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Assessment of Certain Physico-Chemical Parameters of Satpala Lake, Virar, Palghar, Maharashtra

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ABSTRACT: Satpala Lake is situated in Satpala village, 5-6 km away from Virar town, Palghar district, Maharashtra at 19°25'58"N and 72°46'41"E. It is a naturally originated lake having an area of about 90,000 m². The lake waters are utilized for a variety of purposes including domestic, agricultural purposes as well as for cultural and religious processions and other programmes. Regular monitoring of these waters is of paramount importance as a relationship can be established between different parameters that can indicate the health status of a habitat. Our present studies are carried out to examine and assess the quality & sustainability of water. Our observations suggest that the lake is fairly contaminated by varied pollutants and by adopting and implementing modern scientific-cum-technological measures, the lake can be reconstituted for a variety of purposes including pisciculture and other activities.

KEYWORDS: Satpala, pollutants, parameters, domestic, pisciculture.

I. INTRODUCTION

It is well known that there is a definite link between environment and health of organisms including that of human being. The health of an organism depends on the hygienic condition and unpolluted nature of the environment. It is also known that economic growth and technological development have promoted both social and ecological disruption. Different authorities /agencies have prescribed standards for varied categories of water, air etc. and are periodically revised to take advantage of new treatment and management techniques [1]. Technological development has certainly led to the advancement of new industries which have also caused pollution by releasing its contaminants.

Lakes and surface water reservoirs are the planet's most important freshwater resources that provide innumerable benefits. They are used for domestic and irrigation purposes and provide ecosystems for aquatic life especially fish, thereby functioning as a source of essential proteins and significant elements of the world's biological diversity. One of the most unfortunate crisis of 21st century is the constraints in the availability of safe and pure drinking water which is the basic resource of our life [2]. Further lakes have important socio- economic benefits as a result of tourism and recreation that are culturally and aesthetically important for people throughout the world. They also play an equally important role in flood control.

The quality of surface water is largely affected by natural processes (weathering and soil erosion) as well as anthropogenic inputs (municipal and industrial wastewater discharge). The anthropogenic discharges represent a constant polluting source, whereas surface runoff is a seasonal phenomenon, largely affected by climatic conditions.

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Among environmental pollutants, metals are of particular concern, due to their potential toxic effect and ability of bioaccumulation in aquatic ecosystems. The serious environmental problems have been faced in developing as well as developed countries. Dissolved constituents of water bodies are often determined as a major component for baseline limnological studies. The major ions Ca^{2+} , Mg^{2+} , Na^+ , K^+ , Cl^- , SO_4^{2-} , HCO_3^- and CO_3^{2-} are essential constituent of water and responsible for ionic salinity as compared with other ions. Contamination of aquatic ecosystems with heavy metals is a serious problem, all over the world. The free style way of disposal of agricultural, industrial and domestic effluents into natural water bodies may cause serious contamination. Run-off from agricultural land and saline seeps subject the most vulnerable water pollution for increased salinity, so the freshwater lakes are highly affected. The lake water in downstream areas is also important for farmers and fishermen, who depend on the lake for irrigation and fishery.

Increased anthropogenic activities in and around the water bodies damage the aquatic systems and ultimately the physicochemical properties of water. Recently the U.N. convention on climate change (2014) alarmingly indicates a serious water scarcity and drought like conditions in India very shortly and therefore the upkeep, maintenance and management of our water resources is of topmost priority.

The effort to conserve these resources is the present need. Factors that influence the sustainability of such lentic systems are temperature, transparency, salinity, biogenic salts, dissolved gases etc [3].

The present study is aimed at providing accurate data of certain selected parameters of waters analyzed from specific sites of Satpala lake. These parameters signify the quality of water and its assessment will help to prevent any further deterioration and also ensure that it is also aesthetically adequate [4]. Satpala is a small village in Virar, Maharashtra with a lush green area nearly about 70 kms away from Mumbai. Satpala Lake is approximately 22 acres, its length being 450m and breadth 200m.

II. MATERIAL AND METHODS

Collection of water sample: Water samples are collected randomly at regular intervals of three months from 3 sites of Satpala Lake. The samples were collected in plastic cans of 5liters capacity without entrapping any air bubbles. The samples were kept in refrigerator and maintained at 4°C. Recent scientific instruments and procedures with high efficiency and efficacy were utilized for all practical purposes.

