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Diversity of wetland flora in Gujarat: A review

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Abstract

Wetland is an area in which soil is covered or saturated by water. They are the most significant ecosystem on the Earth. In this review paper the global scenario of distribution of wetlands, and distribution patterns of different types of wetlands and their phytodiversity in India and specifically in Gujrat is discussed.. Worldwide there are more than 2,400 Ramsar sites that cover an area of 2.5 million square kilometers. India has distinctive wetland ecosystems due to its varied terrain and climate conditions. Total 730 species of wetland plants are found including 114 endemic species in India. Among all the Indian states, Gujarat has the largest area of wetlands, The first widely used classification categorized wetlands into mainly 5 types: marine, estuarine, lacustrine, riverine and palustrine. The state contains four Ramsar sites: Wadhvana Wetland, Thol Lake, Nalsarovar Bird Sanctuary and Khijadiya Wetland, and 8 wetlands of National Importance. Gujrat has diverse range of wetland vegetation including aquatic plants like *Typha*, *Hydrilla, Nelumbo, Nymphaea.* Sedges and grass vegetation dominated by *Cyperaceae* Family, Tree species include various species of *Vachellia, Salvadora, Prosopis.* Coastal wetlands has mangroves including *Avicennia, Suaeda, Bruguiera and Rhizophora.*

Keywords: Wetlands; Vegetation; Biodiversity; Ecosystem; Conservation and Management

1. Introduction

Wetlands are one of the most fragile ecosystems on the Earth with the highest biodiversity, ecological services and functions. They are the most significant, diverse, sensitive, adaptable and productive systems. Wetland is an area in which soil is covered or saturated by water. According to Ramsar convention (1971) "areas of marsh, fen, peatland or water, weather natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish, or salt, including areas of marine water the depth of which at low tide does not exceed six meters." They are ecotones which is transitional between terrestrial ecosystems and aquatic ecosystems (Mitsch & Gosselink 1986; Prasad *et al*., 2002). Wetlands are the "kidneys of the Earth' because of their importance in hydrological and biogeochemical cycles. Wetlands are also termed as "biological supermarkets" as they support rich biodiversity and extensive food chain. Wetlands provide unique habitat for flora as well as fauna and special functions in the landscape by regulating water resources (Daryadel & Talaei, 2014). Wetlands exhibit wide range of biodiversity in reference to their genesis, geographical location, hydrological condition, dominate community, soil and sediment characteristics (Bassi *et al*., 2014). Various National, regional and local classification systems were developed for management and conservation goals as well as the information used to assess wetland loss or to assign management priorities. These classification systems provide an essential base for the developing an international and common classification system and database (Finlayson *et al*., 1995). The first widely used classification categorised wetlands into mainly 5 types; marine, estuarine, lacustrine, riverine and palustrine, based on their hydrological, ecological and geological characteristics (Cowardin *et al*., 1979; Ratan *et al.,* 2021). The Ramsar convention on wetlands is an international convention that established a framework for national action and international collaboration in the conservation and sustainable use of wetland

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resources. The Ramsar Treaty was signed on 2nd February, 1971 in Iran. The convention addresses wetland degradation through three main implementations based: (i) the wise use of all Wetlands, (ii) the designation and management of wetlands of international importance, (iii) international cooperation on resources management and knowledge information sharing (Ratan *et al*., 2021).

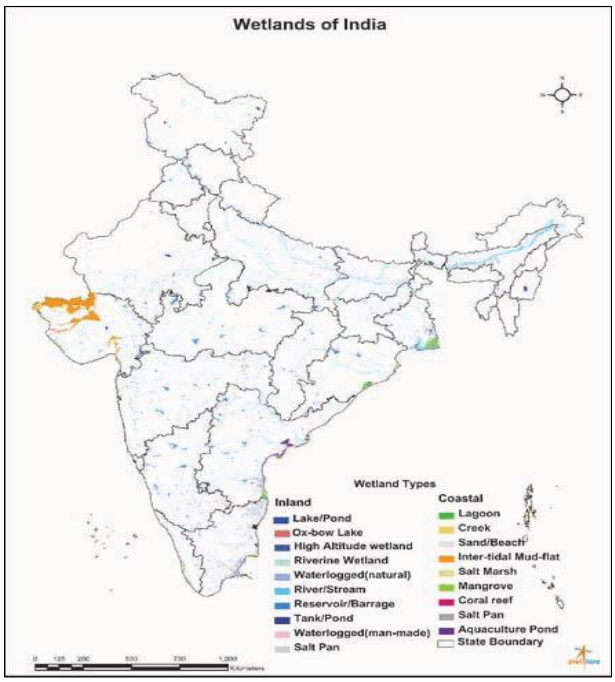
2. Wetlands History and its change over time

