



REVIEW ARTICLE

A Review on Wetlands – Threats, Conservation, Strategies and Policies

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ABSTRACT

Globally 64% of the wetlands have disappeared since 1970 and the loss is higher in Asia, about 5000 km² annually due to agriculture, dam construction and other uses. In India, the loss is about 38% with the disappearance rate of 2-3% per year. Further dependence on these wetlands leads to either extinction or threatened the species including 21% of bird species, 37% of mammal species and 20% fresh water fish species. Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water level. According to Ramsar convention the wetlands are classified as three types via., coastal/marine wetlands, inland wetlands and human made wetlands. Worldwide, the freshwater wetland ecosystems are among the mostly heavily used, depended upon and exploited ecosystems for sustainability and well-being. The main causes of wetland loss have been classified into two types namely acute and chronic wetland loss. This loss in wetland area results in adverse impact on the key functions performed by wetlands. Hence, we have to conserve these wetlands by implementing effective legal framework and management strategies. In this context, Ramsar convention is an important International Treaty for the Conservation and Sustainable use of Wetlands which was signed at a city of Iran (Ramsar) in 1971. There are currently over 2,400 Ramsar sites on the territories of 171 Ramsar Contracting Parties across the world. They cover over 2.5 million square kilometers, an area larger than Mexico.

Received: 28 January 2023

Revised: 09 February 2023

Revised: 12 February 2023

Accepted: 15 February 2023

Keywords: *Endangered; Agriculture; Aquaculture; Ramsar site; Montreux record*

INTRODUCTION

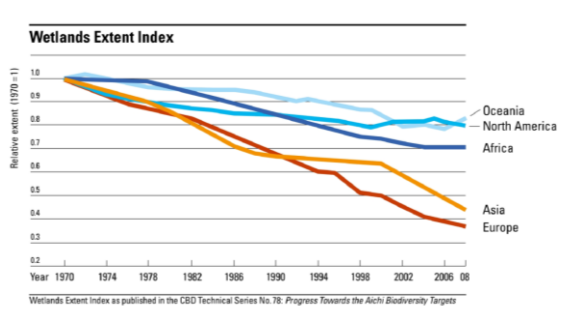
Wetlands are among the world's most productive, ecologically sensitive, and adaptive ecosystems. Origin, geographical location, water chemistry, edaphic and sediment features, presence of dominating species and water management all contribute to the tremendous diversity of wetlands. They maintain a wide range of habitats and provide a wide range of ecological goods and services. Wetlands and human civilizations are inextricably linked. In fact, wetland eco systems have shaped the majority of human civilizations. Wetlands are the centre of human economic and cultural activity such as agriculture,

fishing, transportation, tourism, and religious events. Wetlands also play an important role in carbon sequestration, flood management, soil fertility and pollution control, among other ecosystem services. Wetlands, the most fertile environment on the planet, are essential for survival. However, wetland depletion and degradation have occurred all across the world as a result of fast population increase and economic development. Chemical and physical qualities such as nutrient availability, soil salinity, sediment properties, pH and others can be directly influenced by hydrologic conditions. The biotic response in the wetland is directly affected by these changes in the

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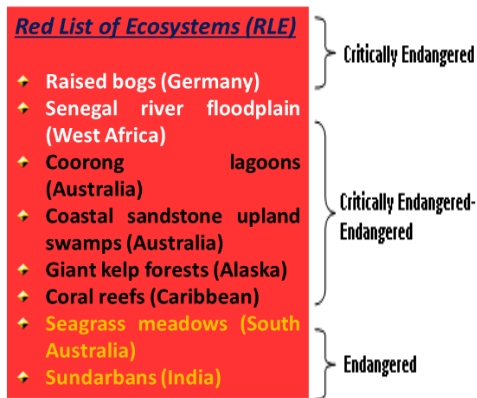


physiochemical environment. When wetlands hydrologic conditions alter even little, the biota may respond with huge shifts in species composition and richness, as well as in ecosystem productivity.



