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Diversity of aquatic macrophytes found in the villages of Kallal Block, Sivagangai District, Tamil Nadu, India

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Abstract

Aquatic macrophytes are huge, visually noticeable aquatic plants that grow in or close to water bodies. These include ferns, mosses, flowering plants, and macroscopic algae. Aquatic macrophytes play a crucial role in aquatic environments, offering both numerous positive effects and several detrimental issues. Therefore, it is crucial to conduct an aquatic macrophyte survey in order to eliminate dangerous aquatic macrophytes and utilize good ones. The objectives of this research were to develop a checklist of aquatic macrophytes, comprehend their biology, and identify medicinally important aquatic macrophytes found in the villages of Kallal Block, Sivagangai District, Tamil Nadu. The study revealed that 71 species of macrophytes, belonging to 27 families, represented the majority of species richness, with Poaceae leading at 11.26% (8 species), followed by Cyperaceae at 9.86% (7 species) and Lemnaceae at 7.04% (5 species). On the basis of morpho-ecology, we found emergent macrophytes were dominant at 47.89% (34 species), followed by floating at 33.80% (24 species) and submerged at 14.08% (10 species). Based on their life cycle duration and origin, the dominant aquatic macrophytes were perennial type 74.65% (53 species), and non-Asiatic species were 53.5%. Overall, this study establishes a baseline for long-term management measures, regular monitoring, and community awareness in order to protect native macrophyte variety.

Keywords: Aquatic macrophyte, emergent macrophyte, Kallal Block, Sivagangai District

Introduction

Macrophytes are aquatic plants that live near or in water. They can be floating, submerged, or emergent, with upright sections above the water's surface. The vast majority of aquatic macrophytes live in shallow regions such as lakes, ponds, pools, marshes, streams, rivers, and so on. Aquatic macrophytes, or giant aquatic plants, play an important role in freshwater environments, providing a variety of ecological, environmental, and social advantages. One of the key advantages of aquatic macrophytes is their ability to enhance water quality by absorbing excess nutrients, notably nitrogen and phosphorus, which can cause eutrophication and toxic algal blooms. By absorbing these nutrients, macrophytes help to reduce the effects of nutrient pollution, resulting in better aquatic habitats.

Additionally, they provide critical habitat and refuge for a diverse range of aquatic creatures, including fish, invertebrates, and amphibians, so supporting biodiversity in these environments. Macrophytes extensive root systems also help to stabilize debris, minimizing erosion and increasing water clarity. Furthermore, these plants contribute to the carbon cycle by sequestering CO₂, which aids in climate management. In terms of social benefits, aquatic macrophytes can improve recreational activities such as fishing and bird watching, as well as be used in bioengineering applications for wastewater treatment and shore stability. Overall, aquatic macrophytes are essential for the health and resilience of freshwater ecosystems, and they provide considerable ecological and societal benefits (Morris & Hargreaves, 1997)^[3].

Aquatic macrophytes have received attention for their various therapeutic characteristics, making them useful in both traditional and modern medicine. Many species include bioactive chemicals with anti-inflammatory, antioxidant, and antibacterial properties. While aquatic macrophytes provide several ecological benefits, they can also have a number of drawbacks that affect freshwater ecosystems and human activities. One big issue is that excessive macrophyte

development can cause overpopulation, which can impair water movement and lower oxygen levels in the water, potentially hurting fish and other aquatic species. This tendency, known as "overgrowth," can cause the production of dense mats that hinder recreational activities such as boating, swimming, and fishing, limiting access to waterways. Furthermore, the decomposition of huge quantities of aquatic plants can reduce oxygen levels in the water, resulting in hypoxic conditions that are harmful to aquatic life. In some circumstances, invasive macrophyte species can outcompete native flora, disrupting local ecosystems and diminishing biodiversity.

