

Wetlands in India

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ABSTRACT: There are wetlands deemed to be of "international importance" under the Ramsar Convention. For a full list of all Ramsar sites worldwide, see the List of Ramsar wetlands of international importance.

According to The Wetlands (Conservation and Management) Rules of 2017, the Indian government's definition of wetlands does not include river channels, paddy fields, or other areas utilized for commercial activities.^[4]

According To WWF-India, wetlands are one of the most threatened of all ecosystems in India. Loss of vegetation, salinization, excessive inundation, water pollution, invasive species, excessive development and road building, have all damaged the country's wetlands.^[5] The surface-area covered by Ramsar Sites are around 13,32,746.24 hectares^{[6],[7]}. Tamil Nadu has the highest number of Ramsar Sites in India with 16 Ramsar Sites.

Till 2014 there were 26 Ramsar sites across India. Since 2014 till date 54 new Ramsar sites have been added across India.^{[8],[9]}

KEYWORDS: wetlands, India, Ramsar, ecosystem, sites, pollution

I. INTRODUCTION

India is home to a wide variety and a myriad number of wetlands. The wide range of precipitation patterns, physiography, geomorphology and climate have facilitated for this rich diversity. Each of these wetlands is an incomparable ecosystem with immense values. Some of these wetlands which are of particular conservation value can be termed Wetlands of International Importance. These are significant in their capacity to become model sites for the nation's commitment to conservation and management under internationally accepted framework.

India became a party to the 'Convention on Wetlands', also known as the Ramsar Convention on 1st February 1982 and has since then designated 82 wetlands covering an area of 13,42,422 hectares under the List of Wetlands of International Importance which includes 5 sites designated during FY 2020-2020. Presently, India stands first in South Asia and third in Asia in terms of number of designated sites.

India has increased its tally of Ramsar sites to 80 from the existing 75 by designating five more wetlands as Ramsar sites.^[1,2,3]

- Three of these sites, Ankasamudra Bird Conservation Reserve, Aghanashini Estuary and Magadi Kere Conservation Reserve are located in Karnataka whereas two, Karaivetti Bird Sanctuary and Longwood Shola Reserve Forest are in Tamilnadu.
- Tamil Nadu continues to have the maximum number of Ramsar Sites (16 sites) followed by Uttar Pradesh (10 sites).
- What is the Ramsar Convention?
- It is an intergovernmental treaty, adopted on 2nd February 1971, in the Iranian city of Ramsar, on the southern shore of the Caspian Sea.
 - In India, it came into force on 1st February 1982, under which wetlands of international importance are declared as Ramsar sites.
- World Wetlands Day (WWD):
 - It is celebrated across the globe to commemorate the adoption of this international agreement on wetlands on 2nd February 1971.
 - The theme of World Wetland Day, latest is 'Wetlands and Human Wellbeing' which underscores the critical role wetlands play in enhancing our lives.
 - It highlights how wetlands contribute to flood protection, clean water, biodiversity and recreational opportunities, all of which are essential for human health and prosperity.
- What are the Characteristics of the Newly Designated Ramsar Sites?
- Ankasamudra Bird Conservation Reserve (Karnataka):

