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# From Aquatic Vegetation to Economic Value: The Role of Plants in Fisheries and Aquaculture

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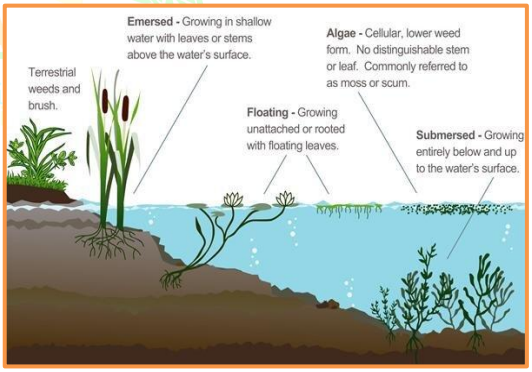
Aquatic plants, commonly referred to as macrophytes, are multicellular photosynthetic organisms inhabiting freshwater and marine ecosystems such as rivers, lakes, wetlands, reservoirs, estuaries, and coastal waters. They include submerged, floating, emergent, and amphibious forms, as well as macroalgae (seaweeds). Traditionally perceived as weeds or obstacles to fishing, aquatic plants are now increasingly recognized as vital ecological and economic resources in fisheries and aquaculture. Through their roles in primary production, habitat provision, water quality regulation, and direct utilization as food, feed, and raw materials, aquatic plants significantly contribute to fish production systems, livelihoods, and the broader blue economy.

## Classification of Aquatic Plants

Aquatic plants are broadly classified based on growth form and habitat into: (i) submerged plants (e.g., *Hydrilla, Vallisneria*), (ii) floating-leaved plants (e.g., *Nymphaea*, *Nelumbo*), (iii) free-floating plants (e.g., *Lemna*, *Azolla*, *Pistia*), (iv) emergent plants (e.g., Typha, Phragmites), and (v) marine macroalgae or seaweeds (e.g., *Gracilaria*, *Kappaphycus*, *Sargassum*). Each group performs distinct ecological functions that collectively support fisheries and aquaculture productivity.




## Role of Aquatic Plants in Fisheries

### Primary Production and Food-Web Support

Aquatic plants form the base of aquatic food webs by converting solar energy and inorganic nutrients into organic matter through photosynthesis. Phytoplankton and macrophyte-derived organic matter support zooplankton, benthic invertebrates, and detritivores, which in turn sustain fish populations across trophic levels. This transfer of primary production to higher trophic levels supports fish biomass and catch potential in rivers, lakes, floodplains, and coastal waters.

**Habitat, Nursery, and Breeding Grounds**

Vegetated aquatic habitats support higher fish abundance and diversity than non-vegetated areas. Submerged and emergent plants provide spawning substrates, nursery grounds, and refuges from predation, particularly for fish and crustacean larvae and juveniles. In inland waters, macrophyte-rich littoral zones enhance recruitment and sustain capture fisheries in lakes, reservoirs, and wetlands. In marine environments, seagrass meadows and mangroves function as critical nursery habitats for many commercially important fish and shellfish species, linking coastal vegetation to offshore fish stocks.

**Support to Capture Fisheries Productivity**

Aquatic plants host periphyton, invertebrates, and microbial communities that serve as high-quality natural food for fish. Detritus from decaying plant material further supports detrital food chains, enhancing overall fishery productivity. By stabilizing sediments, reducing turbidity, and moderating hydrodynamic forces, aquatic vegetation creates favourable conditions for fish growth and survival, thereby indirectly increasing capture fishery yields.

## Role of Aquatic Plants in Aquaculture

**Natural food and feed Resources**

Aquatic plants and algae are widely used as natural feed or feed supplements in aquaculture. Duckweed (*Lemna* spp.), Azolla, are rich in protein, essential amino acids, vitamins, and minerals, making them suitable for carp polyculture and tilapia farming. Microalgae (*Chlorella vulgaris, Scenedesmus* spp., *Skeletonema costatum,* ***Chaetoceros*** **spp.,** ***Isochrysis galbana*****)** are one of the most important **natural food organisms in fisheries and aquaculture**, especially for **fish larvae, shrimp larvae, mollusks, zooplankton culture and for** ornamental fish larvae. They are rich in protein, essential fatty acids (EPA, DHA), vitamins, and pigments that support growth and survival. Their use reduces dependence on costly commercial feeds and supports low-input, small-scale aquaculture.

