *Nymphoides hydrophyllum* (Lour.) Kuntze, *Trapa natans* var. *bispinosa* (Roxb.) Makino, *Ipomoea aquatica* Forssk., and *Ludwigia adscendens* (L.) H.

Hara. Free-floating forms such as *Lemna perpusilla* Torr. and *Spirodela polyrhiza* (L.) Schleid. were frequent in RCH-E01, RCH-E02, RCH-E06, RCH-E07, RCH-W06, and RCH-W07. Submerged species

were represented by *Potamogeton crispus* L., *P. nodosus* Poir., *Utricularia stellaris* L.f., and *Chara fibrosa*, which occurred across multiple sites.

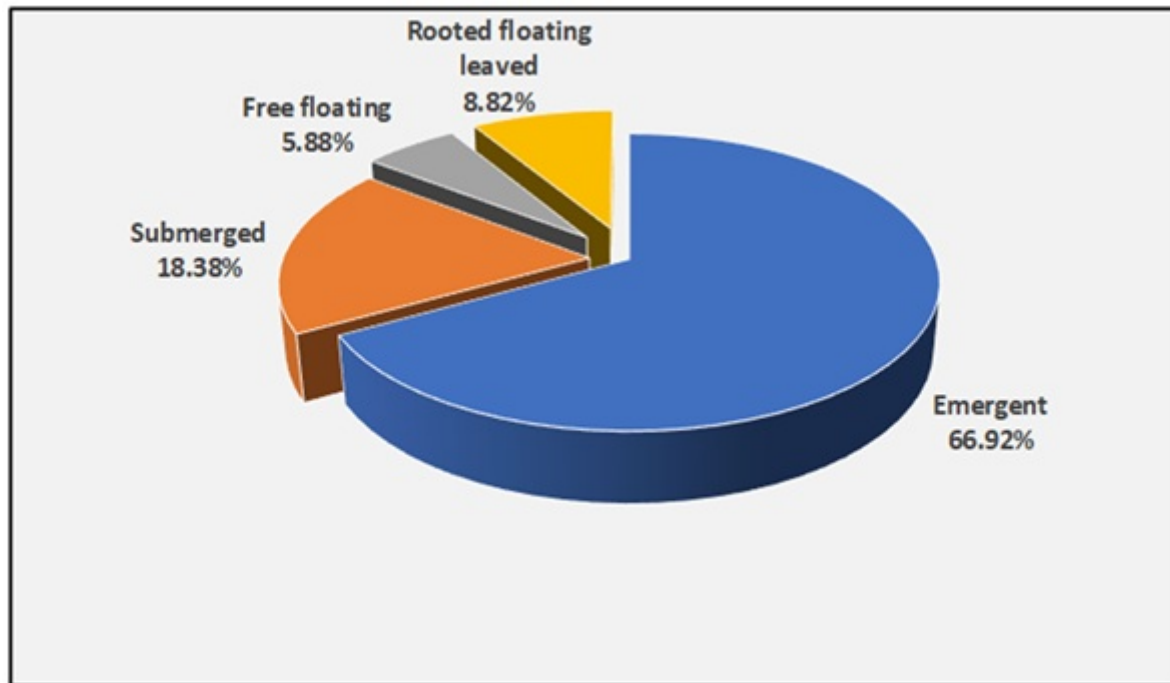


Figure 3: Distribution of macrophytes by growth form in Ranchi wetlands, showing relative proportions of emergent, submerged, rooted floating-leaved, and free-floating species.

3.4 Dominant Families

Nine families were identified as dominant, each contributing more than 3.5% of total richness (Figure 4). Cyperaceae was the most represented, with 21 species from 8 genera (15.44%). This was fol-

lowed by Poaceae (12 species, 8 genera; 8.82%), Hydrocharitaceae (9 species, 5 genera; 6.62%), Plantaginaceae (7 species, 3 genera; 5.15%), and Commelinaceae (7 species, 3 genera; 5.15%). Araceae, Asteraceae, Linderniaceae, and Polygonaceae each contributed 5 species (3.68%).

