G- Journal of Environmental Science and Technology

(An International Peer Reviewed Research Journal)

Available online at http://www.gjestenv.com

Assessment of Water Quality in Harike Wetland - A Review

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ARTICLE INFO

Received: **19 July 2016**
Revised : **07 Aug 2016**
Accepted: **29 Aug 2016**

***Key words*:**
Harike Wetland, Ramsar site, Physicochemical parameters, remote sensing,Water quality

ABSTRACT

Harike, designated as Ramsar site, is the largest manmade riverine wetland in North India. It came into existence in 1952 with the construction of barrage near confluence of rivers Sutlej and Beas. It has high ecological significance as it is the habitat of diverse flora and fauna, source of food for animals and humans and plays an important role in underground water recharge. Despite all these diverse functions, the wetland is facing a threat of extinction because of increasing anthropogenic pressure from industrial development, agriculture and over extraction of water for irrigation. A number of studies have been undertaken to assess the water quality of Harike and the water is found to be unsafe for aquatic life as well as for human consumption. The review deals with the status of harike wetland in terms of water quality and causes of wetland loss. It also provides an overview of the methodology employed for physicochemical and biological analysis, heavy metal determination and use of remote sensing techniques for monitoring of various water quality parameters.

1) INTRODUCTION

Wetland is a distinct ecosystem which remains saturated with water either permanently or seasonally. These are pre-eminent for endless ecosystem benefits they provide from water supply, groundwater recharge to flood control and cure for climate change. They are one of the most productive ecosystems which provides food to stupendous biological diversity. Regardless of ecological importance of these wetlands, increased population growth, vast economic development and unprecedented construction of buildings are deteriorating charm and quality of these valuable attributes of nature[1].

Harike wetland is an internationally recognized wetland which covers three districts in Punjab i.e Kapurthala, Tarn Taran and Ferozpur. It is also important because it is drained by Sutlej and Beas rivers. Wetland is getting degraded because of polluted Sutlej river which is receiving industrial effluents from Ludhiana[2]. Moreover this polluted water is being used by southern districts of Punjab and Rajasthan through two feeder canals. This can be related to rise in cancer cases and other deadly diseases in the region as many studies have shown that the toxic components present in water can cause mutations and DNA damage [3, 4]. A number of ecotoxicological studies have been conducted in Harike wetland to evaluate the water quality.

2) LITERATURE REVIEW

2.1 General: Various technical papers on Water Quality Assessment in Harike have been presented at research level from which I referred many papers for study. These papers are presented below.

2.2 Review of literature:-

2.2.1 Ecological studies: Ladhar [5] studied the ecological status of Harike wetland in year 2002. Harike has rich biodiversity which include four species of snakes, birds species around 360, about 16 taxa of fishes, 6 taxa of amphibians, 7 species of turtles, 38 taxa of plants and 189 taxa of invertebrates. Large number of migratory birds also visits Harike in summers. In spite of having rich biodiversity and status of international wetland, Harike is facing major threats which include siltation problem due to which flow of water has declined, excessive weed growth, industrial effluent and domestic wastewater which is brought by river Sutlej and Beas, illegal encroachments, indiscriminate grazing, and illegal hunting that are damaging the ecology of wetland.

Moza and Mishra [6] studied ecology and fishery of Harike in year 2008. The observations were carried out from 1999 to 2000 for 6 years. The soil in Harike was found to be mainly sandy loam in nature. pH of soil showed decreasing trend. Water was found to be acidic and turbid with less transparency due to the presence of large number of suspended solids. DO and total alkilinity showed decreasing trend in these 6 years. Pollution status was assessed by determination of BOD and COD values which indicated that Sutlej zone is more contaminated than Beas zone. Harike Lake, due to excessive weed growth has become eutrophic. Macrophytes covered the large area of wetland due to which plankton population was affected but after macrophytes removal, micro vegetation

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started growing. The population of phytoplanktons was found to be more than that of zooplanktons. Macro benthic population showed increase in these years. 34 species of aquatic macrophytes were reported in wetland. Fishery resources showed great variation during this period of study. 55 fish species were reported in the wetland. Maximum commercial fishery was found under IMC zone followed by common carp and large sized catfishes.

2.2.2 Toxicological studies: Parmar et al., [7] analysed physicochemical parameters seasonally and developed water quality index (WQI) to assess pollution status of Harike lake. It was found to be severely contaminated in all seasons and unfit for consumption. In rainy season values were lowest due to dilution process as compared to other seasons. In summers, it was found to be highest due to increased concentration of contaminants.

Brraich and Jangu [8] studied the concentration of heavy metals in Harike. Heavy metals like Pb, Cr, Ni, Cu, Cd was found to be above the permissible limits. Heavy metals bioaccumulate in food chain and adversely effects the aquatic animals and plants so toxicological and lepidological studies were also conducted to check accumulation of heavy metals in fish. Studies on scale structure of contaminated fish revealed the presence of various heavy metals like Pb, Cr, Ni, S, Cu, Fe, Al. Water quality pollution indices for heavy metal contamination were also evaluated which revealed the high concentration of of metals like Co, Cr, Cu, Cd, Pb, Fe, Ni and contamination index (C_d) was found to be more than 3 which shows high toxicity of water.

Kaur et al., [9] assessed mutagenic, genotoxic and cytotoxic potential of water samples of Harike using different biological systems in laboratory. Various bioassays like ames mutagenicity assay, plasmid knicking assay, bioluminescence mutagenicity assay, MIT assay were done to check toxic nature of water. Results revealed highest mutagenicity of Sutlej water samples than Beas zone and this accounts for higher contamination in river. Heavy metal analysis revealed the presence of Ni, Cr, Fe, Pb, Hg, Cu, Cd in different regions of Harike and lowest concentration of them was found at confluence of Beas and Sutlej.

