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Water Quality Management of water resources of Bhopal City: Challenges and scope

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Abstract

Water has been the epicenter of human civilizations since the very beginning. Mankind needs water for drinking, irrigation, industrial, navigational and many other uses. With the advancement of time, the dependence of mankind on water has increased many folds. Rapid urbanization, rise in human population, increased industrial uses and wastage of water has resulted in increased water demands. Further the increased environmental pressures on the water resources has resulted in degradation in the water quality of these already scarce water resources, thereby further worsening the water availability scenario. Bhopal, the capital city of the state of Madhya Pradesh in bestowed with a large number of lentic water bodies scattered in its undulating landscape. Once a medium sized town, Bhopal always boasted of plentiful availability of water and water shortage was unheard of a couple of decades ago. However rapid urbanization in the city in past few decades has resulted in an unprecedented rise in the water demand of the city. Further the rise in population has also resulted in increased waste production, which in turn has affected the quality of the water resources in the city. At present the city depends upon Upper Lake, Kolar reservoir and River Narmada for the supply of potable water but that too is proving insufficient to cater the ever increasing demands. This has resulted in the need of probing into alternate sources of water for the city. Though the city has large number of water bodies in and around it which hold considerable amount of water capable of sufficing the immediate need. As these water sources are not used for potable purposes as yet, they often face neglect and are therefore subjected to various anthropogenic pressures resulting in degradation in the water quality of these water sources as depicted by the high concentrations of pollution indicating parameters like BOD, COD, nitrate, phosphate etc. The present study encompasses the study of water quality of some of the most important water resources of the city, identify the environmental problems associated with them and suggest mitigative measures thereof.

Keywords: Water quality, management, water resources, challenges, scope.

Introduction

Water is the key to life. All life on the planet earth is sustained by water. Though a significant portion of the earth's surface is covered with water. However the amount of freshwater which is the usable form of water is relatively a tiny portion of the total water availability. Freshwater is present in rivers, lakes, streams and ponds. These water resources have been the epicenter of human civilization since its dawn. However with the availability of freshwater for usable purposes is decreasing on account of over exploitation due to increasing demand and deteriorating water quality of the water resources on account of increased anthropogenic pressures on the water resources.

Bhopal the capital city of Madhya Pradesh is home to a large number of lentic water resources including the famous Bhoj Wetland, the maiden Ramsar site of the state. Despite having a large number of water bodies in and around it, the city witness decreased water supply, specially during the drier months of the year. The water quality of the water resources which are not used for potable purposes is often neglected hence the water of the water bodies is unfit for human uses. However if proper management practices are adopted, the water quality of these important water resources could be maintained to a level that if required, they can be used for potable purposes. The present paper deals with the management of water quality of some important water resources of the city, existing challenges in doing so and the opportunities these water bodies present if management practices are adopted.

Material and Methods

Bhopal is popularly known as the city of Lakes. Bhopal gets this distinction because of a large number of lakes, tanks and ponds in the city. The city is relatively away from a dependable perennial lotic water source; hence the administrators had to construct ponds and reservoirs in order to cater the needs of the city. The most significant of these is the 1100 years old Upper Lake or the *Bada Talab*. This is the maiden Ramsar site of the state and is therefore a water body of global significance. Apart from the Upper Lake, the city boasts of more than 18 water bodies in and around its municipal limits. Some of these water bodies are relatively small and cater to local needs. However, some of the reservoirs in and around the city are large with

sufficient storage capacities to cater the local demands of water. Most of these reservoirs have been constructed for irrigation purposes and are designed to capture the runoff generated in and around the city. Most of the reservoirs were constructed at places away from the settlements of the city, but due to unprecedented expansion in population and city limits of Bhopal in past few decades, these reservoirs have come well within the urban sprawl. The effects of urbanization are being seen on the water quality of these important aquatic resources. The disposal of municipal liquid and solid waste into the water bodies, direct human intervention, cattle intervention etc. are some of the detrimental factors responsible for the deterioration in the water quality of these reservoirs. The present study has been designed to study two important aquatic resources with respect to their water quality issues, possible management measures so as to ensure their optimum utilization. These include: i. Kaliasot Reservoir: The Kaliasot dam was constructed, as a storage reservoir near the WALMI, Bhopal and its tail end is the downstream of the Bhadbhada spill gates of the Upper Lake. The name of the Kaliasot derived from the name of KalyanStrote, the one of the minister of Raja Bhoj, who had developed spillway of Upper Lake and now known as Kaliasot. The reservoir presently serves the purpose of irrigation water supply. ii. Kerwa Reservoir: Kerwa dam was constructed in the southwest corner of Bhopal city with an objective to store water for irrigational and different uses. The reservoir is a famous tourist spot of the city and is therefore frequented by a large number of persons especially during the weekends. The reservoir supplies irrigation water to the agricultural fields located in its proximity.