3.5 Non-Dominant Families

Thirty families contributed less than 3.5% of total richness (Table 3). Rubiaceae was the most represented, with 4 species from 3 genera (2.94%). Families such as Amaranthaceae, Characeae, Convolvulaceae, Lentibulariaceae, Lythraceae, Marsileaceae, Menyanthaceae, Nymphaeaceae, Onagraceae, and Salviniaceae each comprised 3 species (2.21%). Families repre-

sented by 2 species (1.47%) included Acanthaceae, Aponogetonaceae, Ceratophyllaceae, Pontederiaceae, and Potamogetonaceae. The remaining 13 families, including Alismataceae, Apiaceae, Boraginaceae, Chenopodiaceae, Haloragaceae, Nelumbonaceae, Pteridaceae, Ranunculaceae, Trapaceae, Typhaceae, Urticaceae, Verbenaceae, and others, were each represented by a single species (0.74%).

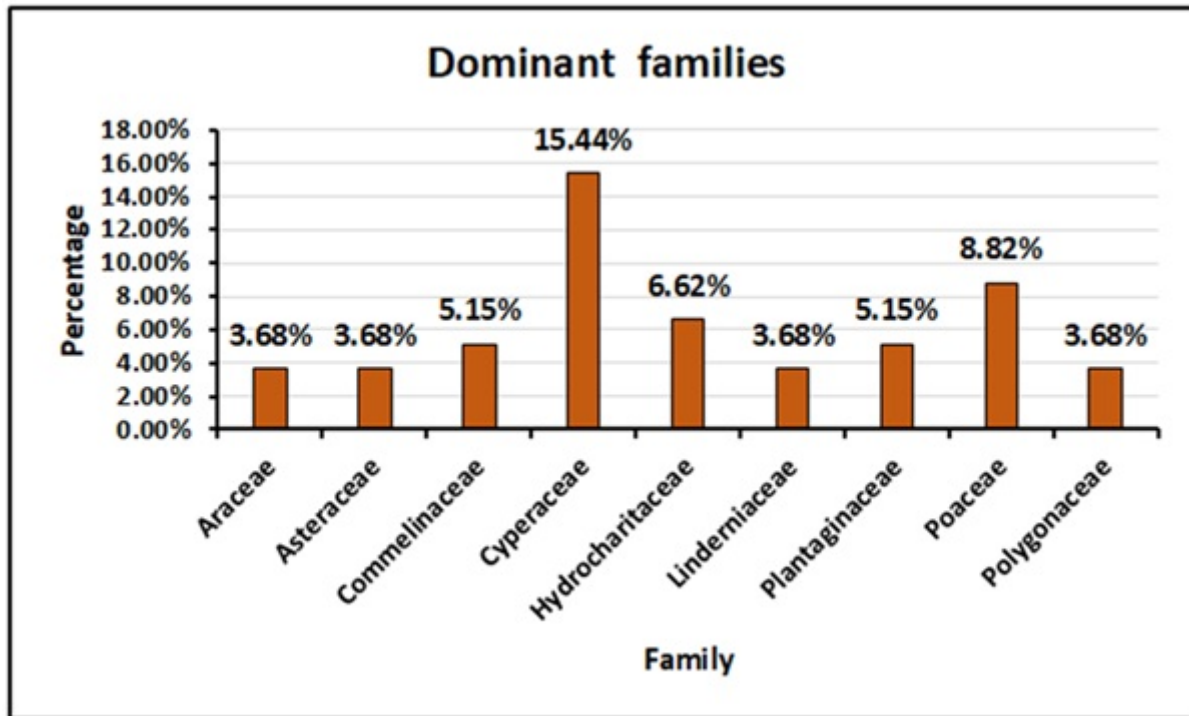


Figure 4: Distribution of dominant macrophyte families across the study sites (RCH-E01–E07 and RCH-W01–W08), showing relative contributions (%) of each family to the total species composition.

Table 2: List of macrophyte species recorded from the studied wetland in Ranchi district, showing their scientific names, families, plant types (PT), and growth forms (GF).

