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Wetlands of India with Reference to Ecosystem Wealth, Threats and Management

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Abstract: India has an unusual wealth of wetland ecosystems. Wetlands are established as passages between land and water ecosystem. They donate versatile benefits, especially in the field of the ecosystem, economy and scenic beauty. They are fertile ecosystems that help elective and special biodiversity and habitats and famous for their divergent welfares and courtesies. These ecosystems do not only enhance agricultural impacts on the environment but also provide ecosystem benefits to human society and are under prodigious stress due to industrial pollution, agricultural and urbanization, tourism and fisheries and many more. The present review is focused on the value of wetlands, providing distribution of wetlands and major threats to wetland. It also provides information on how a series of works had been done to save this vulnerable ecosystem.

Keywords: Wetland, Benefits, Threats, Management, Ecosystem

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Introduction

Wetlands are high-yielding ecosystem on planet (Ghermandi *et al.*, 2011) provides multi-benefits for mankind (De Groot *et al.*, 2012). Wetlands are areas that are short-term or long-term covered by water. It exhibits extensive diversity for various organisms as per the geographical location. They are also ecologically vulnerable and adaptive systems. Factors that distinguish wetlands from other land are the flora that is grown to its sole soil composition. The area of wetlands extend from 917 million hectares to more than 1.275 billion hectares widely with approximate

profitable cost of around 15,000 billion US dollars in a year.

The inter-governmental convention for wetland conservation was registered in Ramsar city of Iran in 1971 known as The Ramsar Convention. It came into existence because of a drastic fall in the waterfowl population and loss of habitat for that organism. Ramsar convention came into action in 1975 and initially seven countries joined. As per the article number 1.1 of convention, wetlands framed as 'region of peat-land, fen, marsh or water that is temporary or

permanent, artificially accumulated or naturally accumulated, flowing or static, salty or fresh, brackish including marine water where the depth of that water surpass 6 meters in water tide. Whereas the article number 2.1 of convention, mentions 'wetland can include zones situated near shore side or river-side and islands or region of marine water that is in low tide more than six meters and incorporate inland waters. There are 172 contracting parties joined in the Ramsar convention so far. Ramsar convention is sole convention which deals with the ecosystem globally (Anon, 2022).

India still has only 49 numerous wetlands which is designated as Ramsar sites (Change, 2022). Though many very valuable wetlands are still disregarded in the legislative process, which results in ecosystem deprivation and loss of many freshwater wetlands and loss due to an increase in commercial activities, population growth and delude urbanization.

The present review is focused on the value of wetlands, providing distribution of wetlands and major threats to wetland. It also provides information on how a series of works had been done to save this vulnerable ecosystem.

India has a range of weather pattern which supports distinct and extraordinary habitats for wetlands (Prasad *et al.*, 2002). The areal size of wetlands ranges from 1% (lowest) to 5% (highest) in India and provides 20% of known biodiversity (Murthy *et al.*, 2013).

Space Application Centre prepared the latest listing of wetlands in India in 2011 known as the National Wetland Atlas. In this work, entire nation mapped on 1:50,000 scale and total 2,01,503 wetlands recognized (Murthy *et al.*, 2013). Apart from those 555,557 wetlands whose area is less than 2.25 hectares were recognized as point appearance, this area is at the minimum measurable unit. The area was measured using GIS and surface of water spread, aquatic vegetation and wetland water boundaries. India has around 757060 wetlands having an area of 15,30,000

hectares and it is around 4.7% nation topographic area (Murthy *et al.*, 2013).

Ecosystem Wealth:

Wetland helps humanity by providing many benefits and commodities. Regional wetlands are an essential part of large land based on their location and existence. These places are also important for various functions and provide value to them. Each wetland is ecologically special. Wetlands are important for attenuating floods, purifying water, recycling nutrients, maintaining stream flow, recharging groundwater, provide fuel, fodder, fish and drinking water. It is also important for wildlife habitat, buffer shorelines against erosion and control runoff water which helps in groundwater recharge. Due to the rapid growth of population in the last few decades, the interaction of human-wetland increased drastically. Human activities from industrial, residential or commercial development lead to pollution in the wetland by industrial dumping, domestic drainage and agricultural water run-offs of pesticides, fertilizers. Therefore, the benefits from these wetlands are ignored resulting in a warning to the sources.

