

Studies on aquatic and semi-aquatic plants growing in and around fisheries ponds of Doranda, Ranchi, Jharkhand

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ABSTRACT

Aquatic and semi-aquatic plants are vital components of freshwater ecosystems. It contributes significantly to ecological stability and productivity. The current study investigates the diversity, ecological significance, and utility of aquatic macrophytes i.e. aquatic and semi-aquatic plant species in the fisheries ponds of Doranda, Jharkhand, India. These man-made ponds, has been developed under the Directorate of Fisheries GOJ, supports a rich assemblage of aquatic flora alongside fish culture activities. Regular field surveys were conducted for a period of two years with seasonal sampling in order to document maximum species during their flowering and fruiting time. Collected specimens were taxonomically identified using standard available floras and keys. The study reflects a total of 51 species distributed over 35 genera and 24 families, indicating somewhat high taxonomic diversity. Out of these, dicotyledons (31 species; ~61%) dominated over monocotyledons (20 species; ~39%), suggesting strong adaptation of dicots to ecotonal and marginal habitats, while monocots were primarily confined to true aquatic conditions. Amongst families, Asteraceae and Amaranthaceae were prominent among dicots, whereas Cyperaceae, Hydrocharitaceae, and Pontederiaceae dominated among monocots. The genus *Cyperus* has maximum representation, showing ecological plasticity and tolerance to fluctuating hydrological conditions. Ecological categorisation revealed the coexistence of submerged (e.g., *Hydrilla*, *Vallisneria*), floating (e.g., *Eichhornia*, *Pistia*), and emergent (e.g., *Cyperus*, *Ludwigia*) forms, indicating habitat heterogeneity and functional complexity. The existence of carnivorous taxa like *Utricularia* suggests microhabitat variability. These macrophytes play a vital role in maintenance of water quality, supports fish productivity, facilitating nutrient cycling, and provides habitat diversity. However, the occurrence of invasive species like *Eichhornia crassipes* and *Pistia stratiotes* indicates nutrient enrichment and potential ecological imbalance. The study reflects that the Doranda Pond ecosystem having taxonomically diverse, structurally complex, and ecologically stable. The amalgamation of floristic assessment with ecological interpretation provides a baseline for conservation of biodiversity and sustainable management of freshwater resources.

Key Words - Aquatic macrophytes, biodiversity, hydrophytes, Doranda ponds, ecological significance, phytoremediation, Jharkhand.

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INTRODUCTION

Aquatic and semi-aquatic plants, commonly referred as hydrophytes or macrophytes, are vital components of freshwater ecosystems due to their role in maintaining ecological balance and productivity. These plants spend either their entire life cycle or a part of it in aquatic environments and shows specialized adaptations for survival under waterlogged conditions. They are broadly classified into submerged, floating, and emergent categories based on their growth forms (K. Subramanyam, 1962; C.D.K. Cook, 1996).

Aquatic macrophytes plays a crucial role as primary producers i.e. oxygen suppliers, as well as habitat providers for aquatic organisms. These plants also contribute significantly to nutrient cycling and help in maintaining water quality (O.P. Gupta, 1979; K.R. Naskar, 1990).

The fisheries ponds of Doranda, Ranchi, shows artificial aquatic ecosystems developed under the Directorate of Fisheries, Government of Jharkhand. In spite their artificial origin, these pond supports rich biodiversity similar to natural wetlands, as observed in other regions of Jharkhand (U.N. Jha, 1965; M.P. Singh, 1990).

Floristic studies on aquatic vegetation have been conducted in different parts of India, including Bihar, Jharkhand, and adjacent regions (H.H. Haines, 1921–25; H.F. Mooney, 1950; P. Kachroo, 1959; J.K. Maheshwari, 1960; N.C. Majumdar, 1965).

In Jharkhand, several workers have contributed to the understanding of aquatic plant diversity and their ecological importance (Mukherjee, 2001; Mukherjee & Kumar, 2003; Mukherjee *et al.*, 2006; Singh, 1998; Verma & Pandey, 2007, 2008; Jha, 2015). Recent studies have also emphasized the economic and ecological significance of aquatic plants in regional water bodies (Mukherjee & Ghosh, 2015; Mukherjee & Kumar, 2019; Mukherjee, 2019).

