The vulnerability of wetlands to climate change

1. Introduction

As per the Ramsar Convention, the natural water bodies and man-made wetlands together constitute the wetland ecosystem in India. The climate change scenario makes wetlands one of the most threatened habitats of the world. Wetlands in India, as in other parts of the world are increasingly facing multiple environmental and anthropogenic pressures. The fast-expanding human population, large-scale changes in land use, burgeoning developmental projects and improper management of watersheds have all caused a considerable decline of wetland resources of the country. The threat of conversion of wetlands to agricultural, industrial, and various urban developmental projects also added to the loss of wetland areas in the country. These unsustainable developments have led to hydrological disruption, pollution, and their consequent effects on existing wetlands. Unsustainable levels of fishing and grazing activities have also resulted in the degradation of wetlands. These are the major threat to the wetland ecosystem in addition to the unavoidable threat from changing climate scenarios. According to NWIA (National Wetland Inventory and Assessment 2011) the total area under wetland in the country is estimated as 15.260 MHa, which accounts for 4.63% of the geographical area. Besides streams and rivers, the total area of wetlands is determined to be 10 MHa. The distribution of wetlands based on the states reflected that Lakshadweep covers 96.12% of the geographic area classified under wetlands, Andaman and Nicobar Islands (18.52%), Daman and Diu (18.46%), and Gujarat (17.56%). The other states with high proportion of wetlands are – Puducherry with 12.88%, West Bengal with 12.48%, Assam with 9.74%, Tamil Nadu with 6.92%, Goa with 5.76%, Andhra Pradesh with 5.26%, and Uttar Pradesh with 5.16%. (http://iictenvis.nic.in/Database/Wetlands,Wetlandecosystemsforhumanhealth_1452.aspx?format).

1.1 Perceived threats

The position of wetlands within hydrologic landscapes determines the vulnerability of any wetland to changes in climate. Mainly the flow behaviour of ground water and surface water and by the interaction of atmospheric water, surface water, and ground water for any given locality or region defines boundary conditions of any hydrological landscapes. The mountainous, flat coastal, high plain and plateau, riverine, broad basins of interior drainage, and dune and hummocky glacial are the six major hydrological landscapes. Ground study of these landscapes suggests that the vulnerability of all wetlands to climate change fall between two extremes: the landscapes, which primarily depend on precipitation as the source of the supply of water are significantly vulnerable, and those, which depend chiefly on discharge from

regional ground system of the flow of water are the least vulnerable, because of the buffering quantity of huge ground systems of flow of the water to climate change. A water balance study based on precipitation, evaporation, and percolation by IIT Delhi (Gosain et al. 2006) on thirteen major river basins of India suggested that under changed climate scenario only four major river basins i.e., Mahanadi, Brahmani, Ganga and the Godavari would remain as a surplus basin (Gosain et al. 2006). Rest all nine river basins (Cauvery, Narmada, Tapi, Krishna, Pennar, Mahi, Luni, and Sabarmati) and wetlands associated with it are likely to suffer from the deficit basin effect. Silting of deltas due to soil erosion making wetlands prone to overflow in high rainfall areas due to extreme rainfall event are also threat for wetlands (Syvitski et al. 2014). According to India State of Forest Report, 2019, there are total of 62,466 wetlands with 3.83% of its recorded forest area in India. A total of 37 sites in India have been recognized under the convention as Ramsar sites till February 2020. There are 5,55,557 small wetlands (less than 2.25 ha) in the country. West Bengal has the highest number of small wetlands (138707). Only 26 of these wetlands have been designated as Ramsar Sites (Ramsar, 2018). Bihar is situated in the Ganga river basin with river dividing it in the middle. Out of 38 districts, 21 are in North Bihar and 17 in South Bihar. The state of Bihar is known for its extensive network of rivers and associated water bodies like floodplains wetlands (comprising of an oxbow lake, meanders, and seasonal floodplain), reservoirs, ponds, and tanks. The state has over 4416 wetlands with around 130 wetlands having an area of over 100 hectares (National Wetland Atlas of Bihar, 2010) and is mostly fed by rainwater. West Bengal has sixteen major wetlands in the state, out of which one (East Kolkata Wetland) is designated as the Ramsar site. The state of Odisha has at least 78,440 wetlands fed mainly by rainfall in topographical depressions and four doabs (Mahanadi-Kathjhori-Debi, Mahanadi-Chitrotpala-Luna-Birupa-Brahmani, Luna-Chitrotpala, and area to the East of high-level canal). Out of 78,440 wetlands, 66,174 are with an area of 2.25 ha or less are small in the category. The total coverage of wetlands has been estimated at 6,90,904 ha in Odisha. All these wetlands are mainly increased to 38998 ha during 1998-99 from 29330 ha in 1988-89 (30% increase) and are still increasing mainly due to basin of Mahanadi and Brahmani river basin and are mainly rain-fed.