Wetlands are also called "kidneys of the landscape". It is a treasury of the ecosystem. Through services to human life by providing several products, these wetlands have unique characters (Prasad *et al.*, 2002). It provides enormous support and health to the ecosystem. The major point of importance from wetlands are-water supply, tourism, diversity for aquatic flora and fauna, fisheries, role in carbon sequestration and many more.

Water Supply:

Wetlands are key supporter in fisheries, irrigation, recreational use and domestic needs by providing water through ponds, tanks, lakes and reservoirs, flood control, silt collection and groundwater recharge. The states like Andhra Pradesh, Tamil Nadu and Karnataka have an enormous number of irrigation tanks roughly around 0.12 million

(Palanisami *et al.*, 2010) which is around sixty per cent of the Indian tank irrigated area. These tanks are essential in storing water which collects the monsoon runoff water and makes use of it later. This water which is collected in tanks is also a source of water in crop development, aquaculture, irrigation, fodder crops, making building material etc. which are very important worth in terms of health, nutrition and earning for poor people.

There are so many important lakes that are used for aquaculture, tourism benefits, irrigation and domestic water supply such lakes are, Chilka in Orissa; Carambolim in Goa; Deepor Beel in Assam; Dal Jheel in Jammu and Kashmir; Kolleru in Andhra Pradesh; Khabartal in Bihar; Nainital in Uttarakhand; Loktak in Manipur; Nalsarovar in Gujarat and Vembanad in Kerala. The water of these lakes is also helpful in groundwater recharge and wildlife habitat of flora and fauna.

Domestic and irrigation water is provided through surface reservoirs in urban and rural areas. In India, for municipal, agricultural, hydropower, industrial and recreational water supply through large reservoirs whose storing capacity is more than one million cubic meters, have been already built whose numbers are around 4700 large reservoirs.

Tourism:

Wetlands provide important opportunities for tourism and recreation, which leads to providing profit making in these industries, government and local groups who lived there. The earnings which are collected from this can be used for their conservation. Tourism is also one of the key factors to provide awareness to save wetlands. The famous places are Upo and Junam wetlands (South Korea)(Do *et al.*, 2015), Camargue wetland (France) (Beltrame *et al.*, 2013), Ondiri and Manguo wetlands (Kenya)(Macharia *et al.*, 2010), Nabugabo wetland (Uganda) (Bikangaga *et al.*, 2007) and Nariva Swamp (Trinidad) (Pemberton and Mader-Charles, 2005). They always attract visitors so earnings can be possible and these earnings are helpful in the conservation of nature

and natural resources. As per records, India's GDP contribution of tourism in 2019 and 2020 was nearly 6.9% and 4.7%, respectively. These numbers are important for the significance of tourism in consideration for various wetlands like coral reefs, reservoirs, lakes beaches and rivers. It is also considered that expansion demand in tourism location. In India, on average three million tourists visit natural lakes and wetlands in Uttarakhand, seven million tourist visits wildlife sanctuaries and beaches in Kerala, one million visit Dal Lake and twenty thousand visits in Tsomoriri and many places annually.

Diversity in Aquatic Fauna and Flora:

Wetlands help in important natural habitats which support species richness. Some organisms stay their entire life in wetlands while some organisms stay during a particular stage of their life cycle. Because wetlands are places where photosynthesis and the biogeochemical cycle take place, these places are also important in various food chains. These wetlands like rivers, lakes and freshwater bodies also provide enormous diversity of most of the taxonomic groups. These places provide food for waterfowl and shelter for almost more than 1200 water plant species (Prasad *et al.*, 2002). The Western Ghats, the southern region of India, covers almost 1,36,800 km² along the coastal area which possess very high amount of biodiversity (Molur *et al.*, 2011). The biggest natural wetland in North- East India named Loktak wetland also provides similar biodiversity. The wetland is known for phumdi (floating vegetation mat) which is a distinctive ecosystem made up of the diversified amount of soil, organic matter and vegetation at different stages of decomposition and only shelter for endangered Sangai animals (brow-antlered deer) (Sharma 2009a), 120 species of rotifers and 75 species of phytoplankton. Wetlands are also breeding sites for many wildlife animals and also provide shelter for migratory bird species. Many migratory bird species from European and Western countries come to Little Rann of Kutch (Gujarat) and Bharatpur Wildlife Sanctuary