(www.ramsar.org)

Figure 1. World Wetland Extent Index



IUCN, 2014

Fig 1. World Wetland Extent Index, Fig.2 Red List of Ecosystem released by International Union for Conservation of Nature in 2014. In that they categories the ecosystems based on the threats faced by the ecosystems into eight categories viz., Collapsed (CO), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD), and Not Evaluated (NE).

Since 1900, 64 percent of the world's wetlands have vanished, resulting in a global wetland area of 12.1 million km² (www.ramsar.org) and according to Wildfowl & Wetlands Trust (WWT) more than third of the world's wetlands have vanished and 83% of freshwater species have declined globally from 1970. Around 5000 km² of wetland area is lost each year in Asia due to agriculture, dam construction and other uses and in India, the loss is 38 percent. Furthermore, the environment's

reliance on water and other resources has put huge pressure on the ecosystem globally, resulting in direct repercussions on species variety and population. As a result, many wetland-dependent species are either extinct or globally vulnerable, including 21% of bird species, 37% of mammal species and 20% of freshwater fish species (MEA, 2005). Wetland loss has a negative influence on the key functions (ecosystem goods and services) that wetland provide. As a result, wetland exploitation and destruction may have negative environmental consequences, necessitating their protection. It is becoming increasingly apparent that the planet earth is confronted with serious environmental issues, including rapidly dwindling natural resources and threats to the existence of most ecosystems. Wetland conservation necessitates a holistic approach to environmental management. To save the wetlands, scientific, technical and socio economic collaboration are required.

Wetlands include a wide variety of habitats such as marshes, peat lands, floodplains, rivers, and lakes, and coastal areas such as salt marshes, mangroves, and sea grass beds, but also coral reefs and other marine areas not deeper than 6 m at low tide, as well as human-made wetlands such as paddy lands, waste-water treatment ponds and reservoirs (Ramsar Convention Secretariat, 2013).

WETLAND LOSSES – A THREAT TO ECOLOGICAL BALANCE

The world's population has nearly tripled in the last 50 years. The majority of this rise has taken place in poorer countries. At the same time, water consumption has more than tripled. Development has resulted in a huge increase in the exploitation of lands, bodies of water, and forests. This has resulted in a variety of serious issues in wetlands. The state of wetlands around the world has been influenced by changes in the natural landscape caused by resource extraction, the introduction of new and more intensive types of agricultural activities, urbanization, changing water balances, and hydrological regimes.

Major threats to wetlands in India (Verma et al., 2001)

Siltation - Each year, approximately 3 million tonnes of silt are deposited in Chilika Lake. The input of silt from rivers into oxbow lakes has caused considerable sedimentation, resulting in the construction of extensive littorals colonized by dense macrophytic flora and the reduction of lake areas such as Dal Lake, Wular Lake, and Kabar

Lake. Sedimentation is a more serious problem in reservoirs, resulting in a drop in their water holding capacity and a reduction in the lake area.

Eutrophication - Except for high altitude trans-Himalayan glacial lakes, the process of water quality degradation caused by excessive nutrients is a severe challenge that all wetlands in India face.

Pollution - These issues are especially severe in urban wetlands such as Hussain Sagar (Hyderabad, Andhra Pradesh), Lower Lake (Bhopal, Madhya Pradesh), Dal Lake (Srinagar, Kashmir), and others. The harmful poisoning of water by pollutants such as DDT, PCB, mercury, and a variety of other heavy metals and pesticides demonstrates the effects of pollution.

Prolific Growth of Aquatic Plants - Increased nutrient levels and high sedimentation have resulted in prolific aquatic plant growth. *Potamogeton pectnatus*, *Hydrilla verticillata*, and *Myriophyllum sp.* are some of the species that have become a nuisance. Aquatic plant infestations have resulted in a reduction in the open water area and its potential for water supply, navigation, fishing, and recreational activities.

Exotic Species Invasion - Exotic species such as *Eichhornea crassipes*, *Salvinia molesta*, *S. natans*, and *Azolla sp.* have caused serious issues in wetlands. In the lakes, these species have proliferated, posing a threat to endemic species. Anoxic (lack of oxygen) conditions and alterations in the flora and fauna have resulted from the weeds' rapid development. Exotic fish species have also had an impact on the genetic diversity of endemic fish species.