In the state of Bihar, which has over 4416 wetlands has 628 x 103 ha surface waterlogged area, i.e. 10.57% of command area (5939 x103 ha) and spread over 132 command areas. Land surface with floods throughout the year covers 2.95% of the waterlogged area in all the command areas. Gandak command has a maximum total waterlogged area (212 x 103 ha), Eastern Kosi irrigation scheme (116 x 103 ha) and modernization of Sone scheme (82 x103ha; Chowdary et al. 2008). These major freshwater resources provide life to the wetland ecosystems in Bihar. The adverse climate change scenario, reduced or excess water flow, or flood due to extreme climate events, as well as the influx of deteriorating water quality in wetlands are a

major concern for the overall health of these wetlands. These freshwater bodies are often subjected to stress due to the extensive land use in their catchments leading to tapered inflows. Excessive diversion of water for agriculture is yet another major problem to keep wetlands to its full brim. Lack of conformity and conflict among government policies in socio-economy, environmental protection, ecological conservation, development planning are among the reasons for the deteriorating condition of these water bodies.

The most important function of wetlands is that it refills, recharges, and filters groundwater and is the basic source of drinking water in urban areas. It supports the life of a range of flora and fauna providing ecological services. However, poor water quality of the 'runoff' laden with overflown fertilizer and pesticide from agricultural fields and poorly maintained sewerage in urban areas located in catchment areas add to the poor health of wetlands. On the other hand, many of them act as the 'sink' for untreated effluents from urban settlement and dump of even solid wastes. In coastal areas, the mangrove wetlands prevent flood and prevent extreme damages during a cyclone or flood.

1.2 Framework for Wetland Management

Inventory creation and management and cataloguing of wetlands is the first step in formulating the strategy of wetland management under a climate change scenario. For characterizing wetlands, the information should be collected and collated under subheads: (i) The description of the study area along with catchment or watershed area and drainage network; (ii) Water Management: Hydro-meteorological data analysis; survey, delineation, and mapping of the wetlands. Maintaining the hydrological balance of wetlands is of paramount importance. Additionally, filtration of the river water has been hampered greatly by deforestation. It's high time steps are taken to improve the source of freshwater, so as to maintain the health of wetlands in catchment of Mahanadi river; (iii) Identification of the effluent discharge sources, their quality assessment, and their control; (iv) Land use and land cover study of the wetlands; (v) Bio-diversity survey; (vi) Analyses of socio-economic scenario and livelihood opportunities and development of Institutional infrastructures (Srivastava, et al 2020).

As a result of climate change, reduced flow of water during lean season and the more frequent onset of extreme weather events like drought, low pressure-induced depression rainfall are major perceived threats for maintaining the health of wetlands. Maintenance of hydrological balance of wetlands is a major challenge under such scenario. There comes the importance of overall catchment management mentioned in the framework above. Policy guidelines are necessary for curbing encroachment of natural drainage basins to maintain inflow and outflows from the wetlands. Once natural water balance in the wetland is established, along with

suitable catchment management protocol as per the above framework, we shall be able to restore the health of wetlands to a large extent.

2. Conclusion

Policy and action plans for flood control, urbanization in catchment areas of wetlands affecting water flows into wetlands, removing demographic pressure on wetlands like excessive commercial fisheries, preventing the use of wetlands as an outlet for untreated sewerage, repair, renovation, and restoration of wetlands are going to play important roles in sustaining the health of the dwindling wetlands under changing climate scenarios. Almost everything in the environment, like change in climate and issues related to it, is interlinked. Therefore, an improved framework of wetland development will not only assist farmers because a majority of them depend on wetlands for irrigation purposes, but will also provide ecological services for overall long-term improvement of the environment for its stakeholders.

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