REVIEW OF LITERATURE

Aquatic and semi-aquatic plants have been widely studied across India due to their ecological, economic, and environmental significance. The

pioneer foundational work on the aquatic flora of eastern India was carried out by H.H. Haines (1921–1925), who worked on the vegetation of Bihar and Orissa, which provides one of the earliest systematic accounts of regional plant diversity. This work was later supplemented by H.F. Mooney (1950).

Detailed ecological and floristic investigations of aquatic vegetation began to emerge in the mid-20th century. P. Kachroo (1959) studied the aquatic vegetation of the Damodar Valley and highlighted the ecological importance of hydrophytes in pond ecosystems. Similarly, J.K. Maheshwari (1960) analysed marsh and swamp vegetation, which emphasise species adaptation to hydric conditions. K. Subramanyam (1962) provided a comprehensive account of aquatic angiosperms in India, establishing a taxonomic and ecological framework which continues to guide modern studies.

Regional studies in eastern India further enriched the understanding of aquatic flora. Worker like N.C. Majumdar (1965) documented aquatic and semi-aquatic plants of Calcutta and adjacent areas, while U.N. Jha (1965) conducted one of the earliest studies on hydrophytes in Ranchi, and their ecological roles in freshwater systems. These studies collectively highlight the diversity and ecological importance of macrophytes in eastern Indian wetlands.

O.P. Gupta (1979) discussed the dual role of aquatic plants as both beneficial components and problematic weeds, mainly emphasising invasive species such as *Eichhornia crassipes*. K.R. Naskar (1990) provided an extensive account of aquatic and semi-aquatic plants of the lower Ganga delta, including their ecological adaptations and uses.

In Jharkhand, several significant contributions have been made toward understanding aquatic biodiversity. M.P. Singh (1990) studied hydrophytes of Ranchi, while Singh (1998) analysed floristic composition and vegetation structure in Hazaribagh. These studies emphasized the influence of local environmental conditions on species distribution.

Verma and Pandey (2007, 2008) documented the ethnomedicinal uses and floristic composition of aquatic plants in Ranchi, highlighted their socio-economic importance. H.K. Jha (2015) worked on aquatic plant diversity in Jamtara district, contributing to regional biodiversity knowledge.

Significant contributions have also been made by Prasanjit Mukherjee and collaborators. Mukherjee (2001) who conducted detailed floristic and ecological studies in Lohardaga, while Mukherjee and Kumar (2003) analyzed aquatic flora of Ranchi ponds. Subsequent studies (Mukherjee *et al.*, 2006; Mukherjee & Ghosh, 2015; Mukherjee & Kumar, 2019; Mukherjee, 2019) emphasised the ecological, economic, and conservation importance of aquatic macrophytes in Jharkhand.

In spite these extensive studies, there remains a lack of integrated research combining floristic diversity, geospatial analysis, and quantitative ecological indices, particularly in artificial

ecosystems like fisheries ponds. The present study addresses this gap by combining taxonomic documentation, GIS-based spatial analysis, and biodiversity indices, thereby providing a comprehensive understanding of aquatic plant diversity in Doranda fisheries ponds.

MATERIALS & METHODS

The study was conducted in 15 interconnected fisheries ponds located near Doranda, Ranchi, Jharkhand. For a period of two years. Regular field visits were conducted in all the fish ponds twice or thrice in every season to collect the maximum plants in their flowering and fruiting time. The plants were collected brought in the laboratory, properly dissected and identified with the help of local available floras and taxonomic keys.

OBSERVATION

A total of 51 species were reported which are distributed over 35 genera and 27 families. The plants species were placed in table I

Table 1- List of Plants of Doranda fish pond with their families and Flowering and Fruiting time