(Rajasthan) during winter in India. The number of migratory birds varies from 1200 to 1300 which is 24% of countries bird species recorded so far (Agarwal, 2011). After Nairobi, Delhi is the only capital city where 450 bird species are sighted every year. Due to the diverse ecology, these places make it possible for migratory birds to stay and congregate there. Brooks Leaf Warbler; Orphean Warbler; Red Crested Pochards; Rock Eagle Owl; White Tailed Lapwing; Sind Sparrow and Great White Pelicans are examples of these migratory birds (Lalchandani, 2012).

Fisheries:

The value of these wetland diversity attempts has been made. The advantages of biodiversity improvement through building wetlands at various places is already done in certain parts (Ghermandi *et al.*, 2010). According to National Fisheries Development Board, in 2018–2019, fisheries put up 6.73 billion US dollars in GDP. This provides a big opportunity for around 25 million people who are directly connected to inland fisheries for livelihood and nourishment. The fish production estimated 18 million tons against 14.16 million tons during 2019-20; in which rivers and canals provide around 1.95 lakh km, while flood plain lakes provide 8.12 lakh hectares for inland fisheries.

Carbon Reclusion:

In the carbon cycle; mangroves, Swamps, mires, peat land and marshes play a major role. Plants, bacteria, animals, fungi etc as existing biomass and dissolved integrant in surface and groundwater are short-term carbon stores and wetland accumulation are long-term carbon stores (Wylynko, 1999). Among land ecosystems wetlands have the highest carbon substances and reclusion capacity due to the emission of CO₂ which is around 40% of global methane emission (Pant *et al.*, 2003). Through reduced rates of decay and more rates of organic matter input reclusion of carbon occur in wetlands (Pant *et al.*, 2003). Compared to its vegetation, the Wetland surface may hold 200 times more carbon. Wetlands collect

large areas of drainage and their cultivation play a vital role in the formation of CO₂. We may repeal atmospheric CO₂ by restoration of wetlands (Lal, 2008). In restored wetlands from the last 50 years of the period carbon reclusion potential may cross 0.4 tonnes Carbon/ha/year (Change, 2007).

Coastal wetlands also play vital role in carbon reclusion in India. The coastal ecosystem length is around 43,000 km² in India (Kathiresan and Thakur, 2008). The eastern India wetlands are more important than western India due to their large size, more biodiversity and complex canal network and tidal creeks. Due to the uppermost layer which is of Mangroves, which can conserve 10% of carbon, it can hold an overall 1.5 metric ton carbon/year. Mangroves also emit methane which has a prime gases role in green house and its reclusion capacity is 19%. Similarly, a lagoon on the western coast of India named Vembanad Lake was also found releasing CH₄ up to 193.2 mg/m²/h (Verma *et al.*, 2002). Depending on their biogeochemical cycle and hydrology, wetlands work as net sequester or greenhouse gases producer. Thus, more research is needed to check whether carbon sinks through wetlands over time and the role of wetlands in climate change.

Threat to Wetland Ecosystems:

Urbanization and Land Usage:

Wetland's structure and function are impacted by nutrients and chemical pollutants through urbanization. Due to urbanization, inland water bodies of cities are at alarming stages. In the National Capital Territory (NCT) of Delhi alone, out of 629 wetlands, 232 cannot be recharged because of large-scale invasion. Similarly, due to the urban slump, Bengaluru lost 66 wetlands which cover almost 1100 ha from 1973 to 2007 (Ramachandra and Kumar, 2008). Further, lack of concrete conservation plans, poor management of water bodies, increase water demand in localized areas and rising pollution are key factors that damage these vulnerable ecosystems.