- It is a human-made village irrigation tank built centuries back and is spread over an area of 244.04 acres adjoining the Ankasamudra village.
- Aghanashini Estuary (Karnataka):
 - It is spread over an area of 4801 ha, and is formed at the confluence of the Aghanashini River with the Arabian Sea.
 - The brackish water of the estuary provides diverse ecosystem services including flood and erosion risk mitigation, biodiversity conservation and livelihood support.
 - The wetland also provides livelihoods by supporting fishing, agriculture, collection of edible bivalves and crabs, shrimp aquaculture, traditional fish farming in the estuarine rice fields (locally known as Gazni rice fields) and salt production.
 - The mangroves bordering the estuary help to protect the shores against storms and cyclones.
- Magadi Kere Conservation Reserve (Karnataka):
 - It is a human-made wetland with an area of nearly 50 hectares which was constructed to store rainwater for irrigation purposes.
 - The wetland harbors two vulnerable species, namely Common pochard (*Aythya ferina*) and River tern (*Sterna aurantia*) and four near-threatened species namely Oriental Darter (*Anhinga melanogaster*), Black-headed Ibis (*Threskiornis melanocephalus*), Woolly-necked Stork (*Ciconia episcopus*) and Painted Stork (*Mycteria leucocephala*).
 - It is also one of the largest wintering grounds for the Bar-headed goose (*Anser indicus*) in Southern India. It has been declared globally as an Important Bird and Biodiversity Area (IBA).[4,5,6]
- Karaivetti Bird Sanctuary (Tamil Nadu):
 - Water from the wetland is utilized by the villagers for cultivating agricultural crops such as paddy, sugar cane, cotton, corn, and split red gram.
 - About 198 species of birds have been recorded here; some of the important visitors being the Bar headed Goose, Pin-tailed duck, Garganey, Northern Shoveler, Common Pochard, Eurasian Wigeon, Common teal and Cotton teal.
- Longwood Shola Reserve Forest (Tamil Nadu):
 - It derives its name from the Tamil word, "Solai", which means a 'tropical rainforest'.
 - The 'Sholas' are found in the upper reaches of the Nilgiris, Anamalais, Palni hills, Kalakadu, Mundanthurai and Kanyakumari in Tamil Nadu.
 - These forested wetlands serve as habitats for the globally endangered Black-chinned Nilgiri Laughing thrush (*Strophocincla cachinnans*), Nilgiri Blue Robin (*Myiomela major*), and vulnerable Nilgiri Wood-pigeon (*Columba elphinstonii*).
- What are the Other Initiative Taken for Conservation of Wetland?
- Global Level:
 - Montreux Record
 - World Wetlands Day
- National Level:
 - Wetlands (Conservation and Management) Rules, 2017.
 - National Plan for Conservation of Aquatic Ecosystems (NPCA)
 - Amrit Dharohar Capacity Building Scheme
 - National Wetland Conservation Programme (NWCP):
 - It was launched in 1985, to tackle threats to vulnerable wetland ecosystems and enhance their conservation.

II. DISCUSSION

“Wetlands are very important for the existence of our earth, because many birds and animals depend on them. Along with enriching Biodiversity, they also ensure flood control and groundwater recharge.”

Prime Minister Narendra Modi

About Wetlands

Wetlands are crucial ecosystems, disappearing rapidly due to human activities such as drainage, pollution, and overexploitation. This loss has profound implications for biodiversity, climate, and economies worldwide. To address this, there's a need to change perceptions and prioritize wetland conservation. Raising awareness, particularly on World Wetlands Day, is essential to catalyze action and safeguard these vital ecosystems.

World Wetlands Day

World Wetlands Day, observed annually on February 2nd, raises awareness about wetlands and commemorates the adoption of the Convention on Wetlands in 1971. This international treaty provides a framework for wetland conservation and wise use. The significance of World Wetlands Day was emphasized in 2019 with the adoption of Resolution 75/317 by the UN General Assembly, establishing it as a global observance.

World Wetlands Day latest[7,8,9]

World Wetlands Day latest focuses on the theme 'Wetlands and Human Wellbeing,' highlighting the critical role wetlands play in enhancing our lives by providing flood protection, clean water, biodiversity, and recreational opportunities essential for human health and prosperity. This year, the Ministry of Environment, Forest & Climate Change (MoEF&CC), Government of India, in collaboration with the Government of Madhya Pradesh, is organizing the national World Wetlands Day event at Sirpur Lake, Indore, a Ramsar site designated in 2019. Dr. Musonda Mumba, Secretary-General of the Ramsar Convention, is visiting India to participate in the WWD latest event at Sirpur Ramsar site in Indore on February 2nd, latest.

