



A review on aquatic and wetland plants of Gujarat

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Abstract

There are a number of wetlands in the Indian state of Gujarat. Given that its wetland area accounts for an incredible 23% of the country's total wetland area, Gujarat is really the largest state in terms of wetland area. The Space Applications Center (SAC-ISRO) estimates that the extent of watery-lands in Gujarat is about 34,350 sq. km (17.6% of the state's geographical area and 22.9 % of the national wetlands). Information on the main kinds of wetlands, their functions, and their ability to hold water was also gathered for the study on Gujarat's plant variety. Gujarat wetlands have medicinal plants, thus certain plant species that flourish in the surrounding wetlands were also looked into for Gujarat wetland and Aquatic plant diversity.

Keywords: Wetland, aquatic plants, biodiversity, conservation, gujarat

Introduction

The 1990 definition of "aquatic" given by Cook. All Pteridophytina and Spermatophytina whose photosynthetically active sections are permanently submerged in water or at least partially submerged for several months each year, or which float on the water's surface, are considered vascular aquatic plants. The term "wetlands" refers to "lands that transition from terrestrial to aquatic ecosystems, where the land is covered in shallow water or the water table is typically at or near the surface." (Cook *et al*, 1996)^[6]

Over 27,000 wetlands are found in India; approximately 23,000 of these are inland, and the remaining 4,000 are coastal wetlands. 18.4% of the country is made up of wetlands, of which 70% is used for paddy farming. Furthermore, 1.5 million of the estimated 4.1 million hectares of wetlands are naturally occurring, and the other 2.6 million hectares are man-made. This suggests that most of India's wetlands are artificial. The mangrove vegetation predominates in the estimated 6750 km² of coastal wetlands. Only 26 of the numerous wetlands—out of 27,000—have been recognized as Ramsar sites (National Wetland Atlas, 2011)^[14].

Gujarat has an arid climate yet an abundance of wetlands. The most notable feature is that Gujarat has the highest percentage of land designated as wetland in the nation—roughly 34.74 lakhs hectares—with an estimated overall wetland area of 3474950 hectares, or 17.56 percent of the state's total land area. Intertidal mud flats (2260365 ha), rivers/streams (275877 ha), reservoirs/barrages (248979 ha), creeks (149898 ha), and salt marshes (144268 ha) are the main forms of wetland habitats. The state is dominated by coastal marshes. Gujarat state is home to some of the rare wetlands, including mangroves and coral reefs. Wetlands' water spread is minimal during the pre-monsoon, especially for inland wetlands, which suggests that the wetlands are rain-fed (National Wetland Atlas, 2010)^[13].

The most significant part of the aquatic ecosystem, aquatic plants are used as producers and phytoplankton in the aquatic ecosystem. They are defined as those whose photosynthetically active parts remain permanently or at

least for several months each year submerged in water or floating on the water's surface (Singh, 2006)^[23].

The first thorough study of the wetland flora in India was conducted by Biswas and Calder (1984)^[3].

Numerous studies on the Wetland and aquatic macrophytes and phytosociology have been conducted in various freshwater bodies of Guajrat (Bhasker.P. *et al*, 2018^[2], Charan R.R. *et al*, 2019^[4, 5], Patel M.M. *et al*, 2018^[18], Patel J. *et al*, 2021^[16, 17], Patel P. *et al*, 2022^[19], Shah J.P *et al*, 2010^[22], Dabgar P.J. *et al*, 2012^[9], Patel J. *et al*, 2021)^[16, 17].

Exploring Aquatic and Wetland Flora:

Gujarat's wetlands are alive with distinct plant groups that have evolved to flourish in these changing conditions. The landscapes are pulsating with vibrant life. From the depths of underwater realms to the lush tapestry of marshes and the complex ecosystems of mangrove forests (Cook, C. D. K. *et al*, 1996)^[6], let's take an exciting trip to discover the varied flora living in these environments.

1. Submerged Plants

A secret world of submerged plants is hidden in the quiet depths of rivers, lakes, and lagoons, where they both contribute to the underwater beauty and provide important ecological functions. For instance, *Hydrilla*, *Vallisneria*, *Najas*, and so on (Sculthorpe, C. D., *et al*, 1967)^[21].

