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Floristic Composition and Ecological Significance of Dominant Aquatic and Wetland Plant Families in Wardha District Reservoirs, Maharashtra

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Abstract: The present study is an extensive assessment of the floristic composition, ecological distribution, life-form spectrum, and environmental importance of the macrophytes of aquatic and wetland environments in Wardha District, Maharashtra State, India. In-field surveys undertaken from 2022 to 2025, covering major aquatic habitats such as the Vena River (Hinganghat), Lal Nalla Dam (Samudrapur), Dham River, and Pulgaon River (Wardha), documented a unique collection of aquatic plants.

In total, 41 species of aquatic macrophytes distributed among 22 families were identified and systematically analyzed. According to the systematic analysis, Cyperaceae is the definite dominant family in the region (6 major species), followed by Asteraceae (5 species), Convolvulaceae (4 species), Poaceae (4 species), and Amaranthaceae (2 species). The morphological grouping into ecological eco-groups has confirmed a clear dominance of emergent hydrophytes (70.7%), alongside a lower presence of submerged (12.2%), free-floating (9.8%), and rooted floating-leaved (7.3%) hydrophytes.

Ecologically speaking, these aquatic and wetland plants play a critical role in regulating nutrient cycling, stabilizing substrates, serving as carbon sinks, and bioremediating domestic sewage and industrial waste. The current inventory is crucial for the primary dataset needed for the preservation of the wetlands, microclimate assessment, and management of freshwater resources in the Vidarbha Region.

Keywords: Aquatic Macrophytes, Cyperaceae, Wardha District, Vena River, Ecological Indicators, Bio-remediation, Emergent Hydrophytes.

1. Introduction

Wetlands are “biological supermarkets”, which provide immense food that attracts many animal species for the completion of their life cycle. They are also very sensitive to change. These areas are between the land and the water. The wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water (Mitsch & Gosselink 1986). They are repositories of diverse species of microbes, plants, insects, amphibians, reptiles, birds, fish, and mammals. The ideal climate, landscape (topology), geology, movement, and abundance of water help the flora and fauna inhabiting the wetland ecosystems.

Wetlands of India, estimated to be 58.2 million hectares, include the areas of wet paddy cultivation. The majority of the inland wetlands are directly or indirectly dependent on the major rivers like the Ganga, Brahmaputra, Narmada, Godavari, Krishna, Kaveri, and Tapti. They occur in the hot arid regions of Gujarat and Rajasthan, the deltaic regions of east and west coasts, highlands of central India, wet humid zones of south peninsular India, and the Andaman and Nicobar & Lakshadweep islands (Prasad et al. 2002). They are also a great purifier of water by absorbing excess nutrients, sediment, and other pollutants before they reach rivers, lakes, and other water bodies.

Wetlands directly or indirectly have an enormous ecological, economic, commercial, and socio-economic importance and value. Such lands constitute a very rich biodiversity of flora and fauna of important local, natural, and regional significance (Anonymous, 2010).

In the Vidarbha region of Central India, the water is not very healthy due to anthropogenic activity; people use a lot of water for farming and cities. The Wardha District is an area of land that has many rivers, including the Wardha, Vena, Yashoda, Bakli, and Dham rivers, and it also has man-made lakes like the Lal Nalla Dam and Bor Dam. These water bodies are very important to farmers, and they also support plants and animals that live in and around them.

The wetlands in Wardha are in trouble because people are filling them in with trash farming on the land, and non-native plants like Eichhornia crassipes are taking over. We need to learn more about the plants that live in the wetlands, what kinds of groups they belong to, and how they help the environment. This study is about the aquatic and wetland plants that live in the water and wetlands of Wardha District. It will help us figure out how to protect them.