Sample Collection: A survey of reservoirs under study was carried out and ten sampling points were fixed in each of the reservoirs so as to represent the water quality of the entire reservoir. Both the reservoirs covered under the study were considerably large ones and therefore possess different water quality characteristics depending on the immediate catchment and activities on the fringes. Samples were collected from the identified sampling stations using standard sample collection techniques and were then analyzed for important water quality indication parameters.

Frequency: The water quality of lentic water bodies is greatly influenced by the seasonal changes. Variations in the ambient conditions like temperature, wind velocity, light intensity etc. has direct effects on surface water. To ensure the effect of these seasonal variations in the present study, samples were collected in different seasons. The tropical climate of Bhopal has four distinct seasons i.e. winter, summer, monsoon and post monsoon. Hence, after the survey and identification of sampling stations, the samples were collected during these four seasons.

Results and Discussion

Kaliasot reservoir: The detailed investigation of the water quality of Kaliasot reservoir reveals that the reservoir possesses moderate water quality. The near neutral to mild alkaline range of pH observed in the Kaliasot reservoir (7.4 to 8.9) indicate that it is a productive water body (figure- 1). Moderately high vales of physical parameters like colour and turbidity indicate that the water body receives suspended and colloidal particles from its catchment. During the present investigation, the concentration of dissolved oxygen has been found fluctuating between 4.8 mg/l to 12 mg/l which indicate satisfactory water quality. Concentrations of other important water quality indicating chemical like total hardness, calcium hardness, total alkalinity and chloride were recorded fairly low, indicative of the acceptable water quality of the reservoir. Moderate concentrations of nitrate (0.76 mg/l to 3.14 mg/l) (figure- 2) and inorganic phosphate, two of the most significant inorganic nutrients and pollutants in inland water bodies indicate the moderate water quality of the reservoir. During the present investigation, high concentrations of BOD ranging from 1.8 mg/l to 26 mg/l and COD ranging from 8 mg/l to 84 mg/l were found in water samples of Kaliasot reservoir (figure-3 and 4). Padamanabha and Belagali[1] studied the water quality and pollution load of lakes in Mysore city and found that water quality of these lakes is deteriorated severely as a result of inflow of domestic sewage and the water is unfit for human consumption. The most significant challenges pertaining to the water quality include silting from the catchment area, weakening of earthen dam, direct human intervention, idol immersion, inflow of treated nutrient rich effluent of Kotra STP etc.

Kerwa reservoir: A detailed investigation of the water quality data of Kerwa reservoir reveals a moderate water quality status. The pH in the water body was recorded in the mild alkaline range (7.2 to 8.9) (figure- 5). Chaurasia and Pandey[2] also reported that the low pH during monsoon is due to inflow of fresh water, lowering in temperature and decomposition of organic matter. The primary production in the lakes brought about the aquatic autotrophs uses up the free carbon dioxide in water, there about bringing the pH in alkaline range. Besides the reaction of carbon dioxide, organic and inorganic solutes present in water also affect the pH value of water bodies. Any variation in pH of water may influence other physico-chemical parameters[3]. Relatively high values of transparency coupled with lower values of colour, turbidity and total suspended solids depict that the physical impurities viz., suspended and colloidal solids are also less in the reservoir, thereby indicating lesser degree of allothounous additions. Similarly, lower concentrations of other chemical parameter indicate lesser degree of chemical contamination. The concentrations of nitrate (0.68 mg/l to 1.36 mg/l) (figure-6) and inorganic phosphorous (0.31 mg/l to 0.99 mg/l) were recorded in moderate range. Water quality of different water bodies, eutrophication and effects of pollutants on aquatic ecosystem were also studied by Mills et al[4] and Paerl[5]. Excess application of fertilizers, oxidation of nitrogenous waste and nutrient rich effluent from sewage treatment plants are the major sources of nitrates in