2. Emergent Plants

Emergent plants, which rise above the water's surface, fill in important biological niches and provide these environments more visual drama. For instance, *Typha*, *Phragmites*, *Nymphaea*, and so on (Cook, C. D. K. *et al*, 1996)^[6].

3. Floating Plants

Nestled in the soft embrace of the water, floating plants create a colorful mosaic on the surface, filling in certain ecological niches and aiding in the cycling of nutrients. For instance, *Lemna*, *Salvinia*, *Eichhornia*, and so on (Maberly, S. A., *et al*, 1996)^[15].

4. Marsh Plants

A specific class of plants that have adapted to live in these dynamic conditions may be found in marshes, which are characterized by their muddy soils and varying water levels. e.g., *Scirpus*, *Juncus*, and *Cyperus*. (Cronk, Q. C. B., *et al.* 2009) ^[8].

Importance of Aquatic and Wetland Plants

The aquatic and wetland plants are among these ecosystems' most important constituents. These amazing plants have evolved to flourish in these changing habitats, and they are essential to the preservation of wetlands' vitality (Mitsch W. J. *et al.*, 2000) ^[11]. Let's examine these aquatic and wetland plants' significance in Gujarat in more detail:

1. Purification of Water

Think of wetlands as the kidneys of nature. Filters that are effective at eliminating contaminants and extra nutrients from the water are aquatic plants. Their root systems improve water clarity by absorbing and decomposing nitrogen and phosphorus, which would otherwise cause hazardous algal blooms. Cleaner water is ensured by this natural filtering process for irrigation, human consumption, and aquatic life survival (Mitsch W. J. *et al.*, 2000) ^[11].

2. Erosion control and flood control

During periods of intense precipitation, wetlands function like enormous sponges, absorbing and gradually releasing floods. This organic flood control system aids in preventing catastrophic floods from damaging towns downstream. Furthermore, wetland plants' complex root systems bind soil particles together to stop erosion and stabilize shorelines. As a result, there is less sedimentation, which might choke off aquatic life and lower water quality (Tiner R. W. *et al.*, 2016) ^[26].

3. Biodiversity Hotspot

The wetlands of Gujarat are abundant with life, providing habitat for a wide variety of plant and animal species. Fish, amphibians, birds, mammals, and other animals all depend on aquatic and wetland plants for food and protection. These ecosystems' general health and production are greatly influenced by their vast biodiversity, which makes them vital to the survival of innumerable species (Barbier, E. B., *et al.*, 2011) ^[1].

4. Mitigation of Climate Change

Wetland and aquatic plants are essential for reducing the impacts of climate change. Through the absorption and storage of atmospheric carbon dioxide in their tissues, they function as effective carbon sinks. This slows down the rate of global warming by lowering the amounts of greenhouse gases in the atmosphere. Wetlands may also hold a lot of organic stuff, which helps sequester carbon dioxide even more (Mitsch W. J. *et al.*, 2013) ^[12].

5. Economic advantages

Aquatic and wetland plants offer a variety of economic advantages to the communities who depend on them in addition to their ecological significance. They help the locals by supporting the fisheries, which give them a source of food and money. Wetlands may also be utilized for environmentally friendly recreation and tourism, which will boost the local economy. Moreover, towns may save a lot of money on water treatment and flood damage due to the

wetlands' ability to purify water and prevent flooding (Costanza R. *et al.*, 2014) ^[7].