Human existence and wetlands have been closely related throughout history. Fossil records of wetlands demonstrate that wetland habitats originated or at least kept uncommon evolutionary features and at other times acted as shelters for distinctive and long-lasting floras and faunas. Since their emergence in the Paleozoic, wetland varieties have also evolved. Forest swamp and mires began to form in the late Devonian. Fens also evolved in the era, while the first marshes appeared in the mid Devonian. In addition to significantly changing the way sedimentological, hydrological and other biogeochemical cycles function worldwide, the differentiation of wetland habitats produced a variety of niches that impacted the terrestrialization of arthropods in the Silurian and terrestrialization of the tetrapods in the Devonian. The Carboniferous saw the evolution of widespread peatlands and tropical mires have appeared. Carboniferous wetland plant communities were essentially structurally and probably dynamically contemporary but having a very different taxonomic composition than Mesozoic and Cenozoic groups. By the late Permian, mires had developed at higher altitudes. Wetlands that formed peat were widespread in the late Paleozoic. Additionally, the emergence of Sphagnum sp. During the Cenozoic allowed bryophytes, an ancient wetland group to dominate high altitude mires, resulting in some of widespread mires ever observed. Recognizing the evolution of wetland types and natural framework locations and niches of flora and fauna are essential to understanding the evolution of wetland function and food webs as well as the paleoecology of Neighboring ecotones (Greb *et al*., 2006).

2.1. Global distribution of wetlands

The estimation of the area of wetlands varies from 1.53 to 14.86 million square kilometers on the Earth surface (Hu *et al*., 2001) of which 46% is temporary and 54% is permanently submerged. Only 7.2% of the continental wetland area is coastal with the remaining 92.8% being inland (Devidson *et al*., 2018). Globally, wetlands occupy nearly 6.4% of the Earth surface, out of which man-made bogs are 30%, fens covers 26%,of the area, swamps cover 20%, floodplains cover 15% and others cover 9%. Worldwide there are more than 2,400 Ramsar sites that covers area of 2.5 million square kilometers. Asia has the largest area covered by wetlands in the world (Gupta *et al*., 2021).

2.2. The wetland Heritage of India



(Image source: SAC, https://images.app.goo.gl/QGRQRh5hGmroorPy8)

Figure 1 Map of India showing distribution of wetlands and it's type**s**

India has distinctive wetland ecosystems due to its varied terrain and climate conditions (Prasad *et al.,* 2002; Bassi *et al.,* 2014). India's wetland are significant repositories of aquatic biodiversity. The country's diverse ecoclimatic regimes have produced a range of wetland ecosystems, from high altitude cold desert wetland to hot and humid wetlands in the coastal zones, each with its own unique geographical characteristics, flora and fauna. India has 85 wetlands recognized as Ramsar sites, which comprises an area of 1,358,066 ha that is highest in Asia. India has a total of 23,195 wetlands comprising 15.98 Mha area (Fig.1), which is 4.68% of the total geographic area of the country (SAC, 2021). Among these, 69% is covered by inland wetlands, 27% by coastal wetlands, and 4% by other wetlands. Coastal wetlands have the largest average area under 5 types of wetlands (Bassi *et al.,* 2014). In terms of the percentage of land covered by wetlands, Mizoram has the lowest area (0.66%) and Gujarat has the largest area (17.5%) in India (Bassi *et al.,* 2014). The majority of inland wetlands are either directly or indirectly dependent on the main rivers, such as the Ganga, Brahmaputra, Narmada, Godavari, Krishna, Kaveri, and Tapi. They are found in the hot, Wetlands are found in the hot, arid regions of Gujrat and Rajasthan, the deltaic region of the seastrand west coasts, the central Indian high lands, the wetland zones of south peninsula India and the Andaman and Nicobar Islands. The high-altitude Himalayan lakes make up India's natural Wetlands, which are followed by Wetlands found in the floodplains of the main river system, saline and temporary wetlands of the arid and semi- arid regions, coastal wetlands like lagoons, backwaters and estuaries; mangrove swamps; coral reefs; and marine wetlands. Aside from bogs, fens and typically salt marshes, Indian wetlands encompass the entire spectrum of ecosystem types. In addition to the many types of many types of natural wetlands, a significant number of manmade wetlands also contribute to the biodiversity (Prasad *et al.,* 2002). Of the Indian subcontinent most of the western part is arid.

