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HOKERSAR WET LAND OF KASHMIR: ITS UTILITY AND FACTORS RESPONSIBLE FOR ITS DEGRADATION

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Abstract

The Valley of Kashmir harbours a chain of wetlands occupying an area more than 7,000 hectares. Wetlands are very effective systems which help in cycling of nutrients, act as supporters of food chains, maintenance of water quality, and it's cycling. Wetlands are recognized by their shallowness, moist soil and aquatic vegetation. Their important services include cleaning of water, recharge of ground water, biodiversity reserves for threatened and endangered species and cycling of nutrients. Hokersar wetland (34°06' N latitude, 74°05' E longitude) lying in the Northern most part of Doodhganga catchment is a protected wildlife reserve and a Ramsar site at an altitude of 1,584 m (amsl). The wetland shelters about two million migratory water fowl during winter that migrate from Siberia and the Central Asian region. The wetland is fed by two inlet streams Doodhganga (from east) and Sukhnag Nalla (from west). Hokersar wet land had traditionally been used for various livelihood purposes for centuries. People living around the periphery of wetland grow paddy crop, vegetables, rare poultry, cattle, fish and also carry out other activities like wood collection, mulch and reed collection. Wetlands of Kashmir provide over-wintering resort to millions of water birds. It has decreased in size and exhausted due to the anthropogenic activities and encroachments. The wetland is bordered by urban habitations on the northern side along the Srinagar-Baramulla highway. All kinds of waste generated by the people are dumped into the Wetland. The encroachments result in the change of mud flats and grasslands into the agricultural lands thus dividing the habitat in to small portions which affects the population of birds in the wetland. Further, throwing of domestic waste into the wetland has resulted in eutrophication and finally in excessive weed growth.

Key words: Kashmir, Wetland, Water quality, Biodiversity, Domestic waste, Weed growth Eutrophication.

Introduction

The wetland resources of India are estimated at 58.2 million hectare (Prasad *et al.,* 2002). The Valley of Kashmir harbours a chain of wetlands occupying an area more than 7,000 hectares. Wetlands are service providing systems that help in the regulation of water cycles, sustenance of good water quality, movement of nutrients and support for food chains. Wetlands are the areas wherein water is the principal representative which controls the environment and the other flora and fauna present there. These are the areas in which underground water table is at or near the surface of land or where the land is covered superficially by water under the text of their arms or convention, as such these are the ecosystems that rely on continuous or recurrent superficial overflow or flooding at or near the surface of substrates (Committee on Characterization of Wetland, 1995). The true nature of a wetland lies in its shallowness, moist soil and aquatic vegetation. The most prominent services these wetlands provide include biodiversity reserves for threatened and endangered species, exchange of nutrients, cleaning of water and recharging of underground water (Pramod, *et al.,* 2011 and Sarkar and Upadhyay, 2013). The importance of world wetlands is being provided duemuch focus as they help in maintaining the clean environment. The far most step for prevention of wetlands is to support anice water quality (Smitha and Shiva Shankar 2013).

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Wetlands occupy about 7% of the Earth's land surface (MEA 2005) and in the Kashmir Himalaya alone; there are 3,813 wetlands and water bodies. Proper management of these wetland ecosystems is necessary as these provide a number of functions and contribute to the livelihoods and wellbeing of people in the area. The most prominent services the wetland ecosystem provide for wellbeing of people involve fisheries, different food products, clean water supply, purification and detoxification of water, and regulation of climate change (Costanza *et al.* 1997; Hruby 1995; MEA 2005). These Wetlands are vanishing from the earth's surface ata fast rate. Loss of wetlands throughout world is estimated as 50% of those that existed since 1990 (Dugan, 1993) with maximum loss being accounted from northern countries. The main reason for loss of Tropical and sub-tropical wetlands since 1950s is the conversion of wetland to agriculture land. Agriculture is the main factor for a total of 26% of wetland disappearance from the worldwide. Actually there is no overall available figure of wetland loss in Asia. However, the region experienced wetland loss for thousands of years, with maximum wetland areas used for growing food grains or settlement as again indicating wetland loss as total in some countries (Vietnams Red river delta flood plains). Hokersar wetland (34°06' N latitude, 74°05' E longitude) lying in the Northern most part of Doodhganga catchment is a protected wildlife reserve and a Ramsar site at an altitude of 1,584 m (amsl). The wetland harbors about two million migratory water fowl during winter that migrate from Siberia and the Central Asian region. The wetland is fed by two inlet streams Doodhganga (from east) and Sukhnag Nalla (from west). The wetland attains a maximum depth of 2.5 min spring due to appreciation in discharge from the snow-melt water in the upper reaches of Doodhganga catchment. The water depth in autumn is minimum. The average rainfall is 650 mm and average temperature ranges from 7.5°C in winter to 19.8°C in summer (Pandit and Qadri, 1990).

