GESA
GLOCAL ENVIRONMENT & SOCIAL ASSOCIATION

International Journal of Biological Innovations
http://ijbi.org.in | http://www.gesa.org.in/journals.php
https://doi.org/10.46505/IJBI.2025.7211
IJBI 7(2): 194-201 **(2025)**
E-ISSN: 2582-1032

DIVERSITY AND SOCIO-ECONOMIC IMPORTANCE OF AQUATIC AND WETLAND PLANTS IN SELECTED WETLANDS OF MORVA (HADAF), DISTRICT PANCHMAHAL, INDIA

Chirag Prajapati* and P. K. Patel

Department of Botany
SPT Arts and Science College, Godhra (Gujarat), India

**Corresponding author*: chiragprajapati2789@gmail.com

Article Info:
Research article
Received
01.07.2025
Reviewed
15.08.2025
Accepted
27.08.2025

Abstract: Wetlands are dynamic and vital components of the global ecosystem, offering essential services such as biodiversity conservation and water management. Aquatic macrophytes play a significant role in supporting aquatic life and sustaining the livelihoods of rural communities. However, limited conservation efforts threaten these valuable ecosystems. The present study documents the floristic composition and investigates the aquatic macrophyte diversity in selected wetlands of Morva (Hadaf) Taluka, Panchmahal district, Gujarat, India, during the 2023-24 growing seasons. A total of 56 species of aquatic and wetland plants belonging to 29 families were recorded. The study also highlights the ethnobotanical and socio-economic significance of these species, many of which are used in traditional medicine, food, fodder, and other rural practices. The findings underscore the urgent need to document and conserve wetland biodiversity to safeguard ecological balance and cultural heritage.

Keywords: Aquatic plants, Biodiversity, Ethnobotany, Macrophytes, Morva, Panchmahal, Wetlands.

Cite this article as: Prajapati C. and Patel P.K. (2025). Diversity and Socio-economic importance of aquatic and wetland plants in selected Wetlands of Morva (Hadaf), district Panchmahal, India. *International Journal of Biological Innovations*. 7(2): 194-201. https://doi.org/10.46505/IJBI.2025.7211

INTRODUCTION

Biodiversity is one of the most crucial features for maintaining the resilience and stability of aquatic ecosystems (Singh *et al*., 2014; Ashok, 2017; Singh *et al.,* 2023). Wetlands are generally defined as areas of land covered by water, either temporarily or permanently (Cronk and Fennessy, 2016; Butt *et al*., 2021). These include a variety of water bodies such as ponds, boggy areas, floodplains, lagoons, rivers, lakes, streams, marshes, swamps, and bogs, as well as man-made water bodies like canals, fish farms, and paddy fields (Sharma *et al.*, 2021). Wetlands are among the most productive aquatic ecosystems, providing both direct and indirect benefits to humans (Prakash and Verma, 2023). Their ecosystem services are estimated to represent about half of the total global ecosystem value, covering nearly 6% of the world's surface area (Thorsell *et al.*, 1997; Shan *et al*., 2021). The Ramsar Convention has adopted a broad definition of wetlands, encompassing various aquatic habitats such as fish ponds, salt pans, reservoirs,

rice paddies, mangroves, coral reefs, and tidal flats (Bridgewater and Kim, 2021). The wetlands act as natural filters that reduce contamination and pollution, while also serving as buffers against floods by storing water during rainy seasons; beneficial for many wetland bird species including Sarus crane (Khan and Arshad, 2014; Prakash and Verma, 2016). Furthermore, wetlands offer valuable resources and ecosystem services to local and regional communities, including erosion control, flood mitigation, and water quality improvement (Mitsch and Gosselink, 2000).

However, a rapid human population growth, pollution and increasing anthropogenic activities have placed considerable pressure on natural resources, resulting in the degradation of wetland ecosystems and biodiversity (Gichuki *et al.,* 2001; Prakash and Verma, 2022; Kumar and Gupta, 2022; Singh *et al.,* 2023; Arya, 2024). Climate change, disruption of natural drainage systems, overgrazing, droughts, and floods influence the health and sustainability of wetlands (Parikh and Datye, 2003; Verma, 2021).

