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Socio-environmental dynamics of freshwater aquatic ecosystem in Manipur State with specific reference to Loktak Ramsar site.

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ABSTRACT

Objective: The paper scrutinizes the status of freshwater aquatic ecosystems in India's Manipur State with particular reference to Loktak Ramsar site, and how their depletion has impacted wetland ecology, biological diversity, and sustainable livelihoods of local communities.

Theoretical Framework: The study attempts at in understanding the human-nature relationship where anthropogenic intervention largely influences environmental degradation, biodiversity loss and species decline, and subsequently leading to food and water insecurity for wetland dependent communities.

Methodology: The study covers around three decades of field-related observation on the gradual degradation and degeneration of wetland ecosystems in Manipur State with particular reference to Loktak Ramsar site, thereby inducing biodiversity loss and species decline, and impacting the sustainable livelihoods of local communities who largely depend on wetlands for their living. The field study is co-related with information from secondary literature sources.

Discussion and Results: The results of the study reveal a trend where state and central institutions, and relevant agencies, are lacking in addressing the concerns on biodiversity loss and species decline induced by anthropogenic intervention leading to wetland degradation and biodiversity loss, and impacting the sustainable livelihoods of wetland dependent communities primarily due to the absence of effective strategies and measures for wetland ecosystem restoration and their long-term conservation and management.

Research Implication: The findings of the study concludes that due to lack of strategic action plan on ground, there is gap in the management policy and due absence of scientific input into wetland ecosystem restoration and management, while the concerns on food and water security for the marginalized local communities are not adequately addressed, thus defeating the purpose of achieving the goals of SDG1, SDG2, SDG3 and SDG13.

Keywords: Freshwater ecosystem, Loktak Ramsar site, ecological decline and biodiversity loss, sustainable livelihoods, SDGs.

INTRODUCTION

Wetlands are disappearing three times faster than forests, with 35 percent of wetland ecosystems lost since 1970 (Wetlands International, 2022). The Ministry of Environment, Forest & Climate Change, Government of

India, indicated that most wetlands in India are under stress due to impacts of urbanization, agricultural run offs which require specific management plans for conservation (MoEF&CC, 2019).

In this context, it is noted that most wetlands in Manipur are in various stages of degeneration and degradation. Rajesh (2023) observed that field assessment revealed most wetlands in the State had been drained and reclaimed for agriculture, fish farms, settlement and other commercial purposes.

Loktak Lake in Manipur, which is one of the largest inland freshwater lakes in India, is the most glaring example of traditional waters under tremendous pressure, largely due to anthropogenic influences. The stress is felt in the observed ecological degradation, biodiversity loss and species decline, and considerable impact on the traditional livelihoods of local communities, in particular the wetland dependent fishing community.

Loktak Lake is one of the largest Ramsar sites in India, out of the 85 notified sites to date. Considering the surface area of 288.96 sq km at full pond level maintained by Ithai Barrage at an elevation of 768.5 meter above mean sea level as suggested by Singh & Singh (1994), or 287 sq km according to Trisal and Manihar (2004), Loktak is the tenth largest Ramsar sites in India.

Taking into consideration the status of inland freshwater wetlands in the country, as per their area coverage, Loktak at 288.96 (287) sq km is the fourth largest freshwater lake in India, after Vembanad-Kol wetland in Kerala at 1512.5 sq km, Satkosia Gorge in Odisha at 982 sq km, and Kolleru Lake in Andhra Pradesh at 901 sq km.

Loktak Lake, located at the geographical coordinates of 24º25’48.12”N to 24º41’19.58”N Latitude and 93º45’32.41”E to 93º54’20.64”E Longitude, was identified by the International Union for Conservation of Nature (IUCN) as a major Indian wetland of significance being located within two highly biodiverse global hotspots, namely, the Eastern Himalaya Biodiversity Hotspot and the Indo-Burma Biodiversity Hotspot.

In 1990, Loktak was designated as a Ramsar site of International Importance, and subsequently was placed in the Monteux Record in 1993 as a Ramsar site ‘where changes in the ecological character have occurred, are occurring, or likely to occur’.

LITERATURE REVIEW

In current global discussions on biodiversity loss and species decline within the larger picture of global warming and climate change impacts, there are scores of literature deliberating on these aspects. Wetlands are featured as significant to climate change mitigation and adaptation measures. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) noted that freshwater ecosystems provide fundamental services to humans such as food, water, nutrient retention, recreation, and climate regulation (IPBES, 2019).