Analysis of Water Sample:

Analysis of the waters were carried out for various parameters such as pH, DO, BOD, COD, CO_2 , nitrate-nitrite, chlorides, sulphate, phosphates, alkalinity, acidity, total hardness etc. using standard methods [5]. All the reagents used for the analysis were of AR Grade and double distilled water was used for preparation of solutions.

All the available and calculated data is used for plotting the graph and subsequent calculation and calibration of Standard Error (SE).

III. RESULT AND DISCUSSION

- 1. pH-:** pH is the term used universally to express the intensity of acid or alkaline condition of a solution. Most of water samples are slightly alkaline due to presence of carbonates and bicarbonates. The pH values fluctuated between 7–9. The higher range of pH indicates elevated productivity of water that may eventually lead to eutrophication [6]. pH value is high during summer season which may be due to reduced water content and discharge of the domestic wastage.
- 2. Dissolved Oxygen-** Dissolved oxygen is very important parameter of water quality and is a index of physical and biological processes in water. DO is of significant importance for the activities of the aquatic organisms [7]. DO values fluctuated between 2-11. DO values were found highest in season I and lowest in Season II probably due to decomposition of organic matter, respiration, presence of iron and rise in temperature.
- 3. BOD-:** It is the amount required by microorganisms in aerobic degradation of the dissolved or even particulate organic matter in water. The decomposable or biodegradable organic matter serves as a food for bacteria and energy is obtained due to such oxidation. The aim of BOD is to determine the amount of biochemically oxidizable carbonaceous matter [8]. BOD gives an idea about the extent of organic pollution in water. BOD

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- depends upon pH, presence of toxins, reduced organic matter and different type of microorganism. BOD values fluctuated between 2-7. BOD values were found highest during season II and lowest during season III.
- COD-:** COD means measuring pollution strength of domestic and industrial effluents. It is the measure of oxygen required in oxidizing the organic compounds present in water by means of chemical reactions involving strong oxidizing agents such as potassium dichromate and potassium permanganate [9]. As most of the organic compounds can be oxidized by strong oxidizing agent in acidic medium, COD is too high, if elevated amounts of biologically resistant organic matter, such as lignin are present. COD values fluctuated between 61-104. COD values were high in all seasons indicating contamination.
 - Total Hardness-** Total hardness may be defined as the sum of the calcium and magnesium concentrations, both expressed as calcium carbonate in milligrams per litre. In common usage, water is classified as soft, if it contains less than 75 ppm of calcium carbonate [10]. Hardness values fluctuated between 77-102. Values were highest in season II and lowest in season III. Highest values are due to addition of effluents or sewage.
 - Chlorides- :** Most of the chlorides in the soil are soluble in water and determined directly in soil solution. This is the most common inorganic anion present in water [11]. In natural fresh waters high concentration of chloride is regarded as an indicator of pollution which due to organic waste of animal origin. The chloride concentration up to 250 ppm makes the water salty in taste; however, a level up to 100 ppm is safe for human consumption. Chloride values fluctuated between 77-216. Chloride values were highest during season II as compared to other seasons probably may due to the decrease in water level, evaporation and deposition of animal waste.
 - Sulphates-:** All natural waters contain appreciable amount of sulphates. These are particularly high in arid and semiarid regions where natural waters in general have high salt content [12]. Mine drainage waste may contribute the large amount of sulphates through pyrite oxidation. Sulphates are generally soluble in water and impart hardness to water. Sulphate values fluctuated between 110-317. Sulphate value is highest during season II and lowest in season III. Discharge of domestic sewage increases the concentration of sulphate in water bodies.
 - Alkalinity-** Alkalinity of natural water is measure of its capacity to neutralize H^+ and is primarily a function of carbonate, bicarbonate and hydroxide contents of water. Alkalinity is the factor responsible for determining the amenability of water to biological treatment [13]. Some other bases which may contribute towards alkalinity include borates, phosphates and silicates. Most of the alkalinity is due to the dissolution of CO_2 in water. Alkalinity values are fluctuated in between 262- 574. Alkalinity values were found high in all the season.
 - Nitrate-:** Nitrate is the highest oxidized form of nitrogen and its presence in water is due to the biological oxidation of nitrogenous organic matter of both autochthonous and allochthonous origin. Domestic sewage and agricultural run-off are the chief sources of allochthonous nitrogenous organic matter. Dead organisms and metabolic wastes of aquatic communities form the autochthonous nitrogenous organic matter. Higher concentration of Nitrate in water body indicates pollution. The high concentration of nitrate in water is indicative of pollution but subsequently an important plant nutrient [14]. Nitrate values fluctuated between 72-148. Nitrate values were found high in all season probably due to domestic sewage and agricultural runoff.
 - Nitrite-:** Nitrite is the partially oxidized form of nitrogen found in very low concentration in natural waters. Nitrite in the water is either due to oxidation of ammonium compounds or due to reduction of nitrate as an intermediate stage in nitrogen cycle [15]. It has no mineral source in water but occurs as an intermediate formed during de-nitrification and nitrification reactions. Presence of even a minute quantity of nitrite in water is indicative of organic pollution. Nitrite values fluctuated between 72-557. Nitrite values were found highest in all season.
 - Phosphates-:** Phosphate is a nutrient that triggers eutrophication and is required by algae and other hydrophytic plants, animals in small quantities [16]. In water phosphorous occur in both organic and inorganic form but since over 85 % of total phosphorous is usually present in organic form, only inorganic phosphorous plays a dynamic role in an aquatic ecosystem. Phosphate values were fluctuated between 18-39. Phosphate values were higher in all season its due to the pollution.