Wetlands in India – Wetlands hold significant cultural and traditional importance in India, with revered sites like Loktak Lake and Khecheopalri Lake. The country's diverse wetlands attract tourists and find mention in ancient texts like Chanakya's Arthashastra. India has made strides in wetland conservation, boasting the largest network of Ramsar Sites in South Asia, covering 1.33 million hectares. These sites contribute significantly to biodiversity, hosting 6200 species across various faunal groups. India's wetlands serve as crucial stopovers for millions of migratory birds, playing a vital role in maintaining waterbird populations globally. Despite global threats, India is reversing the trend of shrinking wetlands through legal protections and conservation efforts.

India's commitment to wetland conservation continues to strengthen with recent milestones marking significant progress. In January latest, India proudly expanded its Ramsar Site count to 80 by designating five new sites in Karnataka and Tamil Nadu, showcasing its dedication to preserving invaluable ecosystems.

This achievement builds upon the momentum set in August 2019 when India added 11 wetlands to its roster, a poignant gesture commemorating the nation's 75th year of Independence. Additionally, the Wetlands of India Portal serves as a knowledge hub for wetland managers and stakeholders, providing comprehensive information and resources.

Recent Developments

- Recognition of New Ramsar Sites: As of January 31, latest, India proudly boasts a total of 80 Ramsar Wetlands, solidifying its position as the country with the highest number of wetlands in South Asia. This achievement was bolstered by the addition of five new sites, including the Karaivetti Bird Sanctuary and Longwood Shola Reserve Forest in Tamil Nadu, along with the Magadi Kere Conservation Reserve, Ankasamudra Bird Conservation Reserve, and Aghanashini Estuary in Karnataka. These designations signify India's unwavering commitment to preserving its invaluable wetland ecosystems.
- Earlier, on August 14, 2020, India celebrated the recognition of four additional wetlands as Ramsar sites by the Ramsar Secretariat. Notably, Haryana gained two new Ramsar sites, while Gujarat expanded its count by three, following the initial designation of Nalsarovar in 2012.[10,11,12]
- Thol Lake Wildlife Sanctuary: Located in Gujarat and situated on the Central Asian Flyway, Thol Lake Wildlife Sanctuary is home to a diverse array of bird species, with over 320 species recorded within its boundaries. Notably, the sanctuary provides crucial habitat for more than 30 threatened waterbird species, including the critically endangered White-rumped Vulture and Sociable Lapwing, as well as the vulnerable Sarus Crane, Common Pochard, and Lesser White-fronted Goose.
- Wadhvana Wetland: Also located in Gujarat, the Wadhvana Wetland serves as a vital wintering ground for migratory waterbirds, hosting over 80 species that traverse the Central Asian Flyway. Among these avian visitors are several threatened or near-threatened species, including the endangered Pallas's Fish-Eagle and vulnerable Common Pochard, along with the near-threatened Dalmatian Pelican, Grey-headed Fish-eagle, and Ferruginous Duck.
- National Wetland Decadal Change Atlas: The National Wetland Decadal Change Atlas, crafted by the Space Applications Centre (SAC) in Ahmedabad, offers valuable insights into the dynamic changes occurring in wetlands across the country over the past decade. This comprehensive resource serves as a vital tool for policymakers, researchers, and conservationists in understanding and addressing the evolving challenges faced by these critical ecosystems.

These recent developments underscore India's proactive efforts in wetland conservation, reaffirming its role as a global leader in safeguarding these ecologically significant habitats for present and future generations.

Government's Initiatives for Wetland Conservation:

- **Amrit Dharohar Scheme:** Launched during the presentation of the Union Budget 2018-24, the Amrit Dharohar Scheme represents a pivotal step towards promoting optimal utilization of wetlands over the next three years. This initiative aims to enhance biodiversity, carbon stock, eco-tourism opportunities, and local community income generation, aligning with the government's vision for sustainable development.
- **National Plan for Conservation of Aquatic Ecosystems:** In 2013, the National Wetlands Conservation Programme merged with the National Lake Conservation Plan, giving rise to the comprehensive National Plan for Conservation of Aquatic Ecosystems. This amalgamation reflects the government's holistic approach towards safeguarding these vital ecosystems.
- **Wetlands (Conservation and Management) Rules:** Enacted in 2017 under the Environment (Protection) Act, 1986, the Wetlands (Conservation and Management) Rules established state wetlands authorities. These rules serve as a pivotal legal framework for the protection and sustainable management of wetlands across the nation.
- **Coastal Protection:** Coastal wetlands are safeguarded under the Coastal Regulation Zone Notification (2018) and the Island Protection Zone Notification 2011. These regulations ensure the preservation of coastal ecosystems, vital for biodiversity conservation and mitigating the impacts of climate change.
- **MoEFCC's Wetlands Rejuvenation Programme:** Initiated in 2020, the Ministry of Environment, Forest & Climate Change (MoEFCC) embarked on a transformative journey towards wetlands rejuvenation. This program employs a multifaceted approach encompassing baseline information development, rapid assessment through wetland health cards, establishment of stakeholder platforms, and comprehensive management planning. With over 500 wetlands covered, this initiative stands as a testament to the government's commitment to conserving these critical habitats.
- **Integration with Namami Gange:** On World Wetlands Day 2020, the Ministry of Jal Shakti underscored the integration of wetland conservation with the Namami Gange program. Through innovative efforts linked to river rejuvenation, the National Mission for Clean Ganga (NMCG)[13,14,15] has spearheaded initiatives serving as a model for wetland conservation nationwide. The development of health cards and management plans for 10 wetlands in each of the 50-plus Ganga districts exemplifies this integrated approach, blending scientific expertise with community participation.
- **National Wildlife Action Plan:** India's National Wildlife Action Plan (2017-2031) prioritizes the conservation of inland aquatic ecosystems, including wetlands. It advocates for a national wetlands mission, emphasizing the importance of preserving these habitats for biodiversity conservation and ecosystem services.

These concerted efforts underscore the government's proactive stance towards wetland conservation, reflecting a commitment to sustainable development and environmental stewardship.

The wetlands play a vital role in mitigating the impacts of natural disasters such as floods, droughts, and cyclones by acting as natural buffers and storing excess water. Events like the floods in Kashmir Valley and Chennai, as well as cyclones like Kalinga, underscore the importance of preserving wetlands for community resilience. Integrating wetlands into disaster risk reduction planning requires collaborative efforts, with assessments of wetland health incorporated into district-level planning processes. Conservation and restoration of wetlands should be prioritized within disaster risk reduction strategies, alongside efforts to raise awareness among stakeholders. The Government of India's commitment to wetlands conservation and mainstreaming their values into developmental planning demonstrates a crucial step towards ensuring the sustainable management of these invaluable ecosystems for future generations.

III. RESULTS

India is home to a wide variety of wetlands, encompassing rivers, lakes, ponds, marshes, mangroves, and estuaries. These wetlands are distributed across different geographical regions, from the Himalayan foothills to the coastal areas. It's quite true that wetlands don't usually cross our minds like rivers, seas and oceans do.

Often overlooked and undervalued, these wetlands play a crucial role in maintaining the delicate balance of ecosystems. How, you ask? The wetlands support an array of flora and fauna, including rich birdlife. It's time we talk about the wetlands and the essential ecosystem services they provide.

In India, there are several wetland areas, but the most notable ones include the Sundarbans in West Bengal, the Chilika Lake in Odisha, the Vembanad wetland in Kerala, Keoladeo National Park in Rajasthan, Loktak in Manipur, Deepor Beel in Assam, and Sultanpur in Haryana.[16,17,18]