Additionally, regulating excessive macrophyte development can be expensive and labor-intensive, necessitating mechanical harvesting or chemical treatments that may have negative environmental consequences. Thus, while aquatic macrophytes are necessary for healthy ecosystems, their uncontrolled proliferation can offer considerable issues (Sharma *et al.*, 2016)^[7]. Aquatic macrophytes can also have a number of negative consequences for freshwater ecosystems and humans. One major worry is that dense macrophyte populations can modify environments, favouring certain species over others and potentially contributing to biodiversity loss. This can occur when invading macrophytes outcompete native species, disrupting local food webs and ecological function. Furthermore, excessive macrophyte development can impede water flow in rivers and lakes, resulting to increased sedimentation, altering ecosystems and potentially harming fish breeding and nursery sites. Thick mats of aquatic plants can also promote mosquito population growth, which can be an annoyance to neighboring

people and present health problems because of disease transmission. Additionally, controlling overgrown macrophyte populations frequently calls for the use of herbicides and other control methods, which may have unforeseen effects on water quality and non-target species. Accordingly, aquatic macrophytes are crucial for the health of ecosystems, but if they grow out of control, they may cause serious ecological and socioeconomic problems (Kumar *et al.*, 2020)^[2]. The most effective integrated management plans frequently incorporate mechanical, chemical, and biological techniques.

The study's goals were to identify medicinally significant macrophytes, create a catalog of weeds, and learn about their biology, growth habits, origins, and habitats. All things considered, this study offers a starting point for sustainable management plans, frequent observation, and community education to preserve the diversity of native macrophytes while managing alien populations.

Materials and Methods

From August 2024 to August 2025, a survey of the diversity of aquatic macrophytes was carried out in villages in the Kallal block of the Sivagangai district, including ponds, irrigation channels, canals, and other wet areas. Kallal is the 12th block in the Sivaganga District. Kallal Block is located at 9.9863°N and 78.6652°E, with an average rainfall of 904.7 mm and an average temperature of 32.9°C. The overall size of the block is roughly 362.33 square kilometers. This block contains 44 villages. We investigated aquatic macrophytes in villages located in this block (Fig. 1)