Sl. No.	Scientific Name	Family	PT	GF
1	<i>Abildgaardia ovata</i> (Burm.f.) Kral	Cyperaceae	M	E
2	<i>Acmella ciliata</i> (Kunth) Cass.	Asteraceae	D	E
3	<i>Acmella paniculata</i> (Wall. ex DC.) R.K. Jansen	Asteraceae	D	E
4	<i>Actinoscirpus grossus</i> (L.f.) Goetgh. & D.A. Simpson	Cyperaceae	M	E
5	<i>Aeschynomene indica</i> L.	Fabaceae	D	E
6	<i>Alternanthera paronychioides</i> A.St.-Hil.	Amaranthaceae	D	E
7	<i>Alternanthera philoxeroides</i> (Mart.) Griseb.	Amaranthaceae	D	E
8	<i>Alternanthera sessilis</i> (L.) DC.	Amaranthaceae	D	E
9	<i>Alysicarpus monilifer</i> (L.) DC.	Fabaceae	D	E
10	<i>Ammannia baccifera</i> L.	Lythraceae	D	E
11	<i>Aponogeton natans</i> (L.) Engl. & Krause	Aponogetonaceae	M	RFL
12	<i>Aponogeton undulatus</i> Roxb.	Aponogetonaceae	M	S
13	<i>Azolla pinnata</i> R.Br.	Salviniaceae	F	FF
14	<i>Bacopa monnieri</i> (L.) Wettst.	Plantaginaceae	D	E
15	<i>Blyxa echinosperma</i> C.B. Clarke	Hydrocharitaceae	M	S
16	<i>Bonnaya oppositifolia</i> (Retz.) Spreng.	Linderniaceae	D	E
17	<i>Centella asiatica</i> (L.) Urb.	Apiaceae	D	E

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Table 2 continued from previous page

Sl. No.	Scientific Name	Family	PT	GF
18	<i>Ceratophyllum demersum</i> L.	Ceratophyllaceae	D	S
19	<i>Ceratophyllum muricatum</i> Cham.	Ceratophyllaceae	D	S
20	<i>Ceratopteris thalictroides</i> (L.) Brongn.	Pteridaceae	F	E
21	<i>Chara braunii</i> S.G. Gmel.	Characeae	MA	S
22	<i>Chara fibrosa</i> (Agardh ex Bruzelius) R.D. Wood	Characeae	MA	S
23	<i>Chara globularis</i> Thuill.	Characeae	MA	S
24	<i>Chenopodium ficifolium</i> Sm.	Chenopodiaceae	D	E
25	<i>Colocasia esculenta</i> (L.) Schott	Araceae	M	E
26	<i>Commelina erecta</i> L.	Commelinaceae	M	E
27	<i>Commelina benghalensis</i> L.	Commelinaceae	M	E
28	<i>Commelina diffusa</i> Burm. f.	Commelinaceae	M	E
29	<i>Cyanotis axillaris</i> (L.) D. Don ex Sweet	Commelinaceae	M	E
30	<i>Cyperus alulatus</i> J.Kern	Cyperaceae	M	E
31	<i>Cyperus brevifolius</i> (Rottb.) Hassk.	Cyperaceae	M	E
32	<i>Cyperus compressus</i> L.	Cyperaceae	M	E
33	<i>Cyperus difformis</i> L.	Cyperaceae	M	E
34	<i>Cyperus flavidus</i> Retz.	Cyperaceae	M	E
35	<i>Cyperus fuscus</i> L.	Cyperaceae	M	E
36	<i>Cyperus iria</i> L.	Cyperaceae	M	E
37	<i>Cyperus polystachyos</i> Rottb.	Cyperaceae	M	E
38	<i>Cyperus rotundus</i> L.	Cyperaceae	M	E
39	<i>Dentella repens</i> (L.) J.R. Forst. & G. Forst.	Rubiaceae	D	E
40	<i>Echinochloa colonum</i> (L.) Link	Poaceae	M	E
41	<i>Echinochloa crus-galli</i> (L.) P.Beauv.	Poaceae	M	E
42	<i>Eclipta prostrata</i> (L.) L.	Asteraceae	D	E
43	<i>Eleocharis acutangular</i> (Roxb.) Schult.	Cyperaceae	M	E
44	<i>Eleusine indica</i> (L.) Geartn.	Poaceae	M	E
45	<i>Enydra fluctuans</i> Lour.	Asteraceae	D	E
46	<i>Evolvulus nummularius</i> (L.) L.	Convolvulaceae	D	E
47	<i>Fimbristylis aestivalis</i> (Retz.) Vahl	Cyperaceae	M	E
48	<i>Fimbristylis albiviridis</i> C.B. Clarke	Cyperaceae	M	E
49	<i>Fimbristylis argentea</i> (Rottb.) Vahl	Cyperaceae	M	E
50	<i>Fimbristylis bisumbellata</i> (Forssk.) Bubani	Cyperaceae	M	E
51	<i>Fimbristylis littoralis</i> Gaudich	Cyperaceae	M	E
52	<i>Fuirena ciliaris</i> (L.) Roxb.	Cyperaceae	M	E
53	<i>Grangea maderaspatana</i> (L.) Poir.	Asteraceae	D	E
54	<i>Heliotropium indicum</i> L.	Boraginaceae	D	E
55	<i>Hydrilla verticillata</i> (L.f.) Royle	Hydrocharitaceae	M	S
56	<i>Hygrophila auriculata</i> (Schumach.) Heine	Acanthaceae	D	E
57	<i>Hygrophila polysperma</i> (Roxb.) T. An- derson	Acanthaceae	D	S
58	<i>Hygroryza aristata</i> (Retz.) Nees ex Wight & Arn.	Poaceae	M	S