| Sl. No. | Name | Family | Dicot/ Monocot | Flowering/ Fruiting time |
|---------|---|------------------|-------------------|-----------------------------|
| 1 | <i>Alternanthera philoxeroides</i> (Mart.) Griseb. | Amaranthaceae | D | April- Aug. |
| 2 | <i>Aponogeton undulatus</i> Roxb | Aponogetonaceae | M | July- Dec. |
| 3 | <i>Aponogeton natans</i> (Linn.) Engl. & Krause in Engl., | Aponogetonaceae | M | July –Dec. |
| 4 | <i>Coldenia procumbens</i> L | Boraginaceae | D | Nov.-May |
| 5 | <i>Ceratophyllum demersum</i> Linn | Ceretophyllaceae | D | Sep.-Feb. |
| 6 | <i>Chenopodium murale</i> Linn., | Amaranthaceae | D | Oct.-March |
| 7 | <i>Centella asiatica</i> (Linn.) Urban | Apiaceae | D | Feb.-Nov. |
| 8 | <i>Commelina benghalensis</i> Linn. | Commelinaceae | M | July-Nov. |
| 9 | <i>Cyperus rotundus</i> Linn | Cyperaceae | M | June-Jan. |
| 10 | <i>Cyperus corymbosus</i> Rottb. | Cyperaceae | M | Oct.-Nov. |
| 11 | <i>Cyperus iria</i> L. | Cyperaceae | M | Aug.-Nov. |
| 12 | <i>Cyperus difformis</i> Linn | Cyperaceae | M | Aug.-Dec. |
| 13 | <i>Eclipta prostrate</i> l. | Asteraceae | D | Throughout the year |
| 14 | <i>Eichhornia crassipes</i> (Mart.) Solms in Dc. | Pontederiaceae | M | April-Nov. |
| 15 | <i>Enydra fluctuans</i> Lour. | Asteraceae | D | Dec.-March |
| 16 | <i>Hygrophila auriculata</i> (Schum.) Heine | Acanthaceae | D | Sept.-Feb. |
| 17 | <i>Hygrophiza aristata</i> (Retz.) Nees ex wt. & Arn. | Poaceae | M | Aug.-Oct. |
| 18 | <i>Hydrilla verticillata</i> (Linn. f.) Royle, | Hydrocharitaceae | M | Nov.-Jan. |
| 19 | <i>Ipomoea aquatica</i> Forssk. | Covolvulaceae | D | Sept.-Feb. |
| 20 | <i>Ipomoea carnea</i> Jacq. | Covolvulaceae | D | Throughout the year |
| 21 | <i>Ludwigia adscendens</i> (Linn.) Hara | Onagraceae | D | Whole year |
| 22 | <i>Ludwigia perennis</i> Linn. | Onagraceae | D | Aug.-Jan. |
| 23 | <i>Lemna perpusilla</i> Torrey | Lemnaceae | M | May-Sept. |
| 24 | <i>Monochoria hastata</i> (Linn.) Solms | Pontederiaceae | M | July-Nov. |
| 25 | <i>Monochoria vaginalis</i> (Burm. f.) Presl, Rel. Haenk | Pontederiaceae | M | July-Nov. |
| 26 | <i>Najas minor</i> All | Najadaceae | M | Sept. –Jan. |
| 27 | <i>Nymphaea pubescens</i> Willd | Nympheaceae | D | Aug.-Nov. |

| | | | | |
|----|--|------------------|---|---------------------|
| 28 | <i>Nymphaea rubra</i> Roxb. ex-Andrews | Nymphaeaceae | D | Aug.-Nov. |
| 29 | <i>Nelumbo nucifera</i> Gaertn., | Nelumbonaceae | D | July-Nov. |
| 30 | <i>Nymphoides hydrophylla</i> (Lour.) Kuntze | Menyanthaceae | D | July-Nov. |
| 31 | <i>Nymphoides indica</i> (Linn.) Kuntze. | Menyanthaceae | D | Whole year |
| 32 | <i>Ottelia alismoides</i> (Linn.) Pers. | Hydrocharitaceae | M | Sept.-Jan. |
| 33 | <i>Oldenlandia corymbosa</i> Linn. | Rubiaceae | D | July. - Jan. |
| 34 | <i>Phyla nodiflora</i> (Linn.) Greene | Verbenaceae | D | Throughout the year |
| 35 | <i>Perscaria glabra</i> (Willd.) M.Gomez. | Polygonaceae | D | Oct.-March |
| 36 | <i>Perscaria barbata</i> (L.)H.Hara | Polygonaceae | D | Oct.-March |
| 37 | <i>Potamogeton nodosus</i> Poir. in Lamk | Potamogetonaceae | M | Oct.-March |
| 38 | <i>Potamogeton crispus</i> Linn. | Potamogetonaceae | M | Oct.-March |
| 39 | <i>Portulaca oleraceae</i> Linn | Portulacaceae | D | Oct.-March |
| 40 | <i>Pistia stratiotes</i> Linn. | Araceae | M | May-Dec. |
| 41 | <i>Ranunculus sceleratus</i> Linn. | Ranunculaceae | D | Nov.- Feb. |
| 42 | <i>Rumex dentatus</i> Linn | Polygonaceae | D | Dec.- June |
| 43 | <i>Sagittaria trifolia</i> Linn | Alismataceae | M | Oct.-March |
| 44 | <i>Spilanthes calva</i> D.C. | Asteraceae | D | Sept.-March |
| 45 | <i>Spirodela polyrhiza</i> (Linn.) Schleid. | Araceae | M | April-Nov. |
| 46 | <i>Spaeranthus indicus</i> L. | Asteraceae | D | Dec.-April |
| 47 | <i>Utricularia aurea</i> Lour., | Lentibulariaceae | D | Oct. – Jan. |
| 48 | <i>Utricularia stellaris</i> L. | Lentibulariaceae | D | Oct. – Feb. |
| 49 | <i>Vallisneria spiralis</i> Linn. | Hydrocharitaceae | M | Nov.-March |
| 50 | <i>Wolffia globosa</i> (Roxb.) Hartog & Plas | Araceae | M | July-Oct. |
| 51 | <i>Zannichellia palustris</i> Linn | Potamogetonaceae | M | Oct.-March |