2. Materials and Methods

Study Area -

Wardha District, situated in the Vidarbha region of Maharashtra, has some of the wetland ecosystems with significant benefits regarding the biodiversity and the ecological balance of the region. The district lies in the geographical coordinates covering 6,309 square kilometers between 20°18' and 21°21' north geographical latitude and 78°30' to 79°15' east geographical longitude. The Wardha, Vena, and Yashoda rivers, which border Wardha, form fertile floodplains and a myriad of wetlands. These water bodies harbor many plants and animals; hence they are big ecological zones in the district.

The district has a tropical wet and dry climate with annual average rainfall of 900 mm to 1100 mm, with heavy concentration during the south-west monsoon (June-September). Representative sampling was provided by selecting four different ecotonal nodes:

- Vena River Basin (Hinganghat Area): Heavy industrial discharges and agricultural runoffs.
- Lal Nalla Reservoir (Samudrapur Tehsil): A large lake system with extensive seasonal shoreline drawdowns.
- River Segments of Pulgaon River: Riverine channels with sand-gravel margins and high domestic water use.
- Dham River Catchment zones: These are slow water flow zones having dense patches of marginal vegetation.

Field Sampling -

The field surveys every two months over a period of time to see the different plants that grow at different times of the year. We used a method to sample the plants by putting grids down from the land into the water, going down as deep as one and a half meters.

Taxon Preservation and Identification

We collected plants. Gave each one a special number so we could keep track of them. We followed the steps to take care of the plants and used books and online databases from our region to figure out what kind of plants they were. We checked the names of the plants with a list of names from around the world.

Functional Group Classification-

We put the plants into four groups based on where they were in the water and what they looked like.

* Floating plants are the ones that float on the surface of the water and are not attached to anything.

* Rooted with Floating Leaves plants have roots in the mud at the bottom of the water. Their leaves float on the surface.

* Submerged plants live their whole lives underwater.

* Emergent plants or Wetland Marshland species are the ones that live in the mud and have parts that stick up out of the water.

3. Results and Discussion

Floristic Composition and Family Dominance

The field study found that there are 41 kinds of plant species in the area. These plants belong to 35 groups and 22 families of flowering plants. When we investigated the different areas, we noticed that the most of the families had a lot more plants than others. This tells us that some plants are better at living in the Vidarbha area than others.

The family Cyperaceae species are dominant in Wardha's wetlands. There are 6 species of the family Cyperaceae, which is about 15% of all the plants in the area. These plants have roots that help them grow in wet soil with little oxygen. The next common family is Asteraceae with 5 different kinds of species. Even though most plants in this family live on land, the ones in Wardha's wetlands can also live in water.

The families Convolvulaceae and Poaceae each have 4 kinds of plant species. The family Amaranthaceae has 2 plant species. The other 17 families only have one kind of plant each. This shows that there is variation in plant species in the area, even though some families are more common than others.

Taxon Checklist and Morpho-Ecological Profiles

The list of 41 aquatic and wetland plant species in the wetlands of Wardha District includes the family, its botanical name, common name, ecological group, and ecological niche is enumerated in the table below.

Table 1: Comprehensive Checklist of Aquatic and Wetland Macrophytes in Wardha District

Sr. No.	Botanical Name	Family	Local / Common Name	Eco-Group	Ecological Niche / Micro-habitat
1.	*Cyperus difformis* L.	Cyperaceae	Small-flower umbrella sedge	EM	Waterlogged mud along riverbanks
2.	*Cyperus iria* L.	Cyperaceae	Rice flatsedge	EM	Shallow ephemeral pools, irrigation canals
3.	*Cyperus articulatus* L.	Cyperaceae	Jointed flatsedge	EM	Permanent reservoir margins, marshy fringes
4.	*Cyperus involucratus* Rottb.	Cyperaceae	Umbrella plant	EM	Rocky or muddy margins of the Vena River
5.	*Cyperus pangorei* Rottb.	Cyperaceae	Chatai sedge	EM	Riverbeds, fast-drying streams
6.	*Cyperus pygmaeus* Rottb.	Cyperaceae	Dwarf sedge	EM	Exposed drying mudflats during summer
7.	*Eclipta alba* (L.) Hassk.	Asteraceae	Bhringraj	EM	Wet soil margins, drainage channels
8.	*Grangea maderaspatana* (L.) Poir.	Asteraceae	Madras carpet	EM	Drying muddy margins of dams