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Table 2 continued from previous page

Sl. No.	Scientific Name	Family	PT	GF
59	<i>Ipomoea aquatica</i> Forssk.	Convolvulaceae	D	RFL
60	<i>Ipomoea carnea</i> Jacq.	Convolvulaceae	D	E
61	<i>Kyllinga melanosperma</i> Nees.	Cyperaceae	M	E
62	<i>Leersia hexandra</i> Sw.	Poaceae	M	E
63	<i>Lemna perpusilla</i> Torr.	Araceae	M	FF
64	<i>Limnophila aromatica</i> (Lam.) Merr.	Plantaginaceae	D	E
65	<i>Limnophila erecta</i> Benth.	Plantaginaceae	D	E
66	<i>Limnophila heterophylla</i> (Roxb.) Benth.	Plantaginaceae	D	E
67	<i>Limnophila laxa</i> Benth.	Plantaginaceae	D	E
68	<i>Limnophila sessiliflora</i> (Vahl) Blume	Plantaginaceae	D	S
69	<i>Lindernia parviflora</i> (Roxb.) Haines	Linderniaceae	D	E
70	<i>Lindernia procumbens</i> (Krock.) Borbans	Linderniaceae	D	E
71	<i>Lobelia alsinoides</i> Lam.	Campanulaceae	D	E
72	<i>Louisiella paludosa</i> (Roxb.) Landge	Poaceae	M	E
73	<i>Ludwigia adscendens</i> (L.) H. Hara.	Onagraceae	D	RFL
74	<i>Ludwigia perennis</i> L.	Onagraceae	D	E
75	<i>Ludwigia peruviana</i> (L.) H. Hara	Onagraceae	D	E
76	<i>Marsilea coromandelina</i> Willd.	Marsileaceae	F	E
77	<i>Marsilea minuta</i> L.	Marsileaceae	F	E
78	<i>Marsilea quadrifolia</i> L.	Marsileaceae	F	E
79	<i>Melilotus indicus</i> (L.) All.	Fabaceae	D	E
80	<i>Murdannia nudiflora</i> (L.) Brenan	Commelinaceae	M	E
81	<i>Murdannia spirata</i> (L.) G.Brückn.	Commelinaceae	M	E
82	<i>Murdannia vaginata</i> (L.) G. Briickn.	Commelinaceae	M	E
83	<i>Myriophyllum spicatum</i> L.	Haloragaceae	D	S
84	<i>Najas graminea</i> Delile	Hydrocharitaceae	M	S
85	<i>Najas indica</i> (Willd.) Cham.	Hydrocharitaceae	M	S
86	<i>Najas kurziana</i> Rendle.	Hydrocharitaceae	M	S
87	<i>Najas marina</i> L.	Hydrocharitaceae	M	S
88	<i>Najas minor</i> All.	Hydrocharitaceae	M	S
89	<i>Nelumbo nucifera</i> Geartn.	Nelumbonaceae	D	RFL
90	<i>Nymphaea nouchali</i> Burm.f.	Nymphaeaceae	D	RFL
91	<i>Nymphaea pubescens</i> Willd.	Nymphaeaceae	D	RFL
92	<i>Nymphaea rubra</i> Roxb. ex Andrews	Nymphaeaceae	D	RFL
93	<i>Nymphoides aquatica</i> (J.F. Gmel.) Kuntze	Menyanthaceae	D	RFL
94	<i>Nymphoides hydrophyllum</i> (Lour.) Kuntze	Menyanthaceae	D	RFL
95	<i>Nymphoides indica</i> (L.) Kuntze	Menyanthaceae	D	RFL
96	<i>Oldenlandia corymbosa</i> L.	Rubiaceae	D	E
97	<i>Oldenlandia diffusa</i> (Will) Roxb.	Rubiaceae	D	E
98	<i>Oryza rufipogon</i> Griff.	Poaceae	M	E
99	<i>Oryza sativa</i> L.	Poaceae	M	E
100	<i>Ottelia alismoides</i> (L.) Pers.	Hydrocharitaceae	M	S
101	<i>Panicum repens</i> L.	Poaceae	M	E