In freshwater ecosystems, a series of combined threats that include land-use change, including water extraction, exploitation, pollution, climate change and invasive species, are prevalent (IPBES, 2019). Which is why the notification of critical wetlands as Ramsar sites becomes significant, where some 2314 freshwater sites are designated as Wetlands of International Importance (Ramsar Sites) covering up to 242,409,779 ha area (Ramsar Convention on Wetlands, 2018).

The preamble to the Post-2020 Global Biodiversity Framework (GBF) mentioned that biodiversity, and the benefits it provides, is fundamental to human well-being and a healthy planet. This comes in line with the objectivity in achieving SDG3 and SDG13 specifically.

Lopez and Mundkur (1997) reported that many important wetlands in India continue to be subject to various uses and threats. Fishing and agriculture are reported to be two of the main activities in the water bodies. Hunting of waterbirds, pollution and excessive growth of vegetation are among the main threats reported at these wetlands (The Asian Waterfowl Census, 1994-96, as quoted in SoIB, 2020).

METHODOLOGY

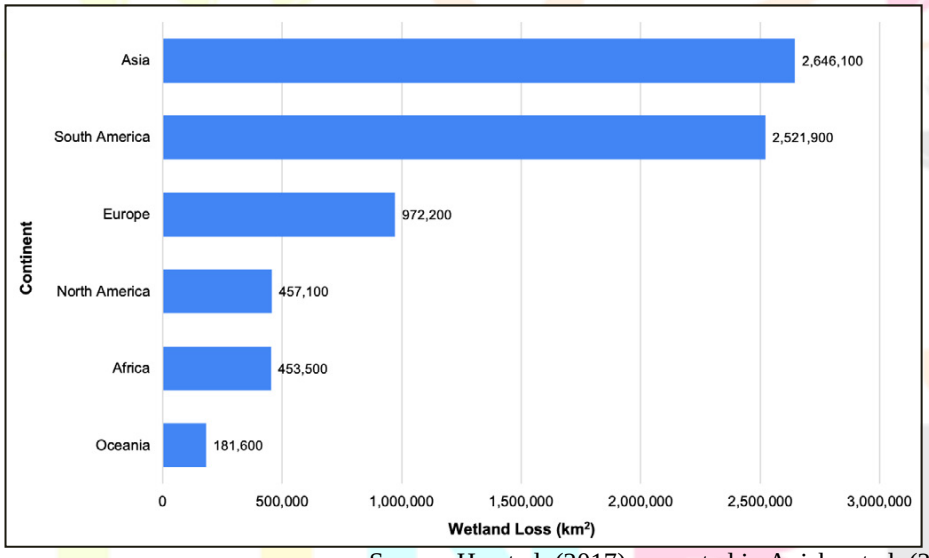
Multiple visits to wetland sites and assessment on ground form the basis upon which the author defines the status of wetlands in Manipur. Interaction with communities at these sites is basic to understanding the changes in physical character and dimension during the past decades, which is duly reinforced by information from secondary literature sources and government data. Physical observation concurrently for near three decades to date reveal the extent to which freshwater wetlands in Manipur had been subjected to many forms of abuse that threaten the dynamics of these critical water bodies that are highly essential in sustaining human needs while significant to climate issues and biodiversity loss recovery.

RESULTS AND DISCUSSIONS

Studies and findings on the status of wetlands locally and globally indicate that wetlands are generally under tremendous pressure, of which anthropogenic interference in nature reserves is clearly evident. Reclamation of wetlands for expansion of cities, earth-filling for roads and rails, agriculture and industries are just a few of the several instances of human-influenced activities inducing wetlands loss.

Figure1 indicates that the area of wetland loss globally since 2009 up to present is considerably high. Asia led the world in wetland area loss by a massive area of 2,646,100 sq km with South America at a close second with a loss of 2,521,900 sq km. Europe figured with a considerable loss of 972,200 sq km while North America lost 457,100 sq km, Africa 453,500 sq km and Oceania 181,600 sq km respectively.

Figure 1: The area of wetland loss through 2009 among different continents.



Source: Hu et al. (2017) as quoted in Anisha et al. (2020).

Beginning 1980, the discussions on the Loktak wetland complex has centered mainly on the impact of the Ithai Barrage[1], commissioned in 1983, on the hydrological and ecological regime of Loktak and its associated wetlands, impacting large areas within the Manipur River basin (Trisal and Manihar, 2002; 2004).

The major controversies within Loktak wetland complex began with the commissioning of the 5-sluice gate operated barrage at Ithai Khunou village in Bishnupur District which cut off the flow of the Manipur River and the Khuga River[2], and subsequently inducing stagnation of water in its upstream areas. Ithai Barrage converted several separate wetlands into one large water body. The barrage, located downstream of Loktak Lake, was meant to serve as a mechanism for storing water in Loktak for generating hydro electric power by the 105 megawatt capacity Loktak Hydroelectric Power Project.