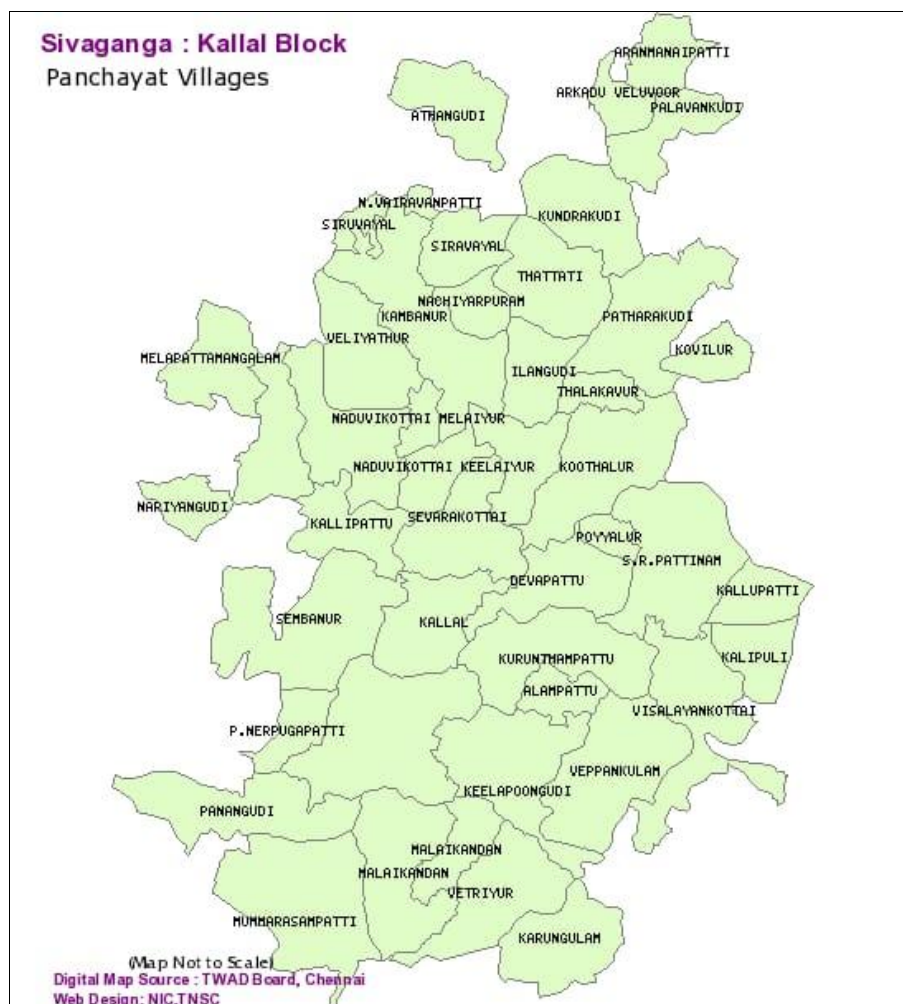


Fig. 1: The map depicts the study area of Kallal block villages in Sivagangai district

Different approaches were employed to identify the species of aquatic macrophytes, including visual identification and oral interviews with the locals. The people who live in these villages provide information about undiscovered aquatic plants, including their local names, economic significance, therapeutic value, and management. Other aquatic plants were discovered through website articles and mobile applications, as well as diverse literary sources and experts. During the survey, aquatic macrophytes are photographed and validated by multiple sources. Photography was done using a Nikon D3500 digital camera and Canon 70-300 mm lenses. Every two months, we conduct observations. The aquatic macrophytes were categorized alphabetically by botanical name, family, vernacular names, and therapeutic application (Table 1).

Results and Discussion

Based on Family

The most species-rich families were Poaceae (11.26%, 8 species), Cyperaceae (9.86%, 7 species), Lemnaceae (7.04%, 5 species), and Pontederiaceae, Nymphaeaceae, Salviniaceae, and Hydrocharitaceae (5.63%, 4 species each) (Table 1). According to this study, Christin *et al.* (2008) ^[1] discovered that Poaceae dominate because they are wind pollinated and have dangling anthers, while Cyperaceae dominate due of their adaptability to both terrestrial and aquatic habitats and their C₄ photosynthetic pathway.

Based on Morpho-Ecology

Emergent 47.89% contains 34 species, floating 33.80% contains 24 species, submerged 14.08% contains 10 species, and floating and submerged 4.23% contain 3 species (Table 1). Emergent macrophytes ability to root in the substrate while their leaves

and stems emerge into the air allows them to efficiently access sunlight, nutrients and atmospheric oxygen, giving them a competitive advantage over other aquatic plant types. They are well-suited to the fluctuating water levels typical of wetlands and effectively remove nutrients and organic matter from wastewater. Comparable study findings were also published by Rezanian *et al.*, (2021) ^[5].

Based on Lifespan

Annual types account for 21.13% (15 species), perennial types for 74.65% (53 species), and annual & perennial (varying depending on environment) for 4.23% (3 species) (Table 1). As stated by Peixoto *et al.*, (2022) ^[4] perennial plants frequently outgrow annuals because of their competitive advantages, which include deeper root systems that allow access to deeper nutrient pools and stability in nutrient-poor or changing environments. The absence of disturbance is essential because it enables perennials to build up biomass over longer periods of time and create root systems that endure rather than being reset by the annuals' life cycle.

Based on origin

Asiatic species make up 46.4% of the 71 species, while non-Asiatic species make up 53.5% (Table 1). Because of their high food availability, adaptability to different environmental conditions, and lack of natural enemies in their new habitat, non-asiatic macrophytes frequently prevail. Additionally, these plants have the ability to change the water's physical and chemical properties, which may benefit their own growth at the expense of native species. Similar study results were also reported by Schultz *et al.* (2011) ^[6].