Significance of the Wetland

Hokersar has been declared as Conservation Reserve under the Jammu and Kashmir Wildlife (Protection) Act, 1978. It was also declared as Ramsar site on November 8,2005 under the Ramsar Convention. India is a signatory to the Ramsar Convention-an international treaty for the conservation and sustainable utilization of wetlands. Wetlands of Kashmir provide over-wintering resort to millions of water birds from their breeding grounds in Pale arctic region extending from north Europe to Central Asia (Ali, 1979) and breeding ground to a segment of water bird species (Pandit, 1982). The Hokersar is protected area under control of the Directorate of Wildlife Protection, as game reserve. On 08/11/05 it was declared as a Ramsar Site no. 1570. It has been listed under National Wetlands Conservation Programme. The Hokersar wetland is differentiated into three varied zones, marshy and exposed area extending from north to north west, central deeper area, south eastern side covering most of the silted area. The North-Eastern zone comprises of different dense macrophyes. The central deep area is largely a free expanse of water except at some areas where two distinguished species of macrophyte *Trapa natans* and *Phragmites australis* cover a huge area. The marshy zone of the wetland and the open waters constitute an excellent living place for the migratory birds. Southern silted up portion acts as pasture land for the domestic cattle.

a) Revenue generation

Wetlands are defined as lands transitional between terrestrial and aquatic ecosystem where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands is home large variety of wildlife including birds, mammals, fish, amphibians, insects and plants (Buckton, 2007). Human beings get renewable resources from the wetland (Mitsch and Gosselink, 2000). Local people living around the wetlands throughout the world get benefitted by different ways from the wetland resource. They get fiber, food, fish etc. from it, thus helps in wellbeing and poverty alleviation of the local people of the area. Local people had traditionally been using the Hokersar wetland for various livelihood purposes for centuries. On an average, people are reported to be involved in a variety of wetland-based livelihoods like paddy crop cultivation, cultivation of vegetables (38%), fishing and other related activities (20%), poultry rearing (12%), cattle rearing (30%), wood collection (53%), mulch and reed collection (10%).

b) Acts as a habitat

The wetlands of Kashmir serve as a congenial habitat to a number of bird species. Birds use this habitat for number of activities like nesting, roosting and feeding. Hokersar wetland is the biggest bird reserve in the Kashmir Valley (Rather and Pandit, 2002) and a Ramsar site known for huge gathering of different species of birds particularly in winter. It acts as a wintering resort to millions of water birds from their breeding grounds in Pale arctic region extending from north Europe to Central Asia (Ali, 1979). It is provides food, acts as spawning ground and nursery for fishes, in addition, it also performs the function or acts as feeding and breeding ground to a variety of water birds. Hokersar wetland is known for providing refuge to thousands of waterfowl in winter.

The birds use aquatic plants of the wetland as food. But now from so many years it is losing this significant property providing shelter to the bird community. Birds that use this wetland as habitat were classified as resident, found throughout the year, summer migrant-migrating in spring season from Indian plains and other countries, winter migrant-Birds from central Asia, Europe and Siberia, Local migrant-found only for a specific period. The threatened species in wetlands need special attention as they are more sensitive to disturbance for long term management and conservation (Pandit *et al.,* 2007). The wetland provides shelter and plants of the wetland act as food for thousands winter migratory birds. These plants are having high nutritional value (Gibb's, 1993; Paracuellos, 2006) that attracts a large congregation of birds.

c) Pollution sink/ Phytoremidation

Wetlands deliver a wide array of hydrological services, for instance, flood regulation, promote groundwater recharge and regulate river. Wetlands are among the most productive ecosystems and a rich repository of biodiversity and are known to play significant role in carbon sequestration (Kraiem 2002). Wetlands play an important role in the water cycle by capturing, holding rainfall and water from the melting snow; retaining sediments and purifying water in the process. In fact wastewater and urban runoff are commonly received by wetlands, which are also an effective filter, sink and transformation system for pollutants. These functions are very important among the other ecological services offered by wetlands (Hansson, 2005).

Factors responsible for deterioration of Wetland

Hokersar wetland has shrunk and depleted due to the human activities and encroachments. During the observation period from 1969 to 2008, the spatial extents of wetland have reduced from 18.75 km^2 in 1969 to 13.00 km^2. The extent of the wetland is seen at various points. As is evident from the data, an area of 5.75 km^2 has been lost during the last four decades. Some areas of the wetland that existed in 1969 have been converted into paddy fields. About 10 hectares of the wetland has been converted into built-up area. A marshy area within the wetland, that forms an important part of the habitat for the migratory birds, has shrunk by 150 hectares and has been colonized by the aquatic weeds.

