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Status of Global Wetland Resources and Restoration Strategies : A Review

Navin K. Ambasht

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ABSTRACT

Wetlands are amongst the most productive ecosystems on the Earth and provide many important services to human society. However, they are also ecologically sensitive and adaptive systems .Wetlands exhibit enormous diversity according to their genesis, geographical location, water regime and chemistry, dominant species, soil and sediment characteristics. Due to the anthropogenic activities, industrialization and urbanization wetlands are under tremendous stress which showed decline in the economic and ecological functions they perform as well the hydrology. Local, international and national efforts are going on and more efforts on ecological lines are required to meet the challenges of vanishing clean water and wetland ecosystem. This paper reviews the wetland wealth of India as well as world-wide in terms of distribution and extent, ecosystem benefits they provide, and the various stresses they are exposed to. The paper also discusses the status of world wetland and importance of wetland conservation strategies as well as restoration for these productive systems.

Keywords Wetlands, Restoration, Biodiversity, Conservation strategies.

Navin K. Ambasht
Department of Botany, Christ Church College, Kanpur 208001, Uttar Pradesh, India
Email: navinkambasht@gmail.com
*Corresponding author

INTRODUCTION

It is only during the last 35 years that the term wetland has acquired popularity and worldwide attention of not only ecologists but also environmentalist, naturalists, ornithologists and pollution scientist. The term gained importance through the Ramsar Convention, when wetland scientists representing 18 nations gathered in Ramsar near the Caspian sea in Iran. The convention was adopted on 2nd February,1971, therefore February 2 is celebrated as World Wetland Day.

The Ramsar Convention has grown very strong and more than 118 countries now constitute the contracting parties and as per stipulations every countries has to designate wetlands of international importance as Ramsar sites (Ambasht and Ambasht 2003, SAC ,2011). However, India signed Ramsar Convention on 1st February 1982 and at present in India 41 Ramsar sites few like Lake Chilika (116,500ha), Keoladeo National Park (2,873ha), Loktak Lake (28,890 ha) and Wular Lake (18,900ha).

As per Ramsar Convention one definition quoted by Dugan (1990) " Areas of marsh, fen , peatland or water , whether natural or artificially created , either permanent or temporary, with water that may be static or flowing, fresh or salt including areas of marine water, the depth does not exceed six meter at low tides. Ramsar (1990) has classified wetlands into (1) marine and coastal wetlands (2) inland wetlands and manmade wetlands. Wetlands are also considered as meeting ground of aquatic and terrestrial systems therefore have advantageous habitat features of both. Ramsar (2013) have given an estimate of 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. The ecotones showed a very high level of bioproductivity. Wetlands can act as a sinks for nitrogen, phosphorus and sediments with adsorbed contaminants (McComb and Chambers 2003). The ability of wetlands to maintain or improve the water quality and provide habitat for the wildlife that depends largely on their hydrology. Among all wetland services, water purification, flood control and climate change mitigation are the most important services for the human communities (Scholz 2015).

Wetlands are the natural resources of the world and considered as the most productive ecosystem as a result wetlands are rich source of global biodiversity with collection of phytoplanktons, zooplanktons, macrophytes and other aquatic animals. As a result they are considered as a house of aquatic ecosystem. Due to the anthropogenic activities there is great loss of wetlands worldwide as a result there is a sharp decline in the population of aquatic habitats like plants and aquatic animals, coral reefs also. The major threat is due to the rise in the temperature as result of global warming (Butchart *et al*. 2010, Ambasht 2015). Wetland biodiversity is the key natural resources for maintaining the balance between man and natural habitats. Many wetlands in India have lost many important species due to invasive alien species, industrial effluents, higher uses of pesticides, herbicides have also degraded the wetlands (Bennett *et al*. 2018). Loss of wetland biodiversity as a result of habitat destruction by land-use (Butchart *et al.*2010, Constanza *et al.* 2017). Peberdy (1998) however ascribed 15,000 ha of wetlands habitats have been created in the United Kingdom as a result of extraction of minerals compensating a little for the impact on biodiversity of the loss of natural wetlands, which includes mineral gravel extraction sites are managed as wetland natural reserves. As a result of mining created wetlands high concentration of iron or manganese can immobilize phosphate and reduced the plant growth (McComb and Chamber 2003). Heavy metals like cadmium, lead and copper causes toxicity to the aquatic habitats as well as macrophytes. Junk *et al.* (2013) have reported that climate change may alter the freshwater wetlands in all geographic regions of the world. A changed climate will alter hydrology, and functionality may be impaired by increased temperatures, drought or flooding events.