9.	*Cyathocline purpurea* (Buch. -Ham.) Kuntze	Asteraceae	Gangotra	EM	Shaded, moist rocky stream banks
10.	*Centipeda minima* (L.) A. Braun	Asteraceae	Nakchikni	EM	Damp soils near seasonal wallows
11.	*Spilanthes calva* DC.	Asteraceae	Akalkara	EM	Wet alluvial micro-habitats
12.	*Ipomoea aquatica* Forsk.	Convolvulaceae	Nali ni bhaji / Kangkong	RFL	Stagnant pools, slow river channels
13.	*Ipomoea fistulosa* Mart. ex-Choisy	Convolvulaceae	Besharam	EM	Invasive on riverbanks and dam margins
14.	*Merremia gangetica* (L.) Cufod.	Convolvulaceae	Undirkani	EM	Moist soils along riparian margins
15.	*Murdannia spicata* (L.) Brenan	Convolvulaceae	Dew-flower	EM	Damp marshes, seasonal wetland edges
16.	*Brachiaria eruciformis* (Sm.) Griseb.	Poaceae	Sweet signal grass	EM	Marginal damp soils, field dikes
17.	*Coix lachryma-jobi* L.	Poaceae	Wild Job's tears	EM	Deep marshy fringes, standing waters
18.	*Paspalum conjugatum* Berg.	Poaceae	Buffalo grass	EM	Waterlogged mud along streams
19.	*Saccharum spontaneum* L.	Poaceae	Kans grass	EM	Sandy riverbeds and littoral zones
20.	*Alternanthera sessilis* (L.) R.Br. ex DC.	Amaranthaceae	Kanchari	EM	Common on damp roadsides, pond edges
21.	*Alternanthera paronychioides* St. Hil.	Amaranthaceae	Joyweed	EM	Creeping over muddy drying stream beds
22.	*Hydrilla verticillata* (L.f.) Royle	Hydrocharitaceae	Jala	SM	Clear perennial open water zones
23.	*Vallisneria spiralis* L.	Hydrocharitaceae	Eelgrass	SM	Rooted in bottom mud of rivers
24.	*Nechamandra alternifolia* (Roxb.) Thw.	Hydrocharitaceae	Water-thyme	SM	Submerged pools within reservoirs
25.	*Nymphaea nouchali* Burm. f.	Nymphaeaceae	Kamal / Blue Lotus	RFL	Deep lentic water bodies, permanent ponds
26.	*Nymphaea pubescens* Willd.	Nymphaeaceae	Hairy water lily	RFL	Silt-rich perennial ponds, village tanks
27.	*Ceratophyllum demersum* L.	Ceratophyllaceae	Hornwort	SM	Rootless submerged mass in slow waters
28.	*Lemna minor* L.	Araceae	Duckweed	FF	Eutrophic static waters, village ditches
29.	*Pistia stratiotes* L.	Araceae	Water lettuce	FF	Sheltered slow-moving river bends
30.	*Eichhornia crassipes* (Mart.) Solms	Pontederiaceae	Jalkumbhi	FF	Heavily polluted eutrophic waters
31.	*Typha angustifolia* L.	Typhaceae	Pankanis / Cattail	EM	Tall dense stands in littoral zones