a) Populous Villages around the Wetland

The wetland is bordered by urban habitations on the northern side along the Srinagar-Baramulla highway. The area is thickly populated and major threat is in terms of eutrophication and poaching (Habib, 2014). Wetland is inhabited by ten populous Villages (Naqash *et al.,* 2014). The name of these villages along with their area, total population and total number of households is given below-

Villages	Area in hectares	Total Population	Total No. of households
Sozeith	282.07	5992	680
Gund Hashibat	520.84	3123	416
Gotapora.	164.71	2224	278
Daharmunnah	490.08	3719	490
Soibugh	604.2	8178	1093
Hajibagh	25.50	1788	196
Shariafabad	312.42	1820	425
Khushipora	110.88	657	86
Zainakote	273.16	813	123
Lawaypora.	196.27	777	106

During recent years the rapid increase in population has resulted in establishment of new human settlements in the catchment area of the lake. Also the vast areas of forest were converted into agriculture and farmlands that resulted in opening up the terrestrial ecosystem, with heavy loads of nutrients leaching into the lake from the fertile top soil of the catchment area (Romshoo and Muslim 2011). In addition to sewage and domestic effluents from the new and expanding human settlements the runoff from fertilized agricultural land and the residual insecticides and pesticides from the arable lands and orchards plantations also drain into the lake. These human activities not only deteriorate the water quality but also affected the aquatic life in the lake, as a result of which the process of ageing of these water bodies is hastened (Rashid and Romshoo 2012). This artificial or cultural eutrophication is exhibited by a large number of Kashmir valley lakes (Garg and Garg 2002). In rural areas of Kashmir standing water bodies are characterized by uncontrolled growth of macrophytic vegetation, anoxic deep water layers, and shallow marshy conditions along the peripheral regions and are also having high nutrient loads (Murtaza *et. al.,* 2010; Jeelani and Shah 2006). Thus main impact of undesirable human activities is responsible for accelerated flow of material/nutrients from the terrestrial to aquatic portion of the watershed.

b) Conversion of Wetland into Agricultural land

Some areas of the wetland that existed in 1969 have been converted into paddy fields. About 10 hectares of the wetland has been converted into built-up area. Habitat fragmentation is the process of splitting of major habitats into smaller pieces or habitat patches by expansion of land use which results in the decrease in biodiversity of natural habitats. The encroachments leading to conversion of mud flats and grasslands into the agricultural lands

and divides the habitat into fragments leading to decrease in waterfowl population (Habib, 2014). Joshi *et al.,* (2002) carried out the study on temporal mapping of the Wetland using the data sets for the autumn and spring seasons to assess the land cover dynamics and observed that the Wetland comprised of small segments of marshy waterfowl habitat along with some open water bodies. It has been fragmented into a large number of land uses due to anthropogenic activities. The increase in the settlement has been observed proportionate to the rate of fragmentation in the Wetland.

c) Discharge of domestic waste into the wetland

The discharge of untreated effluents in aquatic ecosystems is one of the most important environmental concerns in present day content. Experts are of the opinion that said influx of sewage and solid waste from flood spill channel and Doodh Ganga has also led to deterioration of the wetland's condition. Hokersar also bore the brunt of last year's devastating floods last year. The wetland lies in flood Basin of Jhelum River and sub basin of Doodh Ganga and Sukhnag Nala. Flood waters through different tributaries carried tons of silt into Hokersar. The bed of the wetland has been raised by around 12-feet due to heavy influx of silt. This has severely affected its eco-system. After floods, there has been drastic decrease in visit of diving ducks and pochards to the wetland. Influx of sewage and solid waste from flood spill channel and Doodh Ganga has also led to deterioration of the wetland's condition.