World wetlands

Most of the ancient wetlands have become extinct and many new ones have been created by man. However, Mitsch *et al.* (1994) have given that 4 to 6% of earths land surface is covered by wetlands. In different parts of the world different kinds and sizes of wetlands are given different names. In recent years, with the realization of its importance, wetlands have drawn world attention.

The world has 7 to 9 million km^2 of wetland which is approximately 4 to 6% of the land surface. It may be 56% of the 4 to 6% of land surface is found in the tropical and subtropical regions. In 1987 Matthews and Fung estimated the extent of wetlands in the world by climatic zones they found: Polar/ boreal 2.7 million km^2,Temperate 0.7 million km^2, Subtropical/tropical 1.9 million km^2 Rice Paddies 1.5 million km^2 Total Wetland Area 6.8 million km^2 .(Cowardin *et al.* 1979).

In Asia most of its wetlands have been converted for agriculture South and Southeast Asia has the biggest wetlands. Some of the major rivers are the Indus, Ganges, Chao Praya, Mekong, Red. The Mekong begins at the Tibet Plateau and runs through China, Laos, Cambodia and Vietnam draining 625,000 km^2. In Asian countries more than 20 million peoples gets rich source of protein as a result of fishing. Due to the over exploitation of wetlands there is degradation of

many wetland habitats in different parts of the world species like birds (21%), mammals (37%) and freshwater fishes (20%) have become threatened (MEA 2005). In the Himalayan mountain ranges covered with snow several large rivers like Indus, Brahmaputra, Ganga, Mekong and Yangtzi originate. China has highest area under wetlands in Asia. The Ramsar Convention (2018a) reported that wetland-dependent species, such as fish, water birds, and turtles, are in serious decline, with one-quarter threatened with extinction, particularly in the tropics.

Rice is the most important human food produced in the wetlands of India, China, and South Asia. It has been reported the global climate change is one of the most important cause for the vanishing and transformation of important wetland ecosystem (MEA 2005, Colette 2013). South America, with the great river Amazon and extensive wetlands is very rich in flood plains, wet savannas and forests. Mitsch *et al.*1994 have described the wetlands of the old world and new world. Some important worlds wetlands are (1) saline deltaic marshes of Mediterranean seas which are the richest source of biodiversity. There are numerous nesting sites for flamingos. (2) Rhine river delta in Netherlands is extremely important. Dutch people are experts in creating and managing new wetlands. Maximum diversity of birds is found in these wetlands. The swamp is more used in the Eastern Hemisphere while marsh in the Western Hemisphere to mean same kind of wetland. At least half of the original wetlands have disappeared in America and Europe (UNEP 1992). Díaz *et al.* (2019) reported that more than 85% of wetlands present in 1700 had been lost by 2000, current wetland loss is three times faster than forest loss.

In context to India wetlands occupy 58.2 million hectares, including areas under wet paddy cultivation (Directory of Indian Wetlands). Majority of the inland wetlands are directly or indirectly dependent on the major rivers like, Ganga, Bhramaputra, Narmada, Godavari, Krishna, Kaveri, Tapti. The Indo- Gangetic flood plains farmers cultivate the vegetables and crops, this is the largest wetland system in India. However coastal wetlands in India vary from mangroves, Lagoons along the 7500 km long coastal line in Odisha, West Bengal, Tamil Nadu and other states of India. However in Deccan small and large reservoirs in every part of the villages, it is source of water for them. According to the Ramsar (2018b) there are presently 39 wetland World Heritage Sites, 96 river Biosphere Reserves, and 2,314 listed Wetlands of International Importance (Ramsar Sites) covering 2.42 million km^2 (Ramsar 2018b).

