ANALYSIS OF WATER PARAMETERS AND ECOLOGICAL HEALTH OF CHATREE LAKE BASIN, AMRAVATI, INDIA

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ABSTRACT

Water crisis is one of the greatest environmental challenges that India is currently facing. Since the 1980s lakes and rivers in India have been undergoing increasing water deterioration. By the 1990s some main water basins have been seriously polluted causing related ill effects. Chatree Lake is one of the significant water basins of Amravati area since British Empire. However at present it becomes one of the most polluted lakes in Maharashtra, India. The present research paper focused over the water parameters, plant wealth, and sources of deterioration and ecosystem health of Lake Basin. Beside that the study also highlighted the basic reasons causing water deterioration, including natural and human-made factors. The observation revealed that the lake basin increasing their capture area especially during rainy season, on the other hand decreasing the depth due successive siltation and eutrophication. The paper argues that there is serious and urgent need of proper governance and restoration of Chatree Lake. The ecosystem needs a comprehensive policy and governance model at a regional and provincial level for its sustainability.

Keywords: *Lake Ecosystem, Pollution, Siltation, Sustainability*

Introduction

Lakes are one of the significant fresh water bodies present on the earth surface. Lacks serve as an important life support system which not only recharge and regulate the hydrological regime but also plays significant role in water table maintenance (Jadhav and Khare, 2008). The lakes act as a potential habitat of many aquatic birds and represent significant network of tropic levels. Thus, many lakes around the world are favourite bird watching destinations. The lakes of India act as a warm habitat for many migratory birds during winter. Lakes have great aesthetic significance, attracted peoples since historical time for worship as well as recreation. Kailash Mansarowar is a popular pilgrims spot for the people of India, Tibet and the neighbouring countries from centuries (Ranade 2007).

Today lake tourism provides significant economy to the related nations. Several European countries which have great lake potential and appropriate tourist infrastructure, creating good economy through lake tourism. Since 1980^{s} India also develop lake tourism as a revenue generating industry. Beside that of water supply under ecotourism, lakes provide bird watching, water sport, fishing and boating facilities to the tourists. The demand of lakes for economic gains has contributed to the deterioration of water quality, biodiversity and aesthetic values of the lakes (Zurick, 1992). Since the commencement of tourism the values of lakes as well as the other water bodies is dwindling. Due to override urban lake use pattern the catchment area of the lakes are reducing in terns, decreasing the water level of the lake Hadwen, *et al*., (2012). In most of the cases lakes have been use as dumping grounds for effluents of domestic, industrial as well as agricultural runoff. Lakes at hills station, losing their natural habitat due to tourist activity as well as tourism development The rapid population growth, industrialization, mining development, over extraction and tourism have disturbing the lake ecosystem resulted into loss of biodiversity, eutrophication, proliferation of

invasive weeds, siltation and toxic contamination (Shang and Shang, 2005). According to MEA (2005) the healthy lakes should have clean water, free of algal blooms, suitable for water supply and recreation and rich biodiversity.

Study area

Chhatri Lake is one of the oldest, manmade lake of Amravati jurisdiction areas. The lake is situated south- east of city on 20.53^0 north latitude and 77.47^0 Waste longitudes. The lake brought under construction by the English rulers in 1888 for emergency water demand of that time. The lake is distributed over 73.90 hector land area and has about 5.34 square miles catchment area. The maximum water holding capacity of the lake is of about 5 million gallon. The catchment area of the lake receives average annual rain fall is of about 7.9 inches. The lake fulfilled the water demand of the city from last 1890 to the early 1990. Recently the lake is handover by Municipality to a private agency and developed as a picnic spot.

Ecology and biodiversity of Lake catchment area

Ecologically Chhatri Lake is one of the significant ecosystems and plays a significant role in the surrounding area. The watershed deposits of the area shows luxurious growth of wetland herbaceous flora including *Sutera dessecta, Glinous lotoidis, Heliotropium supinum, Vicoa indica, Diagera muricata, Cleome gynandra, Cyperus rotundus, Euphorbia hirta, Bacopa, Indigofera linifolia, Goniogyna hirta, Echinops echinatus, Andrographis falcata, Orthosiphon, Exzcum bicuspidatum, Tricodesma zeylanica, Peristrophae bicaliculata, Papaver somniferum, Polygonum plebejum, Solanum xanthocarpum, Ipomoea aquatic etc.*