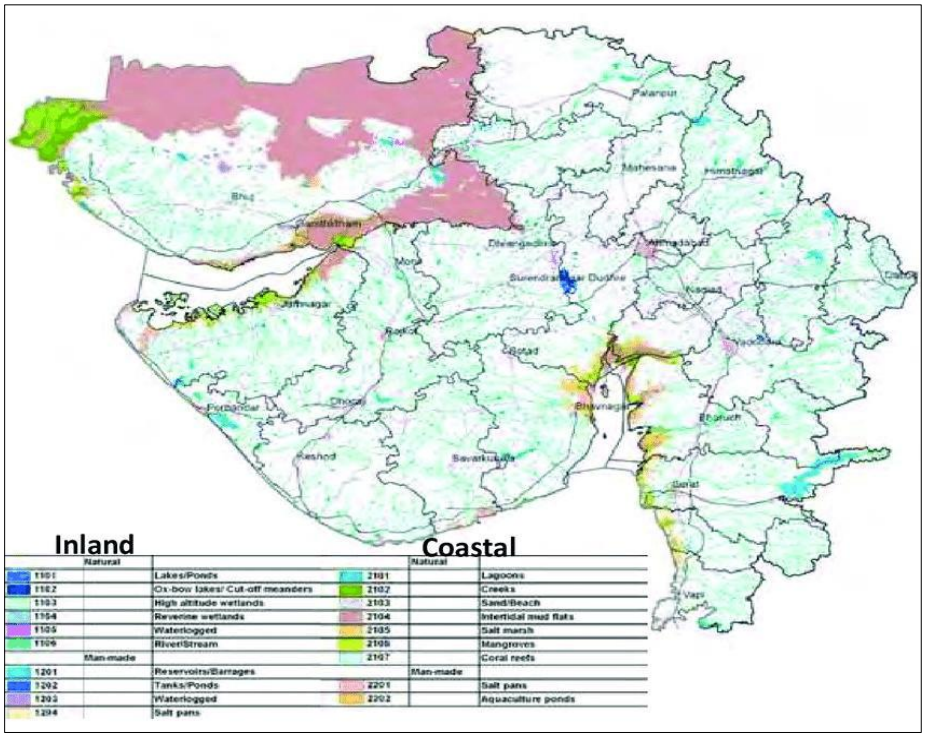


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Figure 2 Map of Gujarat showing distribution of wetlands and its types

Rivers, lakes and other freshwaters as well as saline water habitats support a large diversity of biota and include all most taxonomic groups in India. Macrophytes are dominant vegetation in wetlands. Total 730 species of wetland plants are found including 114 endemic species in India. The major plant families found in Wetlands are *Alismataceae, Menyanthaceae, Xyridaceae, Lemnaceae, Podostemaceae, Polygonaceae, Najàdaceae, Trapaceae, Typhaeceae, Poaceae, Nymphaeaceae, Juncaceae, Hydrophyllaceae, Hydrocharitaceae, Ericalaceae, Elatinaceae, Droseraceae, Cyperaceae, Ceratophyllaceae, Callitrichaceae, Cabomabaceae, Aponogetonaceae* (Vijayan *et al.,* 2004). Algae is also represent floristic diversity but it's difficult to assessment the algal diversity because of diverse range of habitats and endemicity as well as changes occurs by climatic conditions and anthropogenic pressure. Biodiversity of various species are indicators of ecological conditions of wetland. Wetlands are important testing and roosting sites of migratory birds. Aquatic plants are the main source of food for migratory birds, especially for the waterfowl (Prasad *et al.,* 2002).

2.3. Gujarat's rich wetland ecosystem

Of all the Indian states, Gujarat has the largest area of wetlands (around 3.5 million hectares), which makes up 17.8% of the state's total land area (Fig 2).Its area is the largest in the nation for creeks (67%), intertidal mud flats (46.8%), salt marshes (91.6%), and salt pan-coastal (75.5%).The only state with more than 1% of the nation's acreage covered by wetlands is this one. Decadal variations from 2006–07 to 2017–18 indicate that the overall wetland area (50016 ha, primarily reservoirs, tanks, and ponds) has increased. While man-made (coastal & natural) classes have increased, there has been a notable decrease in coastal-natural wetlands (3.3%). Additional changes include the creation of new wetlands (1822; 19878 ha), mostly in the man-made category, the loss of a small number of wetlands, including waterlogged and abandoned mines, and the growth of mangrove (19%) and coral reef (5.6%) regions. The state contains four Ramsar sites: Wadhvana Wetland, Thol Lake, Nalsarovar Bird Sanctuary and Khijadiya Wetland, and 8 wetlands of National Importance.

The Indian state of Gujarat boasts more than 2,340 kilometers of coastline according to Survey of India. Coastal wetlands, which accounted for around 80% of the state's total wetland area in 2017–18, are the predominant wetland category. The Little Ran of Kachchh is a major wetland that spans around 1.54 million hectares (Fig 2). The Inventory includes over 250 species of plants (Meena *et al*., 2005; Ishnava *et al*., 2011). 170 species of algae, numerous zooplankton Inventory and macro invertebrates, there are around 150 species of avifauna (Stanley, 2004; Prusty, 2009; Gajera *et al*., 2012). Only a few species predominate, despite the fact that (Ishnava *et al*., 2011) list 104 plant species from the Little Rann of Kachchh alone. *Spirulina*, one type of algae, is in charge of the salt pans. The herbaceous plants found in locations that flood seasonally includes common halophytes as *Sesuvium portulacastrum, Salsola sp., Suaeda fruticosa, Cressacretica, and Salicornia brachiata.* The most prevalent *Aelurops lagopoides* and species of *Scirpus and Juncus* are examples of sedges and grasses. *Avicennia marina* makes up about all of the mangroves. *Avicennia officinalis*, *Aegiceras corniculatum, A. alba,* and other sporadic mangrove species *Sonneratia apetala, Rhizophora mucronata,* Ceriops tagal, and Bruguiera gymnorhiza. (Gopal & Sharma, 1994; Shan *et al*., 2021).