Importance of wetlands

Wetlands play an important role in maintaining the ecological balance. Wetlands are the storage blocks of water which man uses during dry phase for different purposes. Wetlands can be thought as the biological super market as it provides food, shelter and speciation of new species. It attracts many animal species for the food. They are considered as store house. Worldwide, wetland covers about 40.6% of the total global ecosystem services value (Costanza *et al.* 2014). Wetlands store precipitated water, which if not held would cause floods elsewhere. The marginal wetland vegetation not only checks soil and nutrient runoff, but also acts as harvesters of pollutants, heavy metals and pesticides, thus reducing the load of pollution on stream flow water which man utilizes for domestic purposes. Wetlands are the rich source of biomass. The shallow water belt is amongst the most efficient biomass producing ecosystem. Mangroves produce huge amount of fuel wood at a faster rate. Indonesia exports annually mangrove products worth US$18 million (Hamilton and Snedaker 1984). Wetland play an important role in carbon sink to climate regulation. The wetland plays an important role in the hydrological cycle also, influencing groundwater recharge, low flows, evaporation and floods (Pattison-Williams *et al.* 2018). Some important aquatic plants play an important role in removing heavy metals like *Eichhornia, Typha, Lemna* (Ali *et al.* 2020). Wetlands are regarded as cradle of speciation as it provides different kinds of environmental condition, both stressed as well as favorable. In the shallow regions they are the richest source of biodiversity. In many of the Indian wetlands the migratory birds on the surface of the water and nearby trees are so much that free water surface is not visible. Due to the overexploitation of biota have threatened the existence of plants and many animals also. Royal Bengal tiger found in the wetlands of the Bengal and jaguars in the Pantanals

of Brazil and lowlands of Nicaragua need intervention by conservationists to protect them. In India tourism on account of wetlands and national parks brings millions of dollars. Fish, of course is the most important source of animal protein and wetlands are the habitat and indirectly spawning site, contribute enormously to the total world fish harvests. Dugan (1990) has complied fish yield data from several parts of the world. Fishes produced in Waden sea (4000 km^2) in the northern Europe is more than 100 million dollars this suggests that how important our wetlands are. It brings lot of money and improve the economy of country. More than 1200 aquatic plant species are the source of food resources for human beings as well as for the herbivore animals (Hidding *et al.* 2010, Wood *et al*. 2012).

In India specially North East regions diversity of fishes, molluscs and amphibians have been reported and is a good source of food. Many of the molluscs and aquatic plants are restricted in the Western Ghats and considered as endemic (Molur *et al.* 2011). This suggests that wetlands are among the most productive ecosystems in the world as compared to the rain forests and the coral reefs. There is large variety of species of microbes, plants amphibians reptiles, birds, fishes and large mammals like Dolphin, Whale are the part of a wetland ecosystem. Seeds of many aquatic plants like Lotus are eaten. In the north Bihar people use to cultivate *Euruyale ferox* (Talmakhana) in shallow lake and it is an important cash crop for its dried and puffed fruits. The creation of wetlands helps in the feeding and breeding of wetland vertebrates, especially water birds. Most of the nature reserves, biosphere reserves, national parks and sanctuaries have wetlands within it. Wetlands are the good source of employment of a sizable segment of humanity connected with tourism, fishing, cultivating crops, harvesting timbers, cottage industries based on fresh water ecosystem. Marine ecosystems are the store house of important species of plants and coral reefs.

Marine ecosystems are very productive due to the phytoplankton, a heterogeneous group of microscopic and short lived organisms that inhibit the upper layer of the water column. Marine macrophytes in shallow coastal ecosystem accounts 10% of the annual marine primary production (Ramus 1992).