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12. **Silicates-** Silica is the oxide form of silicon and is present in quartz and sand [17]. In natural waters silica is present as suspended particles, in a colloidal or polymeric state as silicate ions. Silica is an important structural constituent of diatoms and sponges [18]. Silicate values fluctuated between 15-43, values were high in all seasons probably due to the sand mining, constructions and infrastructure development and sewage runoff.
13. **Free Carbon Dioxide-** The source of carbon dioxide in the form of bicarbonates and carbonates are called as combined, fixed or bound carbon dioxide. Free CO₂ is one of the raw materials for photosynthetic phenomenon in green plants[19]. Decomposition of organic matter and respiration of plants and animals contribute to the free carbon dioxide present. If more CO₂ present in water than is equilibrium with air, more calcium carbonate will be converted into calcium bicarbonate. CO₂ values fluctuated between 0.2-2.3; values were steady in all season.
14. **Acidity-** Acidity indicates the total available acid and H⁺ ions. Acidity of water is its capacity to react with a strong base to a fixed pH. Acidity is due to the presence of strong mineral acids, weak acids and hydrolyzing salts of strong acids [20]. In natural fresh water the acidity is mostly due to the presence of free CO₂ in the form of carbonic acidity. In acid waters, productivity is low because acidity not only inhibits nitrogen fixation it also prevent the recirculation of nutrients by reducing the rate of decomposition. Acidity values fluctuated between 6-13. Acidity values were high in season II as compared to other seasons.
15. **Total Dissolved Solids-** Total solid is term applied to the material residue left in the vessel after evaporation of an unfiltered sample and includes “total suspended solids”, portion retained by filter and “total dissolved solids” [21]. TDS values fluctuated between 0.05- 0.8. TDS value were high during season II and lowest in all season. High value is due to the evaporation of or garbage deposition in to water body.
16. **Electrical Conductance-** It is the ability of substance to conduct the electric current. The conductivity or the specific conductance of water is related to the amount of substance dissolved in it which act as conductors to the temperature of solution. The conductivity of solution is the sum of conductivities of the individual species of positive and negative ions [22]. EC values fluctuated between 0.9-1.8. EC values were high in all seasons due to the fluctuations in TDS and organic matter.

IV. CONCLUSION

The present day scenario of water, its available resources and indiscriminate utilization including contamination has led to the depletion and scarcity resulting into undue stress on environment and human welfare. Recent studies indicate that water and its resources have to be effectively conserved, reconstituted, treated and managed by scientific measures so as to serve the biosphere for time immemorial. The parameters of Satpala Lake indicate that by adopting and implementing technological measures, including chemical, biological, mechanical etc., the lake can be reconstituted and its water can be utilized for a variety of purposes including introduction of organism for propagation.