32.	*Heliotropium ovalifolium* Forsk.	Boraginaceae	Shweta surasa	EM	Silted margins of reservoirs
33.	*Coldenia procumbens* L.	Boraginaceae	Tripungki	EM	Prostrate on dry clayey tank bottoms
34.	*Phyla nodiflora* (L.) Greene	Verbenaceae	Jalpipli	EM	Creeping dense mats on wet river edges
35.	*Rotala serpyllifolia* (Roth) Bremek.	Lythraceae	Roundleaf rotala	EM	Amphibious over rocky river shallows
36.	*Ammannia baccifera* L.	Lythraceae	Blistering ammannia	EM	Low-lying damp agricultural fallows
37.	*Bacopa monnieri* (L.) Wettst.	Scrophulariaceae	Neer brahmi	EM	Perennial wet muddy banks
38.	*Lindernia ciliata* (Colsm.) Pennell	Scrophulariaceae	Fringed false-pimpernel	EM	Moist micro-habitats in forest streams
39.	*Hoppea dichotoma* Willd.	Gentianaceae	Flannel weed	EM	Minor muddy depressions near wetlands
40.	*Commelina benghalensis* L.	Commelinaceae	Kena	EM	Humid soils bordering wet zones
41.	*Hygrophila auriculata* (Schumach.) Heine	Acanthaceae	Kolshinda / Talmakhana	EM	Spiny emergent stands around ditches

Quantitative Analysis of Eco-Groups

The distribution of the **41** plant species across structural eco-groups reflects the physiological pressures exerted by water-level changes in the Wardha district.

Life-form spectrum distribution

- Emergent (EM) 29 Species (70.7%)
- Submerged (SM) 5 Species (12.2%)
- Free-Floating (FF) 4 Species (9.8%)
- Rooted Floating (RFL) 3 Species (7.3%)

Emergent plants are the common type and make up 70.7% with 29 species. This is because the water levels in reservoirs and rivers change a lot with the seasons. During the monsoon, the water covers these areas completely. They dry up quickly between winter and summer. Emergent plants, like *Cyperus* species, *Typha angustifolia* L., and *Ipomoea fistulosa* L., do well in these changing conditions. They have roots that anchor them and sturdy stems that help them survive long floods and dry soil.

There are submerged plant species, but they only account for 12.2% with 5 species. The main reason they are limited is that the water gets very cloudy and muddy during the monsoon. Free-floating plant species make up 9.8%. Rooted floating-leaved plants make up 7.3%. These types of plants do best in slow-moving or still water, like village tanks and quiet river beds.

4. Ecological Significance

Aquatic and wetland plant species are really important for keeping the water clean and healthy in Wardha's lakes and rivers. The jobs that water plants do in the ecosystem are:

Water Quality Regulation and Bio-Remediation-

The plant species that grow in wetlands are like a filter that helps keep the water clean. Around Hinganghat, the Vena River has a lot of untreated polluted water because of the cities and factories. The water has a lot of bad stuff like nitrogen, phosphates, and heavy metals. Some plants, like *Typha angustifolia* L. and sedges that grow in the wetlands, can absorb pollutants to some extent, which helps keep the water from getting too dirty.

Plants like *Lemna minor* L. that float on the water can even absorb metals, which is a sign that the water is polluted by the factories. Other plants like *Ceratophyllum demersum* L. that grow under the water help keep the water clean by using up the nutrients that would make the bad algae grow. This helps prevent the water from getting covered in algae that can be harmful. Wetland vegetation, like the plants in the Vena River, is very important for keeping the water clean.

Substrate Stabilization and Flood Mitigation-

When there are storms during the monsoon season, rivers like the Wardha and Dham get flooded as a result, water erodes the banks and washes away the soil on top. The Wardha and Dham rivers have plants, like *Saccharum spontaneum* L. and *Coix lachryma-jobi* L., that grow near the water. These plants have roots that hold the sandy soil and dirt together. This helps the shoreline be strong and not fall apart. It also keeps the water from farms away from the deep water. The plants help keep the water clean by filtering out the stuff before it gets to the deep open-water zones of the Wardha and Dham rivers.