Ecological significance of wetlands

- Biodiversity hotspots: Wetlands serve as breeding grounds, nurseries, and resting places for various species, including migratory birds. The Chilika Lake, Sultanpur, Mangalajodi for instance, hosts a significant population of migratory birds during the winter months. These are just some of the many important wetlands in India that are also biodiversity hotspots.
- Water purification: Did you know that wetlands act as natural filters. They play a crucial role in improving water quality and are instrumental in maintaining the health of rivers and lakes. Unlike rivers that flow away, these wetlands hold water and filter the water, thus supplying clean water for both human consumption and agricultural activities.
- Flood mitigation: Wetlands absorb excess rainfall and reduce the risk of downstream flooding. Have you noticed how a sponge works? The wetlands act in the same way, it absorbs all the excess water, purifies, then slowly releases.
- Carbon sequestration: This means storing carbon. Wetlands are effective carbon sinks, meaning they absorb large amounts of carbon dioxide. Mangroves, which are a type of wetland found along coastal areas, are particularly efficient at capturing carbon. The wetland plants, when they absorb carbon from the atmosphere, don't release it back. Instead, these plants, even after they die, since they don't fully decompose, trap carbon dioxide with them. So, when human activities disturb the wetlands area, we release large amounts of previously hidden carbon back into the atmosphere.

In India, we have 75 known Ramsar Sites (Ramsar site is a wetland site). Despite their ecological importance, Indian wetlands face numerous threats, including pollution, habitat loss, over-extraction of water, and encroachment. Due to rapid urbanisation and industrialisation, a lot of the wetlands are now a part of the concrete world.

Wetlands are invaluable ecosystems that contribute significantly to the ecological health of the world we live in. Wetlands are amongst the most productive ecosystems on the Earth (Ghermandi et al., 2008), and provide many important services to human society (ten Brink et al., 2012). However, they are also ecologically sensitive and adaptive systems (Turner et al., 2000). Wetlands exhibit enormous diversity according to their genesis, geographical location, water regime and chemistry, dominant species, and soil and sediment characteristics (Space Applications Centre, 2011). Globally, the areal extent of wetland ecosystems ranges from 917 million hectares (m ha) (Lehner and Döll, 2004) to more than 1275 m ha (Finlayson and Spiers, 1999) with an estimated economic value of about US\$15 trillion a year (MEA, 2005).

One of the first widely used wetland classifications systems (devised by Cowardin et al., 1979) categorized wetlands into marine (coastal wetlands), estuarine (including deltas, tidal marshes, and mangrove swamps), lacustrine (lakes), riverine (along rivers and streams), and palustrine ('marshy' – marshes, swamps and bogs) based on their hydrological, ecological and geological characteristics. However, Ramsar Convention on Wetlands, which is an international treaty signed in 1971 for national action and international cooperation for the conservation and wise use of wetlands and their resources, defines wetlands (Article 1.1) as "areas of marsh, fen, peatland or water, whether 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 metres". Overall, 1052 sites in Europe; 289 sites in Asia; 359 sites in Africa; 175 sites in South America; 211 sites in North America; and 79 sites in Oceania region have been identified as Ramsar sites or wetlands of International importance (Ramsar Secretariat, 2013).

As per the Ramsar Convention definition most of the natural water bodies (such as rivers, lakes, coastal lagoons, mangroves, peat land, coral reefs) and man made wetlands (such as ponds, farm ponds, irrigated fields, sacred groves, salt pans, reservoirs, gravel pits, sewage farms and canals) in India constitute the wetland ecosystem. Only 26 of these numerous wetlands have been designated as Ramsar Sites (Ramsar, 2013). However, many other wetlands which perform potentially valuable functions are continued to be ignored in the policy process. As a result many freshwater wetlands ecosystems are threatened and many are already degraded and lost due to urbanization, population growth, and increased economic activities (Central Pollution Control Board, 2008).

The negative economic, social, and environmental consequences of declining water quality in wetlands are also an issue of concern for India. The problem of deteriorating water quality is particularly more alarming in the case of small water bodies such as lakes, tanks and ponds. In the past, these water sources performed several economic (fisheries, livestock and forestry), social (water supply), and ecological functions (groundwater recharge, nutrient recycling, and biodiversity maintenance). Despite all these benefits, many decision-makers and even many of the 'primary stakeholders' think of them as 'wastelands'. Every one claims a stake in them, as they are in the open access regime, but rarely are willing to pay for this extractive use (Verma, 2001).