Aquaculture - Large sections of wetlands, particularly along the coast, have been turned into aquaculture, resulting in salinization, eutrophication, and a loss of biodiversity. To increase fish productivity, fishponds have been built in several lakes, such as Kolleru (Andhra Pradesh). Algal blooms and a severe fall in oxygen content have resulted from the addition of fish feed, manures, antibiotics, and other chemicals. All of these changes have had a significant impact on the quality of the water in these wetlands.

Encroachment - Because wetlands contain different value systems, parts of them have been changed for agriculture and other development purposes. As a result of these invasions, the wetland area has shrunk, posing a threat to ecosystems. The problem of invasion is especially

acute in urban wetlands, where conversion for settlements, industrial activity, and tourism has proceeded unabated. Changes in hydrological regimes, which affect water levels and cause fluctuations, can be seen as a result of human activity in the catchment area, particularly via the diversion of river waters.

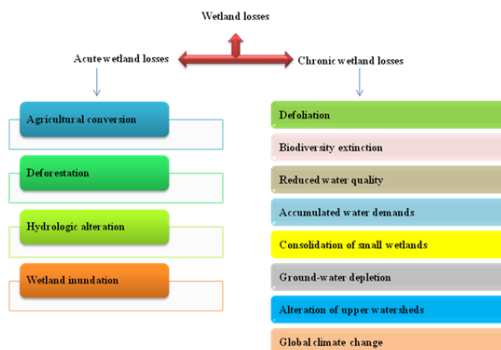


Fig. 4 Classification of wetland losses

Between 1950–1951 and 2020–2021, India's total cultivated land increased from 129 to 196.5 million hectares, while the area under non-agricultural uses increased from 9 to 51 million hectares. In recent years, 34,000 acres of the Kolleru Lake's water spread area (Andhra Pradesh) have been reclaimed for agriculture. In India, agricultural intensification increased fertilizer consumption from about 2.8 million tonnes in 1973–1974 to 32.5 million tonnes in 2020–2021. About 10%–15% of the nutrients given to the soil were leached into the water bodies. When there is 0.5 mg/l inorganic nitrogen and 0.01 mg/l organic phosphorus in the water, it promotes unwanted algal development (Jain *et al.*, 2007)

Due to large-scale encroachment, 232 of the 629 water bodies found in the National Capital Territory (NCT) of Delhi cannot be revived (Khandekar, 2011). Due to urban growth, the Greater Bengaluru Region lost 66 wetlands with a total water spread area of roughly 1100 hectares between 1973 and 2007 (Ramachandra and Kumar, 2008). Most river basins in southern and western India are already experiencing environmental water scarcity, which means that water withdrawals have lowered discharge to the point where the amount of water remaining in the basin is less than what is required by freshwater-dependent ecosystems (Smakhtin *et al.*, 2004).

According to WWT (Wildfowl and Water Trust), nearly 80% of the world's waste water is dumped into wetlands. In India's urban areas, just 31% of home wastewater gets treated, compared to 80% in the industrialized world (CPCB, 2010). The capital



city of Delhi alone sends 1789 MLD (Millions of Liters per Day) of untreated wastewater to the River Yamuna. This accounts for almost 78 percent of the entire pollutant load that enters the river each day. Metropolitan cities' sewage treatment capacity is at 8,040 MLD, while sewage generation capacity is around 15,644 MLD (CPCB, 2009).

The level of glacial fed in high altitude lakes has risen as a result of climate change (Tsomoriri in Ladakh - endangered migratory birds like the Black-necked Crane and Bar headed Goose) (Chandan *et al.*, 2008). Rising sea surface temperature and sea level is owing to thermal expansion in coastal wetlands such as the Indian half of the Sunderbans mangrove. Changes in precipitation, runoff, temperature, and evapo-transpiration will all have an impact on inland natural wetlands' hydrological regimes. With a 1 m rise in sea level caused by climate change, India will lose around 84 percent of coastal wetlands and 13 percent of saline wetlands. (Centre for Science and Environment, 2012; UNESCO, 2007).