What work done till now on Aquatic and wetland plants in Gujarat

In the downstream region of the Sipu River, close to the Sipu dam, in the district of Banaskantha, Gujarat, India, between November 2016 and April 2017, Punjani B., Panchal B., Patel N., Mali B., Patel A., and Pandey V. conducted a survey. The richness of the aquatic and wetland flora in the study area was revealed by this floristic survey, which was carried out for the first time in the area. In all, 22 species from 18 genera and 12 Angiosperm families were identified for the first time in the study region during the current survey. Dicotyledons made up 58% of all species that were reported, whereas monocotyledons made up 42%. In the current study, the family Cyperaceae was shown to be dominant, and the genus *Cyperus* was identified as the dominating genus. During field research from the study region, *Azolla pinnata* R. Brown, an aquatic Pteridophyte, was seen. The results of this study indicate that the study area is home to a considerable variety of aquatic and wetland plant species that are well adapted to unique edaphic and climatic conditions. However, the poor frequency, abundance, and other characteristics of these species may be the result of unchecked anthropogenic activities in the area (Punjani B., *et al.*, 2018) ^[20].

In the years 2017–18, The study of wetland angiosperms conducted in aquatic environments of Rani Talav, Idar, Sabarkantha district, Gujarat, India, is described in the current paper. The survey found about 35 species from 20 families and 33 genera. There were 33 herbs, 1 climber, and 1 shrub among the 35 species. Additionally, 28 upper wetland species, comprising 3 facultative and 4 obligatory species, were assigned to the plants. Ecologists and academics will find this study useful for field analysis and reporting on wetlands (Charan R., *et al.*, 2019) ^[4, 5].

In Panchmahal District, Godhra Taluka is one of the wetland areas with the least amount of floristic research. This report provides an overview of the research conducted on Bandheli wetland species. The research was conducted in the aquatic environments of the Panchmahal district, Gujarat, India's Bandheli Wetland, Dumelav, Godhra, Panchmahal Distict. The period of the taxonomic surveys was January through March 2019. According to the study, there are about 36 species in 32 genera and 23 families. There were 24 herbs, 4 climbers, 4 shrubs, and 4 trees among the 35 species are noted. Ecologists will benefit from this work in terms of wetland field investigation and reporting, as would biodiversity conservators (Charan R., *et al.*, 2019) ^[4, 5].

According to the Patel J. and Maitreya B., 28 different species of aquatic angiosperms have been identified from the Heranj wetland in the Matar taluka, Kheda, Gujarat. These species include 8 submerged species, 2 free floating species, 5 rooted species with floating leaves, and 13 emergent species. In freshwater wetland environments, *Najas* sp., *Hydrilla* sp., *Typha* sp., and *Potamogeton* sp. are the dominating species. The study will also assist to exactly reproduce the diversity of wetland in Gujarat's Kheda District, which has the greatest concentration of wetland. Additionally, research might be useful in knowing the complex nature of the ecology of wetlands (Patel J., *et al.*, 2021) ^[16, 17].

During 2016 to 2021. The Panchmahals district in Gujarat, India, was surveyed, and a collection of aquatic and wetland angiosperms was made in different seasons from 16 lakes with a variety of aquatic environments from as many villages. The district has yielded records for 128 species of angiospermic aquatic and wetland plants, representing 89 genera and 36 families. Of these, 64 species are dicots, belonging to 45 genera and 23 families, and 64 species of monocots, belonging to 44 genera and 13 families. Documenting the aquatic and wetland angiospermic variety of Gujarat's Panchmahals district is the study's aim (Patel P., 2022) ^[19].

The study was carried out between 2007 and 2008. Only the baseline condition of the vegetation in 11 specially chosen wetlands was covered in this study. There are 56 plant species total that have been identified from the wetlands, representing 46 genera and 28 families. Seven of the 56 plant species are classified as algae, and the other 49 as angiosperms (Shah J., *et al*, 2010) ^[22].

According to Patel M., During 2015 and 2016, the Qualitative floristic surveys were conducted in area of Aravalli district, Gujarat, India. Since ancient times, the residents of the Aravalli area have used about 18 kinds of aquatic and wetland medicinal plants to treat a variety of illnesses. The scientific names, common names, and medical use of the various plants are listed for the plants. The goal of the activity is to preserve and prepare this knowledge of aquatic medicinal plants for future productive research using current scientific methods (Patel M., 2018) ^[18].

