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IMPACT OF HUMAN ACTIVITIES ON LAKES: A CASE STUDY OF TWO MAJOR LAKES (NALSAROVAR AND THOL) IN GUJARAT, INDIA

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Gujarat State in India, comparatively less endowed with surface water resources (per capita water availability of 980 m³/year puts the State in water scarce category as per United Nations Criteria), has natural and manmade lakes occupying around 1746 sq.kms providing habitat to a variety of rare and endangered avifauna. As majority of these water bodies have multiple uses, they are experiencing severe anthropogenic pressures like intensive agricultural activities, water contamination due to use of fertilisers, pesticides, industrial effluents, oil spills, unregulated fishing, tourist influx etc. This paper seeks to describe the conflicts between the human and avian interests in two of Gujarat's most important lakes – Nalsarovar and Thol which have been declared as Protected Areas under Wildlife (Protection) Act, 1972. A series of recommendations have also been formulated to bring some harmony between the interests of avifauna and the human beings.

Anthropogenic Pressures, Agriculture, Water Contamination

IMPACT OF HUMAN ACTIVITIES ON LAKES: A CASE STUDY OF TWO MAJOR LAKES (NALSAROVAR AND THOL) IN GUJARAT, INDIA

INTRODUCTION

Wetlands are among the most productive and diverse eco-systems on the earth. Apart from being supportive to a great array of flora and fauna, they provide benefits to all forms of life including people, through hydrological and buffering functions. Maintenance of water cycle through ground water recharging, storage and water purification, agriculture, energy, water transport, gene banks, scientific research, recreation and education are some of the important functions of wetlands for people (Lopez & Mundkur ed. 1997).

Gujarat State, recently known world-over hit by the devastating earthquake, situated in Western part of India, has 6.39% of geographical area, 4.88% of population and just 2.28% of surface water resources of the country. Average per capita water availability of 980 m³ per year (1570 m³ in South and Central Gujarat and 414 m³ in North Gujarat) puts the State in 'water scarce' category, as per the United Nations criteria. An average rainfall of 25 cm to 200 cm with high coefficient of variance, skewed pattern of surface water availability, over-extraction of ground water, recurrent droughts etc. make it imperative to efficiently manage available water resources for irrigation and drinking water purposes.

The diverse physiography and vegetation have also made Gujarat important bird habitat with an avifaunal wealth of 454 species (Singh, 1998). Out of the 35 Protected Areas of India which have been specially notified for birds conservation, 6 are in Gujarat. The State also falls adjacent to the Indus flyway-highly used by birds migrating from their breeding grounds in the Palearctic realm (Grinnell et al, 1998). International Union For Conservation Of Nature And Natural Resources (IUCN), International Waterfowl Research Bureau (IWRB) and Bird International have rated this passage as the fourth major bird migration flyway in the world. The passage migrants passing through India to reach their winter haunts in Arabia and East Africa also use this flyway. Through this route migrants pass across various parts of State of Gujarat. It is also a State with strong sentiments of local people for bird protection and thus provide a safe refuge to avifauna. Of the total 2092 sq.kms of inland wetlands in Gujarat, the natural and manmade lakes occupy around 1746 sq.kms providing variety of benefits to both waterfowls and human beings.

As majority of these water bodies have multiple uses like irrigation, drinking water, fishing, hydroelectricity etc., they are experiencing severe anthropogenic pressures. This paper seeks to describe the conflict between human and avian interests in two of Gujarat's most important lakes - The Nalsarovar (350 sq.kms, one of the largest lakes in the country) and Thol (7 sq.kms.). Both have been declared as Protected Bird's Sanctuaries (Protected Areas-PAs) under Wild Life (Protection) Act, 1972.

FEATURES:

Amongst the aquatic flora, submerged rooted vegetation (*Ceratophyllum demersum*, *Hydrilla spp.*, *Vorticillata spp.*), free floating vegetation (*Eicchornia crassipes*, *Algae*) and rooted floating vegetation (*Ipomoea aquatica*, *Neptunia oleracea*) are mainly found. A study of zooplankton has revealed various planktonic forms belonging to Anthropoda, Protozoa, Coelenterate and Rotifera (WWF, 1999). Amongst the vertebrates, around 19 species of fish (*Catla catla*, *Labeo rohita*, *Cirrhinus mrigala*, *Heteropneustes fossilis*, *Barbus stigma* etc.) have been observed in these lakes, in addition to amphibians and reptiles like bull frog, marbled toad, rat snake, Indian flapshell turtle etc.