Continued on next page

Table 2 continued from previous page

Sl. No.	Scientific Name	Family	PT	GF
102	<i>Paspalum distichum</i> L.	Poaceae	M	E
103	<i>Paspalum scrobiculatum</i> L.	Poaceae	M	E
104	<i>Paspalum vaginatum</i> Sw.	Poaceae	M	E
105	<i>Persicaria barbata</i> (L.) H. Hara	Polygonaceae	D	E
106	<i>Persicaria glabra</i> (Willd) M. Gomez	Polygonaceae	D	E
107	<i>Persicaria hydropiper</i> (L.) Delabre	Polygonaceae	D	E
108	<i>Persicaria pulchra</i> Sojak	Polygonaceae	D	E
109	<i>Phyla nodiflora</i> (L.) Greene	Verbenaceae	D	E
110	<i>Pistia stratiotes</i> L.	Araceae	M	FF
111	<i>Polygonum plebeium</i> R.Br.	Polygonaceae	D	E
112	<i>Pontederia crassipes</i> Mart.	Pontederiaceae	M	FF
113	<i>Pontederia vaginalis</i> Burm.f.	Pontederiaceae	M	E
114	<i>Potamogeton crispus</i> L.	Potamogetonaceae	M	S
115	<i>Potamogeton nodosus</i> Poir.	Potamogetonaceae	M	S
116	<i>Pouzolzia zeylanica</i> (L.) Benn.	Urticaceae	D	E
117	<i>Ranunculus sceleratus</i> L.	Ranunculaceae	D	E
118	<i>Rotala indica</i> (Willd.) Koehne	Lythraceae	D	S
119	<i>Rotala rotundifolia</i> (Buch. -Ham. ex Roxb.) Koehne	Lythraceae	D	E
120	<i>Sagittaria guayanensis</i> Kunth	Alismataceae	M	RFL
121	<i>Salvinia cucullata</i> Bory	Salviniaceae	F	FF
122	<i>Salvinia natans</i> (L.) All.	Salviniaceae	F	FF
123	<i>Schoenoplectiella articulata</i> (L.) Lye	Cyperaceae	M	E
124	<i>Schoenoplectiella senegalensis</i> (Steud.) Lye	Cyperaceae	M	E
125	<i>Scleromitron brachypodum</i> (DC.) T.C. Hsu	Rubiaceae	D	E
126	<i>Spirodela polyrhiza</i> (L.) Schleid.	Araceae	M	FF
127	<i>Torenia anagallis</i> (Burm.f.) Wannan et al.	Linderniaceae	D	E
128	<i>Torenia crustacea</i> (L.) Cham. & Schltldl.	Linderniaceae	D	E
129	<i>Trapa natans</i> var. <i>bispinosa</i> (Roxb.) Makino	Trapaceae	D	RFL
130	<i>Typha domingensis</i> Pers.	Typhaceae	M	E
131	<i>Utricularia aurea</i> Lour.	Lentibulariaceae	D	S
132	<i>Utricularia australis</i> R.Br.	Lentibulariaceae	D	S
133	<i>Utricularia stellaris</i> L.f.	Lentibulariaceae	D	S
134	<i>Vallisneria spiralis</i> L.	Hydrocharitaceae	M	S
135	<i>Veronica anagallis-aquatica</i> L.	Plantaginaceae	D	E
136	<i>Wolffia globosa</i> (Roxb.) Hartog & Plas	Araceae	M	FF

Abbreviations: **PT** = Plant Types; **GF** = Growth Forms; **M** = Monocot; **D** = Dicot; **F** = Fern and Fern allies to indicate recorded Pteridophyte specimens; **MA** = Macroalga; **E** = Emergent; **S** = Submerged; **RFL** = Rooted with Floating Leaf; **FF** = Free Floating.