Table 1: List of aquatic macrophytes discovered in the villages of Kallal Block, Sivagangai District, Tamil Nadu, India

Sl. No	Scientific name	Vernacular name	Family	Morpho-Ecology	Lifespan	Origin	Habitat	Medicinal use
1.	<i>Aeschynomene indica</i>	Netti	Fabaceae	Emergent/ Submerged	Annual	Asia	Semi Aquatic	Urinary Tract Infection
2.	<i>Alisma plantago</i>	-	Alismataceae	Emergent	Perennial	Europe	Semi Aquatic	Anti-Inflammatory
3.	<i>Alternanthera philoxeroides</i>	Ponnangani	Amaranthaceae	Emergent	Perennial	South America	Aquatic & Semi Aquatic	Blood Sugar Level
4.	<i>Alternanthera sessilis</i>	Ponnangani	Amaranthaceae	Floating	Perennial	South America	Aquatic & Semi Aquatic	Treat Wounds And Bronchitis
5.	<i>Ammania baccifera</i>	Kalluruvi	Lythraceae	Emergent	Annual	Spain	Semi Aquatic	Skin Disease & Fever
6.	<i>Aponogeton natans</i>	Kottikizhangu	Aponogetonaceae	Floating Leaved Anchored	Perennial	India	Aquatic	Tuberculosis And Jaundice
7.	<i>Asteracantha longifolia</i>	Neermuli	Acanthaceae	Emergent	Annual	South Asia	Semi Aquatic	Urinary Issues
8.	<i>Azolla imbricata</i>	Mookkuthi	Salviniaceae	Free Floating Weed	Perennial	Asia	Aquatic	Fever
9.	<i>Azolla pinnata</i>	Azolla	Salviniaceae	Free Floating Weed	Perennial	Africa	Aquatic	Traditional Cooling
10.	<i>Bacopa monnieri</i>	Nirppirami	Scrophulriaceae	Emergent Anchored	Perennial	India	Aquatic & Semi Aquatic	Amnesia
11.	<i>Brachiaria mutica</i>	Tannipul	Poaceae	Emergent	Perennial	Africa	Semi Aquatic	Watering Eyes
12.	<i>Callitriche palustris</i>	Sathuppunilam starwort	Plantiganaceae	Submerged, Floating	Perennial	East Africa	Aquatic & Semi Aquatic	Dropsy And Gonorrhoea
13.	<i>Cynodon dactylon</i>	Arugampul	Poaceae	Emergent Anchored	Perennial	North America	Aquatic & Semi Aquatic	Antiviral And Antimicrobial
14.	<i>Cyperus difformis</i>	Koraipasi	Cyperaceae	Emergent	Annual	Southern Europe	Semi Aquatic	Diarrhoea
15.	<i>Cyperus iria</i>	Kirai	Cyperaceae	Emergent	Annual	Asia	Aquatic & Semi Aquatic	Treat Fever
16.	<i>Cyperus longus</i>	-	Cyperaceae	Submerged	Perennial	Europe	Aquatic &	Diuretic And Tonic