In Dabhoi Taluka, Gujarat, the wadhvana wetland was carefully investigated in 2010–2011. A total of 43 Angiospermic families' 73 Genera and 82 Species are represented in the wetland's floral variety. There were 31 families and 63 species that were dicotyledonous, whereas there were 12 families and 19 species that were monocotyledonous. *Azolla pinnata* and *Marsellia*, two pteridophytes, were found in the lake. Some of these species were observed in marshy areas, and they included free floating, rooted floating submerged, and emergent species. It has been discovered that a notable number of species appear throughout the year (Dabgar P., 2012) ^[9].

According to Patel J. and their team - around the Pariej wetland, 74 species of Flowering plants, representing 39 families and 63 genera, as well as two non-flowering species, *Chara* sp. (Algae) and *Marsilea quadrifolia* L. (Pteridophyte), have been identified & noted in the current research. 48 species of dicots belong to 41 genera and 29 families, whereas 26 species of monocots belong to 20 genera and 9 families. This research recorded 32 species of aquatic macrophytes, which were divided into 18 groups. The majority of the species are found in emergent vegetation (13 species), which is followed by submerged vegetation (10 species), rooted floating vegetation (7 species), and free-floating vegetation (2 species). Three distinct seasons were used for data collection: summer, monsoon, and winter (Patel J., *et al*, 2021) ^[16, 17].

The variety of hydrophyte species in three inland wetlands in Central Gujarat—the Pairej, Kanewal, and Wadhvana wetlands—is compared in this research. A total of 19 species of hydrophytes were found in the research, including 8 rooted submerged species, 1 free floating species, 5 rooted species with floating leaves, and 5 emergent species. Pariej Wetland has a comparatively greater richness of

hydrophytic plant species than Wadhvana Wetland and Kanewal Wetland (Suthar A., *et al*, 2019) ^[25].

According to Gamit S. research paper “Check list of flowering plants in Tapi district, Gujarat, India”. From the research region (Tapi district), 703 species and 481 genera from 119 families were reported in the current study. Each plant in the list has a family, botanical name, and generic name. There are 703 kinds of flowering plants in total, along with 318 species of herbs, 176 species of trees, 125 species of shrubs, and 84 species of climbers. This study demonstrates that the forest and its environs are dominated by herbaceous plants (Gamit S., *et al*, 2015) ^[10]. In this research paper many of the flowering plants are recorded of Songadh and Vyara taluka's Aquatic and Wetland areas. Around 200+ plants are recorded.

Over a period of seven months, the aquatic plants in three ponds in Gujarat's Gandhinagar area were investigated. In all, a total of 24 genera of marsh and aquatic plants were found in this study (Singh M., *et al*, 2021) ^[24].

Conclusion

The sources given focus on Gujarat, India's abundant and varied wetland flora. Several important aspects become apparent:

High Species Richness: Research conducted in Gujarat's various locations by Bhasker *et al.* (2018) ^[2], Charan *et al.* (2019a, 2019b) ^[4, 5], and Patel *et al.* (2021 ^[16, 17], 2022) demonstrates the great diversity of aquatic and wetland plant species.

Habitat Importance: For these various plant groups, wetlands such as the Sipu River Bed, Rani Talav, and Bandhali Lake are essential habitats (Bhasker *et al.* 2018 ^[2], Charan *et al.* 2019) ^[4, 5].

Medicinal Value: According to Patel (2018) ^[18], several plants found in wetlands have therapeutic qualities. More study on this topic may be beneficial.

Conservation Need: Costanza *et al.* (2014) ^[7] and Mitsch *et al.* (2000, 2013) ^[12] highlight the significance of wetland habitats for plant variety and their economic and ecological functions. This emphasizes how important it is to carry out successful conservation plans.