**Water Quality Improvement and Biofiltration**

Aquatic plants play a crucial role in maintaining water quality in aquaculture systems. Submerged plants enhance oxygen availability and nutrient cycling, while emergent and floating plants absorb excess nitrogen, phosphorus, heavy metals, pesticides, and organic waste. This natural biofiltration reduces eutrophication, lowers disease incidence, and improves fish survival. In integrated systems, aquatic plants reduce water exchange requirements and operational costs, contributing to environmentally sustainable aquaculture.

**Integrated Farming Systems**

Aquatic plants are integral to several integrated farming approaches. In rice–fish–Azolla systems, Azolla acts as a nitrogen-fixing biofertilizer, fish feed, and surface cover, enhancing both rice and fish productivity. Integrated multi-trophic aquaculture (IMTA) combines fed species (fish or shrimp) with extractive species such as seaweeds and bivalves, enabling nutrient recycling, reducing environmental impacts, and generating multiple income streams. Aquaponics systems integrate fish culture with vegetable or aquatic plant production, offering efficient use of water and space with dual economic returns.

## Direct Economic Uses of Aquatic Plants

**Edible and Nutritional Benefits**

Several aquatic plants and algae are directly consumed as food. Aquatic plant species such as water spinach (*Ipomoea aquatica*), lotus (*Nelumbo nucifera*), water chestnut (*Eleocharis dulcis*), wild rice (*Zizania* spp.), and edible algae (Spirulina, Chlorella, Porphyra) contribute to food security and nutrition. Seaweeds form the basis of a multi-billion-dollar global industry, supplying food, hydrocolloids (agar, alginate, carrageenan), and nutraceutical products.

### Ornamental Plant Trade

The cultivation and trade of ornamental aquatic plants for aquariums, water gardens, and landscaping constitute a rapidly growing sector. Species such as *Nymphaea, Vallisneria, Hygrophila*, and *Echinodorus* generate income through domestic and international markets, supporting livelihoods associated with fisheries and aquaculture value chains.

### Livestock Feed, Compost, and Industrial Uses

Aquatic plants such as Azolla and duckweed are used as livestock feed due to their high protein content. Excess biomass is composted to enrich soils or processed into biofuels, biogas, and fertilizers. Constructed wetlands employing species like Phragmites and Typha are widely used for wastewater treatment and phytoremediation, providing ecosystem services with tangible economic benefits.

### Socio-Economic Benefits

Beyond direct economic returns, aquatic plants support rural livelihoods, employment generation, and cultural practices. They also contribute to carbon sequestration, climate change mitigation, eco-tourism, and recreational fisheries.

| Use Category | Aquatic Plant Species | Application | Source |
|---|---|---|---|
| Medicinal | *Eichhornia crassipes*, *Azolla pinnata* | Used in traditional medicine for inflammation, skin disease, and wound healing | Ghosh *et al.* (2004) [17]; Vymazal (2013) [39] |
| Edible | *Ipomoea aquatica*, *Nelumbo nucifera* | Consumed as vegetables or snacks; seeds and roots eaten | Pandey (2011) [29]; Hasan & Chakrabarti (2009) [18] |
| Livestock Feed | *Lemna minor*, *Azolla filiculoides* | High protein content; used as poultry and cattle feed | Hasan & Chakrabarti (2009) [18] |
| Compost and Green Manure | *Salvinia natans*, *Hydrilla verticillata* | Used for composting, increasing organic matter in soils | Ghosh *et al.* (2004) [17]; Nafea & Zyada (2015) [26] |
| Industrial/Commercial | *Typha angustifolia*, *Eichhornia crassipes* | Used in handicrafts, paper pulp, fiberboard, biogas production | Vymazal (2013) [39]; Ali *et al.* (2020) [2] |
| Traditional Use | *Nelumbo nucifera*, *Ipomoea aquatica* | Used in religious ceremonies, cultural practices | Pandey (2011) [29]; Dudgeon *et al.* (2006) [13] |