							Semi Aquatic	
17.	<i>Cyperus rotundus</i>	Koraikilangu	Cyperaceae	Emergent Anchored	Perennial	Africa	Semi Aquatic	Menstrual Irregularities
18.	<i>Eichornia crassipes</i>	Aagayathamarai	Pontederiaceae	Floating	Perennial	South Asia	Semi Aquatic	Anti-Inflammatory
19.	<i>Fimbristylis litoralis</i>	Mullupul	Cyperaceae	Emergent	Annual	Asia	Aquatic	Fever
20.	<i>Fimbristylis miliacea</i>	Nandukalpul	Cyperaceae	Emergent	Annual/Perennial	Coastal Asia	Aquatic & Semi Aquatic	Bee Stings
21.	<i>Fimbristylis quinquangularis</i>	Varudandi	Cyperaceae	Emergent	Annual	Tropical Asia	Aquatic & Semi Aquatic	Fever
22.	<i>Hydrilla verticillata</i>	Velampasi	Hydrocharitaceae	Sub Merged	Perennial	Asia	Aquatic & Semi Aquatic	Urinary Tract Issues
23.	<i>Hydrocotyleumbellata</i>	Malai vallarai	Hydrocolylaceae	Emergent	Perennial	America	Aquatic & Semi Aquatic	Severe Inflammatory Disorders
24.	<i>Hygrophila auriculata</i>	Neermuli	Acanthaceae	Emergent Anchored	Annual	Tropical Asia	Semi Aquatic	Hepatoprotective And Antioxidant
25.	<i>Ipomea carnea</i>	Nevelikaattamanakku	Convolvulaceae	Emergent	Perennial	Tropical America	Aquatic & Semi Aquatic	Antimicrobial Disease
26.	<i>Ipomoea aquatica</i>	Vaalaikerai	Convolvulaceae	Sub Merged	Perennial	South East Asia	Aquatic & Semi Aquatic	Digestive Issues
27.	<i>Ipomoea fistulosa</i>	Vaelikkaathan	Convolvulaceae	Submerged	Perennial	Tropical America	Aquatic & Semi Aquatic	Skin Disease
28.	<i>Jussiaea repens</i>	Neeraalam	Onagraceae	Emergent	Perennial	Asia	Aquatic & Semi Aquatic	Ant-diabetic
29.	<i>Lemna gibba</i>	Kinnaththavalaithaa	Lemnaceae	Floating	Perennial	Europe	Aquatic	Phytoremediation
30.	<i>Lemna minor</i>	Thaneerthamarai	Lemnaceae	Free Floating	Perennial	North America	Aquatic	Protein Source
31.	<i>Lemna perpusilla Torrey</i>	Siruthavalaithamarai	Lemnaceae	Floating	Perennial	America	Aquatic	Antioxidant
32.	<i>Limnophila heterophylla</i>	-	Scrophulariaceae	Emergent Anchored	Annual	South East Asia	Aquatic & Semi Aquatic	Constipation
33.	<i>Limnophila indica</i>	-	Scrophulariaceae	Submerged Anchored	Perennial	South East Asia	Aquatic	Fever And Dysentery
34.	<i>Ludwigia parviflora</i>	Muyalkathuilai	Onagraceae	Emergent	Annual	Tropical Asia	Aquatic & Semi Aquatic	Antibacterial /Wound Healing
35.	<i>Marsilea minuta L.</i>	-	Marsileaceae	Emergent	Perennial	Africa	Aquatic & Semi Aquatic	Anti-Inflammatory
36.	<i>Marsilea quadrifolia</i>	Aalaikkeera	Marsilaceae	Floating	Perennial	Eurasia	Aquatic & Semi Aquatic	Snake Bite
37.	<i>Meteranthera limosa</i>	-	Pontederaceae	Emergent	Annual	Central America	Aquatic	Wound Treatment
38.	<i>Monochoria vaginalis</i>	Karu-n-kuvalai	Pontederaceae	Emergent	Annual/Perennial	Tropical Asia	Semi Aquatic	Anti-Oxidant
39.	<i>Najas marina</i>	Kadalpasi	Hydrocharitaceae	Floating And Submerged	Annual	North America	Aquatic	Anti -Oxidant And Anti-Microbial
40.	<i>Nelumbo nucifera</i>	Thamarai	Nymphaeaceae	Root Floating Weed	Perennail	India	Aquatic	Diarrhoea And Skin Issues
41.	<i>Neptunia oleraceae</i>	Sundaikira	Fabaceae	Floating	Perennial	America	Aquatic	Dysentery
42.	<i>Nitella species</i>	-	Characeae	Submerged Anchored	Annual And Perennial	Asia	Aquatic & Semi Aquatic	Antioxidant And Anti-Microbial
43.	<i>Nymphaea nouchaliBurm.</i>	Naalambal	Nymphaeaceae	Floating Leaved Anchored	Perennial	India	Aquatic	Diabetes Liver Issues
44.	<i>Nymphaea pubescens</i>	Sengkaluneer	Nymphaeaceae	Floating Leaved Anchored	Perennial	Asia	Aquatic	Diabetes And Cancer
45.	<i>Nymphea alba</i>	Aambal	Nymphaeaceae	Root Floating Weed	Perennial	Africa	Aquatic	Diarrhoea And Anti-Inflammatory
46.	<i>Nymphoides indica</i>	Chinnaambal	Mentianthaceae	Floating Leaved Anchored	Perennial	Asia	Aquatic	Jaundice And Dysentery
47.	<i>Ottelia alismoides</i>	Nirkuliri	Hydrocharitaceae	Submerged Anchored	Annual/ Perennial	Asia	Aquatic & Semi Aquatic	Tuberculosis And Cancer
48.	<i>Phargmites australis</i>	Koraipul	Poaceae	Emergent	Perennial	Europe	Semi Aquatic	Urinary Problems
49.	<i>Phargmites karka</i>	Perunanal	Poaceae	Emergent	Perennial	Africa	Aquatic & Semi Aquatic	Cardiac Issues
50.	<i>Panicum perpurascens</i>	-	Poaceae	Emergent	Perennial	Africa	Semi Aquatic	Astringency
51.	<i>Paspalum fluitans</i>	Varagu	Poaceae	Emergent	Annual	South America	Aquatic & Semi Aquatic	Pulmonary Disease
52.	<i>Phragmites communis</i>	Nalam	Poaceae	Emergent	Perennial	Europe	Semi Aquatic	Fever