Micro-Habitat Provisioning and Food Web Support-

Macrophytes make freshwater ecosystems more complex. Big groups of *Hydrilla*, *Vallisneria spiralis* L., give baby fish and small animals like crabs and zooplankton a safe place to live and grow. These plants also give them a place to hide from animals that might eat them. When macrophytes break down, they make food for animals that live on the bottom of the water. Birds like to nest and find food in the plants that stick out of the water.

Ethnobotanical Value and Tribal Livelihoods-

Local people and tribes like the Gonds and Banjaras in the Arvi and Samudrapur regions use the plants that grow in the wetlands. They use plants like *Bacopa monnieri* (L.) Wettst. and *Hygrophila auriculata* (Schumach.) to make medicine. They also eat *Ipomoea aquatica* Forssk., as a vegetable. People use stems of *Cyperus pangorei* Rottb. and *Typha* species to make mats and roofs for their homes.

5. Anthropogenic Pressures and Conservation Threats

The aquatic and wetland plants that grow in the wetland areas of Wardha District are getting damaged. This is happening because of reasons as follow.

Invasive Species Encroachment: An invasive weed called *Eichhornia crassipes* (Mart.) Solms is growing over the water surface, blocking sunlight. It uses all the oxygen in the water. This kills the plants that used to grow in the water and on the shore, the plants like *Ipomoea fistulosa* Mart., growing everywhere, killing the good plants and disturbing the flora that used to grow there.

Domestic Pollution: Factories and cities are putting their domestic waste and chemicals into the Vena River, Dham River, etc. This changes the water quality and makes it hard for most plant species to grow.

Agricultural Encroachment: When people turn the wetlands into farms, they destroy the habitat of the plants that grow there. They also use a lot of chemicals that disturb and alter the life cycle of the plants and animals.

Unregulated Livestock Grazing: When animals eat the plants that grow near the water, they disturb the flora and the soil. This happens in most of the areas, like the Lal Nalla reservoir, Bor dam, etc. It makes it hard for the plants to grow back.

6. Conclusion and Recommendations

The survey of Wardha District shows a variation in aquatic and wetland flora. In total, **41** species across **22** families were documented, and most of them belong to the Cyperaceae family. These plants help keep the water clean, prevent soil erosion on riverbanks, and support wildlife and people's livelihoods. Pollution from cities and industries is turning land into barren land, and non-native, i.e., invasive plants are threatening the diversity of wetland plant species.

To save these water ecosystems, the following recommendations are suggested:

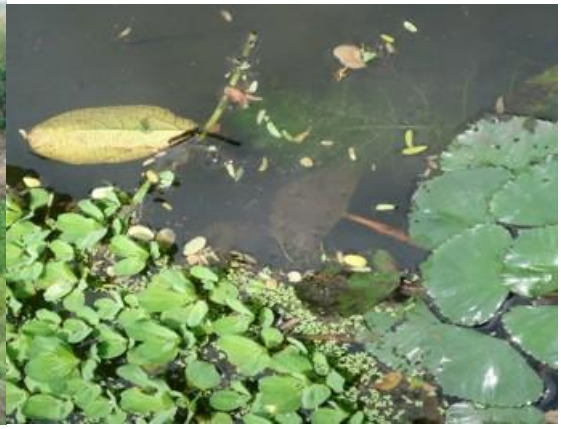
* Create protected areas along the Vena and Dham rivers to keep them safe from farm and industrial waste.

* Regularly remove invasive plants like *Eichhornia crassipes* (Mart.) Solms to help native plants grow back.

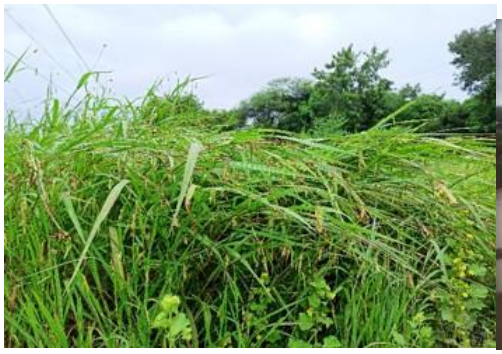
* Urban sewage and industrial wastewater should be treated properly before being released into rivers to keep the reservoir water healthy.

