Assessment of water Quality, Rejuvenation and Restoration of lakes in Nagpur city

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***Abstract*- The present study deals with trophic status to assess water quality of three lakes in the Nagpur city and to assess the impacts of anthropogenic activities. Results indicated higher values of pH, conductivity, total dissolved solids, total hardness, alkalinity, chlorides and Sulphate. Results shows that water quality of goes Gandhi Sagar lake >Futala lake>Ambazari lake. Among three lakes, Gandhi Sagar Lake appears to be highly polluted having high values of physical and chemical parameters (alkalinity, conductivity, total dissolved solids, chloride, and sulphate). Gandhi Sagar and Futala lakes are polluted and eutrophic in nature because of discharge of sewage and other anthropogenic activity. Ambazari Lake show the starting of mesotrophic conditions. These study lakes require immediate attention to conserve the lake water quality, New insights are discussed into trophic interactions and potential lake restoration methods, especially since eutrophication is expected to increase in the future owing to economic development. Variety of possible strategies for restoration of lakes has also been discussed.**

***Index Terms*- Lakes, Alkalinity, hardness, Conductivity.**

I. INTRODUCTION:

India is facing a serious problem of natural resource scarcity, especially that of water in view of population growth and economic development. Most of fresh water bodies all over the world are getting polluted, thus decreasing the potability of water. All life is depend on water and exists in nature in many forms like ocean, river, lake, clouds, rain, snow and fog etc. However, strictly speaking chemically pure water does not exist for any appreciable length of time in nature. A lake is a large body of water surrounded by land and inhabited by various aquatic life forms. Lakes are subjected to various natural processes taking place in the environment, such as the hydrological cycle. The degradation of lake has occurred not only due to waste water effluent inflow but also by saltation, domestic sewage, immersion of idols and other activities around the lake. Thus, the lake is subjected to enormous anthropogenic stress; the overall impact has resulted in the deterioration of the water quality, accumulation of toxic chemicals and sediments, shrinkage of lake area and above all, loss of the aesthetic value. Several investigations and research studies have been made on water quality and increasing pollution level of the water body. They all indicate the alarming contamination of the lake which is very high as compared to the standard guidelines, revealing that nutrient load in the lake is very high and hyper eutrophic conditions are prevailing. Hence periodic monitoring and preventive measures are required to save the lake from eutrophication. The urban lakes have always served as an important source of water for the people living around the lake. They were constructed in such a manner that they harvest all the runoff rainwater from the surrounding areas along with organic components. People living nearby areas use this lake for various purposes like bathing, washing and immersion of idols. Other solid wastes are also dumped in these lakes which increase organic pollution of the lake. As a result, most of the lakes are directly and indirectly become eutrophic affecting its designated use for aesthetic purpose or domestic use or public supply. It is the need of the day to carry out water quality assessment diligently to identify the process and Causes Of eutrophication, status of eutrophication and identification of potential mitigation measures for restoration of lakes to their designated use. The main problem in Lakes of Nagpur locality of Maharashtra state has arisen due to discharge of domestic sewage and effluents from upstream and surrounding residential areas. During

rainy season the run-off brings the eroded topsoil from the catchment which settled in the lake causing turbidity in lake water. Release of wastes through inlet streams contributed to the internal nutrient loading of the lake. Immersion of idols has been in practice since a very long time. This has increased the nutrient load and concentration of toxic heavy metals in the lake water, Henceforth, there is urgent need to study the significance of lakes situated in Nagpur for Conservation. An examination of the traditional uses of these lakes, their ecology and structure is helpful in understanding how it may be possible to develop urban oriented by assessment of water quality, rejuvenation and restoration of selected lakes which will be ecologically and socially inclusive. This study deals with assessment of water quality in lakes of Nagpur city. The purposes of this study was also to monitor the physico-chemical parameters of the Lake water and assess the status of the lakes and to provide the information of the Nagpur city to take action for Rejuvenation and Restoration of the lake and prevent the lake water from deterioration.

II. MATERIAL AND METHODS

Study Area

The study was conducted in three lakes in Nagpur city: Futala, Gandhisagar and Ambazari (Figure l). Futala lake is situated at latitude of 21'09'11.74" N and longitude 79'02'32.77" E. The catchment area of the lake is 0.40 sq. Kms. Futala Lake built by King Bhosle dates back centuries. Gandhisagar lake is situated at latitude of 21'8'44.82" N and longitude 79'5'59.50" E. The catchment area of Gandhisagar Lake is 0.181 Sq. Kms. Gandhisagar lake was established as a source of water supply by Chand Sultan, the ruler of Nagpur, India in the year 1737. Ambazari lake lies at lat. 20'35'21.44" N and long. 78'15'79.40" E. It is the largest lake in the city and catchment area is 1.185 Sq. Kms. Ambazari tank supplies the drinking water to the Nagpur city. Futala, Gandhisagar and Ambazari lakes practices for irrigation and commercialized fishing.