water[6,7]. The concentration of BOD varied between 1.4 mg/l to 15.6 mg/l, while that of COD varied between 4 mg/l to 52 mg/l (figure- 7 and 8). This also indicates the moderate water quality of the reservoir. The major challenges to the existing water quality of the water body includes direct human intervention, change in land use/land cover, agriculture in the submergence/fringes, siltation from catchment etc.

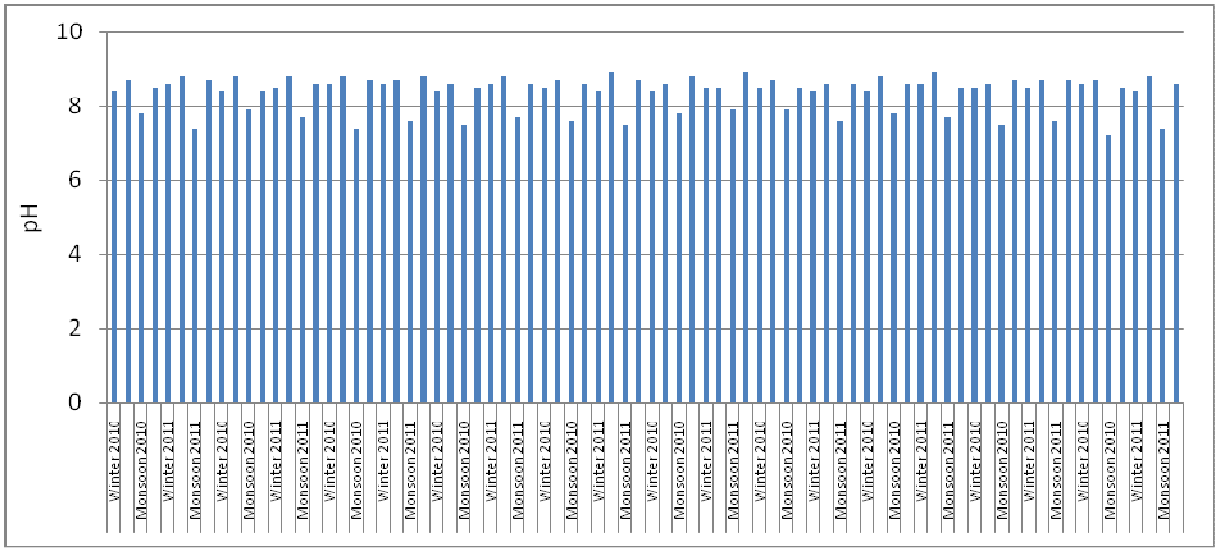