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| PARAMETERS | Observation for the year 2014 (January to December) | | | | | | | | | | | | | | | |
|-----------------|---|--------|--------|--------|-------------|--------|--------|--------|--------------|--------|--------|--------|-------------|--------|--------|--------|
| | Season - I | | | | Season - II | | | | Season - III | | | | Season - IV | | | |
| | S1 | S2 | S3 | Mean | S1 | S2 | S3 | Mean | S1 | S2 | S3 | Mean | S1 | S2 | S3 | Mean |
| DO | 11.32 | 10.06 | 9.09 | 10.16 | 2.20 | 2.55 | 1.92 | 2.22 | 5.62 | 4.61 | 5.62 | 5.28 | 5.00 | 4.84 | 6.86 | 5.57 |
| BOD | 3.60 | 3.80 | 3.70 | 3.70 | 5.40 | 6.30 | 6.90 | 6.20 | 2.60 | 2.80 | 3.10 | 2.83 | 3.40 | 3.10 | 4.10 | 3.53 |
| COD | 77.00 | 82.00 | 85.00 | 81.33 | 101.00 | 104.00 | 105.00 | 103.33 | 65.00 | 60.00 | 60.00 | 61.67 | 70.00 | 65.00 | 67.00 | 67.33 |
| CO ₂ | 0.40 | 0.40 | 0.30 | 0.37 | 2.30 | 2.20 | 2.30 | 2.27 | 1.90 | 1.70 | 1.80 | 1.80 | 1.20 | 0.90 | 1.10 | 1.07 |
| ACIDITY | 2.50 | 12.50 | 10.50 | 8.50 | 6.50 | 7.00 | 6.50 | 6.67 | 12.50 | 12.50 | 12.60 | 12.53 | 10.50 | 11.00 | 10.50 | 10.67 |
| ALKALINITY | 500.00 | 375.00 | 450.00 | 441.67 | 546.00 | 580.00 | 595.00 | 573.67 | 245.00 | 268.00 | 275.00 | 262.67 | 498.00 | 453.00 | 423.00 | 458.00 |
| pH | 7.64 | 7.68 | 7.66 | 7.66 | 8.44 | 8.61 | 8.48 | 8.51 | 7.12 | 7.23 | 7.09 | 7.15 | 7.64 | 7.86 | 7.59 | 7.70 |
| HARDNESS | 174.37 | 99.18 | 105.36 | 126.30 | 174.30 | 182.30 | 179.80 | 178.80 | 75.26 | 80.21 | 73.26 | 76.24 | 99.25 | 89.36 | 100.96 | 96.52 |
| CHLORIDE | 106.50 | 99.40 | 100.50 | 102.13 | 269.80 | 184.60 | 196.50 | 216.97 | 78.50 | 75.10 | 79.60 | 77.73 | 96.40 | 96.60 | 95.50 | 96.17 |
| TDS | 0.05 | 0.05 | 0.05 | 0.05 | 0.89 | 0.85 | 0.88 | 0.87 | 0.02 | 0.07 | 0.05 | 0.04 | 0.06 | 0.06 | 0.07 | 0.06 |
| NO ₂ | 320.00 | 200.00 | 250.00 | 256.67 | 480.00 | 640.00 | 550.00 | 556.67 | 40.00 | 56.00 | 120.00 | 72.00 | 400.00 | 380.00 | 350.00 | 376.67 |
| NO ₃ | 130.00 | 135.00 | 131.00 | 132.00 | 155.00 | 140.00 | 150.00 | 148.33 | 40.00 | 56.00 | 120.00 | 72.00 | 135.00 | 130.00 | 135.00 | 133.33 |
| PHOSPHATE | 27.00 | 13.00 | 15.00 | 18.33 | 40.00 | 37.00 | 39.00 | 38.67 | 35.00 | 35.00 | 30.00 | 33.33 | 30.00 | 30.00 | 35.00 | 31.67 |
| SULPHATE | 158.00 | 159.20 | 155.50 | 157.57 | 352.00 | 300.00 | 300.00 | 317.33 | 110.00 | 112.00 | 110.00 | 110.67 | 141.00 | 141.00 | 140.00 | 140.67 |
| SILICATE | 16.00 | 32.00 | 20.00 | 22.67 | 45.00 | 40.00 | 42.00 | 42.33 | 16.00 | 16.00 | 15.00 | 15.67 | 35.00 | 40.00 | 40.00 | 38.33 |
| EC | 1.32 | 1.37 | 1.35 | 1.35 | 1.78 | 1.79 | 1.81 | 1.79 | 0.93 | 0.91 | 0.92 | 0.92 | 1.25 | 1.24 | 1.22 | 1.24 |

Table 1 - Average values of varied Physico-Chemical parameters from 3 different sites (S1, S2, S3) of Satpala lake and Mean Values of all sites in each Season for year 2014