Fig. 1 & 2- Satellite images of Doranda fish Pond

DISCUSSION

The total floristic composition remains unchanged at 51 species, distributed across 35 genera and 24 families, indicating a moderately high level of taxonomic diversity. With the revised classification, the number of dicot species increases slightly, resulting in 31 dicots and 20 monocots. This shift further strengthens the dominance of dicotyledonous taxa, which now constitute

approximately 61% of the total flora, while monocots account for about 39%. This pattern suggests that dicots are more adaptable to ecotonal conditions, particularly along pond margins and shallow water zones, whereas monocots continue to dominate strictly aquatic niches.

At the family level, dicotyledonous families now show increased representation and internal

consolidation. *Amaranthaceae*, for instance, now includes both *Alternanthera philoxeroides* and *Chenopodium murale*, making it relatively more prominent within the flora. *Asteraceae* remains the most dominant dicot family with five species, followed by *Polygonaceae* with three species after the reassignment of *Chenopodium*. Other well-represented dicot families include *Convolvulaceae*, *Onagraceae*, *Menyanthaceae*, and *Lentibulariaceae*, each contributing multiple species and reflecting ecological versatility.

Monocot families, though fewer in number, continue to play a crucial ecological role. *Cyperaceae* remains the most dominant monocot family with four species, followed by *Hydrocharitaceae*, *Pontederiaceae*, and *Potamogetonaceae*. These families are typically associated with submerged, floating, or emergent hydrophytes and indicate stable aquatic conditions.

At the genus level, the distribution remains consistent with earlier observations. The genus *Cyperus* continues to be the most dominant with four species, highlighting its ecological plasticity and tolerance to fluctuating water levels. Several genera such as *Nymphaea*, *Ipomoea*, *Ludwigia*, *Persicaria*, *Potamogeton*, and *Utricularia* are represented by two species each, indicating moderate genus-level diversification without excessive dominance. This reflects a balanced community structure with niche partitioning.

Ecologically, the revised dataset reinforces earlier interpretations. The dominance of dicots suggests strong influence of semi-aquatic and marginal habitats, while monocots are indicative of permanent aquatic conditions. The coexistence of submerged (*Hydrilla*, *Vallisneria*), floating (*Eichhornia*, *Pistia*), and emergent (*Cyperus*, *Ludwigia*) growth forms reflects habitat heterogeneity and functional complexity. Additionally, the presence of genera like *Utricularia* points toward microhabitats with varying nutrient conditions.

The corrected classification enhances the scientific accuracy of the dataset without altering its ecological conclusions. The Doranda Pond

ecosystem can still be characterized as taxonomically diverse, structurally complex, and ecologically stable, with a slight predominance of dicotyledonous flora and a well-represented assemblage of aquatic monocots supporting core ecosystem functions.