Water supply and irrigation facility develop enormously very high in India which affect inflows

and water spread in many water bodies. India completed around 276 vital and 1000 medium irrigation projects till 2007. These increased around 12% of total water resources and capacity is 225 BCM. The larger wetlands played a major role in water supply, irrigation, hydroelectric power production, flood control etc. but constructing small dams in the arid and semi-arid regions caused loss and fragmentation of freshwater habitats because of low runoff water (Zhao *et al.*, 2006; Mukherjee *et al.*, 2010). Due to water withdrawal to such a level that basin water amount is less than required freshwater ecosystem, most of the western and southern river basins experiencing a scarcity of water (Smakhtin *et al.*, 2004).

Agricultural, Municipal and Industrial Pollution:

In agriculture, fertilizer consumption shows 175 kg/ha from the last four decades. The average usage is 5.96% annually. Table 1 shows how rapidly the usage of fertilizer increased. The fertilizers which are added to soils ultimately reach to surface water system.

Table 1: Consumption of fertilizers (in Metric ton)

YEAR	N	P ₂ O ₅	K ₂ O	TOTAL (N+P ₂ O ₅ +K ₂ O)
2010-11	16,558.2	8,049.7	3,514.3	28,122.2
2011-12	17,300.3	7,914.3	2,575.5	27,790.0
2012-13	16,820.9	6,653.4	2,061.8	25,536.2
2013-14	16,750.1	5,633.5	2,098.9	24,482.4
2014-15	16,949.6	6,098.9	2,532.9	25,581.3
2015-16	17,372.3	6,978.8	2,401.5	26,752.6
2016-17	16,735.9	6,705.5	2,508.5	25,949.9
2017-18	16,959.3	6,854.4	2,779.7	26,593.4
2018-19	17,637.8	6,910.2	2,680.3	27,228.2
2019-20	18,863.9	7,464.8	2,640.9	28,969.6

Total may not exactly tally due to rounding off.
Source : Biswas *et al.*, 2022.

The high number of fertilizers that are added to the soils leads to the growth of algae which leads to

eutrophication in water bodies. Studies suggest that 0.5 mg/l inorganic nitrogen and 0.01 mg/l organic phosphorus in water can lead to algal growth on the water surface. This runoff water from agricultural fields is one of the main regions of non-point pollution in Indo- Gangetic plains (Jain *et al.*, 2007). Apart from that, the algal blooms water is costliest to make purify for drinking water. Lakes also lose the fish population because of eutrophication.

Water bodies whose source is untreated water also lead to pollution. The data shows that not more than 31% of domestic waste water is treated while the developed countries' ratio is 80%. In overall 35 metropolitan cities, the sewage treatment capacity exists in only 51% of sewage generated. This means that Category A cities in which population is 1,00,000 or more can treat only 18% of sewage generated while Category B cities whose population is 50,000 to 1,00,000 can treat only 9% of sewage generated. The reason for low sewage treatment is because of inoperative treatment plants and deficiency of sewage collection. Thus, India is suffering from untreated sewages discharged to natural water bodies like rivers and river streams because of the gap between treatment and the creation of sewage.

Tourism:

By providing lands for recreation, encouraging physical and mental health, increasing tourism or promoting spiritual and cultural experience and awareness of places, wetlands provide a wealthy biological diversity and ethnic services to mankind (De Groot *et al.*, 2012). The advantages which we get from this ecosystem cannot be calculated by trade mechanism because their benefits go unvalued or undervalued (Ghermandi *et al.*, 2010). In Kerala, an increase in fishing boats and houseboats leads to an increase in water pollution. More than 600 houseboats are operating in Alappuzha (one of the Kerala cities) alone. The houseboats also create pollution problems. Tourism also causes pollution, over-consumption of water, habitat loss and noise impacts which affects decline in species diversity.

Other Threats:

Agricultural conversion is also one of the threats. In the Indian subcontinent, there are losses in wetlands because of rice culture. Farming of rice is dependent on wetlands mainly in the region of riparian zones, river deltas and savannah areas. Water is deprived of the downstream natural wetlands because of the fishpond water system in catchment areas. In India, freshwater fishponds cover almost 1.6 million hectares. Though fish ponds and rice fields come under wetlands, they rarely work like natural wetlands. Rice cultivation is estimated as 45 million hectares in India.