The Thol and Nalsarovar (interconnected through a waste weir), their associated irrigation tanks, wetlands and crop lands have a pivotal role, when considered from the point of view of water resources and bird conservation. These wetlands, cropland mosaic is a crucial alternative habitat as it provides multiple edges (eco-tones) for waterfowls. This factor is important as edges are known to increase diversity in aquatic as well as terrestrial ecosystems. Various habitat types which have been identified here are Deep open water habitat (DOW), Shallow open water habitat (SOW), Emergent aquatic vegetation (EAV), Muddy habitat (MH), Shoreland and island (SH), Cultivations in surrounding areas (CSA), Fallow lands in surrounding areas (FSA), Woodland habitat (WH). Each has been observed with high population of birds (Nalsarovar - more than 200,000 and Thol - more than 60,000) like Ruff (*Philomachus pugnax*), Common Crane (*Grus grus*), Sarus Crane (*Grus antigone*), Great White Pelican (*Pelecanus onocrotalus*), Greater Flamingo (*Phoenicopterus ruber*) and Ducks etc.

ANTHROPOGENIC ACTIVITIES AND THREATS

The following activities have been posing threats to the bird life and also to the human denizens living around these lakes:

a. Agriculture

Traditionally, small and marginal farmers belonging to backward communities have been drawing water from these lakes by flow and lift irrigation to grow paddy and other crops. Rapid decline in water depth and spread due to irrigation also reduces bird species' richness and abundance. Fertilisers and pesticides reach the aquatic ecosystems either through leaching or by way of run off from crop fields. Leaching of fertilisers containing nitrogen and phosphorous could cause eutrophication of these lakes leading to reduced species diversity, change in dominant biota, increased biomass, increased turbidity, high sedimentation and anoxic conditions ultimately shortening life span of water body or sometime mass mortality of one or more groups of fauna. Pesticides like DDT and BHL are known for their bioaccumulation effects (Mason, 1981). An additional effect is the thinning of eggshells of birds leading to low reproductive success (Timbrell, 1989). Studies on Sarus Crane in Gujarat (Singh and Tatu, 2000) have reported high concentrations of organochlorine pesticides (Aldrin etc.) in tissues and excreta, sometimes leading to mortality due to pesticide poisoning in this and other species of water fowls. Changes in agricultural practices in recent years around these lakes from food to non food (cash) crops and intensification of farming has reduced food availability for many species and has led to greater use of fertilisers and pesticides leading to overall degradation in soil quality and damage to habitat. Studies have already identified intensive farming as a threat for Sarus Crane much earlier (Gole, 1989).

b. Industries

Polluting industries like dyes, paints, pharmaceuticals, plastics, paper and packaging, foam, rubber, oil and metallurgical units etc. are found in the catchment areas of these lakes. According to a study (WWF, 1999) at least 32 such industries were reported in catchment of Thol Bird sanctuary. The system of canals and village ponds that connect Thol lake to its catchment, makes it even more vulnerable to harmful effects of pollution. Since North Gujarat is land locked with no perennial river systems, pollutants are generally disposed off on land. Very few of industries have facilities of effluent treatment and therefore the waters of lakes are gradually getting contaminated both by advection and diffusion. Industries are expanding further and good agricultural land is getting diverted to industrial use as the latter results in better price for the farmer. This process could lead to a perilous situation for the ecosystems of these lakes.

c. Fishing

Organised fishing activity (8 fishing cooperatives on the periphery of Nalsarovar) and the practice of catching fish without observing regulation of net size and fishing season is resulting in overall depletion of fish stocks and ultimate reduction in availability of food for piscivorous avifauna - Great White Indian Pelican, Storks, Egrets, Herons etc. as most of the species consume small size fish. Practice of using fishing nets for poaching has also been reported (GEER, 2000).

d. Oil Drilling

There are seven oil wells belonging to the Public Sector Corporation Oil and Natural Gas Commission inside the Thol Bird Sanctuary area which are actively drilling oil and transporting the same through pipeline. Occurrences of oil spills are not uncommon (Singh, 1998). These may have following impacts on physico-chemical as well as biological environment of the lake:

1. Damage to birds and mammals would result from smothering which would lead to fatal cooling and drowning as well as suffocation of insects that need to come on the surface to breathe, the oil film obstructing this process (Jeffries & Mills, 1990). This would also affect the fish and food chain of the lake.
2. The oil film may also reach the crop fields along with irrigation water affecting agricultural ecosystems.

e. Tourism

Tourist influx and activities have been reported to have caused disturbance to birds and have also prevented roosting birds from landing.

f. Live stock Grazing

Buffaloes, sheep and goats have been found to be wading and wallowing inside these lakes causing disturbance to incubating birds.