Figure 2. Decadel Wetland Inventory and Change Analysis of Manipur

Wetlands of India

Decadal wetland inventory and change analysis of Manipur

Sr. No.	Wetland Type				2017-18			2006-07			Decadal Change	Disappeared		New	
	Wetland code	Level -I	Level -II	Level -III	Number	Area (ha)	Area (% of wetlands)	Number	Area (ha)	Area (% of wetlands)	Area (ha)	Number	Area (ha)	Number	Area (ha)
1	1101	Inland	Natural	Lake/Pond	21	42660	64.39	28	40043	63.9	2617	-	-	-	-
2	1102			Ox-bow lake/ cut-off meander	8	56	0.08	8	50	0.1	6	-	-	-	-
3	1103			High altitude lake	-	-	-	-	-	-	-	-	-	-	-
4	1104			Riverine Wetlands	-	-	-	-	-	-	-	-	-	-	-
5	1105			Waterlogged	40	2365	3.42	43	1914	3.1	451	-	-	6	102
6	1106			River/Stream	18	16828	25.40	17	16974	27.1	-146	-	-	-	-
7	1201		Man-made	Reservoir/Barrage	5	1878	1.28	3	860	1.4	1018	-	-	2	1027
8	1202			Tank/Pond	24	114	0.17	24	96	0.2	18	-	-	-	-
9	1203			Waterlogged	-	-	-	-	-	-	-	-	-	-	-
10	1204			Salt pan	-	-	-	-	-	-	-	-	-	-	-
11	1205			Aquaculture Pond	16	3507	5.25	16	2720	4.3	787	-	-	2	28
12	2101	Coastal	Natural	Lagoon	-	-	-	-	-	-	-	-	-	-	-
13	2102			Creek	-	-	-	-	-	-	-	-	-	-	-
14	2103			Sand/Beach	-	-	-	-	-	-	-	-	-	-	-
15	2104			Intertidal mud flat	-	-	-	-	-	-	-	-	-	-	-
16	2105			Salt Marsh	-	-	-	-	-	-	-	-	-	-	-
17	2106			Mangrove	-	-	-	-	-	-	-	-	-	-	-
18	2107			Coral Reef	-	-	-	-	-	-	-	-	-	-	-
19	2201		Man-made	Salt pan	-	-	-	-	-	-	-	-	-	-	-
20	2202			Aquaculture pond	-	-	-	-	-	-	-	-	-	-	-
				Total	132	67408	100.00	139	62657	100	4751	-	-	10	1157

Note: wetlands database of 2006-07 was updated by incorporating interpretational changes

Source: Gupta et al. (2021)

Figure 2 indicates the decadal change of wetlands in Manipur for the study periods 2006-2007 and 2017-2018 showing fluctuations in the number and the area coverage of wetlands mainly within the Manipur River Basin.

The Manipur State Wetlands Authority (MSWA) outlined the salient challenges faced by wetlands in Manipur as primarily impacted by (i) Siltation, (ii) Eutrophication, and massive and overgrown weeds, (iii) Encroachment and owning of the lake portions by individual interests, (iv) Aquaculture conversions, and (v) Pollution.

Trisal and Manihar (2002) maintained that the main changes to the water regime in Loktak Lake are those pertaining to the hydro-period, water spread area, residence and turnover time, and wave hydro-balance due to the construction of the barrage for the purpose of hydro-power generation and irrigation.

Trisal and Manihar (2004) further noted that the serious implication of Ithai barrage had led to: (a) Changes in hydrological regimes thereby affecting ecological processes and functions of the wetlands; (b) Inundation of agricultural lands and displacement of people from flooded lands; (c) Loss of fish population and diversity; and (d) Decrease in the thickness of Phumdi[3] biomass in Keibul Lamjao National Park, threatening the habitat of the endangered Manipur Brow-antlered Deer.

Kosygin (2002) noted that the main reasons for the rapid proliferation of Phumdi biomass in the Loktak wetland complex are: (i) Inflow of high amounts of nutrients in the lake from point to non-point sources, (ii) Phum fishing practice, and (iii) Construction of Ithai barrage and other hydraulic structures along the Manipur River which blocks the outflow of sediments and nutrients resulting in their deposition into the lake.