Ecology and Uses

The ecological categorization of aquatic macrophytes recorded from the Doranda fish ponds clearly reflects functional diversity and habitat specialization within the ecosystem. The submerged category, represented by genera such as *Hydrilla*, *Vallisneria*, and *Najas*, plays a crucial role in maintaining underwater ecological processes, particularly oxygenation and nutrient balance. Floating species, including *Eichhornia crassipes*, *Pistia stratiotes*, and *Lemna*, dominates the water surface and are typically associated with nutrient-rich conditions, often usually acting as indicators of eutrophication. Emergent plants such as *Cyperus*, *Ipomoea*, and *Ludwigia* inhabit the interface between land and water, which contributes significantly to shoreline stabilisation and provides structural habitat complexity.

These ecological groups collectively contribute to overall functioning of the aquatic ecosystem. Aquatic plants help in maintaining water quality by regulating nutrient levels and trapping sediments, hence reduces turbidity. They support productivity of fish by providing breeding grounds, shelter, and feeding habitats, which are essential for sustaining fisheries. Additionally, the diversity of growth forms enhances habitat heterogeneity, supporting a wide range of aquatic organisms. Importantly, many of these species' act as bioindicators, reflecting nutrient status and levels of pollution within the water bodies.

Beyond ecological roles, the recorded plant species possess substantial economic and utilitarian value. A significant number of species are used in traditional medicine. For instance, *Centella asiatica* is widely recognized for its role in memory enhancement and wound healing, while *Eclipta prostrata* is used in treating liver disorders and promoting hair growth. Similarly, *Enydra fluctuans*,

Hygrophila auriculata, *Ranunculus sceleratus*, *Rumex dentatus*, and *Spilanthes calva* are valued for their anti-inflammatory, renal, digestive, and analgesic properties.

Several aquatic plants also serve as important food sources. *Ipomoea aquatica* is a commonly consumed leafy vegetable, whereas *Nelumbo nucifera* provides edible rhizomes and seeds. Species of *Nymphaea* and *Portulaca oleracea* also contribute to local diets, highlighting the nutritional importance of aquatic flora. In addition, certain plants function as fodder resources, with *Alternanthera philoxeroides*, *Cyperus* species, and *Phyla nodiflora* being utilized as livestock feed, particularly in rural areas.

The aesthetic value of aquatic plants is also notable. Ornamental species like *Nymphaea pubescens*, *Nymphaea rubra*, and *Nelumbo nucifera* are widely used in water gardens and landscaping, while *Monochoria* species add to aquatic ornamental diversity. Moreover, several species play a key role in phytoremediation and water purification. Notably, *Eichhornia crassipes* and *Pistia stratiotes* are capable of absorbing heavy metals and excess nutrients, while small floating plants such as *Lemna*, *Spirodela*, and *Wolffia* are efficient in nutrient removal from wastewater.

Submerged macrophytes like *Hydrilla verticillata*, *Vallisneria spiralis*, and *Ceratophyllum demersum* act as oxygenators, which are particularly important for maintaining dissolved oxygen levels in fisheries. Emergent and marginal plants such as *Ipomoea carnea*, *Ludwigia* species, and *Persicaria* species contribute to soil binding and erosion control, thereby stabilizing pond margins.

Some species, despite their ecological roles, act as problematic weeds. *Eichhornia crassipes* and *Pistia stratiotes* are invasive and can form dense mats that hinder water flow, reduce light penetration, and disrupt aquatic ecosystems. *Cyperus rotundus* is another persistent weed which can dominate disturbed habitats.

Aquatic plants also play a vital role in supporting fish habitats and nursery grounds. Species like

Najas minor, *Potamogeton* spp., and *Ottelia alismoides* provide shelter and spawning substrates for fish and other aquatic organisms. Additionally, several species have specialized uses; for example, *Cyperus rotundus* is used in perfumery due to its aromatic properties, *Sagittaria trifolia* produces edible tubers, and *Aponogeton* species are popular in aquarium cultivation.

The aquatic plant diversity of Doranda ponds shows a strong linkage between ecological functionality and economic utility. The coexistence of beneficial, utilitarian, and invasive species highlights the need for balanced management strategies to conserve biodiversity while optimising ecosystem services.

CONCLUSION

The study reveals that Doranda fisheries ponds support a rich diversity of aquatic and semi-aquatic flora, which plays a vital role in maintaining ecological balance and enhancing fish productivity. The presence of economically important and ecologically functional species highlights the need for sustainable management and conservation of these aquatic ecosystems. Proper control of invasive species and promotion of beneficial macrophytes can significantly improve fisheries output and biodiversity conservation.

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