Figure-1
Seasonal variation in pH at Kaliasot reservoir

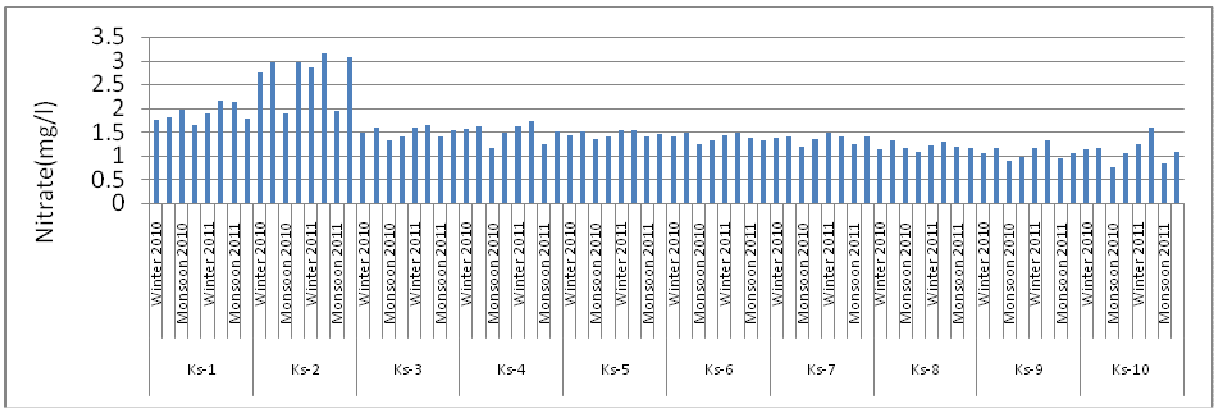

Figure-2
Seasonal variation in nitrate at Kaliasot reservoir

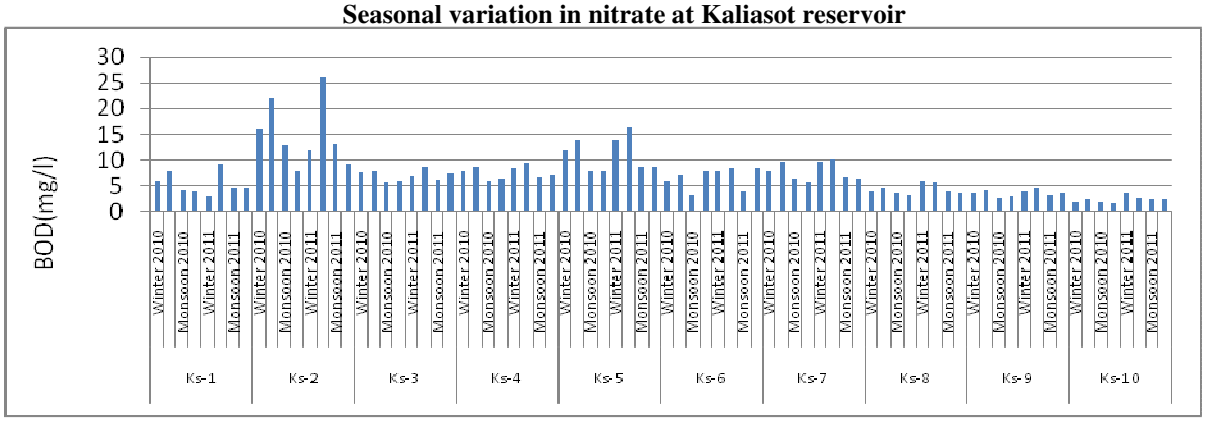

Figure-3
Seasonal variation in BOD at Kaliasot reservoir

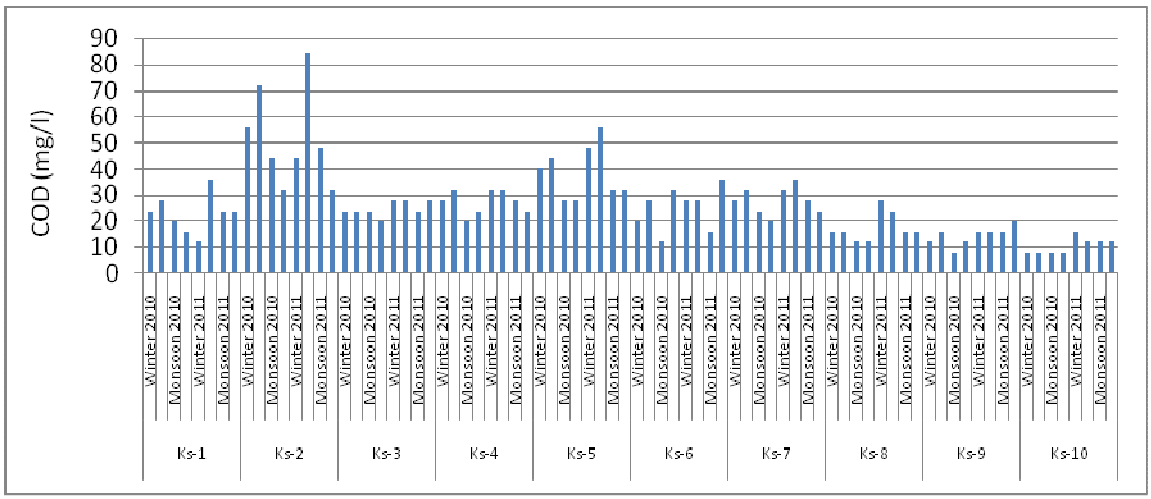

Figure-4
Seasonal variation in COD at Kaliasot reservoir

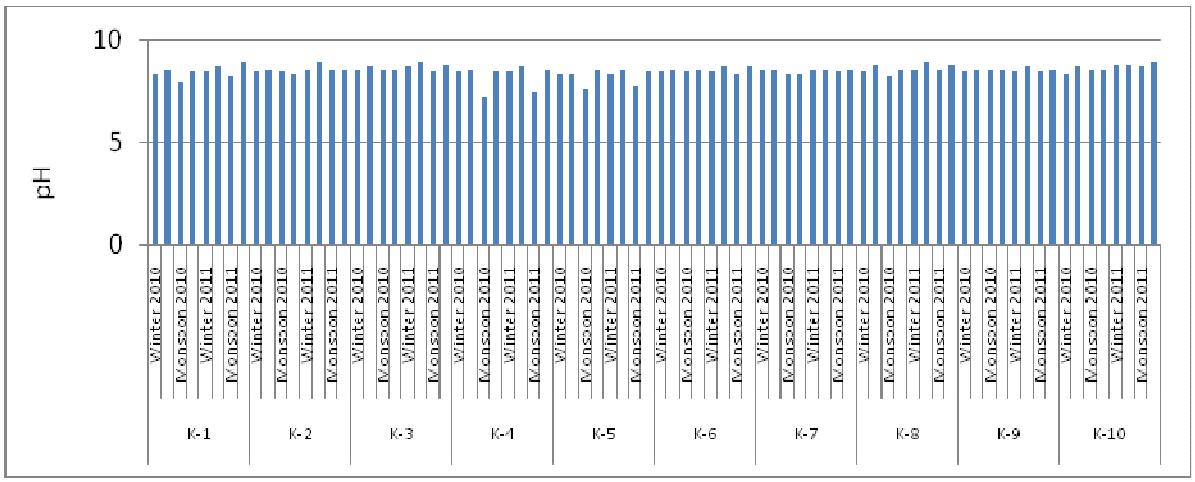

Figure-5
Seasonal variation in pH at Kerwa reservoir