The conversion of Loktak and its associated wetlands into an artificial water reservoir led to stagnation of water inducing changes in the ecological profile of the wetland complex. Stagnation of water induced the invasion of Invasive Alien Species (IAS) of aquatic and semi-terrestrial plants[4]. The entire Loktak wetland complex is dominated by IAS like *Brachiaria mutica*, *Pistia stratiotes*, *Alternanthera philoxeroides* and

Pontederia crassipes within the wetland while IAS like *Lantana camara*, *Parthenium hysterophorus*, Pampa grass and *Mikania micrantha* are prominent on land. IPBES (2023) identified 3500 invasive species globally as severely harming biodiversity and human livelihood.

Brachiaria mutica is considered nuisance plant in Loktak wetland complex as it had practically dominated over the native plants and the floating biomass with its tenacious spread. Extensive growth of the IAS like *Brachiaria mutica*, *Pontederia crassipes*, *Pistia stratiotes*, *Alternanthera philoxeroides* and *Mikania micrantha* had caused the decline of edible aquatic plants like *Zizania latifolia*, *Ludwigia claveliana*, *Cyperus esculentus*, *Ipomoea aquatica*, *Oenanthe javanica*, *Hedychium coronarium*, *Alpinia galanga*, *Nelumbo nucifera*, *Polygonum barbatum*, *Euryale ferox* and *Trapa natans* that are harvested by the locals for food.

The uncontrolled spread of Paragrass (*Brachiaria mutica*) and other invasive species while reducing the open water body in Loktak Lake also blocks the waterways used by local fishers in their dugout canoes. This impacts the traditional capture fishery practice by local fishers, thus reducing their earning capability and defeating the objectivity of SDG1 and SDG3.

Water stagnation and resulting nutrient enrichment is observed to influence the rapid proliferation of submerged aquatic plants like *Hydrilla verticillata*. Food plants like *Euryale ferox* and *Trapa natans* have declined due to the spread of the hydrilla, inducing loss of food supplements for the locals which is negative to the objectivity of SDG2.

Vishwanath (2000; 2017) stressed that pollution, habitat loss, damming, over-exploitation besides species invasion are the major threats in Manipur.

CONCLUSION

Habitat loss and degradation driven by infrastructure development, water regulation, agricultural intensification and human disturbance are among the most frequent threats to key wetlands and their waterbird populations (Wetlands International, 2010). Dasgupta (2021) stressed that habitat fragmentation reduces biodiversity by impairing important ecosystem functions and altering nutrient cycles.

Biodiversity loss and species decline impacts the sustainable livelihoods of local people (Millennium Ecosystem Assessment, 2005). Rapid decline in indigenous fish population and edible aquatic plant species due to ecosystem degradation impacts the food needs for the wetland dependent communities. This poses threat to sustainable living for the locals, defeating the goals of SDG1, SDG2 and SDG3.

IPBES (2019) suggests possible solutions for maintaining freshwater for nature and humanity, maintaining that pathways exist that can improve water use efficiency, increase storage and improve water quality while minimizing disruption of natural flow regimes.

Suggested pathways:

The multiple issues confronting wetlands in Manipur serve to impact the wetland ecosystems negatively, consequently affecting the human and natural environments, and leads to biodiversity loss and species decline. Few suggested pathways may be to:

(a) Assess the current status of wetlands in Manipur to understand their present conditions;

(b) Come up with strategic action plans to check and halt deforestation in the catchments to prevent top soil loss, erosion and silt runoff, check environmental flow decline of feeder streams and rivers, biodiversity loss recovery, and prevention of species decline;

(c) Check and halt the uncontrolled spread of invasive alien terrestrial and aquatic plant species that aids in wetlands ecosystem decline.

(d) Control and check land-fills and conversion of wetlands for agricultural activities, fish farms, encroachment for settlements and other commercial activities;

(e) Strengthen the functioning of Manipur State Wetlands Authority for more effective management of wetlands in the State.

Notes

1. Ithai Barrage is largely seen as the central point of the genesis of ecological and hydrological changes, and degradation, within the Loktak wetland complex since the early 1980s.

2. Ithai Barrage blocks the flow of Manipur River and Khuga River to maintain desired water level in Loktak Lake at 768.5m above MSL for the Loktak hydro project.

3. Phumdi is the local name for the living floating biomass which is a heterogeneous mix of living and decayed vegetation matter. Many variety of edible aquatic plants grow on the phumdi and these are harvested by the locals for diet supplement. Fishers also built shelter huts (Phumshang) with bamboo and thatch upon the Phumdi for their fishing activities.

4. The National Biodiversity of India in 2022 listed several Invasive Alien Species of plants and animals that it proposed for complete removal within India by 2030. These include Cyprinus carpio, Tilapia amongst the fish IAS, and water hyacinth, alligator weed among the plant IAS.

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