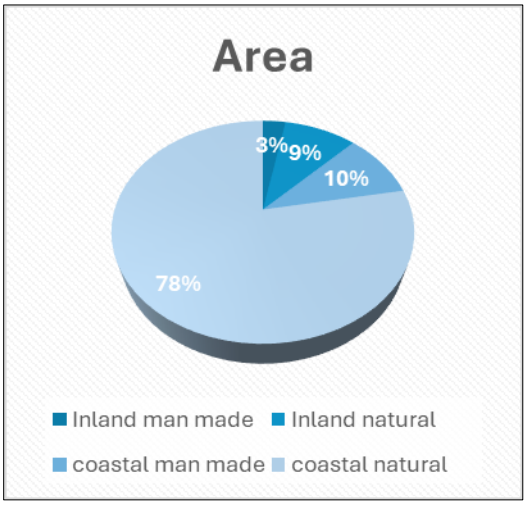

Figure 3 Showing the area of different types of wetlands in Gujrat

3. Wetland Plant Vegetation of Gujarat

One of the Ramsar sites and Gujarat's largest freshwater reservoir and one of India's most significant biodiversity hotspots, Nal Sarovar Bird Sanctuary is significant both socioeconomically and biologically. (Nirmal *et al*., 2007; Vankar, 2018). The study carried out to monitor aquatic vegetation in Nalsarovar by using spectral indices that conclude Between 2002 and 2018, the amount of aquatic vegetation increased from 146.81 hectares to 510.93 hectares. The wetland has extensive emergent and dense hydrophytic cover where common plants are *Typha, Cyperus,, Phragmites* are found (Vankar, 2018). The change in land use shows a decrease in areas damaged by salt and a rise in built-up, agricultural, water body, and wetland land (Chauhan *et al*., 2021).

Khijadiya wetland and Bird sanctuary is a important Ramsar sites located at Jamnagar in Gujrat with its unique geographical characteristics as a combination of coastal saline water marshland and freshwater lake. It is well known for its avifaunal diversity (Rao *et al*., 2017). Khijadiya is a wetland with two distinct vegetation types: halophytes that grow in or close to intertidal mud flats and hydrophytes that thrive in or around freshwater ponds. The diversity and

community makeup of halophytes and hydrophytes in Khijadiya wetland were investigated. 10 halophytes and twelve hydrophytes were identified. While halophyte (mangrove) species like *Avicennia marina* dominated the saline habitat, emergent hydrophytes like *Bolboschoenus maritimus, Fimbrystylis ferruginea, and Cyperus difformis* dominated the freshwater area (Gujar *et al*., 2020).

Wadhwana wetland is Ramsar sites located in Dabhoi Taluka of Gujrat. There are 73 genera and 82 species of flowers in the wetland, representing 43 Angiospermic groups. Twelve families and nineteen species represented the monocotyledon, while thirty-one families and sixty-three species represented the dicotyledonous. These species were found in marshy areas and were classified as free floating, rooted floating, submerged, and emergent species. It has been discovered that a remarkably large number of species exist throughout the year (Dabgar, 2012).

Thol wildlife sanctuary is a man made wetland in Mahesana, recognized as Ramsar sites. Most of the area has scrub land, and only 15% vegetation cover dominated by *Ipomea fistula* and *Vachellia nilotica.* It was concerning to examine the dominance of *Prosopis chilensis* (Molina) in a protected area of "Thol Lake wildlife Sanctuary" in relation to other prominent tree species. After *Acacia nilotica* the species is currently the second most dominant tree species in the research region (Vyas & Dabgar, 2013).

The "Bhal" region is located on Saurashtra's southwest border. Includes half of Gujarat state's Bhavnagar district and half of Ahmedabad. In essence, this region is well known for its salinity; The area is level as the forehead and free of pebbles or stones. This area is the source of important rivers like Bhogavo, Ghelo, and Kalubhar. Because of these the "Bhal" region contains rivers, marshy habitat, and estuarine habitat. In marshes, halophytes predominate, although in coastal Wetlands they are home to grass species belonging to the *Chenopodiaceae* family. Quantitative evaluation of every species found in the Bhal region of the District of Bhavnagar (Vyas & Joshi, 2015).

Nani Kakrad is an wetland of national importance located in Navsari. Vegetation such as Piludi (*Salvadora persica),* Gando Baval *(Prosopis juliflora),* different mangrove species, sedges, and other hydrophytic plants predominate in wetlands. In addition, *Typha sp.* Vegetation found in some marshes serves as a home for skulker species including bitterns and warblers (Patel, 2021). Twelve species are near threatened, seven are vulnerable, and two are endangered, under the IUCN Red List (Patel *et al*., 2022).

Kanewal's vegetation is incredibly diverse. Research indicates Existence of many pteridophyte and angiosperm species. The Kanewal Wetland's vegetation demonstrates the variety of several kinds of plants. About 125 species are included in the study. These 125 species are divided into 46 Families and 97 Genera. 14 trees, 18 shrubs, 5 climbers, and 68 are represented in the study. Five species of grasses, four sedges. The herbaceous vegetation is found in area where *Bergia, Desmodium, Indigofera* are common. Grasses like *Apluda, Aristida* and *Digitaria* are major species. The most of them are Typha vegetation is visible. *Escherichia crassipes* is expanding there very quickly and *Nelumbo, Potamogeton, Nymphea, Hydrilla* are also found (Gajjar & Solanki, 2021).

Kheda's wetlands are home to 130 species that are members of There are 21 tree species in all over 48 families and 106 genera. 18 species of climbers, 57 species of herbs, and 17 species of shrubs Seven grass species and eight sedge species. Additionally, all the Observed species have been discovered in several levels, including such as the ground, middle, and upper layers. The Different plant species from various strata have displayed distinct ecologically important functions in the ecosystem of wetlands. (Rathore *et al*., 2020).