Table 3: Contribution (%) of non-dominant macrophyte families to the diversity in Ranchi District wetlands (RCH-E01–RCH-E07; RCH-W01–RCH-W08), indicating the number of genera, number of species, and their relative percentage share.

Name of the Family	No. of Genus	No. of Species	% Value of Species
Acanthaceae	1	2	1.47
Alismataceae	1	1	0.74
Amaranthaceae	1	3	2.21
Apiaceae	1	1	0.74
Aponogetonaceae	1	2	1.47
Boraginaceae	1	1	0.74
Campanulaceae	1	1	0.74
Ceratophyllaceae	1	2	1.47
Characeae	1	3	2.21
Chenopodiaceae	1	1	0.74
Convolvulaceae	2	3	2.21
Fabaceae	3	3	2.21
Haloragaceae	1	1	0.74
Lentibulariaceae	1	3	2.21
Lythraceae	2	3	2.21
Marsileaceae	1	3	2.21
Menyanthaceae	1	3	2.21
Nelumbonaceae	1	1	0.74
Nymphaeaceae	1	3	2.21
Onagraceae	1	3	2.21
Pontederiaceae	1	2	1.47
Potamogetonaceae	1	2	1.47
Pteridaceae	1	1	0.74
Ranunculaceae	1	1	0.74
Rubiaceae	3	4	2.94
Salviniaceae	2	3	2.21
Trapaceae	1	1	0.74
Typhaceae	1	1	0.74
Urticaceae	1	1	0.74
Verbenaceae	1	1	0.74

4 Discussion

The inventory of 15 wetlands across Ranchi district (Table 1) revealed notable variation in macrophyte richness, ranging from 20 species at Umedanda Talab (RCH-W08) to 44 species at Patratoli Bara Talab (RCH-W06), with a mean of 30.6 species per wetland. Species richness did not always correspond to wetland size; for instance, the smaller Patratoli Bara Talab (2.02 ha) supported more species than the larger Pithoria Jora Talab (7.26 ha) and

Umedanda Talab (2.67 ha). This suggests that local catchment conditions, such as agricultural runoff, sewage inflow, and effluents exert a stronger influence on community composition than size alone. Similar observations have been made in tropical and subtropical wetlands, where nutrient inflows increased richness in smaller sites, although some studies report a positive size–richness relationship [32, 33, 34]. The heterogeneity recorded here also parallels findings from central Indian wetlands, where anthropogenic pressures and

hydrological regimes were found to be more critical determinants of macrophyte assemblages than wetland area [35]. Mechanistically, nutrient enrichment enhanced habitat heterogeneity and productivity in some sites, while disturbances such as pollution and habitat degradation reduced richness in others. This highlights the role of catchment-level processes in structuring macrophyte communities.

The floristic survey recorded a total of 136 macrophyte species belonging to 78 genera and 39 families (Table 2), reflecting the high taxonomic diversity of Ranchi wetlands. Dicots (64 species, 25 families) slightly outnumbered monocots (62 species, 10 families), while pteridophytes (7 species, 3 families) and macroalgae (3 species, Characeae) were comparatively less represented (Fig. 2). This composition indicates a flora dominated by angiosperms, with specialized groups occupying restricted ecological niches. Comparable patterns have been reported from other Indian wetlands, where dicots and monocots are the primary groups and pteridophytes and charophytes occur less frequently [35]. Unlike many tropical wetlands where monocots, particularly Poaceae and Cyperaceae, dominate richness [11, 36], dicots slightly surpassed monocots in Ranchi, reflecting local floristic variation. The presence of specialized taxa such as *Marsilea spp.* and *Chara spp.* is consistent with observations from central and eastern India, where seasonal hydrological regimes favor niche-adapted groups [33]. The near balance between dicots and monocots suggests heterogeneous habitats across the wetlands, while the restricted distribution of pteridophytes and charophytes highlights their sensitivity to hydrological and water-quality fluctuations.