The area also favours some shrubby and tree species like *Gymnosporia montana, Accacia chundra, Acacia hirta, Ziziphus jujuba, Plumbago zeylanica, Gloriosa superba, Phoenix silvestris, Combritum ovalifolium etc. Butea monosperma, Dyospirus, Bombax pentandra, Acacia nilotica, Azadiracta indica, Buchnania lanzan, Grevia pestifolia, Moringa stricta, Erythrina stricta, Cordia dichotoma, Aegele marelos, Calatropis procera, Madhuca indica, Semicarpus anacardium, Capparis zeylanica, Syzygenum cumnium, Ficus racemosa, Terminalia chebula,* and *Terminalia bellarica.*

The aquatic flora of the lake consist of the submerged plant like *Hydrila, Valisnaria, Potamogeton, Ceratophylum, Najas*; whereas, the rooted floating plants include *Pestia, Woolfia, Lemna,* with several green and blue green algae. The wetland flora shows *Cyperus, Bacopa, Polygonum, Trapa and Ipomoea aquatica*. The fauna of lake include several worms, Insects, Fishes, Molluscs, Zooplankton, Amphibians, and Reptiles.

The overall flora of the lake favours the colonization of different local birds as well as some migratory birds from long distances. The local faunal diversity include *Psittacu lakrameni* (rose winged parakeet), *Eudynamyss clopacea* (Asian Koyal), *Bubo bubo* (Eurasian eagle owl), *Athene brama* (Spotted owlet), *Carprimulgus asiaticus* (Common Indian nightjar), *Apus affinis* (House swift), *Meropsori analis* (Small bee eater), *Alcado atlhis* (Small blue kingfisher), *Dinopium benghalense* (Wood peaker), *Eremopterix gresea* (Ashy crowned sparrow lark), *Galerida cristata* (Common crested lark), *Hirundo smithi* (Wire-tailed swallow), *Hirundo daunica* (Red-romped swallow), *Acrido threstristis* (Common myna), *Clamptor jacobinus* (Pied crested-cookoo) etc.

Since last two decades as the city imparted its boundaries and the living standard becomes increased, the lake area also gaining extra burden of different mane made activities. The tourist activities including boating, industrial effluent discharge, dumping of idols and worship litter, grazing and illegal fishing along lake disturbed the overall ecology of the lake. As

the lake presently comes under private supervision, there is nothing to say about the maintenance and conservation strategies.

The present study takes an overview of water parameters and ecological status of Chhatri lake ecosystem. The study also tried to emphasize the pollution sources, impact of tourism and highlighted the challenges ahead.

Review and Literature

From the literature survey it was observed that, the investigation on status of Lake Ecosystem as well as tourism is the popular topic of research.

According to Borocoz, (1996) the mass involve in tourism and its concentration on space and time has obvious effect on the economic, environmental, and natural factor of the ecosystem as well as people involve in tourism. The effect of tourism activities on the macrophytes of the lake ecosystem from the different areas have been worked out by Suclthrope (1967). Anonymous (1998) carried out lake analysis from different parts of the world in relation to tourism lake water becomes highly nutritious which favours colonization of the weeds.

Hadwen, *et al*., (2012) detected the effect of tourist activities in the Littoral Zones of Oligotrophic due to lakes in Australia. According to them intensive recreational use of Oligotrophic Lake can lead to increase in nutrients concentration and development of undesirable algal blooms. Shrestha (1999) investigated the management of water bodies and wetland in an urban area of Nepal According to the studies the tourist activities establishes water pollution and sedimentation in Lake. He advised that to extend the life span on the ecosystem its cleanliness is important.

Ranade (2007) carried out overall survey of same major Lakes of India in relation to tourism. She concluded that a variety of environmental growth and service provided by lakes make them vulnerable to human demand. Society demands for economic gains have contributed to the deterioration of water quality and aesthetic values of lakes. Delan (2012) made a case study of Rudrasagar lake Tripura and concluded that conservation of natural resources through sustainable development is the key to our secured future. Apart from governmental regulation, better monitoring of physical chemical and biological characteristic with proper understanding of wetland dynamics could be conserved wetland ecosystem. Mirsanjari, *et al*., (2008) investigated the importance of Lakes potential for development of ecotourism in Pune district. According to the recommendation given by their work the stakeholders undertaken the sustainable tourism and generate much employment areas.

Thakare and Kadam, *et al*., (2004) studied that the pollution of fresh water is one of the most serious environmental problem for the lake serve as a source of drinking water to the majority of population. Khare and Jadhav (2008) carried out the water quality of Katraj Lake of Pune and suggested the means to improve through eco-remediation measures.