The southernmost district of Gujarat, Valsad; Is located on the shore of the Arabian Sea. The district's 23,116-hacters wetland area and 3034-square-kilometer geographic area make up 0.67 percent of the entire wetland area .At the Pardi wetland in Gujarat's Valsad district, 43 macrophyte species have been identified . 43 species of macrophytes from 35 genera and 24 families were identified during the study at the chosen wetland, Pardi Lake. *Azolla pinnata* R. Br. And *Marselia quadrifolia L.* were two macrophyte species that represented pteridophytes, 40 macrophyte species represented angiosperms, Herbaceous vegetation is dominated by *Alternanthera* and *Cyperus species, Typha, Azolla, Eicchornia, Polygonum, Nymphea* are common plants, and one macrophyte species, *Chara globularis* L., represented macroalgae (Patel *et al*., 2023;18).

Wetlands at Pariej, Khambhat, Gujarat state .In area that ranges in depth from 4 to 10 feet. In the current investigation, 74 species in all, including There are 39 flowering plant families, 63 genera, and 2 non-flowering, such as *Chara* sp. (algae), and The pteridophyte *Marsilea quadrifolia L.* has been recorded in the Pariej marsh and its environs. *Cyperaceae* is dominate family and *Typha, Plebecium, Polygonum, Eliptica, Najas, Vallisneria, Hydrilla* are common plants in Wetland. The vegetation is herbaceous Dicots 48 species are represented, spanning 41 genera and 29 Families, whereas 26 species are monocots. Belongs to nine families and twenty genera (Jaivin *et al.*, 2021).

Gujarat's Porbandar district's coastal vegetation was 23 coastal settlements were examined in order to evaluate the richness of plants. 213 species were identified by systematic field surveys. Dicotyledons predominate among the 58 families and genera, 172 Monocotyledons and species from 48 families and 140 genera consisting of 10 families, 34 genera, and 41 species (Odedra *et al.*, 2024).

The Bandheli wetland is located in Gujarat, close to Godhra. A recent scientific study conducted in India looked into the distribution of aquatic biomass dynamics, community diversity, and vegetation. 36 plants were found in the study. Species from 23 families and 32 genera, including 4 climbers, 4 shrubs, 24 herbs, and There are four trees spread out across the swamp (Charan *et al.,* 2023).

In the coastal regions of Devbhoomi Dwarka District and its islands in the Gulf of Kachchh, the study detailed the phytosociological characteristics and diversity of plant species (trees, shrubs, and herbs). In this investigation, a random sample technique was used. There were 243 plant species identified, with 30 species each ltures. Global values include maintaining water and air quality influences on a much broader scale than that of the ecosystem level, especially in regional and global cycles of nitrogen, sulfur, and carbon (Das *et al.,* 2021).

3.1. The crucial role of wetland in our ecosystem

Wetlands considered as the most productive ecosystems in the biosphere by providing significant contribution to ecological and economical sustainability of a region as compared to tropical evergreen forests (Brink *et al.,* 2012; Nayak & Bhushan, 2022). 47% of the world's ecosystem values accounted by the total values of wetland ecosystems (Xu *et al*., 2019). It is generally acknowledged that wetlands significantly impact the hydrological cycle, because of that wetlands are crucial component of regional, national and global water management policies (Bullock & Acreman, 2023). India's wetland ecosystems support variety of distinct and diversified habitats and provide wide range of ecological goods and services. Regulation of air quality, climate, water purification, pollination, and natural hazards are example of regulating ecosystem services. Benefits that individuals receive from ecosystems pertaining to spiritual enrichment, leisure, ecotourism, aesthetics, formal and informal education, inspiration, and cultural heritage are referred to as cultural ecosystem services. The fundamental ecosystem processes of primary productivity and nutrient cycling are examples of supporting ecosystem services (Mitsch *et al.,* 2015). The combine environment of aquatic and terrestrial ecosystem of Wetlands supports a wide range of habitats for flora and fauna that increasingly meet human needs by contributing to agriculture, biofertilizer, energy sources, industrial raw materials and pharmaceuticals. Due to their significance supply of physiologically active compounds with therapeutic properties, herbal macrophytes have been utilized in traditional medicine since ancient times (Patel *et al.,* 2023). Wetlands provide shelter and habitat of many plants, specially migratory birds, mammals, insect etc. Many local ecosystems, fuel wood supply, carbon sequestration, fishery based industries and several other ecological and socio-economic factors are regulated by this biodiversity. Other ecological features of the wetlands include nutrient conservation, sedimentation-based freshwater quality maintenance (Bhowmik, 2023).

3.2. Challenges facing wetland today

Wetlands are considered as most endangered and threatened ecosystems of the world. The claim that 50% of the world's wetlands have disappeared (or 50% since 1900 AD) has been made often without any supporting data (Nichollas, 2004; Prasad *et al*., 2002). The documented long-term loss of natural wetlands has been between 54 and 57%, according to the change in wetland area; however, after 1700 AD, the loss may have reached 87%. With a loss of 64–71% of wetlands since 1900 AD, wetland loss has occurred at a significantly quicker rate (3.7 times) in the 20th and early 21st centuries (Davidson *et al*., 2014). Inland natural wetlands have seen greater and quicker losses than coastal ones.In India, wetland loss can be classified into two categories named as acute and chronic. Acute loss is the feeling up of wetlands by soil. The reasons of acute loss can be hydrological alteration, deforestation in wetland, agricultural development and inundation by dam made reservoirs. The slow loss of forest cover, over many decades followed by erosion and sedimentation of the wetlands, known as chronic loss. The cause of chronic loss includes, various aspects like degradation of water quality, alternation of upper watersheds, depletion of ground water, extinction of native biota and dominance of invasive species (Prasad *et al.,* 2002).