Wetland plants, particularly aquatic macrophytes, which include mosses, ferns, macroalgae, and angiosperms, play a vital role in these ecosystems. They have evolved a wide range of morphological and structural adaptations as per changing environmental conditions (Cook, 1996; Burlakoti and Karmacharya, 2004; Patel *et al.,* 2023). Fresh water macrophytes contribute to ecosystem functioning by providing habitat and food for aquatic organisms, accumulating heavy metals, and facilitating natural water purification. Their seasonal growth patterns influence the dynamics of the littoral zones in lakes and wetlands (Wetzel, 2001; Singh and Singh, 2020; Khan *et al.,* 2022). While there has been significant research on aquatic macrophytes in Gujarat and India, little attention has been paid to the diversity and quantitative analysis of macrophytes in the Panchmahal District. This study aims to address this gap by: (1) compiling a comprehensive checklist of macrophyte species in selected wetlands of Morva (Hadaf) Taluka, including their scientific and local names, families, habitats, and life forms; and (2) analyzing the ethnobotanical and socioeconomic significance of these aquatic plants.

MATERIALS AND METHODS

Study area

Panchmahal district is located at the eastern end of Gujarat state (fig. 1). The district lies between latitudes 20° 18.00' N to 23° 18.00' N and longitudes 73° 09.00' E to 74° 01.80' E. It covers an area of 5,210 square kilometres. Panchmahal is bounded by Dahod district to the northeast and east, Vadodara district to the southwest, Chhota Udaipur district to the southeast, Kheda district to the west, and Mahisagar district to the north. The district is divided into seven talukas: Shahera, Morva (Hadaf), Kalol, Ghoghamba, Halol, Jambughoda, and Godhra, which serves as the district headquarters. The present study was conducted in four selected natural wetlands (fig. 2; table 1) of Morva (Hadaf) Taluka: Kuwajar, Ganesh Muvadi, Kelod, and Dangariya, with rainfall as the primary water source. Among the selected wetlands, Ganesh Muvadi covers approximately 100 acres, while Kuwajar, Kelod, and Dangariya cover around 15, 25, and 29 acres, respectively.

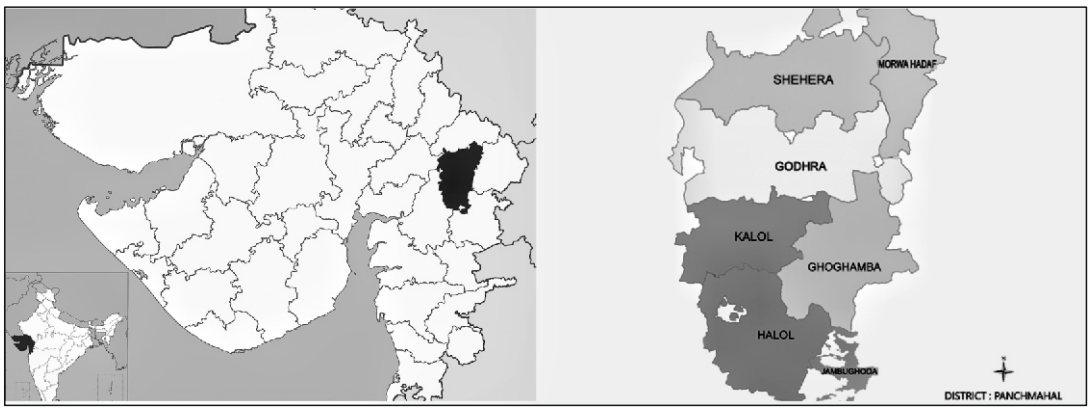

Fig. 1. Geographical location of Panchmahal district within Gujarat state, India.