Deforestation is also one of the determinant factors for the threat to wetlands. Mangrove vegetation is valued for livestock fodder, building materials, fish, fuel wood, bee wax, honey, local medicine and tanning leather material extraction. Mangroves are also a continuous threat due to fisheries production and replacement farming method. Sundarbans and the Andaman and Nicobar Islands possess 80% of India's mangrove forests which is around 4240 km². Due to the economic demand on shrimps, most of the mangroves which grow along the coastal region are under tremendous pressure. Shrimp farming leads to freshwater withdrawal which can increase lime, organic waste, pesticides, chemicals and disease-causing organisms. The impacts were more on those people who are dependent on mangroves for natural material, fish protein and revenue. The trap sediments and water storing capacity of wetlands have also been reduced.

The groundwater recharge also has depleted draining of wetlands. In rural India recent estimate indicates that, because of the low level of groundwater, more than 6000 villages are facing an inadequate level of drinking water (Prasad *et al.*, 2002). More than 2500 species and subspecies of birds are sheltered in wetlands in India. But due to habitat loss, this species diversity is threatening. The prime reason is invading of foreign species like *Eichhornia crassipes* (Water hyacinth) and *Salvinia molesta* (Salvinia). These species obstruct the waterways and competition with native

species. In a recent attempt to the priority of wetlands for conservation, almost 800 wetlands do not have any data in which most of them are threatened.

India will no longer have around 84% of coastal and 13% of saline wetlands because of the rise up of 1 m seawater as per estimation. This has an unfavourable effect on wetland birds, particularly migratory birds which are directly dependent on a variety of wetlands for their life cycle and that cannot shift to appropriate habitat.

Wetland Management in India:

In water resources development and management plans, wetlands continue to be seen in isolation. The prior accountability for these ecosystems is in the management of the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India. There was no policy for wetland conservation till 2000. The work for wetland management was primarily impacted due to international commitments under Ramsar Convention and Indirectly through many policy plans like Coastal Zone Regulation (1991); National Conservation Strategy and Policy Statement on Environment and Development (1992); National Policy and Macro Level Action Strategy on Biodiversity (1999) and National Water Policy (2002).

India is a signatory partner to both Conservation of Biological Diversity and the Ramsar Convention, there were no distinct legal facilities for conservation of wetlands, it is indirectly regulated by many other regulations till 2016. This incorporates:

- Indian Fisheries Act (1857);
- Indian Forest Act (1927);
- Wildlife Protection Act (1972);
- Water (Prevention and Control of Pollution) Act (1974);
- Territorial Water, Continental Shelf, Exclusive Economic Zone and other Marine Zones Act (1976);

- Water Cess Act (1977);
- Maritime Zone of India (Regulation and Fishing by foreign vessels) Act (1980);
- Forest Conservation Act (1980);
- Environment Protection Act (1986);
- Wildlife Protection Amendment Act (1991);
- Biodiversity Act (2002) and
- Schedule Tribes and Other Traditional Forest Dwellers (Recognition Of Forest Rights) Act (2006).

Then, The Wetland Conservation and Management Act 2017 came into action. Though, all previous policy processes act in a range of factors including water quality, maintaining the ecologically sensitive area, maintaining flora and fauna of aquatic water bodies etc. the specific term “Wetland” was not mentioned in any of the legal instruments.

As a signatory partner of Ramsar Convention of wetlands and providing importance to protect water bodies, the Indian government declared two sites, Keoladeo National Park of Rajasthan and Chilika Lake of Orissa as Ramsar sites in 1981. Thereafter, with concerned State Governments, National Wetland Conservation Programme (NWCP) was inaugurated in close collaboration in 1985-1986. According to this program, only Ramsar nominated sites were recognized for conservation and management. In 1993, National Lake Conservation Plan (NLCP) was formed from NWCP to focus on Lakes especially those that are located in urban and surrounding areas which are under anthropogenic pressure. Initially, this plan included 10 lakes for conservation and management. There was also a National River Conservation Plan (NRCP) whose motto was to make better water condition of big Indian rivers operational till 1995. National Water Resources Council also recognizes the new National Water Policy (2012) cleared for the need of conservation of river corridors and water bodies including wetlands in a scientific manner. Apart from that, the policy also recognizes the environmental need

of the aquatic ecosystem and wetlands should be considered and recognized while making a plan for water resources conservation.