3.3. Conservation and management of wetlands

The preservation of ecological functions that leads to variety of benefits, such as groundwater recharge and discharge, flood flow modification, sediment stabilization, water quality, food chain support, wildlife habitat, fisheries and heritage is the basis for rational for the conservation of wetlands .The biological and ecological costs that results from degradation or disturbance of the wetland ecosystem serve as a stark reminder of their true significance. Unlocking current planning and decision-making conflicts requires the development of functional and analytical procedures

(Maltby, 1991; Acharya *et al*., 2009). In India some legal actions and policies are made for the conservation and management goals of the wetlands, such as Water Act – 1997, Maritime zone of India -1980, The Indian fisheries Act-1857, Wildlife Act-1972, Coastal Zone Regulation Notification – 1991, The Indian Forest Act – 1927, Water Act- 1974, National Policy And Macro level Action, Terrestrial Water, Continental shelf, Exclusive Economic Zone and other Marine Zone Act -1976. The conservation can be done by using various strategies like, use of GIS and Remote sensing in the management of wetlands, coordinated approaches, legalization, comprehensive inventory, planning, managing and monitoring, and research for achieving sustainable success in conversation of wetlands (Acharya *et al.,* 2009).

Table 1 Common plants of the wetlands of Gujarat.

Sr. No.	Botanical Name	Family	Habitat
1	*Acalypha indica L.*	*Euphorbiaceae*	Free floating
2	*Acanthospermum hispidum DC.*	*Astreceae*	Free floating
3	*Acanthus ilicifolius L*	*Acanthaceae*	Marshy
4	*Aegiceras corniculatum (L.)*	*Myrsinaceae*	Marshy
5	*Ageratum conzoides L.*	*Astreceae*	Free floating
6	*Aleuoropes lagopoides (L.) Pellegrin*	*Poaceae*	Marshy
7	*Alternanthera sessilis (L.) DC*	*Amaranthaceae*	Marshes
8	*Alyscirpus monilifer (L.) DC.*	*Fabaceae*	Marshy land
9	*Amberboa ramosa (Roxb.) Jeffry.*	*Astreceae*	Free floating
10	*Ammannia baccifera L.*	*Lythraceae*	Marshy land
11	*Ammannia baccifera L.*	*Lythraceae*	Marshey
12	*Ammannia multiflora Roxb.*	*Lythraceae*	Marshy land
13	*Anagallis arvensis L.*	*Primulaceae*	Free floating
14	*Andrographis ehioides L.*	*Acanthaceae*	Free floating
15	*Andrographis paniculata Wall.*	*Acanthaceae*	Free floating
16	*Anisomeles indica (L) O. Ktze.*	*Lamiaceae*	Free floating
17	*Apluda mutica L.*	*Poaceae*	Rooted emergent
18	*Aristida adscensionis L.*	*Poaceae*	Rooted emergent
19	*Aristida funiculate Trin. & Rupr*	*Poaceae*	Rooted emergent
20	*Arthrocnemum indicum (Willd.) Moq.*	*Amaranthaceae*	Marshy
21	*Asparagus recemosus Willd.*	*Liliaceae*	Submerged
22	*Asphodelus tenuifolius Cav.*	*Asphodelaceae*	Submerged
23	*Avicennia alba Blume*	*Avicenniaceae*	Salt marshes
24	*Avicennia marina (Forsk.)*	*Avicenniaceae*	Salt marshes
25	*Avicennia officinalis L.*	*Avicenniaceae*	Salt marshes
26	*Azolla pinnata;*	*Salviniaceae*	Free floating
27	*Bacopa monnieri (L) Pennell.*	*Scrophulariaceae*	Free floating
28	*Bergia odorata Edgew.*	*Elatinaceae*	Marshy land