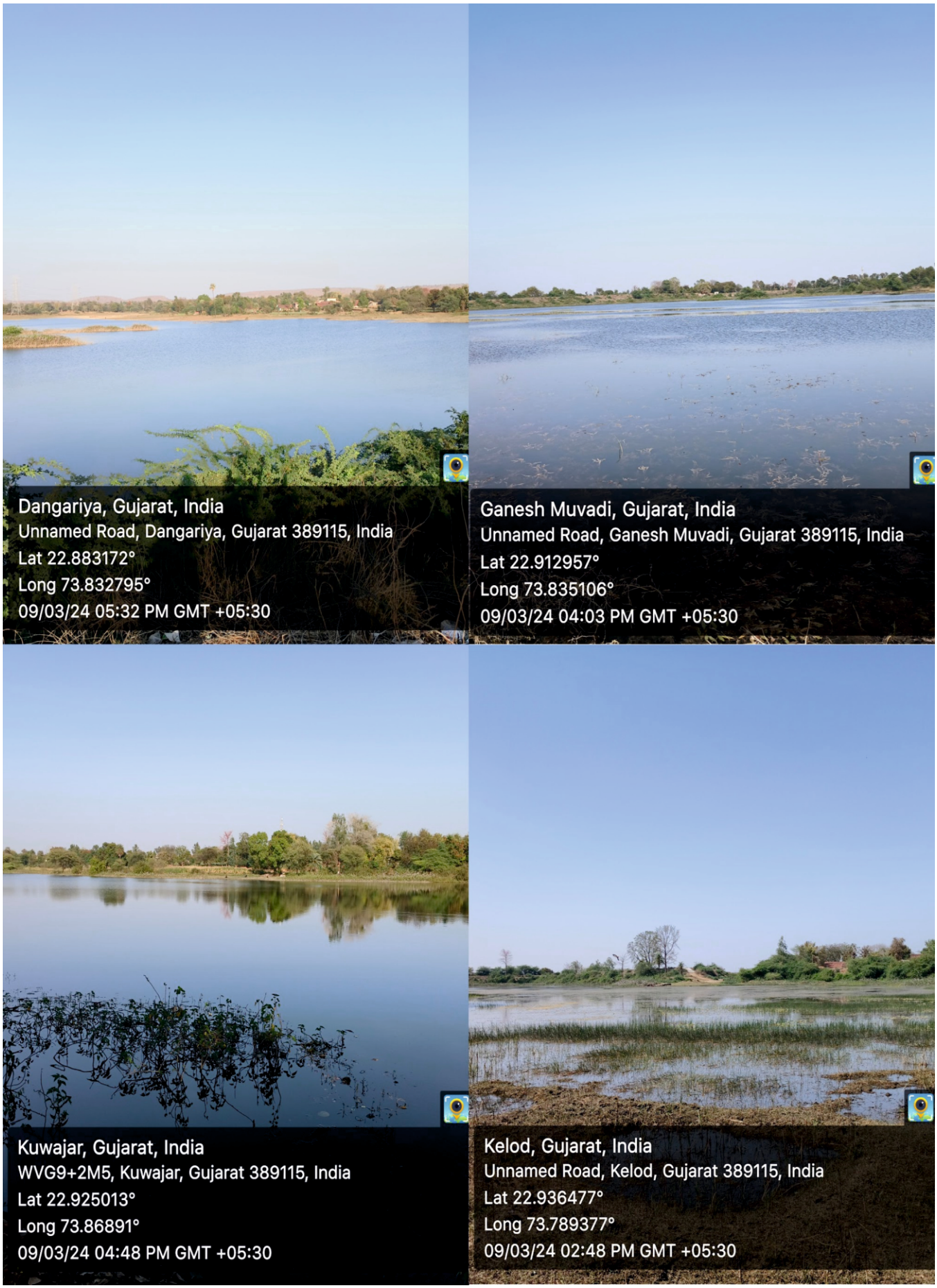

Fig. 2: Locations of the selected wetlands in the study area.

Table 1: List of wetlands selected for floristic and ethnobotanical survey during 2023-2024.