The number of Ramsar sites increased to 26 and the number of rivers increased to 39 over the years. While wetlands protected by National Wetland Conservation Programme (NWCP) and National Lake Conservation Plan (NLCP) have increased to 115 and 61, respectively. Though, considering the ecological sensitivity of the wetland ecosystem of the country, the work is too little. It is also noted that only adopted few wetlands were taken under supervision and management program. To avoid overlaps and promote better synergies NWCP and NLCP merged into one ‘National Plan for Conservation of Aquatic Ecosystems’ in 2013. Through the implementation of constant policy and guidelines, it aims is conserving aquatic ecosystems like lakes and wetlands.

The policy named ‘National Environment Policy’ which was built in 2006 considered that wetlands give many ecological amenities. The policy considered that international commitments made under the Ramsar convention are not yet followed so there is a requirement of a regulatory mechanism which can identify wetlands and prevent their degradation and amplify their conservation. The central government of India put in picture Wetland (Conservation and Management) Rules 2010 as action, based on National Environment Policy, 2006 and suggestion made by the National Forest Commission, who suggest prohibited and regulated activities within wetlands and help in research and development of lakes and wetlands, enforced by Central Wetland Regulatory Authority (CWRA). In September 2017, the Central government notified Wetland (Conservation and Management) Rules 2017 by superseding the 2010 rules. But the new rule excludes - paddy fields, river channels, water bodies specifically constructed for purpose of drinking water, aquaculture, salt production, irrigation purpose and recreation; from the definition of a wetland. The new rule is applicable to wetlands

categorized as 'wetlands of international important under the Ramsar Convention and wetlands as notified by the state and central government and union territory authorities, but not applicable to wetlands falling in protected areas, forest areas and the Coastal Regulation Zone (CRZ) areas. This law also decentralized wetland management by creating State Wetland Authority (SWAs) in each State and union territory (in place of CWRA). Now the State/UT governments have authority to identify and manage the wetlands but also keep watch on prohibited activities.

The Wetland Health Card scheme was launched in 2019 and the government identified around 130 wetlands in the country to be restored in the next five years. Each wetland will be given a health card, which will indicate its health. For increasing people's participation awareness, individuals were selected as 'Wetland Mitras' for taking care of these 130 identified wetlands across India. India is located at the heart of the Central Asian Flyway (CAF), nearly 71% of the migratory water-birds of the CAF use India as a sojourn site. Thus, crucial for maintaining the water-bird populations within the Flyway by maintaining the health of these wetlands. The MoEFCC approved a National Action Plan for the conservation of migratory birds and their Habitats along the Central Asian Flyway in 2018. Its long-term goal is to provide healthy habitats to decline migratory bird species.

Conclusion

The wetland ecosystem provides a wide range of diversity in flora as well as fauna. They are well-productive ecosystems and provide diversification of habitat. Apart from biological diversity, Wetlands also possess ecosystem wealth. Wetland provide supply of water, fisheries from freshwater, irrigation and water for amusement. Wetlands are important in groundwater restore, carbon sequestration, flood control and control declining population of flora and fauna. Though, wetlands have not received consideration in the central agenda of the water division. Thus, most of the wetlands in rural and urban areas are under tremendous biogenic pressure, pollution from the

industry, overexploitation of natural resources and tourism.

India is a signatory partner in Ramsar Convention on wetlands and has had Wetland (Conservation and Management) Rules since 2017, there is no progress in conservation and judicious use of wetlands. A small country like the UK has 71 Ramsar sites but India still has very few in number. The reason behind that is only a few wetlands got attention while remaining ones are in the neglected state under the wetland conservation program.

These wetlands have limited evidence of good governance and finance is also one of the concerns. Along with this much testing prominence on the physical, socio-economic and institutional aspects (rules, policies, organizations and regulation) and components impacting wetlands' environment and their uses are also essential.

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