29	*Boerhavia diffusa L.*	*Nyctaginaceae*	Free floating
30	*Bonaya veronicaefolia Spr.*	*Scrophulariaceae*	Free floating
31	*Borreria aricularis L.*	*Rubiaceae*	Free floating
32	*Bruguiera cylindrica (L.) Bl.*	*Rhizophoraceae*	Salt marshes
33	*Bruguiera gymnorrhiza (L.)*	*Rhizophoraceae*	Salt marshes
34	*Caesalpinia crista L.*	*Fabaceae*	Marshy
35	*Canavalia gladiata (Jacq.) DC.*	*Fabaceae*	Marshy
36	*Cayratia carnosa (Lam.) Gagnep.*	*Vitaceae*	Marshy land
37	*Ceretophyllam demersum L.*	*Ceretophyllaceae*	Submerged
38	*Ceriops tagal (Perr.) C.B.*	*Avicenniaceae*	Salt marshes
39	*Chara globularis L.*	*Characeae*	Submerged
40	*Cissus quadrangularie L.*	*Vitaceae*	Marshy land
41	*Clerodendron inerme (L.) Gaertn.*	*Lamiaceae*	Marshy
42	*Coldenia procumbens L.*	*Boraginaceae*	Free floating
43	*Commelina benghalensis L.*	*Commelinaceae*	Submerged
44	*Commelina forskalaei Vahl.*	*Commelinaceae*	Marshes
45	*Conscora diffusa (Vahl.) R.*	*Gentianaceae*	Free floating
46	*Convorvulus microphyllus (Roth.)*	*Convolvulaceae*	Free floating
47	*Corchorus aestuans L.*	*Tiliaceae*	Marshy land
48	*Corchorus olitorius L.*	*Tiliaceae*	Marshy land
49	*Cressa cretica L.*	*Convolvulaceae*	Marshy
50	*Cyperus bulbosus Vahl*	*Cyperaceae*	Emergent
51	*Cyperus difformis L.*	*Cyperaceae*	Emergent
52	*Cyperus difformis L. Cent.*	*Cyperaceae*	Marshy
53	*Cyperus iria L*	*Cyperaceae*	Emergent
54	*Cyperus rotundus L.*	*Cyperaceae*	Rooted emergent
55	*Cyperus rotundus L.*	*Cyperaceae*	Emergent
56	*Datura innoxa Mill.*	*Solanaceae*	Free floating
57	*Derris trifoliata Lour.*	*Fabaceae*	Marshy
58	*Desmodium triflorum L.*	*Fabaceae*	Marshy land
59	*Desmostachya bipinnata (L.)*	*Poaceae*	Marshes
60	*Dyerophytum indicum (Gib. Ex Wt.) O.*	*Plumbaginaceae*	Free floating
61	*Echinops echinatus Roxb.*	*Astreceae*	Free floating
62	*Eclipta prostrata (L.) L. Manf.*	*Astreceae*	Free floating
63	*Eichhornia crassipes (Mart.)*	*Pontederiaceae*	Free floating

64	*Eichhornia crassipes Mart.*	*Pontederiaceae*	Submerged
65	*Enicostema littorale Bl.*	*Gentianaceae*	Free floating
66	*Eriocaulon sp.*	*Ericulaceae*	Marshy
67	*Evolvulus alsinoides L.*	*Convolvulaceae*	Free floating
68	*Fimbristylis aestivalis Vahl*	*Cyperaceae*	Emergent
69	*Glinus lotoides L.*	*Molluginaceae*	Free floating
70	*Grangea mederaspatana (L) Poir.*	*Astreceae*	Free floating
71	*Heliotropium indicum L.*	*Boraginaceae*	Free floating
72	*Hydrilla verticillata (L.f.)*	*Hydrocharitaceae*	Submerged
73	*Hydrilla verticillata (L.f.) Royal.*	*Hydrocharitaceae*	Submerged
74	*Hygrophila auriculata*	*Acanthaceae*	Emergent
75	*Ipomoea aquatica Forssk.*	*Convolvulaceae*	Rooted floating
76	*Ipomoea biloba Forsk.*	*Convolvulaceae*	Marshy
77	*Ipomoea carnea Jacq.*	*Convolvulaceae*	Emergent
78	*Ipomoea marginata (Desr.)*	*Convolvulaceae*	Rooted floating
79	*Ipomoea triloba L.*	*Convolvulaceae*	Rooted floating
80	*Kixia ramossisima (Wall.) Janch.*	*Scrophulariaceae*	Free floating
81	*Launaea procumbens (Roxb.) Ramayya*	*Astreceae*	Free floating
82	*Lemna minor L.*	*Lemnaceae*	Free floating
83	*Lemna verticellata Hegelm.*	*Lemnaceae*	Free floating
84	*Leptadenia reticulata (Retz.) W & A.*	*Apocynaceae*	Free floating
85	*Leucas cephalotes (Roxb. Ex Roth.) Spr.*	*Lamiaceae*	Free floating
86	*Limnophyton obtusifolium*	*Alismataceae*	Emergent
87	*Limnophyton obtusifoliuym,*	*Alismataceae*	Emergent
88	*Lindergia urticaefolia Lehm.*	*Orobanchaceae*	Free floating
89	*Ludwigia adscendens (L.)*	*Onagraceae*	Emergent
90	*Ludwigia parviflora Roxb.*	*Onagraceae*	Marshy land
91	*Marselia spp*	*Marseliaceae*	Emergent
92	*Mollugo pentaphylla L.*	*Molluginaceae*	Free floating
93	*Najas marina L.*	*Hydrocharitaceae*	Submerged
94	*Najas minor All.*	*Hydrocharitaceae*	Submerged
95	*Nelumbo nucifera Gaertn.*	*Nelumbonaceae*	Free floating
96	*Nelumbo nucifera Gaertn.*	*Nelumbonaceae*	Rooted floating
97	*Nymphaea nouchali Burm.f.*	*Nymphaeaceae*	Rooted floating
98	*Nymphaea pubescens Willd*	*Nymphaeaceae*	Marshes