Shirbhate, *et al*., (2011) studied the physicochemical parameter of Chhatri lake water, before and after immersion of Ganesh idols. Their study reveals that, immersion of idols becoming serious environmental issues. Kukde and Warhekar (2010) worked the avifaunal diversity of Chhatri Lake, and stated that the ecosystem has good potential of aquatic habitat. Manvar, *et al.*, (2012) investigated the diversity and abundance of Dragonflies and Damselflies of Chatri Lake catchment area. According to them the biodiversity of the Lake as well as the organic potential of the Lake maintain the tropic status.

The cited literature reveals that Lake is a potential fresh water ecosystem having good biodiversity as well act as a sustainable habitat. As far as Chatri Lake is concerned the water quality assessment as well as biodiversity has been worked out

earlier but the status of lake related to anthropogenic activity is steel waiting.

Materials and Methods

Frequent surveys were made for the investigation of ecological status of lake and the tourist activities during the month of December to April 2013. In the stipulated period the investigation were carried out according to the following plan.

- In the first phase of investigation the overall area of lake as well as its surrounding was minutely explored.
- Floristic exploration was carried out by frequent visits to the site and species identification were done with the help of authentic floras and related expertise.
- Similarly aquatic flora was also analyzed with respect to their habitat.
- The bird fauna was studied by frequent visits along with bird watchers.
- In the second phase of investigation the period of tourist crowding were observed and overall activities monitored throughout the day.
- The observations were documented in relation to tourist vehicles, their enjoyment food accessories and recreation in field diary.
- The sources as well as status of pollution were monitored.
- The water samples were collected from different sites of Lake area as well as from its sources.
- Photographic data were also collected from different sensitive area of the lake.
- The consequences of tourist activity on the water quality, flora and fauna, surrounding vegetation as well as overall status of lake were observed and notified.
- In the final phase of investigation, the observations were analyzed and some conclusions regarding to the present status, future picture and the necessary conservatives aspects were put forward.

Observations and Results

The investigation mainly focused on the developmental activities, tourist activities, idol dumping and related consequences on the status of Chhatri Lake as an ecosystem. The observed data is classified as fallowing.

Tourist impact

It was observed that during holidays the area remains noisy throughout the day. In an average 50 four wheelers and 200 two wheelers get parked out in the vicinity of the lake. The tourist throws their food waste, snacks wrappers, fruit waste, and ice-cream pouches in the lake area. Tourists also used snacks during boating and throw the wrapper in the lake water. Tourists gathering around the lake for boating make soil hard and disturb the ground flora. As the spot comes under private jurisdiction the developmental activity degrading the Lake natural beauty.

Soil erosion and siltation

Soil erosion in the catchment area of the lake is one of the important factors which are decreasing the depth of the lake. The developmental activities and grazing around lake exposes the surface soil which becomes the silt through surface run off. As lake is rain fed type it receives lot of soil during rainy season and causing siltation. According to Delan (2012) siltation along with organic pollution increases the nutritional status of lake which in turn becomes the cause of eutrophication.

Loss of vegetation covers

It was keenly notified that, expansions of lake vicinity for tourism and infrastructural development disturbing the catchment flora. During the study it was observed that lot of tourist made tracking around lake area which not only disturb the ground vegetation but also causes fragmentation of shrubs and trees. It was also observed that the lake authority and commercial stake holders made illegal construction by destroying nearby vegetation. Due to extra

siltation the exotic weed like *Ipomoea fistulosa* invading their population and suppressing the earlier colonization of species. Grazing and fuel wood collection along lake vicinity also destroying the vegetation.

Eutrophication

The deposition of organic matter naturally through surface run off, dumping of aesthetic waste as well as waste through tourist activities increased the nutritional status of the lake. In the study area it was observed that increase in nutritional status as well as siltation decreased the water level and depth of the lake. The organic waste favours the bacterial growth and impart the nutritional level which in turned favoured the growth of several weedy species such as *Hydrilla, Valisnaria, Potamogeton, Ceratophylum , Najas*. Beside that some rooted floating plants including *Pistia, Woolfia, Lemna*, with the bloom of green and blue green algae shows their crowding over water surface. The wet land flora associated along the shoreline shows healthy growth of *Cyperus, Bacopa, Polygonum ,Exacum. Blumea, Polygonum, Hygrophyla* and *Ipomoea*. The fauna of lake includes worms, Insects, fishes, molluscs, zooplankton, amphibians, reptiles etc. Such a tropic development would be the initiative of succession and ultimately loss of ecosystem. Eutrophication considered being the major parameter of poor water quality (Delan, 2012).