### Economic Values of aquatic plant- Dominated wetlands in India

| Location / Ecosystem | Approx. Value (₹ per ha / yr) | Key Services (Including Aquatic Plant Benefits) | Source & Authors (Year) |
|---|---|---|---|
| Karnataka freshwater wetlands | ~1,005,600 ₹/ha/yr (1.005 million ₹) | Provisioning, regulating, cultural services involving macrophytes, water purification | Ramachandra *et al.* (2024) [33] (ResearchGate) |
| Karnataka state wetlands (total) | ~285 billion ₹/yr statewide (~41,286 ₹/ha) | Fish & plant harvesting, flood control, groundwater recharge, recreation | Ramachandra *et al.* (2024) [33] (SpringerLink, ResearchGate) |
| Tumakuru district, Karnataka | ~47.1 billion ₹/yr total | Wetland services including provisioning and regulating mediated by aquatic plants | IISc study met SEEA methods (2021) [20] (WGBIS) |
| Kole Wetlands, Kerala | ~₹390 crore (~3.9 billion ₹) total | Paddy cultivation, fishing, lotus farming, duck-rearing, carbon sequestration | Neha & Tamhankar (2021) [28] (Krishikosh) |
| Ashtamudi Estuary, Kerala | ₹66.8 million per yr (~₹668 /ha for small area) | Navigation, coconut retting, recreation, fisheries | Market valuation (2007) |
| Sundarbans estuarine ecosystem | ₹69,527 lakh (~6.95 billion ₹ total) | Fisheries, tourism, agriculture, carbon storage, flood protection | Ekka, Pandit, Katiha & Biswas (2021) [15] (eBook Icar) |

## Threats to the aquatic plants

| Threat | Source | Impacts on Aquatic Plants | Example Species Affected |
|---|---|---|---|
| Nutrient Pollution | Agricultural runoff, sewage | Eutrophication, algal blooms, suppressed growth | *Vallisneria spiralis*, *Nymphaea spp.* |
| Heavy Metal Contamination | Industrial effluents | Toxicity, reduced photosynthesis, inhibited reproduction | *Hydrilla verticillata* |
| Habitat Alteration | Dams, land reclamation, urban encroachment | Loss of wetlands, change in flow regimes, disrupted life cycles | *Typha angustifolia* |
| Invasive Species | Introduction by humans or animals | Competition for light/nutrients, monoculture formation | *Eichhornia crassipes* |
| Climate Change | Global warming, erratic rainfall | Range shifts, phenological changes, stress on sensitive species | *Limnophila indica* |

**Source:** Compiled from Bornette *et al.* (1998) [7]; Dudgeon *et al.* (2006) [13]; Ali *et al.* (2020) [2]

## Conclusion

Aquatic plants are no longer merely weeds to be controlled but valuable biological assets that underpin fisheries productivity, aquaculture sustainability, and economic development. Through their multifunctional roles in food-web support, habitat provision, water quality regulation, and direct utilization, aquatic plants contribute significantly to capture fisheries, aquaculture, and the blue economy. Recognizing and integrating their value into fisheries management and aquaculture practices is essential for sustainable resource use and livelihood security. By enhancing ecosystem resilience and sustainability, aquatic plants strengthen the long-term viability of fisheries and aquaculture systems.

## References

1. Amoros C, Bornette G, Henry CP. A vegetation-based method for the ecological diagnosis of riverine cut-off channels. *Environ Manage*. 2000;25(2):211-27. 4.
2. Bornette G, Amoros C, Lamouroux N. Aquatic plant diversity in riverine wetlands: The role of connectivity. *Freshw Biol*. 1998;39(2):267-83.
3. Li DL, Wang L, Ding JJ, Rui WY. Ecological functions and resource utilization of aquatic plants. *Wetl Sci*. 2011;9(3):290-6. 24.
4. Nagajyothi GN, Taj A, Seetharamu GK, Pavan Kumar P. Review on: Aquatic plants revitalize the lakes by phytoremediation. *Int J Agric Food Sci*. 2025;7(6E):336-49.
5. Piloyan, A., 2023. Assessing Spatio-temporal Changes of Floating Aquatic Vegetation in Lake Sevan Using Landsat Imagery and Vegetation Indices. *International Journal of Geoinformatics*, *19*(11), pp.1-11.