S. No.	Name of Wetland	Area (Acres)
1.	Ganesh Muvadi	100
2.	Dangariya	29
3.	Kelod	25
4.	Kuwajar	15

Field survey and data collection

To survey the flora, systematic exploration was conducted in the selected wetlands during the growing seasons of 2023 and 2024. Plant specimens were collected, and all relevant data regarding wetland flora were immediately recorded in a field notebook. After collection, the plant specimens were identified using standard nomenclature and classification, primarily referring to authoritative regional floras such as The Flora of Gujarat State (Shah, 1978), The Flora of the Presidency of Bombay (Cook, 1903) and Aquatic and Wetland Plants of India (Cook, 1996). Socio-economic and ethnobotanical information was gathered through personal interviews and structured conversations with local inhabitants, particularly elderly villagers. A semi-structured questionnaire was administered to 35 informants, comprising 20 females and 15 males. Fieldwork was carried out in villages surrounding the selected wetlands to ensure a comprehensive understanding of traditional knowledge systems. Ethnobotanical data were obtained on several parameters, including local names of aquatic plants, parts used, and their specific applications in traditional medicine for disease treatment. Interviews were conducted in the Gujarati language to ensure proper and accurate communication, given that many informants lacked formal education and were not conversant in English. Information collected through interviews was supplemented with direct observations and systematic field surveys. A detailed inventory of economically significant macrophytes was compiled and categorised based on their traditional uses, reflecting the various ways local communities utilize these plant resources.

RESULTS AND DISCUSSION

A total of 56 species of aquatic macrophytes (table 2) were documented from the selected wetlands of Morwa Taluka in Panchmahal district, Gujarat. These species belonged to 46 genera and 29 families. The families Asteraceae and Hydrocharitaceae were the most dominant, each represented by six species, followed by Convolvulaceae with four species and Potamogetonaceae with three species. Fifteen families were represented by a single species, comprising approximately 78% of the total family diversity in the study area, while eight families had two species, and three families had three species each.

Regarding life forms, emergent macrophytes were the most abundant, with 36 species, followed by submerged species (11 species), rooted floating species (6 species), and free-floating species (3 species). These macrophytes were utilized by local people/ communities for diverse purposes including food, fodder, and traditional medicine, highlighting their ethnobotanical and socio-economic importance (table 3).

Table 2: List of aquatic and wetland plants recorded from Morwa Taluka, Panchmahal, Gujarat.

No.	Scientific Name	Family	Local Name	Habit	Habitat
1.	*Acalypha indica* L.	Euphorbiaceae	Dadaro	Herb	Emergent
2.	*Acanthospermum hispidum* DC.	Asteraceae	Bristly starbur	Herb	Emergent
3.	*Alternanthera sessilis* (L.) R.Br. ex DC.	Amaranthaceae	Jal jambvo	Herb	Emergent
4.	*Ammannia baccifera* L.	Lythraceae	Jalagio	Herb	Emergent
5.	*Ammannia multiflora* Roxb.	Lythraceae	Zino agio	Herb	Emergent
6.	*Anagallis arvensis* L.	Primulaceae	Khet fuli	Herb	Emergent
7.	*Apluda mutica* L.	Poaceae	Lapdu	Grasses	Emergent
8.	*Bacopa monnieri* (L.) Wettst.	Plantaginaceae	Brahmi	Herb	Emergent
9.	*Bergia odorata* Edgew.	Elatinaceae	Ropatri	Herb	Emergent