Fishing

It was also observed that, along lake area lot of illegal fishing is carried out, which is not only disturb the tropic parameters but also impart turbidity of the Lake.

Water quality status

During investigation, physico-chemical analysis of water was done to analyze the potentiality of the lake water quality parameters. Water samples collected from different sites **(Spot-I, polluted site; spot – II, wet land; Spot-III, deep water)** of study area according to the standard method. The analyzed data compared with the standard data and used for conclusions (Table)

Table 1: Physico- chemical parameters of Chhatri Lake.

Sr.No.	Parameters	Spot-I	Spot-II	Spot-III
1	Temperature	22^0C	21^0C	24^0C
2	Color	Muddy	Muddy	Muddy
3	pH	8.2	7.8	7.9
4	Total Dissolve Solid	1080 mg/lit	400 mg/lit	1400 mg/lit
5	Electrical Conductivity	319 mmho/cm	312 mmho/cm	313 mmho/cm
6	Turbidity	12 NTU	7 NTU	5 NTU
7	Total Hardness	304 mg/lit	324 mg/lit	284 mg/lit
8	Calcium Hardness	41.68mg/lit	44.88 mg/lit	41.68 mg/lit
9	Magnesium Hardness	262.31 mg/lit	279.11 mg/lit	235.31 mg/lit
10	Alkalinity	172 mg/lit	140 mg/lit	128 mg/lit
11	Chlorides	112.18 mg/lit	126.89 mg/lit	129.22 mg/lit
12	Dissolve Oxygen	6.2 mg/lit	6.4 mg/lit	9.6 mg/lit
13	BOD	50 mg/lit	62 mg/lit	79 mg/lit
14	COD	32 mg/lit	36mg/lit	84 mg/lit
15	Phosphate	0.80 mg/lit	0.22 mg/lit	1.0 mg/lit

(Spot-I, polluted site; spot –II, wet land; Spot-III, deep water)

Fig.1. Chatree lake basin

Fig.2. Dumping of religious idols

Fig.3. Algal Blooms in the Lake area

Fig.4.Eutrophication due to organic deposition

Fig.5.Siltation through catchment and grazing

Fig.6. Weed encroachment

Discussion and Conclusion

The investigations on water analysis and ecological status of Chatree Lakes revealed that**,** the lake is deteriorating its ecological health day by day. In most part of the world anthropogenic impacts on lake caused its qualitative and quantitative disturbances (Pandey 1993). Similarly due to increased tourism, Chatree Lake quality as well as quantity is deteriorating. The tourist activities as well as other related anthropogenic activities threatening the natural sustainability of the lake. The calm and quite area of the lake showing nuisance of air, noise as well as water pollution, The organic deposition creating Eutrophication which should be the alarm of loss of ecosystem imbalance. Similar observations was also made by Ranade (2007) related to several lakes in India. Manwar *et al.* (2012) while working on the same lake already mentioned that the lake is rich in

Dragonflies and Damselflies which is the sign of Eutrophication. The plastic waste depositions in the lake vicinity as well as in lake water are disturbing the lake biodiversity as well as the soil fertility. According to Verma *et al*. (2008), the solid waste deposition in the corridor of Rana Pratap Sagar Lake at Jaipur declining the biotic potential and increasing the growth of weedy flora. The present study also got the similar observation. The dumping of POP idols imparted the pollution level and decreasing the taste and odour of lake water. This result of the present investigation supported by the study of Shirbhate *et al*. (2012) related to same site.

The continuous developmental activities with respect to increasing tourist flow already disturbed the natural framework of the lake as well as the nearby vegetation.

The overall tourist activity related to Chatree Lake disturbing the water quality through various ways. A large number of pollutants can imparts taste and odour to the receiving water, thus, unfit for domestic consumption, the changes in oxygen, temperature, and pH affected the chemistry of water which may trigger the formation of unwanted products. Abraham Susheela, (1980) while working on lake analysis concluded that the man made dumping interfere the chemical parameters of lake water. If the lake remains continue with such a devastating exposure then it will become a environmental issue. Thus in order to protect water bodies from the foregoing threat, mass public awareness is needed. Beside that pollution control authorities, Municipal Corporation and local people should work hands in hand to combat against the dwindling health of Chatree Lake.

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