Restoration and degradation of wetlands

Most of the terrestrial systems are the result of degradation of wetlands, shrunk in area or totally disappeared. This causes a great loss of aquatic diversity. In some states of United States upto 99% of the natural marshes of Iowa were lost in the year 1981, Tiner (1999). Khandekar (2011) reported that 232 water bodies in Delhi have destroyed due to lack of conservation and proper management. Due to burgeoning increase in population in India severe loss of wetlands have been recorded in different states for the need of land use and habitats are degraded very rapidly cause severe impact on diversity of wetlands (Grumbine and Pandit 2013, Ambasht 2015). Dugan (1989) has reported the chain of wetland degradation due to construction of dams in Africa, as a result 60 to 90% loss in fish, pasture and agricultural production has been found in African flood plains due to dams. In India many important lakes and streams have been degraded due to unsustainable agricultural practices. Severe use of pesticides, herbicide and insecticides, discharge of industrial effluents leads to degrade the natural water resources as a result there is loss of clean drinking water (Hagirath *et al.* 2011, Bassi *et al.* 2014). Many of the pesticides show biological magnification of toxic substances in higher trophic level organisms which include phytoplankton, zooplankton, fishes and birds eaten by man. Water storage capacity is also reduced due to dumping of solid wastes and encroachment of the peripheral shallow lands. Due to nutrient enrichment there is severe loss in the fish population in Indian lakes and river (Singh *et al*. 2018). Due to the excessive emission of methane, carbon dioxide and severe climate change is the major cause for the vanishing of wetland ecosystem (MEA 2005, Colette *et al*. 2013). Ramchandra and Kumar (2008) have reported that in Bengaluru region more than 66 wetlands have vanished due to industrialization and urbanizatison. Restoration of these converted wetlands is quite difficult once these sites are occupied for non -wetland uses. Other factors for the degradation of wetlands are over exploitation of wetland resources like too much removal of macrophytes for herbage, excessive fishing not leaving enough to rebuild a sustainable supply level and destruction of marginal vegetation. MEA (2005) reported that due to the degradation of the water bodies many habitat

species like mammals, freshwater fishes, prawns and birds have become threatened. There should be proper conservation strategies to be adopted to save them from extinction. The problem of decline in the water quality is particularly more alarming threat for the economic, social and ecological functions likes nutrient cycling and maintenance of biodiversity (Kumar *et al.* 2013). Lack of proper management and good governance are the major reasons for loss of wetland habitats. Many important lakes like Loktak (Manipur), Chilka (Odhisa), Dal Lake (Jammu Kashmir) and Nalsarovar (Gujrat) have been providing lot of tourism , irrigation and domestic water supply services and support ground water recharge this helps in supporting the diversity of aquatic flora as well as fauna (Jain *et al.* 2007). If the wetlands are restored properly then it plays an important role in flood control. Wetland traps suspended solids as well as nutrients during the period of floods (Boyd and Banzhaf 2007, Rebelo *et al*. 2019). Government should give emphasis on the physical, economic and institutional factors affecting the wetland conditions and better management strategies for wetland conservation and keeping them free from many anthropogenic activities done by human beings as well as the climatic factors to be checked. Depletion of ground water recharge is mainly due to draining of wetlands. In the rural areas of India more than 8000 villages are without a source of drinking water which is due to rapid depletion of ground water. Wetland inventory and monitoring program should be developed to attain sustainability for monitoring wetlands. Waste disposal technology must be adapted and enforced by waste producing units and keeping the wetlands free from waste disposal this would enhance the diversity of aquatic flora. Wetland conservation has important implications for atmospheric carbon cycles, a substantial portion of the soil carbon pool which is stored in wetlands (Ambasht 1998, Hugelius *et al.* 2014). Climate change may cause more evapotranspiration and consequently a water level drawdown and also more flood inundation, which may critically affect the biogeochemistry and water quality (Waddington *et al.* 2015).

CONCLUSION

Wetland both lotic and lentic are undergoing degradation due to global climate change as well as anthropogenic activities and overexploitation of important aquatic species. Wetland have played an important role to maintain the hydrological cycle and supporting large diversity of different types of flora, fauna and microbes. Due to the change in the water quality as a result of sewage discharge the water carrying capacity is reduced. Algal blooms known as red-tides or nuisance blooms. They are the common feature of eutrophic systems world- wide, particularly in our India coastal regions. Efforts to create new modern technologies to maintain the diversity of wetlands with minimal external input of energy. Wetlands are the most severely damaged and degraded ecosystems and need restoration measures. World-wide identifications of wetlands of importance for their protection for sustainable use and in the interest of the user. Some international coordination system should be developed for wetlands of global importance. Wetland plays an important role in recharging of ground water so efforts are taken to avoid using pesticides, herbicides so that ground water remains clean.

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