RECOMMENDATIONS

In India Protected Areas have been created chiefly to protect special floral, faunal or geomorphological values of any site. Creation of any sanctuary leads to curbing of many human activities, which have been taking place historically, to further wildlife interests. This obviously hinders human interests. Yet, human dimensions have been ignored or overlooked in creation of many PAs of the country. Neither the Wildlife (Protection) Act, 1972 nor any amendments made in it later, clearly spell out the problems that could arise owing to its use (past/present/future) by human denizens residing within or around any PA. That is why many PAs in the country exist only on paper. These lakes are peculiar example in this regard as they have also existed as irrigation tanks before being declared Sanctuaries. Because they were good bird habitats attracting myriads of resident and migratory waterfowl, they were declared bird Sanctuaries. This move gave rise to a conflict

between human and avian interests and subsequently between the two concerned Government Departments. Following recommendations have been formulated with this background in mind.

1. An independent body-Lakes Development Authority, should be set up, drawing representatives from Forest and Irrigation Departments of the State Government, local village and NGO representatives, prominent ornithologists and/ naturalists for taking decisions considering widest range of interests and ensuring interdepartmental coordination for management of multiple use water bodies. The rights and privileges concerning use of water and land in and around these lakes should be settled as an immediate priority by the aforesaid authority in order to mitigate the problems related to human disturbances to their ecosystems.
2. Catchment areas of these lakes need soil and water conservation measures like planting of native tree species and grasses along the ravines and nullahs and also rain water harvesting through check dams, percolation tanks, ponds etc. This will reduce silting of these lakes, increase ground water recharge and green the catchment.
3. Presently, there are no guidelines or regulations on the type of industries that could be set up in catchment areas of lakes. Immediate policy measures are required to be taken on following lines:
 - No more hazardous industries should be set up in catchment areas of these lakes.
 - No agricultural land in catchment areas should be allowed to be converted for industrial development. These are productive areas and industries would only bring pollution and other socio economic problems.
 - The existing industries should be compelled to treat their hazardous effluents before releasing them. Gujarat Pollution Control Board (GPCB) appears to be dormant and Forest and Irrigation Departments need to intervene and force the GPCB to take some concrete actions against polluting industries.
 - All the oil wells located in these areas should be monitored regularly to check for oil spills or leaks.
4. A ban or regulation on the use of pesticides, particularly the organo-chlorine pesticides (Aldrin, BHC, DDT etc.) should be made effective. Use of less damaging pesticides such as malathion and parathion which degrade biologically should be encouraged by the extension workers of the Agricultural and Rural Development Departments. Similarly, the use of nitrate based fertilisers should be controlled and phosphate based fertilisers should be promoted. Popularising organic farming is obviously the best alternative but active propaganda and Government help would be crucial to its acceptance by farmers at large.
5. Unregulated fishing constitutes a threat to birds. Ideally fishing should be completely stopped and those engaged in this activity should be absorbed in other employment generation programmes of the Government. As an interim measure regulation of mesh size and the observation of fishing season should be adopted.
6. Skill upgradation and employment generation activities for backward communities around lake areas and synergies with existing programmes for integrated rural development would gradually make them less economically dependent on these ecosystems. In particular, the 'Padhar' community which catches and sells fish should be given financial support to raise inland and sweet water fish in a more scientific way which can take away the load from the lake.
7. Tourism is an important activity as it can generate positive public opinion about these bird sanctuaries and at the same time provide employment to local people and also involve locals in birds conservation efforts. However, regulation in number of tourists, fixation of tourist timings and season (October to February) in addition to preparation of high quality IEC (Information, Education and Communication) material and provision of orientation desk and bird watching hides and prohibition of littering around lakes, are some steps which are required for promoting eco-tourism and public awareness.
8. A research and monitoring facility should be set up that would carry out continuous studies on physico chemical parameters, avifauna and anthropogenic activities in lake areas which would help in evolving better strategies of conservation.
9. The fact that these two lakes form part of the most important wetland habitats of the country and that in terms of total birds population and assemblage of rare, vulnerable, threatened or endangered species they meet the criteria laid down by the Ramsar Convention, there is every reason to propose them to be declared so. This would bring more resources and benefit the bird conservation efforts.

CONCLUSION:

These lakes pose a dilemma. They present a conflict between human and avian interests at first sight (superficially), but if one goes in depth, it is a conflict between our old and new values. It is a conflict reflecting our changing attitudes. It is also a rural-urban conflict in one sense (WWF, 1999). The needs of birds and our needs are basically the same – clean air and water, adequate food and safe dwelling. Water is a common need for all life in these lakes, be it human or otherwise. The solution probably lies in the fact that our needs and theirs are the same, only levels are different. Sacrifice is needed at times, tolerance is certainly needed at all the times. These lakes must have a great volume of clean water for as long as possible and this is only in our hands. Political will, people's support and wise perspective planning might change the situation.