CONSERVATION OR MANAGEMENT STRATEGIES

Wetlands are not defined by any particular regulatory authority. The Ministry of Environment and Forests holds primary responsibility for the management of these habitats. While some wetlands have been protected since the Wildlife Protection Act was enacted, others remain in dire danger of extinction. The protection of these ecosystems requires effective cooperation between the many Ministries of energy, industry, fisheries revenue, agriculture, transportation, and water resources.

Legal framework

S.No	Year	Framework / Act
International convention		
1.	1971	Ramsar Convention on Wetlands
2.	1992	Convention of Biological Diversity
National level		
1.	1857	The Indian Fisheries Act
2.	1927	The Indian Forest Act
3.	1972	Wildlife (Protection) Act
4.	1974	Water (Prevention and Control of Pollution) Act
5.	1976	Territorial Water, Continental

		Shelf, Exclusive Economic Zone and other Marine Zones Act
6.	1980	Maritime Zone of India (Regulation and fishing by foreign vessels) Act
7.	1980	Forest (Conservation act)
8.	1986	Environmental (Protection) Act
9.	1991	Coastal Zone Regulation Notification
10.	1991	Wildlife (Protection) Amendment Act

[Source: Bassi *et al.*, 2014 and Prasad *et al.*, 2002]

These statutes include provisions such as protecting water quality and notifying ecologically sensitive areas, as well as contributing to the conservation, maintenance, and enhancement of the floral, faunal, and avifaunal biodiversity of the country's aquatic bodies. However, none of these legal documents utilized the phrase "wetland" precisely.

Policy support

S.No	Year	Policy intervention / support
1.	1992	National Conservation Strategy and Policy Statement on Environment and Development
2.	1999	National Policy and Macro level Action Strategy on Biodiversity
3.	2002	National Water Policy
4.	1985–1986	National Wetland Conservation Program (NWCP) was established in close coordination with state governments. Encroachment, siltation, weed infestation, catchment erosion, agricultural run-off bringing pesticides and fertilizers, and wastewater discharge were all addressed to prevent further degradation of the identified water bodies.



5.	1993	National Lake Conservation Plan (NLCP) was established to focus on lakes, particularly those in urban and peri-urban settings.
6.	1995	National River Conservation Plan (NRCP), with the goal of improving the water quality of major Indian rivers to the level of defined best use through the implementation of pollution abatement works.
7.	2012	National Water Policy emphasizes the importance of river corridors and water bodies (including wetlands) conservation, as well as the environmental needs of aquatic eco-systems, wetlands, and embanked flood plains.

[Source: Bassi et al., 2014 and Prasad et al., 2002]

National wetland strategy

A national wetland strategy should include (i) conservation and collaboration, (ii) loss prevention and restoration, and (iii) long-term management. These are some of them; the first stepping stone in every management approach is to protect our existing resource besides an effective management plan and ongoing ecosystem monitoring should be conducted in order to make modifications to the current management plan. Enough inventories of wetland flora, fauna, avifauna, and other species in India are lacking and enforcement of appropriate legal frameworks and protection legislation. Wetlands are community property with multiple uses, thus their protection and management must be a shared responsibility. Understanding the dynamics of these ecosystems necessitates research in the creation of national strategies. This could be helpful to planners in developing pollution mitigation methods. To protect the wetlands, creating awareness among the general public, educational institutions, and corporate institutions is essential for long-term success.

Table 2. Conservation status of India

S.No.	Particulars	Status
1.	Total number of natural wetlands in the country as per the latest National Wetland Atlas	55,862
2.	Number of natural wetlands under conservation:	
	a) Wetlands designed as Ramsar sites and under NWCP	119
	b) Wetlands under NLCP	61
	c) Wetlands under NRCP	39
	Overall number of natural wetlands under conservation	219
3.	% under conservation to total number of natural wetlands in the country	0.4

[Source: MoEF (2007, 2012), Ramsar Convention on Wetlands (2012) and SAC (2011)]