2.2.3 Monitoring by Remote Sensing technique: Remote sensing technique has been used as a most reliable tool for assessment of water quality in various water bodies [10, 11]. This technique is cost effective and saves time also. Different sensors capture large information regarding the land cover which is used by researchers and scientists involved in monitoring spatial information for characterization of change in wetlands [12]. Various studies have shown positive relationship between water quality parameters and radiance data from satellites [13, 14]

Chopra et al., [15] prepared landcover map of Harike by using IRS LISS II data and was compared with data for year 1996 to observe the changes, nevertheless no visible difference was observed. The study area was divided into five classes. Results obtained showed that out of total wetland area 10.8 sq. km was waterlogged. Wasteland occupied 3.4 sq km Swamps and marshes extend upto 43.1 sq km Plantations and Built up land occupied 0.08 and 0.66 sq. km respectively. Large part of wetland is covered with water hyacinth. Turbidity was found to be variable. Water was severely contaminated.

Sarkar et al., [16] demonstrated the impact of declining water flow in wetland. Landcover maps were prepared using NDWI. Study area consists of three major divisions – aquatic vegetation (water hyacinth and grass), water and waterlogged area. It was observed that total wetland area has been reduced from 100.31 sq.km (1990) to 71.08 sq.km (2003) which shows 30 % reduction in wetland in 13 years due to siltation and decreasing flow in upstream catchment area.

Mabwoga and Chawla [17] studied water quality parameters like Ph, DO, COD, EC, TDS, SS, TS, turbidity and temperature and correlation between parameters was calculated. Significant correlation was found between SS and turbidity, turbidity and TS, SDT and SS, SDT and TS. Other parameters did not show significant correlations. Satellite data was also used to observe correlation among these parameters which revealed similar results. However, visible difference between waters of Beas and Sutlej was also observed. High EC was observed in river Sutlej. It was concluded that IRS LISS II bands 2(green), 3(red), 4(NIR) can be used to assess water quality.

Mabwoga and Thukral [18] with the help of satellite images of Landsat TM and ETM observed changes in Harike wetland. Change was detected for two time periods from 1989 to 2000 and 2000 to 2010. From 1989 to 2000 waterlogged area decreased by 9.7% and then increase of 5.3% was observed in second period. 3.99% Decline in weed growth was observed in first 11 years and then it increased by 0.7% in 2010. The decrease may be due to the efforts of various agencies involved in conservation work. There was increase of 2.6% in grass zone in first period and decrease of 7.8% in second period. Barren land increased by 4.8% in first 11 years and subsequent decrease of 0.3% occurred in next 10 years.

2.2.4 Conservation strategies to overcome wetland loss: Extensive anthropogenic influences on wetlands are causing unusual changes in the delicate ecosystems. Indubitably, harike is an important wetland and its regular monitoring is required for planning right conservation strategies to save this wetland from extinction. Government has taken several initiatives to check environmental degradation. It includes various environmental laws which are amended time to time according to the changing scenario. India is also the member of Ramsar Convention on Wetlands and Conservation of Biological Diversity. Besides this, Punjab government launched the Pilot project Sahyog in 1999 for restoration of Harike wetland. This project was the joint venture taken up by Indian army in Punjab. It took around 6 months to get rid of water hyacinth and silt there. Besides these laws, better monitoring strategies are also required to gain knowledge about the current status of water quality and other resources of wetlands. Several workers have suggested measures to save this valuable resource of nature.

Prasad et al., [19] suggested framing national wetland strategy which should be based on prevention, conservation and restoration principles. Sustainable development should be the key feature of this strategy.

(a) India is a mega diversity nation but not all the wetlands present here are protected till date. So, legal status should be given to the wetlands which need immediate attention due to environmental degradation.

(b) Community approach should be adopted in areas which are not covered in protected ones. Local people along with

corporate sector can together implement the management plan. Strict punishments should be given to law offenders and proper environmental impact assessment should be done prior giving NOC to developmental projects.

(c) Sustainable management of resources requires awareness generation among people so awareness campaigns should organized to educate general public regarding environmental safety.

Ramachandra [20] gave strategies for restoration and management of wetlands in developing countries.

(a) Database should be created which would stress upon different types of wetlands, water quality and social and economic dependence.

(b) Water quality standards should be maintained and water quality data should be updated with recent information. Such data should be accessible to all for monitoring and research purposes.

(c) Collaborated research programmes should be promoted so that various factors like water quality, biodiversity and dependence of local people on these resources can be evaluated.

(d) Random pollution sources should be identified so that appropriate steps can be taken to reduce the same.

(e) Anthropogenic interferences should be limited around wetlands.

(f) Restoration goals should be made according to the needs of local environment. It should include all the facets of ecosystem- biodiversity, habitat and water quality.

3) CONCLUSION

Harike wetland is extremely important not only for its ecological benefits but also due to its rich biodiversity. But the wetland is heading towards extinction due to degradation of environment at an alarming rate. The lake has become a sink for industrial, agricultural and domestic waste which is brought by the rivers Beas and Sutlej. Studies have shown that water quality is unfit for consumption and contaminated to the level that it can cause deadly diseases. So, in order to save this wetland from extinction, measures should be taken to prevent pollution and insure proper restoration. More community based programmes like project Sahyog should be initiated to revive natural water resources and wetlands.

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