10.	*Ceretophyllam demersum* L.	Ceretophyllaceae	Hornwort	Herb	Submerged
11.	*Chrozophora prostrata* Dalzell & A. Gibson	Euphorbiaceae	Betho okharad	Herb	Emergent
12.	*Coldenia procumbens* L.	Boraginaceae	Basario okharad	Herb	Emergent
13.	*Commelina benghalensis* L.	Commelinaceae	Motu sismuliyu	Herb	Emergent
14.	*Cressa cretica* L.	Convolvulaceae	Rudravanti	Herb	Emergent
15.	*Cynodon dactylon* (L.) Pers.	Poaceae	Dharo	Herb	Emergent
16.	*Cyperus difformis* L. Cent.	Cyperaceae	Chiyo	Herb	Emergent
17.	*Cyperus rotundus* L.	Cyperaceae	Common nut sedge	Herb	Emergent
18.	*Dentella repens* J.R. Forst. & G. Forst.	Rubiaceae	Creeping dentella	Herb	Emergent
19.	*Eichhornia crassipes* Mart. Solms	Pontederiaceae	Water hyacinth	Herb	Free floating
20.	*Evolvulus alsinoides* L.	Convolvulaceae	Kali sankhavoli	Herb	Emergent
21.	*Grangea maderaspatana* (L.) Poir.	Asteraceae	Zinkimundi	Herb	Emergent
22.	*Heliotropium indicum* L.	Boraginaceae	Hathisundhi	Herb	Emergent
23.	*Helitropium supinum* L.	Boraginaceae	Spreading heliotrope	Herb	Emergent
24.	*Hydrilla verticillata* (L. f.) Royle	Hydrocharitaceae	Water thyme	Herb	Submerged
25.	*Ipomoea aquatica* Forssk.	Convolvulaceae	Naar-ni-vel	Climber	Rooted floating
26.	*Ipomoea carnea* Jacq.	Convolvulaceae	Alpavardhini	Climber	Emergent
27.	*Launaea procumbens* (Roxb.) Ramayya & Rajagopal	Astreceae	Moti bhonpatri	Herb	Emergent
28.	*Ludwigia adscendens* (L.) H. Hara	Onagraceae	Water dragon	Herb	Emergent
29.	*Ludwigia perennis* L.	Onagraceae	Paddy clove	Herb	Emergent
30.	*Mollugo pentaphylla* L	Molluginaceae	Jhras	Herb	Emergent
31.	*Najas marina* L.	Hydrocharitaceae	spiny water nymph	Herb	Submerged
32.	*Najas minor* All.	Hydrocharitaceae	brittle waternymph	Herb	Submerged
33.	*Nechamandra alternifolia* (Roxb. Ex Wight) Thwaites	Hydrocharitaceae	Indian oxygen-weed	Herb	Submerged
34.	*Nelumbo nucifera* Gaertn.	Nelumbonaceae	Vado kamalful	Herb	Rooted floating
35.	*Nymphaea pubescens* Willd.	Nymphaeaceae	Pink water lily	Herb	Rooted floating
36.	*Nymphoides cristatum* (Roxb.) O. Ktze.	Gentianaceae	Kumudini	Herb	Rooted floating
37.	*Nymphoides indicum* (L.) O. Ktze.	Gentianaceae	Water snowflake	Herb	Rooted floating
38.	*Ottelia alismoides* (L.) Pers.	Hydrocharitaceae	Duck lettuce	Herb	Submerged
39.	*Parthenium hysterosporus* L.	Astreceae	Gajargas	Herb	Emergent
40.	*Phyla nodiflora* (L.) Greene.	Verbenaceae	Jalbuti	Herb	Emergent
41.	*Polygonum plebeium* R. Br.	Polygonaceae	Lal okharad	Herb	Emergent
42.	*Portulaca oleracea* L.	Portulacaceae	Moti luni	Herb	Emergent
43.	*Portulaca quadrifida* L.	Portulacaceae	Zini luni	Shrub	Emergent
44.	*Potamogeton crispus* L.	Potamogetonaceae	Curly pondweed	Herb	Submerged
45.	*Potamogeton nodus* Poir.	Potamogetonaceae	Long leaf pondweed	Herb	Submerged
46.	*Potamogeton pectinatus* L.	Potamogetonaceae	Sago pondweed	Herb	Submerged
47.	*Rumex dentatus* L.	Polygonaceae	Jangli palak	Herb	Emergent
48.	*Sphaeranthus indicus* L.	Asteraceae	Gorakh mundi	Herb	Emergent