Ramsar convention on wetlands

Ramsar convention on wetlands is the International Treaty for the Conservation and Sustainable use of Wetlands was signed at a Iranian city of Ramsar in 1971. This convention is mainly to protect the wetlands. The International wetlands day is celebrated every year on February 2. It works with organizations like, International Union for Conservation of Nature (IUCN), Birdlife International, International Water Management Institute (IWMI), Wetlands International, Wildfowl & Wetlands Trust (WWT), WWF International. Currently there are 2,400 Ramsar sites on the territories of 171 Ramsar contracting parties, with the total area of 2.5 million square kilometers. Cobourg Peninsula in Australia (1974) was the first Ramsar site in the world. India signed in this convention on 1st February 1982, Chilika lake and Keoladeo National Park was first Ramsar sites of India. Out of 54 Ramsar sites in India, the Sundarbans is the largest one.

The three pillars of the Convention viz., i) ensure that all of their wetlands are used wisely, ii) designate eligible wetlands for inclusion on the list of wetlands of international concern, and ensuring



that they are well-managed, iii) cooperate on transboundary wetlands, shared wetland systems, and shared species on a global scale. Any wetland location that has been listed under the Ramsar Convention is referred to as a Ramsar site. The Montreux Record is a database of wetland areas on the Ramsar list that have experienced, are experiencing, or are projected to experience changes in ecological character as a result of technological advancements, pollution, or other human influence. Currently, two Indian wetlands are in the Montreux Record:

- National Park of Keoladeo (Rajasthan)
- Loktak Lake (Manipur)

Table 3. Ramsar sites in India

Ramsar Sites in India	State Location
Khijadia Wildlife Sanctuary	Gujarat
Bakhira Wildlife Sanctuary	Uttar Pradesh
Haiderpur Wetland	Uttar Pradesh
Sultanpur National Park	Haryana
Bhindawas Wildlife Sanctuary	Haryana
Thol Lake Wildlife Sanctuary	Gujarat
Wadhvana Wetland	Gujarat
Ashtamudi Wetland	Kerala
Beas Conservation Reserve	Punjab
Bhitarkanika Mangroves	Odisha
Bhoj Wetlands	Madhya Pradesh
Chandra Taal	Himachal Pradesh
Chilika Lake	Odisha
Deepor Beel	Assam
East Kolkata Wetlands	West Bengal
Harike Wetlands	Punjab
Hokera Wetland	Jammu & Kashmir
Kanjli Wetland	Punjab
Keoladeo National Park	Rajasthan
Keshopur-Miani Community Reserve	Punjab
Kolleru lake	Andhra Pradesh

Loktak lake	Manipur
Nalsarovar Bird sanctuary	Gujarat
Nandur Madhameshwar	Maharashtra
Nangal Wildlife Sanctuary	Punjab
Nawabganj Bird Sanctuary	Uttar Pradesh
Parvati Agra Bird Sanctuary	Uttar Pradesh
Point Calimere Wildlife and Bird Sanctuary	Tamil Nadu
Pong Dam lake	Himachal Pradesh
Renuka lake	Himachal Pradesh
Ropar Wetland	Punjab
Rudrasagar Lake	Tripura
Saman Bird Sanctuary	Uttar Pradesh
Samaspur Bird Sanctuary	Uttar Pradesh
Sambhar lake	Rajasthan
Sandi Bird Sanctuary	Uttar Pradesh
Sarsai Nawar Jheel	Uttar Pradesh
Sasthamkotta lake	Kerala
Surinsar- Mansar lakes	Jammu & Kashmir
Tsomoriri	Ladakh
Upper Ganga river	Uttar Pradesh
Vembanad Kol Wetland	Kerala
Wular lake	Jammu & Kashmir
Sunderban Wetland	West Bengal
Asan Barrage	Uttarakhand
Kanwar Lake or Kabal Taal	Bihar
Lonar Lake	Maharashtra
Sur Sarovar	Uttar Pradesh
Tso Kar Wetland Complex	Ladakh
Karikili Bird Sanctuary	Tamil Nadu
Pallikaranai Marsh Reserve Forest	Tamil Nadu
Pichavaram Mangrove	Tamil Nadu
Sakhya Sagar	Madhya Pradesh
Pala Wetlands	Mizoram

[Source: www.ramsar.org]



Point Calimere Wildlife and Bird Sanctuary

The 8th meeting of the Conference of the Parties (COP 8) was held at Velancia on November 18-26, 2002. In this meeting, the Point Calimere Wildlife Sanctuary (10°18"N; 79°51'E), along with the Great Vedaranyam Swamp spanning an area of 22436.91 ha, was named a RAMSAR Wetland Site (No.1210).