Analysis of growth forms further demonstrated a clear dominance of emergent species (91 species; 66.91%), followed by submerged (25 species; 18.38%), rooted floating-leaved (12 species; 8.82%), and free-floating taxa (8 species; 5.88%) (Ta-

ble 2; Figure 2). Widespread emergents such as *Cyperus iria*, *Paspalum distichum*, *Echinochloa colonum*, *Alternanthera sessilis*, and *Panicum repens* formed the structural backbone of wetland vegetation, while rooted floating-leaved taxa (*Nymphaea pubescens*, *Trapa natans*) and free-floating forms (*Lemna perpusilla*) added to diversity. The dominance of emergents indicates that Ranchi wetlands provide extensive shallow littoral zones with nutrient-rich sediments, conditions that strongly favor rooted emergent growth. Such patterns have been widely reported from Indian and tropical wetlands, where emergents thrive under fluctuating hydrological regimes [33, 35]. Submerged species were comparatively less diverse, consistent with findings from nutrient-enriched or disturbed systems [35]. In contrast, oligotrophic and hydrologically stable wetlands elsewhere often support greater representation of submerged and floating-leaved forms [4, 36]. Collectively, the predominance of emergents reflects the interplay of shallow habitats, nutrient enrichment, and resilience to seasonal fluctuations in water levels. This underscores their structural and ecological importance.

Family-level analysis revealed nine dominant families, each contributing more than 3.5% of total richness (Fig. 3). Cyperaceae (21 species; 15.44%) was the most speciose, followed by Poaceae (12 species; 8.82%), Hydrocharitaceae (9 species; 6.62%), Plantaginaceae and Commelinaceae (7 species each; 5.15%). Araceae, Asteraceae, Linderniaceae, and Polygonaceae contributed five species each (3.68%). The predominance of Cyperaceae and Poaceae reflects their ecological adaptability to shallow, nutrient-rich habitats, a feature widely reported in Indian wetlands [31, 33, 34]. Hydrocharitaceae, another important contributor, is also recognized as a widespread and functionally significant family in tropical Asian aquatic systems [4]. The success of these families can be attributed to their wide ecological amplitude, vegetative

propagation, and tolerance of hydrological variability. These characteristics underscore their role as ecological keystones.

In contrast, 30 families were non-dominant, each contributing less than 3.5% of species richness. Rubiaceae was the most represented with four species (2.94%), followed by 10 families with three species each (2.21%), five families with two species (1.47%), and 13 families represented by a single species (0.74%). This uneven distribution, where a few dominant families coexist with many species-poor families, is a characteristic feature of tropical wetlands [33, 34]. Despite their low numerical representation, several non-dominant families such as Nymphaeaceae, Salviniaceae, and Characeae are ecologically significant, contributing to habitat complexity, nutrient cycling, and niche specialization [4, 37]. Similar uneven patterns of family-level richness have been reported in other Indian wetlands [38]. The prevalence of these non-dominant families likely reflects habitat heterogeneity, with specialized taxa restricted to particular microhabitats but showing limited ecological amplitude compared to dominant groups. Importantly, their contribution to ecological balance and functional diversity highlights the need to include both dominant and non-dominant families in conservation strategies.

5 Conclusion

Macrophyte diversity in the wetlands of Ranchi district is shaped more by catchment conditions than by wetland size, with nutrient inflows enhancing species richness and pollution reducing it. The assemblages are dominated by angiosperms and emergent macrophytes, with Cyperaceae and Poaceae forming the ecological backbone, while specialized pteridophytes, macroalgae, and non-dominant families contribute critically to resilience, functional diversity, and ecosystem balance. Effective conservation should therefore pri-

oritize catchment management and pollution control, and the protection of both dominant and non-dominant taxa is essential to ensure long-term ecological integrity.

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Conflict of Interest Statement

The authors hereby declare that they have no conflicts of interest regarding the publication of this manuscript. The authors also confirm that no financial or personal relationships with any organization influenced the research reported herein.

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