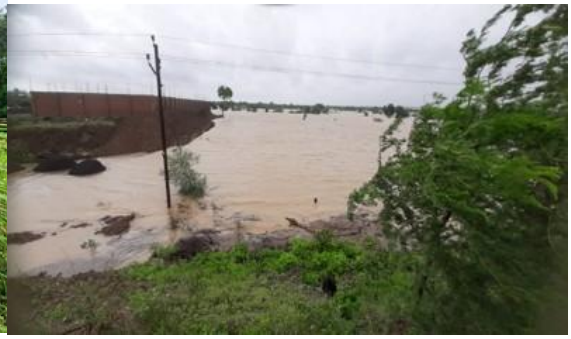
* Work with communities to harvest plants, like *Bacopa monnieri* (L.) Wettst. and *Cyperus pangorei* Rottb. in a way that helps both the economy and conservation.

Overview of Study Area Sites -



Wardha River near Kharangana **Micro-Habitat Provisioning and Food Web Support** (*Pistia stratiotes* L., *Ceratophyllum demersum* L., *Trapa natans* L.)

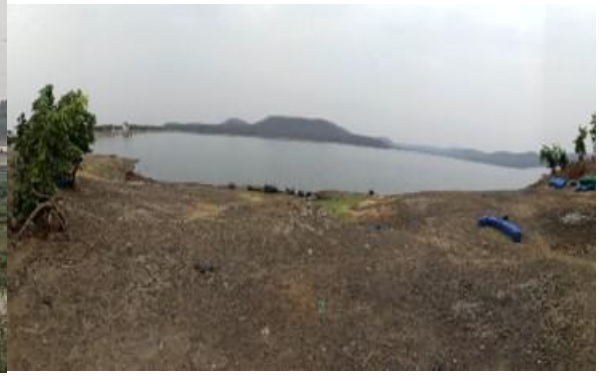




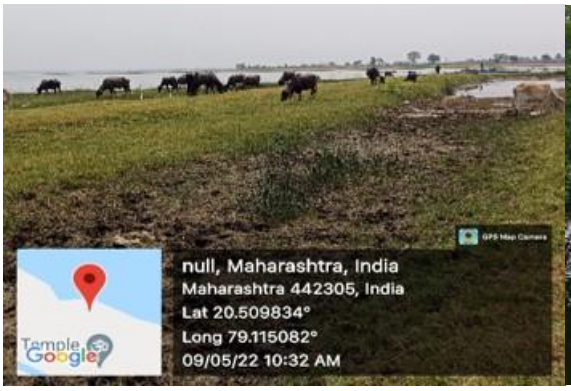
Coix lachryma-jobi L. (near Vena River) **Vena River** – Flooded, Encroachment area

Vena River (Mandgao)-Anthropogenic impact

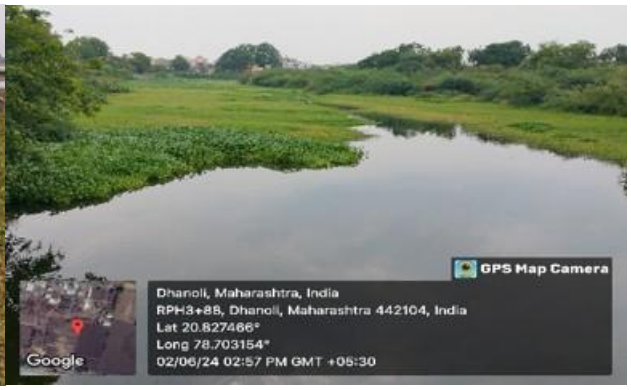
Bor Dam- Unregulated Livestock Grazing



Lal Nalla Dam- Grazing



Dham River- Invasive plants clogging the river



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