The Point Calimere Wetland Complex has a total area of 38500 acres and is located in the Nagapattinam and Tiruvarur districts. The name of the sanctuary comes from the term 'Point Calimere,' which refers to a location within the sanctuary where the coast turns 90 degrees from the Bay of Bengal to the Palk Strait in Southern India (www.tnswa.org)

Table 4. Area designated as RAMSAR site

Point Calimere Wildlife Sanctuary	2250.17 (ha)
Muthupet Mangroves	11885.91
Panchanathikulam Wetlands	8096.96
Un-surveyed salt swamps	15030.19
Thalainayar Reserve Forests	1236.77

[Source: www.tnswa.org]

In 1962, the late Dr. Salim Ali identified this area as having significant conservation value for birds. It has a wide range of ecosystems and biological characteristics, besides there are a total of 209 bird species that have been identified. It is home to 30,000 flamingos, 200-300 endangered grey pelicans, the endangered Asian dowitcher, the vulnerable spoonbill sandpiper, and tens of thousands of other water birds.

Conclusion

Wetlands are areas where land and water combine. These lands protect us from flooding and drought and 40 percent of the world's natural species depend on freshwater wetlands for survival, in addition to purifying water for all of us. However, wetlands are nearing their limit. Even a small country like the United Kingdom can designate 161 wetlands as Ramsar sites, whereas India, a mega-diversity country, has only delineated 49 sites so far. There is definitely a lot of ground to cover in our wetland's protection efforts. Furthermore, a paradigm shift in conservation ethics is a critical requirement of the hour. Because of the nature of the resource, being saved and 'protected,' this shift is necessary and perhaps even mandatory.

Since wetland loss is three times quicker than forest loss, many species are facing extinction and extreme weather is becoming more common. Inland and marine/coastal WLs both declined by around 35 percent between 1970 and 2015, although human-made wetlands doubled (12 percent). We can reverse their decline if we act now. According to the United Nations "Sustainable management, conservation, and restoration of ecosystems to offer services that minimize catastrophe risk by minimizing hazards and boosting livelihood resilience".

Funding and Acknowledgment

The authors acknowledge facilities provided by department of Agronomy to carry out the review work and I thank my Chairperson and Editor of Journal of Current Crop Science and Technology.

Ethics statement

No specific permits were required for the described field studies because no human or animal subjects were involved in this research.

Originality and plagiarism

We ensure that we have written and submitted only entirely original works, and if we have used the work and/or words of others, that has been appropriately cited.

Consent for publication

All the authors agreed to publish the content.

Competing interests

There was no conflict of interest in the publication of this content

Data availability

All the data of this manuscript are included in the MS. No separate external data source is required. If anything is required from the MS, certainly, this will be extended by communicating with the corresponding author through corresponding official mail; vasumathi1307@gmail.com

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Related websites:

- http://www.wiienviis.nic.in/Database/ramsar_wetland_sites_8224.aspx
- <https://www.pmfias.com/ramsar-sites-india-ramsar-convention-wetlands/>
- <https://byjus.com/free-ias-prep/upsc-map-ramsar-sites-india-infographics/>
- <https://www.forests.tn.gov.in/pages/view/Ramsar-Site-Of-TN>
- <http://tnswa.org/wetlands-of-tamil-nadu>
- <https://indianexpress.com/article/cities/chennai/tamil-nadu-kazhuvelli-wetland-bird-sanctuary-7660209/>
- <https://sandrp.in/2020/03/03/ramsar-wetlands-in-crisis-south-india/>