d) Excessive weed growth

This wetland is now characterized by low water levels since it is surrounded by cultivation areas which wash organic and inorganic constituents into the wetland thus resulting in exceedingly high macrophytic growth. The wetland is infested with number of macrophyes. Some of the macrophytes include- *Butomus umbellatus* Linn. (Flowering rush), *Carex wallichionaspreng* (Sedge), *Cyperu sglomeratus* (Sedge), *Cyperus pumilla* Linn. (Low spikesedge), *Sparganiumramosum* (Bur-Reed), *Phragmitescommunis* (Common Reed) *Typha latifolia* (Broadleaf cattail), *Nelumbium nucifera* (Indian Lotus), *Trapa natans* (Water Chestnut), *Ceratophyllumdemersum* (Horn Wort), *Salvinianatans* (Floating Fern), *Azolla pinnata* (Water velvet), *Phragmites australis* (Common Reed), *Roripa indica* Linn. (Yellow Cress), *Potamogeton crispus* Linn. (Curly Pond Weed), *Potamogeton lucens* Linn. (Shining Pond Weed), *Utricularia aurea* L. (Golden Bladderwort), *Nymphea alba* Linn. (Water Lily), *Potamogetonnatans* Linn. (Floating Pond Weed), *Wolfia polyrhizaschield* (Duck Weed), *Lemna gibba* L. (Swollen Duck Weed), *Cyperus rodundus* L. (Nut Grass) etc. Afshan *et al.,* (2014) studied the macrophytic diversity in Hokersar wetland and classified them into submerged, free floating, rooted macrophytes, emergent, marshy plants, fringe plants, facultative plants and facultative upland plants. The emergent macrophytes had the highest diversity followed by submerged leaf-type species, fringe plants, free floating, rooted leaf, marshy plants. In the wetland the dominant species present include Typha *spp, Phragmites australis, Sparagnium ramosum* and *Scripus lacturis*. Study by Khan *et al*. (2004) on the macrophyte community in relation to environmental stresses of Hokersar wetland reserves probably the only long-term study carried out so far. The study indicates a shift in macrophyte community structure of Hokersar wetland as evidenced by *Nelumbo nucifera* and near disappearance of *Eurayle ferox* and *Acorus calamus.* Among the free floating macrophytes recorded from Hokersar wetland, *Lemna sp*. and *Salvinia natans, Azolla* were found to have an explosive growth in open waters of the wetland. *Lemna* sp. often increases in density and coverage especially during late spring and early June, in response to increased nutrients. Later invasive plants, especially non-native invaders, such as *Azolla,* usually form a solid cover which creates compact, thick, floating mats, that shades the water column below them, restricting the submerged growth and thus altering the species composition of the wetland. Their explosive expansion, thus pose a great threat to the lake ecosystem. Dr A.M. Kak, an environmentalist in his study states that the waters of Hokersar has been highly polluted and chocked by noxious *Azolla*. Peripheral portions of the wetland near surrounding villages including Sozeit, Goethpora, Dharmuna, Soibugh, HMT side and Haji Bagh have been encroached. The problem is compounded by weed infestation, change of land use, agricultural activities and extensive willow plantations in the wetland.In the recent years the invasion of exotic species has drastically changed the habitat composition of the wetland. The study conducted by Pandit and Kumar, (2006) reveals the presence of 46 plant species from the wetland. Habib, (2014), retorted that *Sparganium ramosum, Azola* spp, *Salvinia natans, Nymphoides peltatum, Ceratophylum demersum, Myriophyllum* spp. and *Potamogeton crispus*are as the dominant invasive species of the wetland. Some of the economically important plants of Hokersar wetland such as *Nelumbium nucifera*have been completely replaced and *Trapa natans* restricted to small patches by extensive growth of reed beds.

e) Eutrophication

The nutrient enrichment in the wetland causes changes in the biotic community composition, some new invasive and exotic species start growing there. Sometimes the native species disappear because of excessive nutrient loads in the wetland which change the quality of water drastically ultimately results in the excessive growth of algal mats, macrophyes finally resulting in the death of fishes and decrease in water bird population. Microorganisms, algae, invertebrates and vertebrates are directly or indirectly affected by the chemical change altering the physical makeup of the wetland. The anthropogenic activities have resulted in heavy inflow of nutrients into lakes from the catchment areas (Romshoo *et al.,* 2011, Romshoo and Rashid 2012). These anthropogenic influences not only deteriorate the water quality, but also affect the aquatic life in the lakes, as a result of which the process of aging of these lakes is hastened (Odada*et al.,* 2004; Li *et al.,* 2007). As a consequence, most of the lakes in the Kashmir valley are exhibiting eutrophication (Khan 2008). Due to various anthropogenic activities, and siltation due to release of waste into the wetland and deforestation in the catchment area, the depth of the lake has been decreased considerably and 54.26% of the lake has been converted to marshy land (Joshi *et.al.,* 2002).

f) Waterfowl hunting

Hunting is a common practice among the local people around the Zainakote, Hajibagh and Soibugh villages. Some people are dependent on waterfowl for food and their daily needs. The hunting continues from the month of November and ends in the month of April. The birds are killed by gun shots and sometimes trapped by traditional hair snarls. The Mallard and Greylag goose are the favourite birds for the hunters of the locality as they have a great demand in the market for meat and taste.

Following conservation measures need to be taken to save the wetland:

1. Minimising the use of chemical fertilizers or agrochemicals in the fields around the wetland.
2. Planting of trees in the catchment area which can check the flow of silt into the wetland and also help in remediation of toxic elements.
3. Waste water from the surrounding villages should be treated in sewage treatment plants before letting it into the Wetland.
4. Reduction in waste that is thrown into the Wetland can be achieved by educating the local people or by making them aware regarding the drastic effects of Wetland degradation on the surrounding communities.
5. LAWDA should employ some local people who could keep vigil on the unlawful bird hunting.
6. Govt. should construct several sewage treatment plants around the wetland to reduce its pollution.

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