53.	<i>Pistia stratiotes</i>	Akasha-t-thamarai	Araceae	Free Floating	Perennial	Africa	Aquatic & Semi Aquatic	Ringworm
54.	<i>Polygonum amphibium</i>	Arralari	Polygonaceae	Free Floating	Perennial	North America	Aquatic & Semi Aquatic	Diabetes
55.	<i>Polygonum glabrum</i>	Sivappukumakodaali	Polygonaceae	Emergent	Perennial	Asia	Semi Aquatic	Treat Wound And Burns
56.	<i>Pontederia cordata L</i>	Karunkuvalai	Pontedericeae	Emergent	Perennial	America	Aquatic & Semi Aquatic	Liver Complaints
57.	<i>Potamogeton species</i>	Koraipasi	Potamogetonaceae	Submerged And Floating	Perennial	North America	Aquatic	Anti-Inflammatory
58.	<i>Rotala densiflora</i>	-	Lythraceae	Emergent	Annual	South East Asia	Aquatic & Semi Aquatic	Sore Throat
59.	<i>Sacharrum spontaneum</i>	Naanal	Poaceae	Emergent	Perennial	South Asia	Semi Aquatic	Treat Burning Urination
60.	<i>Sagittaria guayanensis</i>	Neelambaram	Alismataceae	Root Floating Weed	Perennial	South America	Aquatic	Rheumatism
61.	<i>Salvinia molesta</i>	Karumporival	Salviniaceae	Free Floating	Perennial	Brazil	Aquatic	Anti-Microbial
62.	<i>Salvinia auriculata</i>	Karumbupoondur	Salviniaceae	Free Floating	Perennial	America	Aquatic	Anti-Microbial
63.	<i>Spirodela polyrhiza</i>	Sirukaththazhai	Lemnaceae	Free Floating	Perennial	North America	Aquatic	Liver Detox
64.	<i>Stuckenia pectinate</i>	-	Potamogetonaceae	Submerged	Perennial	North America	Aquatic	Stomachache And Ulcers
65.	<i>Typha latifolia</i>	Sambu	Typhaceae	Emergent	Perennial	Europe	Semi Aquatic	Menstrual Issues
66.	<i>Typha orientalis</i>	Cumbungi	Typhaceae	Emergent	Perennial	Asia	Aquatic & Semi Aquatic	Intestinal Problem
67.	<i>Trapa bispinosa</i>	Cinkarakkottai	Trapaceae	Emergent	Annual	India	Aquatic	Urinary Issues
68.	<i>Typha angustifolia</i>	Sambu	Typhaceae	Emergent	Perennial	Eurasia	Semi Aquatic	Bleeding Disorder
69.	<i>Utricularia bifida L</i>	Chundelikkundu	Lentibulariaceae	Submerged	Annual	Asia	Semi Aquatic	Urinary Problems
70.	<i>Vallisneria spiralis</i>	Neerpasi	Hydrocharitaceae	Submerged	Perennial	Asia	Aquatic	Aperitif, Demulcent
71.	<i>Wolffia globosa</i>	Mankai	Lemnaceae	Free Floating	Perennial	South East Asia	Aquatic	Anemia

Conclusion

This work has taught us to identify prospective macrophytes and their potential impacts on plants and the environment. It also made it possible to learn about the biology and unique characteristics of each macrophyte. In order to preserve the diversity of native macrophytes while reducing invasive populations, stress the importance of sustainable management techniques, frequent monitoring, and community awareness.

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