Sampling

Water samples were collected from Futala, Gandhisagar and Ambazari lakes in Nagpur, India. Water samples were taken in sterilized sampling bottles, below 10 to 20 cm of the surface from study sites. The sampling sites were selected on the basis of magnitude of anthropogenic activities and distribution. The pH of water were measured at the sampling sites by using digital pH meter. Other parameters were analyzed per methods described by APHA 2005.Water samples were subjected to chemical analysis with the prescribed procedures of Alkalinity, Total hardness, sulphate, chloride, calcium and magnesium Hardness and TDS (APHA. 2005).

III. RESULT AND DISCUSSION

Results for water samples of three lakes were illustrated in Table I and Figure 2. pH of the lakes varied from 8.11 to 839, being highest in Gandhisagar lake. High water values of pH during summer months may be due to utilization of bicarbonates and carbonates buffer system (Bohra. 1976). The low values obtained during rainy months may be attributed to influence of fresh water influx, dilution of lake water, and organic matter decomposition (Zingde et al., 1987). According to Spence (1967) the pH of a typical eutrophic lake ranges from 7.7 to 9.6. Thus, current three study lakes water are eutrophic on the basis of its pH range, as suggested by Spence (1967). The pH value are positively correlated to conductivity and total hardness and negatively correlated with total dissolved solids (TDS). Alkalinity ranged from 148.9 to 320.7 mg/L, being highest in Gandhisagar Lake. Durrani (1993) has suggested that the withdrawal of C02 from the bicarbonates for photosynthesis by algae may increase total alkalinity. Based on alkalinity, Spence (1996) classified the lakes into three categories; (i) 1-15 mg/L is nutrient poor. (ii) 16-60 mg/L is moderately nutrient rich, and (iii) > 60 mg/l is nutrient rich. On the basis of this classification, current three study Lakes could broadly be considered as nutrient rich. This may be due to higher input of nutrients in water through anthropogenic activities. The conductivity ranged from 480 to 1092 µs/cm, being highest in Gandhisagar Lake. The sum of cations and anions concentration determines total dissolved solids (TDS) of water. A high content of dissolved solids elevates the density of water, influence osmo regulation of fresh water organism, and reduces solubility of gases and utility of water for drinking purposes and results in eutrophication of the aquatic systems. The total dissolved solids of the lakes varied from 291 to 761 mg/L, being highest in Gandhisagar Lake. Thus, high ranges of TDS this three study lakes water are due to contamination of water by

wastewater, garbage, mass bathing, and offering foods, flowers, garlands and other religious matters. Indeed, high concentrations of TDS enrich the nutrient status of the water body which resulted in to eutrophication of this aquatic ecosystem (Swamiatha and Rao, 1998, Singh and Mathur, 2005).

Total hardness of the lakes varied from 137.62 to 187.8 mg/L Calcium hardness of the lakes varied from 45.2 to 84.1 mg/L. Magnesium hardness of the lakes varied from 68.62 to 123.17 mg/L Hence, Reddy and Kumar (2001) informed that magnesium is non-poisonous but increases the hardness of water, whereas, Wetzel in 1983 reported that increase in salt content declines oxygen solubility exponentially in the water bodies. This hardness may be attributed to the presence of high content of calcium and magnesium in addition to sulphate, nitrate and sewage in now (Patel and Singh, 1998, Angadi et al., 2005). Kannan (1991) classified water on the basis of hardness values as, (i) 0-60 mg/L: soft, (ii) 61-120 mg/L: moderately hard, (iii) 121-160 mg/L: hard, and (iv) > 160 mg/L: very hard. On the basis of above classification, Ambazari lake water may be placed under hard and Futala and Gandhi sagar lake water placed under very hard category. The source of hardness in this lake is mainly due to the addition of calcium and magnesium salts through surface runoff from catchment area and immersion of high numbers of idols in both lakes. The chloride status in water is indicative of pollution, especially of human origin. Chloride was found high (111.10 mg/L) in Gandhi Sagar Lake and less (31.26 mg/L) in Ambazari Lake whereas sulphate was observed to vary from 26.20 to 48 mg/L being highest in Gandhi Sagar Lake. Rose and Cravotta (1998) reported that, sulphate is a primary constituent of the effluent waste.