These freshwater bodies are often subject to changes in land use in their catchments leading to reduction in inflows and deteriorating quality of the “runoff” traversing through agricultural fields and urban areas. On the other hand, many of them act as the “sink” for untreated effluents from urban centres and industries. Encroachment of reservoir area for urban development, excessive diversion of water for agriculture is yet another major problem (Verma, 2001). Lack of conformity among government policies in the areas of economics, environment, nature conservation, development planning is one reason for the deterioration of these water bodies (Turner et al., 2000). Lack of good governance and management are also major reasons (Kumar et al., 2013a).

Given this background, the objective of this paper is to review the status of wetlands in India, in terms of their geographic distribution and areal extent; the ecosystem goods and services they provide; various stresses they are being subject to; and the various legal and policy approaches adopted in India for their conservation and management.

Distribution and extent of wetlands in India

India, with its varying topography and climatic regimes, supports diverse and unique wetland habitats (Prasad et al., 2002). The available estimates about the areal extent of wetlands in India vary widely from a lowest of 1% to a highest of 5% of geographical area, but do support nearly fifth of the known biodiversity (Space Applications Centre, 2011). These wetlands are distributed in different geographical regions ranging from Himalayas to Deccan plateau.

Initial attempts to prepare wetland inventory of India were made between 1980s and early 1990s (Table 1). As per the Country report of Directory of Asian Wetlands (Woistencroft et al., 1989); and the Directory of Indian Wetlands 1993 (WWF and AWB, 1993), the areal spread of wetlands in India was around 58.3 m ha. But, Paddy fields accounted for nearly 71% of this wetland [19,20]area. However, as per the Ministry of Environment and Forests (1990) estimates, wetlands occupy an area of about 4.1 m ha, but it excludes mangroves. The first scientific mapping of wetlands of the country was carried out using satellite data of 1992–1993 by Space Applications Centre (SAC), Ahmedabad. The exercise classified wetlands based on the Ramsar Convention definition. This inventory estimated the areal extent of wetlands to be about 7.6 m ha (Garg et al., 1998). The estimates did not include paddy fields, rivers, canals and irrigation channels. Thus, all these early assessments were marred by problem of inadequate understanding of the definition and characteristics of wetlands (Gopal and Sah, 1995).

Table 1. Number and size of wetlands as per the various wetland inventories of India.

Inventory	Year	Total number of wetlands		Total area of wetlands (m ha)	
		Natural	Man-made	Natural	Man-made
Empty Cell	Empty Cell				
Directory of Asian Wetlands and 1989		Not specified		58.3	
Directory of Indian Wetlands (WWF and AWB) 1993		Not specified		58.3	
Directory of Indian Wetlands (MoEF, GoI) 1990	1990	2167	65,253	1.45	2.59
Wetlands of India (Space Applications Centre) 1998	1998	18,154	9249	5.31	2.27

Source: Adapted from Garg et al. (1998), Woistencroft et al. (1989) and WWF and AWB (1993).

India's wetland extent as per the latest wetland inventory

National Wetland Atlas 2011, prepared by SAC, is the latest inventory on Indian wetlands. Entire Country was considered for assessment and a total of 201,503 wetlands were identified and mapped on 1:50,000 scale (SAC, 2011). In addition, 555,557 wetlands (area <2.25 ha, which is smaller than minimum measurable unit) were identified as point features. Area estimates of various wetland categories have been carried out using GIS layers of wetland boundary, water-spread, and aquatic vegetation. As per the estimates, India has about 757.06 thousand wetlands with a total wetland area⁴ of 15.3 m ha, accounting for nearly 4.7% of the total geographical area of the country. Out of this, area under inland wetlands accounts for 69%, coastal wetlands 27%, and other wetlands (smaller than 2.25 ha) 4% (SAC, 2011). In terms of average area under each type of wetland,⁵ natural coastal wetlands have the largest area