49.	*Spilanthes calva* DC.	Asteraceae	Akkalkaro	Herb	Emergent
50.	*Spirodela polyrhiza* (L.) Schleid.	Araceae	Common duckmeat	Herb	Free floating
51.	*Trapa natans* L. var. bispinosa (Roxb.) Makino	Lythraceae	Singoda	Herb	Rooted floating
52.	*Typha angustata* Bory & Chaub.	Typhaceae	Gha bajariu	Herb	Emergent
53.	*Utricularia inflexa* Forsk.,	Lentibulariaceae	Star bladderwort	Herb	Submerged
54.	*Vallisneria spiralis* L.	Hydrocharitaceae	Jal sarpoliya	Herb	Submerged
55.	*Verbascum chinense* (L.) Sant.	Scrophulariaceae	Kalhar	Herb	Emergent
56.	*Wolffia arrhiza* (L.) Horkel ex Wimm.	Araceae	Rootless duckweed	Herb	Free floating

Table 3: Ethnobotanical uses of macrophyte species in selected wetlands of Morwa Taluka.

No.	Plant Species	Parts used	Uses
1.	*A. sessilis* (L.) Dc.	Leaf and root	Leaf and root extracts are taken orally for asthma indigestion.
2.	*A. multiflora* Roxb.	Leaf	The leaf paste can be used externally to treat ringworm and parasite skin infections.
3.	*C. demersum* L.	Whole macrophyte	It is utilized in aquariums as objects or substrate.
4.	*H. verticillata* (L. f.) Royle	Whole macrophyte	During Sasthi puja, shoots are utilized for prayer and adoration as well as fish food.
5.	*I. aquatica* Forsk.	Young tender shoots and leaves	Young tender shoot is a popular vegetable with high demand. A curry made with them is advised for those suffering from gastritis.
6.	*L. adscendens* L.	Young tender shoots and leaves	The young shoot can be used as a vegetable. The leaf decoction is taken with black pepper to treat stomach ache and intestinal worms. Young delicate branches and leaves taken orally can cause weakness in women who are pregnant.
7.	*N. nucifera* Gaertn.	Whole macrophyte	Flowers were used as offerings in temples to God. Seeds, leaves, petioles, roots, flowers, filaments, anthers, and stalks are all edible
8.	*T. angustata* Bory & Chaub.	Whole macrophyte	The edible parts of the plant include dormant sprouts on the roots and bases of leaves, the inner core of the stalk, green bloom spikes, and ripe pollen, which can also be used for thatch in roofing.
9.	*V. spiralis* L.	Leaves	The leaves are used as poultry feed for chicken.

The floristic diversity of aquatic macrophytes recorded in Morwa Taluka reflects the ecological richness of the wetlands within Panchmahal district. The identification of 56 species across 29 families is comparable to findings from other wetlands in Gujarat. The said finding is more or less similar to findings of Patel *et al.* (2023) who reported the aquatic macrophyte species of Pardi wetland, Valsad district, Gujarat, India. The predominance of emergent macrophytes (36 species) corroborates observations noted that emergent species frequently dominate wetlands in Gujarat due to their adaptability to fluctuating water levels and sediment conditions (Shah and Singh, 2019). The relatively lower number of submerged and floating species observed aligns with hydrological characteristics unique to the study sites (Desai *et al.,* 2015).

Hydrocharitaceae and Asteraceae were found to be the most species-rich families, consistent with earlier studies from the region (Shah and Singh, 2019). The presence of many families represented by a single species suggests high taxonomic

diversity, although the distribution of uneven species may be influenced by habitat specificity as well as environmental and local pressures. The documented ethnobotanical uses of these macrophytes for food, fodder, and medicinal applications emphasise the strong socio-economic link between local communities and wetland biodiversity, supporting the previous findings of Mehta *et al.* (2018). This indigenous knowledge plays a crucial role in sustaining community livelihoods and preserving cultural heritage.