References

1. Barbier EB. The Policy Challenges for Green Economy and Sustainable Economic Development. Nat Resour Forum, 2011;35:233-245.
2. Bhasker P, Baldev P, Nikunj P, Bhavesh M, Ankit P, Vinod P. Observation on aquatic and wetland plant diversity in Sipu river bed near Sipu dam, Banas Kantha district, Gujarat. Life Sci Leaflets, 2018;100:53-71.
3. Biswas K, Calder CC. Handbook of common water and marsh plants of India. B. S. Mahendrapal Singh (Dehradun), 1984;16:216.
4. Charan RR, Oza K, Maitreya B, Solanki H. Angiosperms diversity of Rani talav wetland (Pavapuri), Ider, Sabarkanth, Gujarat. Interdiscip Res Innov, 2019;7(2):153-157.
5. Charan RR, Solanki H, Gadhavi K. Plant diversity of Bandhali lakewetland (Dumelav), Godhra, Panchmahal, Gujarat. Int J Res Analyt Rev, 2019;6(2):947-952.
6. Cook CDK. Aquatic and Wetland Plants of India. Oxford University Press, 1996.

7. Costanza R, de Groot R, Sutton P, van der Ploeg S, Anderson SJ, Kubiszewski I, *et al.* Changes in the global value of ecosystem services. *Glob Environ Change*,2014;26(1):152-168.
8. Cronk QCB. *Wetland flora of the world. Vol. 11, Asia.* Springer Science & Business Media, 2009.
9. Dabgar PJ. A contribution to the flora of Wadhvani wetland, Dabhoi Taluka (Gujarat) India. *Biosci Discov*,2012;3(2):218-221.
10. Gamit S, Maurya R, Qureshimatva U, Solanki H. Check list of flowering plants in Tapi district, Gujarat, India. *Int J Adv Res*,2015;3(10):1104-1123.
11. Mitsch WJ, Gosselink JG. *Wetlands (3rd ed.)*. John Wiley & Sons, 2000.
12. Mitsch WJ, Bernal PM, Zhang L, Clough B. Could constructed wetlands reduce the net carbon footprint of coal-fired power plants? *Wetlands*,2013;33(3):567-577.
13. *National Wetland Atlas, Gujarat. Space Applications Centre (ISRO), Ahmedabad, 2010.*
14. *National Wetland Atlas, India. Space Applications Centre (ISRO), Ahmedabad, 2011.*
15. Maberly SA. *Macrophytes. Plants in water.* Chapman and Hall, 1996.
16. Patel J, Maitreya B. Diversity of aquatic and associated species of Heranj wetland, Kheda- Gujarat for sustainability. *Sci Res Sci Technol*,2021;8(2):214-222.
17. Patel J, Maitreya B. Diversity of Aquatic Angiosperms and Associated Species of Heranj Wetland, Kheda–Gujarat for Sustainability. *Int J Sci Res Sci Technol*,2021;8(2):214-222.
18. Patel MM. Some aquatic and wetland medicinal plants in the Aravalli district of Gujarat. *J Med Plants*,2018;6(1):143-145.
19. Patel PK. Floristic account of aquatic and wetland angiosperm plants of Panchmahal district, Gujarat. *Nelumbo*,2022;64(2):136-146.
20. Punjani B, Panchal B, Mali N, Patel A, Pandey V. Observation on aquatic and wetlands plant diversity in Sipu river bed near Sipu dam, Banaskantha district, Gujarat. *Life Sci Leaflets*,2018;100:53-71.
21. Sculthorpe CD. *The biology of aquatic vascular plants.* Edward Arnold (Publishers) Ltd, 1967.
22. Shah JP, Dabgar YB, Jain B. A contribution to the flora of selected wetlands in Kachchh district of Gujarat. *Asian J Environ Sci*,2010;5(2):126-130.
23. Singh AK. A contribution to the Aquatic and Wetland flora of Varanasi. *J Econ Taxon Bot*,2006;30(1):6–24.
24. Singh M, Maitreya B. Study of aquatic flora of selected ponds of Gandhinagar, Gujarat. *Int J Sci Res Sci Technol*,2021;8(3):48-51.
25. Suthar A, Tatu K, Gujar R, Kamboj R. A comparative account of diversity of Hydrophytes in some inland wetland (Pariej, Kanewal and Wadhwana) of central Gujarat. *Res Rev J Life Sci*,2019;9(2):39-43.
26. Tiner RW. *Wetland indicators: A guide to wetland formation, identification, delineation, classification, and mapping.* CRC press, 2016.