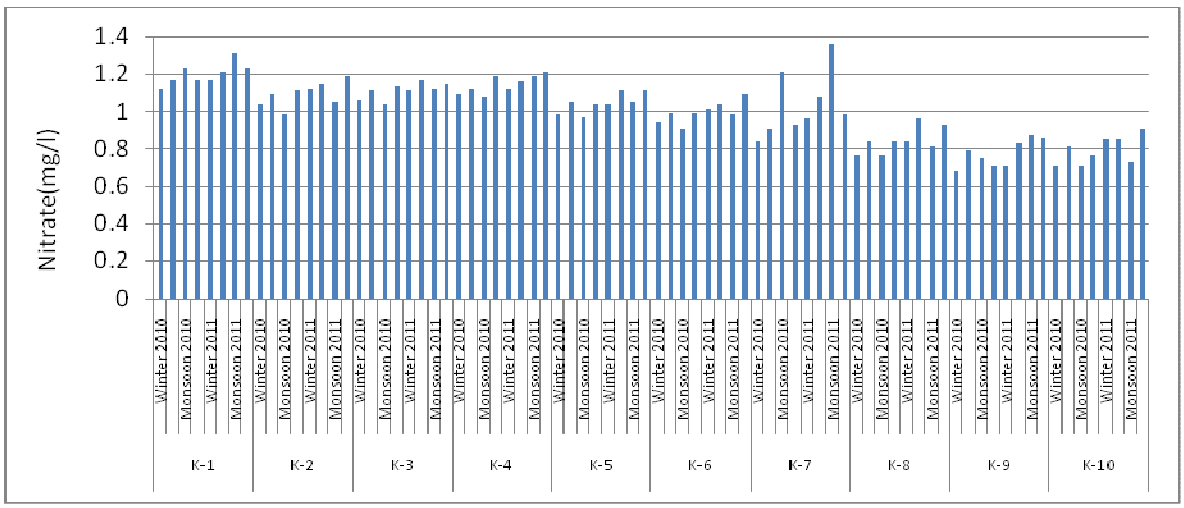

Figure-6
Seasonal variation in Nitrate at Kerwa reservoir

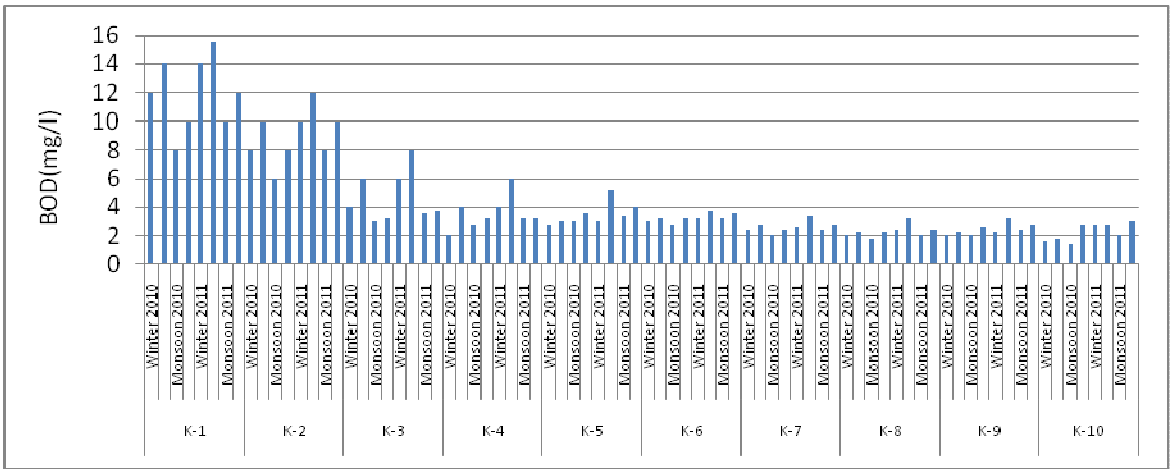

Figure-7
Seasonal variation in BOD at Kerwa Reservoir

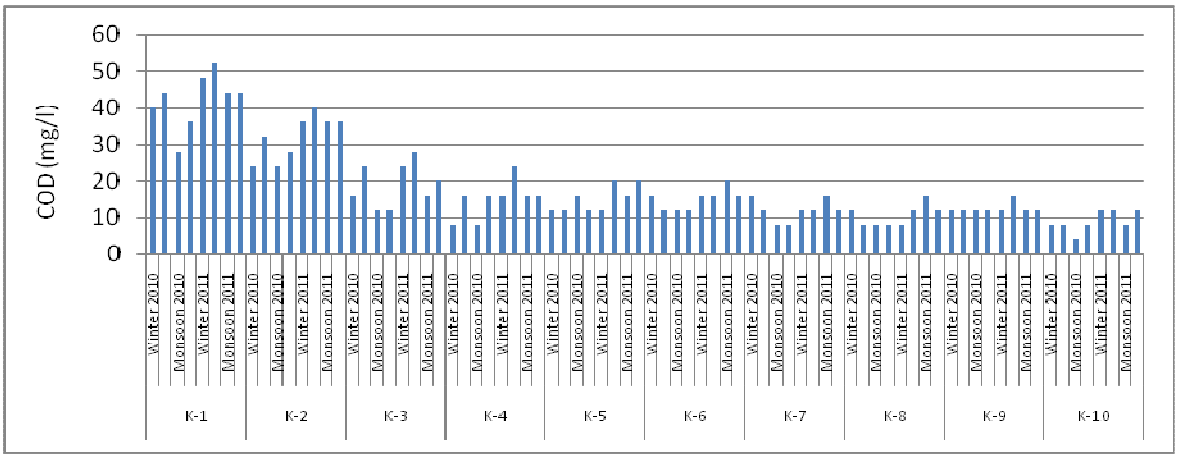

Figure-8
Seasonal variation in COD at Kerwa reservoir

Conclusion

The present study reveals that the water quality of Kaliasot and Kerwa reservoirs satisfies the norms of potable water source and thus the water could well be used for potable purposes. The environmental problems associated with these reservoirs could very easily be tackled without much capital expenditure. However, the water quality of these important water resources is being degraded due to a number of factors. Though, if proper management of water quality is adopted, the water bodies could be used for a befitting use.

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