99	*Nymphea stellata Wild.*	*Nympheaceae*	Marshy land
100	*Nymphoides peltatum*	*Nympheaceae*	Free floating
101	*Ocimum gratissimum L.*	*Lamiaceae*	Free floating
102	*Ocimum sanctum L.*	*Lamiaceae*	Free floating
103	*Oldenlandia corymbosa L.*	*Rubiaceae*	Free floating
104	*Orobanche aegyptica Pers.*	*Orobanchaceae*	Free floating
105	*Oxalis corniculata L.*	*Oxalidaceae*	Marshy land
106	*Parthenium hysterosporus L.*	*Astreceae*	Free floating
107	*Paspalum distichum L.*	*Poaceae*	Marshes
108	*Pergularia daemia (Forsk.) Chiov.*	*Apocynaceae*	Free floating
109	*Persicaria glabra (Willd.)*	*Polygonaceae*	Emergent
110	*Phragmites karka (Retz.)*	*Poaceae*	Marshes
111	*Phyla nodiflora (L) Greene.*	*Verbenaceae*	Free floating
112	*Plumbago zeylanica L.*	*Plumbaginaceae*	Free floating
113	*Polycarpaea corymbosa (L.) Lam.*	*Caryophyllaceae*	Marshy land
114	*Polygala erioptera DC.*	*Polygalaceae*	Marshy land
115	*Polygonum glabrum Willd.*	*Polygonaceae*	Free floating
116	*Polygonum plebeium R. Br.*	*Polygonaceae*	Free floating
117	*Polygonum plebeium R.Br.*	*Polygonaceae*	Marshes
118	*Pontederia crassipes Mart*	*Pontederiaceae*	Marshes
119	*Porteresia coactata (Roxb.) Tateoka*	*Poaceae*	Marshy
120	*Portulaca olearacea L.*	*Portulacaceae*	Marshy land
121	*Portulaca quadrifida L.*	*Portulacaceae*	Marshy land
122	*Potamogeton crispus L.*	*Potamogetonaceae*	Submerged
123	*Potamogeton nodosus Poir.*	*Potamogetonaceae*	Submerged
124	*Potamogeton nodosus Poir.*	*Potamogetonaceae*	Submerged
125	*Ranunculus sceleratus L.*	*Ranunculaceae*	Rooted emergent
126	*Rhizophora apiculata Bl.*	*Rhizophoraceae*	Salt marshes
127	*Rhizophora mucronata Lam.*	*Avicenniaceae*	Salt marshes
128	*Salicornia bractiata Roxb.*	*Amaranthaceae*	Marshy
129	*Scirpus ciliaris L.*	*Cyperaceae*	Rooted emergent
130	*Scirpus littoralis Auct.*	*Cyperaceae*	Rooted emergent
131	*Scirpus littoralis Schrad.*	*Cyperaceae*	Emergent
132	*Segittaria segitifolia L.*	*Alismataceae*	Rooted emergent
133	*Sesbania bispinosa Jacq)W.F.Wight*	*Fabaceae*	Marshy land

134	*Sesuvium portulacustrum L.*	*Aizoaceae*	Marshy
135	*Sonneratia apetala Buch. Ham.*	*Avicenniaceae*	Salt marshes
136	*Spergula arvensis L.*	*Caryophyllaceae*	Marshy land
137	*Stuckenia pectinata (L.)*	*Potamogetonaceae*	Submerged
138	*Suaeda fruticosa Frost.*	*Amaranthaceae*	Marshy
139	*Suaeda nudiflora (Willd.) Moq.*	*Amaranthaceae*	Marshy
140	*Suaeda vermiculata Forssk.*	*Amaranthaceae*	Marshes
141	*Tamarix ericoides Rottler*	*Tamaricaceae*	Marshes
142	*Thespesia populinea (l.) Sol. Ex Corr*	*Malvaceae*	Marshy
143	*Thypha angustata Bory.*	*Thyphaceae*	Rooted emergent
144	*Trapa bi-spinosa Roxb.*	*Trapaceae*	Free floating
145	*Tribulus terrestris L.*	*Zygophyllaceae*	Marshy land
146	*Vallisnaria spirallis L.*	*Hydrocharitaceae*	Submerged
147	*Wolffia globose,*	*Araceae*	Free floating
148	*Zoysia matrella (L.) Merr.*	*Poaceae*	Marshy land

4. Conclusion

Wetlands are the one of the most and fragile ecosystem on the Earth. They comprise wife range of biodiversity and habitat. The distribution area of wetlands is varies globally and has nearly 6.4% of the total area of world. Asia has highest area of the world. India encompasses the largest area covered by wetlands in Asia, having 23195 wetlands and 85 Ramsar sites. Gujrat has the highest number of wetlands in India, comprising 4 Ramsar sites and 8 wetlands of National Importance. There are total 720 species of plants found in the wetlands of India.Aquatic phytodiversity of wetlands is less explored as compare to avifaunal diversity although the vegetation of wetlands in India as well as in Gujrat has a wide range of diversity including macro and micro alages, phytoplanktons, sedges, grasses, mangroves and scrublands. Most common herbs are *Typha, species of Cyperus, Nelumbo, Nymphaea, Hydrilla, Eicchornia; Shrubs like Calotropis, Lantana, Gymnosporia* and tree species like various species of *Vachellia, Salvadora persica, Prosopis* found in Wetlands of Gujrat. Mangrove species like *Avicennia, Rhizophora, Bruguiera., Suaeda* are common in coastal wetlands. Wetlands support occurrence of pteridophytes like *Marselia, and Azolla.* Wetlands provide provisional, supporting and regulating services. They are the most threatened ecosystems and conservation efforts are made for the conservation and sustainable management of wetlands, Ramsar convention is the international convention for the conservation and management of wetlands.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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