IV. CONCLUSION

The above discussion shows that among the three lakes in Nagpur, water quality of goes Gandhi sagar lake >Futala lake>Ambazari lake. These lakes need to protect from human activity and sources of water pollution. Among three lakes, Gandhi Sagar Lake appears to be highly polluted having high values of physical and chemical parameters (alkalinity, conductivity, total dissolved solids. chloride, sulphate). This was due to uncontrolled use for solid waste disposal by surrounding people. The findings clearly indicate that Gandhi sagar and Futala lakes are polluted and eutrophic in nature because of discharge of sewage and other anthropogenic activity. Ambazari Lake show the starting of mesotrophic conditions and require immediate attention to conserve the lake water quality. All above impacts have resulted in the deterioration of water quality of three lakes and require attention to conserve the lake water quality. It gives the clue to develop appropriate management strategies for Rejuvenation and Restoration of the lake by municipal authorities and prevent the water from deterioration.

Restoration strategies for Fresh water lakes:

There are certain steps have to be taken to keep the fresh water lakes biologically healthy. A variety of restoration techniques have been employed in the lakes: hydrological management, reduction of Phosphorus (P) in the external loads, in-lake reduction or immobilization of P, and complementary ecological management. In broad sense restoration of fresh water bodies includes following steps and strategies;

I. Rehabilitation projects should be planned or implemented, as these projects greatly contributes to our present understanding of lake systems.

2. The main concern of limnologists and hydro-biologists should be the cycling of basic nutrients within a lake System, particularly carbon, nitrogen, phosphorus and sulphate. An excess of the latter in runoff water entering a lake may result in high concentration of hydrogen ions from produced acids in water and is harmful to the lake biology.

3. Lake side park should be developed, shady trees should be planted and a plant nursery should be developed.

4. Lakes rehabilitation benefits from a consideration of fresh water bodies ecosystem concepts in quantitative terms, comparison with reference conditions, historical or others, and the establishment of interdisciplinary strategies for lakes. This includes co-operation among lakes managers, environmental NGOs and scientists.

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Figure and Table

Table 1: Physico- Chemical quality of water in different lakes of Nagpur

Parameter	pH	Alkalinity as CaCO3 (mg/L)	Conductivity (µS/cm)	TDS (mg/L)	Total hardness as $CaCO_3$ (mg/L)	Ca-Hardness as $CaCO_3$ (mg/L)	Mg-Hardness as $CaCO_3$ (mg/L)	Chloride (mg/L)	Sulphate (mg/L)
Ambazari Lake	8.11	148.9	480	291	137.62	69	68.62	31.26	26.20
Futala Lake	8.20	187.3	723	439	187.8	84.1	103.7	38.23	34.41
Gandhi Sagar Lake	8.39	320.7	1092	761	168.37	45.2	123.17	111.10	48

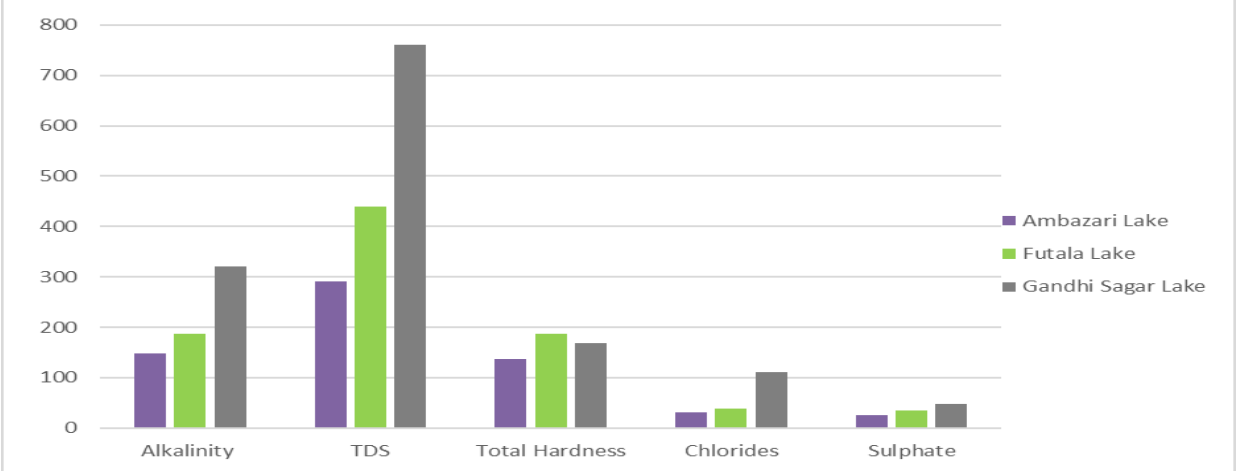

Fig 2: Graph showing various water parameters with respect to three study lakes