Differences in species richness when compared with other Gujarat wetlands, such as the Nalsarovar Bird Sanctuary (Shah and Singh, 2019), may reflect varying degrees of anthropogenic disturbance, conservation status, and habitat quality. These contrasts underscore the necessity for site-specific conservation strategies. The dominance of emergent macrophytes and diverse family representation indicate the wetlands' ecological complexity and suggest that maintaining habitat heterogeneity should be a priority in conservation planning. Protecting these ecosystems is critical not only for preserving biodiversity but also for safeguarding the traditional knowledge systems associated with these plants. Future research should investigate seasonal variations in macrophyte composition and assess the impact of land-use changes and pollution on wetland health. Combining ecological monitoring with the participatory management approaches could enhance the resilience and sustainability of wetlands in this region. Conservation efforts should prioritize the protection of both biological and cultural diversity associated with wetlands to ensure ecological resilience and sustainable community development.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest regarding this paper. All authors confirm that there are no competing interests to disclose.

ACKNOWLEDGMENTS

The authors express their sincere gratitude to Mr. Naranbhai R. Baria for his unwavering support during the entire fieldwork; informants and local communities for their cooperation and sharing invaluable indigenous knowledge, which significantly contributed to the success of this study.

REFERENCES

1. **Arya S.** (2024). Wetland Ecosystem: A better place for rich biodiversity. *International Journal of Fauna and Biological Studies.* 11(6): 106-110. 10.22271/23940522.2024.v11.i6b.1066
2. **Ashok K.V.** (2017). Necessity of Ecological Balance for Widespread Biodiversity. *Indian Journal of Biology*. 4(2): 158-160.
3. **Bridgewater P. and Kim R.E.** (2021). The Ramsar convention on wetlands at 50. *Nature Ecology & Evolution.* 5(3): 268-270. https://doi.org/10.1038/s41559-021-01392-5
4. **Burlakoti C. and Karmacharya S.B.** (2004). Quantitative analysis of macrophytes of Beeshazar Tal, Chitwan, Nepal. *Himalayan Journal of Sciences*. 2(3): 37-41. https://doi.org/10.3126/hjs.v2i3.229
5. **Butt M.A., Zafar M., Ahmad M., Kayani S., Bahadur S., Ullah F. and Khatoon S.** (2021). The use of taxonomic studies for the identification of wetlands weeds. *Advances in Weed Science*. 39: e222645. 10.51694/AdvWeedSci/2021;39:000013
6. **Cook C.D.K.** (1996). Aquatic and Wetland Plants of India. Oxford University Press, Oxford, U.K.
7. **Cook T.** (1903). The Flora of the Presidency of Bombay. Taylor & Francis, London.
8. **Cronk J.K. and Fennessy M.S.** (2016). Wetland Plants: Biology and Ecology. CRC Press, Boca Raton, FL, USA. 482p.
9. **Desai N.K., Patel K.P. and Mehta H.R.** (2015). Aquatic macrophytes diversity and their ecological significance in wetlands of Gujarat, India. *Journal of Wetland Ecology*. 8(2): 45-57.
10. **Gichuki J., Guebas F.D., Mugo J., Rabuor C.O., Triest L. and Dehairs F.** (2001). Species inventory and the local uses of the plants and fishes of the Lower Sondu Miriu wetland of Lake Victoria, Kenya. *Hydrobiologia*. 458: 99-106. https://doi.org/10.1023/A:1013192330498
11. **Khan A.A. and Arshad S.** (2014). Wetlands of Pakistan: Distribution, degradation and management. *Pakistan Geographical Review*. 69(1): 28-45.

12. **Khan K., Shah G.M., Saqib Z., Rahman I.U., Haq S.M., Khan M.A. and Elshikh M.S.** (2022). Species diversity and distribution of macrophytes in different wetland ecosystems. *Applied Sciences*. 12(9): 4467. https://doi.org/10.3390/app12094467

13. **Kumar Sheo and Gupta P.** (2022). Wetlands of Maldah District, West Bengal (India). *International Journal of Biological Innovations*. 4(2): 385-395. https://doi.org/10.46505/IJBI.2022.4215

14. **Mehta S., Joshi A. and Raval P.** (2018). Ethnobotanical uses of aquatic plants among rural communities of Gujarat. *Indian Journal of Ethnobiology*. 12(1): 23-34.