IV. CONCLUSION

The water spread area of wetlands varies greatly. Overall, inland wetlands have a water spread area of 7.4 m ha in post monsoon and 4.8 m ha in pre-monsoon; and coastal wetlands have 1.2 m ha and 1 m ha in post monsoon and pre monsoon, respectively (SAC, 2011). Across all categories of wetlands, the water spread area from post monsoon to the peak of summer reduces significantly indicating the uses and losses the wetlands go through. This has major implications for the total water availability of these wetlands and the various functions that they can perform in different seasons. Overall, reduction in water spread area of inland wetlands is highest (35%) followed by that of coastal wetlands (16%). Within inland wetlands, reduction is significantly higher in man-made types (49.5%), such as surface reservoirs and tanks, in comparison to natural types (24%), such as lakes and ponds, as they are under pressure to meet various irrigational and non-irrigational needs and are also subjected to higher evaporation losses. In terms of average water spread area for each category of wetland, man-made coastal wetlands have the highest area. The aquatic vegetation in all the wetlands put together, account for 1.32 m ha (9% of total wetland area) in post monsoon and 2.06 m ha (14% of total wetland area) in pre monsoon (SAC, 2011). Major wetlands types in which aquatic vegetation occur include lakes, riverine wetlands, ox-bow lakes, tanks and reservoirs.

In terms of the proportion of the geographical area, Gujarat has the highest proportion (17.5%) and Mizoram has the lowest proportion (0.66%) of the area under wetlands. Among Union Territories in India, Lakshadweep has the highest proportion (around 96%) and Chandigarh has the least proportion (3%) of geographical area under wetlands.

Gujarat has the highest proportion (22.8%) and UT of Chandigarh has nearly negligible part of the total wetland area in the country. Water-spread area of wetlands changes over seasons. The States of Sikkim, Nagaland, Mizoram, Meghalaya, and Jharkhand have more than 90% of the total wetland area as water spread area during post monsoon. Significant reduction in water spread area of wetlands from post monsoon to pre monsoon was found in the States of Uttar Pradesh (28%), Chhattisgarh (29%), Himachal Pradesh (29%), Tripura (29%), Sikkim (30%), Andhra Pradesh (31%), Jharkhand (32.5%), Punjab (33%), Bihar (34%), Gujarat (36%), Karnataka (38.5%), Maharashtra (53.5%), Tamil Nadu (55%), Madhya Pradesh (57%), and Rajasthan (57%). [17,18,19]

In terms of contribution of the total water spread area in the country, highest during post monsoon was observed in the State of Gujarat (13.5%) and lowest in Sikkim and Tripura (0.1% each). During pre-monsoon, highest was again in Gujarat (12.6%) and lowest was in Sikkim and Tripura (0.1% each).

As regards percentage area under aquatic vegetation, Andhra Pradesh, Delhi, Karnataka, Manipur, Orissa, Punjab, Tamil Nadu, Tripura, and West Bengal have 15–59% of the wetland area under aquatic vegetation. Further, Andhra Pradesh, Gujarat, Karnataka, Orissa, Tamil Nadu, Uttar Pradesh, and West Bengal account for nearly 3/4th of the total area under aquatic vegetation. In Andhra Pradesh, maximum amount of aquatic vegetation is found in reservoirs, aquaculture ponds and irrigation tanks. In Gujarat, it is found in rivers, reservoirs and creeks. In Karnataka, it is in irrigation tanks, ponds and reservoirs. In Orissa, aquatic vegetation was more in rivers, reservoirs, lagoons, irrigation tanks and ponds. In Tamil Nadu, it is in lakes and irrigation tanks. In Uttar Pradesh, most of the aquatic vegetation is found in rivers, lakes and riverine wetlands, whereas in West Bengal, most of it is in Mangroves.

Wetlands are considered to have unique ecological features which provide numerous products and services to humanity (Prasad et al., 2002). Ecosystem goods provided by the wetlands mainly include: water for irrigation; fisheries; non-timber forest products; water supply; and recreation. Major services include: carbon sequestration, flood control, groundwater recharge, nutrient removal, toxics retention and biodiversity maintenance [20]

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