15. **Mitsch W.J. and Gosselink J.G.** (2000). Wetlands. 3rd ed. John Wiley and Sons Inc., New York, USA.

16. **Parikh J. and Datye H.** (2003). Sustainable Management of Wetlands: Biodiversity and Beyond. Sage Publications, Delhi, India.

17. **Patel H.A., Sahoo S. and Thakor A.** (2023). Diversity of aquatic macrophyte species of Pardi wetland, Valsad district, Gujarat, India: Social-economic and Ethnobotanical importance. *Current World Environment*. 18(3):1325-1336. http://dx.doi.org/10.12944/CWE.18.3.32

18. **Prakash S. and Verma A.K.** (2016). Marital fidelity and congregation of Indian sarus crane, *Grus antigone antigone* in and around Alwara lake of district Kaushambi (Uttar Pradesh), India. *International Journal of Biological Research*. 4 (1):10-13. 10.14419/ijbr. v4i1.5692

19. **Prakash Sadguru and Verma A.K.** (2022). Anthropogenic activities and Biodiversity threats. *International Journal of Biological Innovations*. 4(1): 94-103. https://doi.org/10.46505/IJBI.2022.4110.

20. **Prakash S. and Verma A.K.** (2023). Wetland: An impact of Environmental Degradation and its Conservation. In: Environment and Society 2022; Publisher: Nature Light Publications, Pune. 01-08.

21. **Shah G.L.** (1978). Flora of Gujarat State, Vols. I & II. Sardar Patel University Press, Vallabh Vidyanagar, India.

22. **Shah K. and Singh M.** (2019). Macrophyte diversity and distribution in Nalsarovar Bird Sanctuary, Gujarat. *Wetlands Science and Practice*. 11(1): 12-24.

23. **Shan Vandana, Singh S.K. and Haritash A.K.** (2021). Present status, conservation, and management of wetlands in India, pp. 235-256. In: *Advances in Energy and Environment*. Springer, Singapore. https://doi.org/10.1007/978-981-33-6695-4_22

24. **Sharma Sanjeev, Phartiyal M., Madhav S. and Singh Pradeep** (2021). Global wetlands: categorisation, distribution and global scenario, pp. 1-16. In: Wetlands Conservation: Current Challenges and Future Strategies. Wiley, Hoboken, USA. https://doi.org/10.1002/9781119692621.ch1

25. **Singh N. and Sharma R.C.** (2014). Some important attributes which regulate the life of macro-invertebrates: A review. *International Journal of Recent Scientific Research*. 5(2): 357-361.

26. **Singh R., Verma A.K. and Prakash S.** (2023). The web of life: Role of pollution in biodiversity decline. *International Journal of Fauna and Biological Studies*. 10(3): 49-52. 10.22271/23940522.2023.v10.i3a.1003

27. **Singh S. and Singh S.** (2020). Macrophytes as Bioindicator in Bichhiya River, Rewa (M.P.), India. *International Journal of Biological Innovations*. 2(1): 25-30. https://doi.org/10.46505/IJBI.2020.2104

28. **Thorsell J.W., Levy R.F. and Sigaty T.A.** (1997). Global Overview of Wetland and Marine Protected Areas on the World Heritage List: A Contribution to the Global Theme Study of World Heritage Natural Sites. IUCN:The World Conservation Union, Gland, Switzerland.

29. **Verma A.K.** (2021). Influence of climate change on balanced ecosystem, biodiversity and sustainable development: An overview. *International Journal of Biological Innovations*. 3(2):331-337. https://doi.org/10.46505/IJBI.2021.3213

30. **Wetzel R.G.** (2001). Limnology. Academic Press, San Diego, USA