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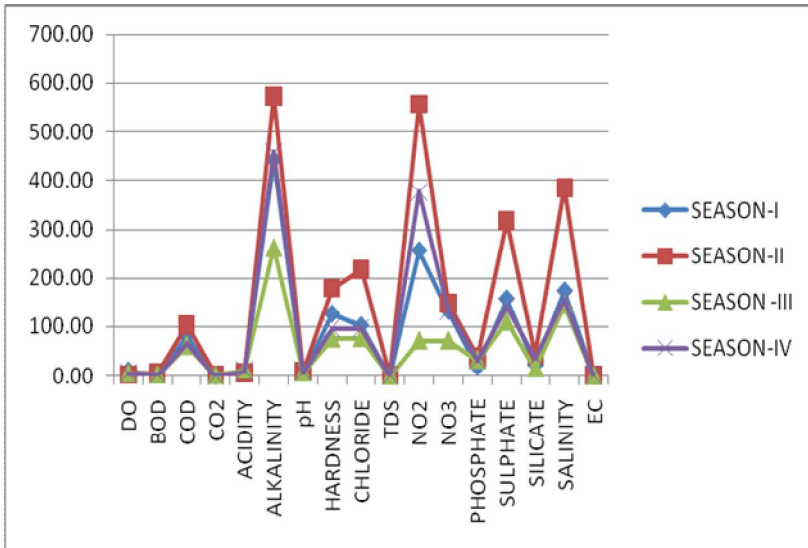


Fig. 1 Mean Average values of physico-Chemical parameters from 3 sites (S1,S2,S3) of Satpala lake during different seasons
Season I- (Jan-March 2014),
*Season II- (Aril- June 2014),
*Season III - (July-September 2014)
*Season IV- (Oct-Dec 2014)

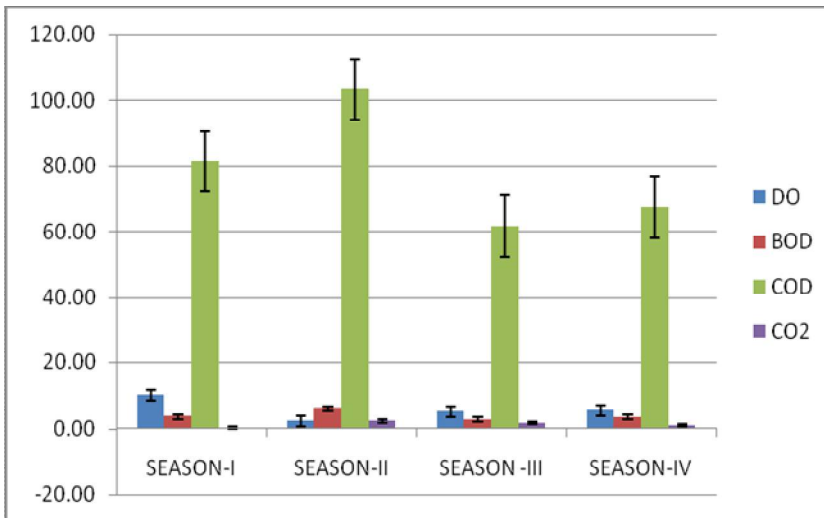
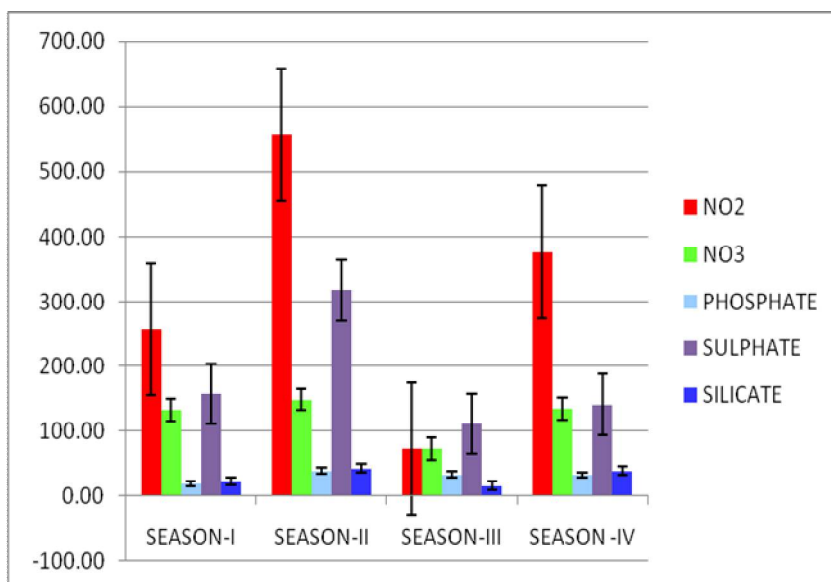


Fig.2.1

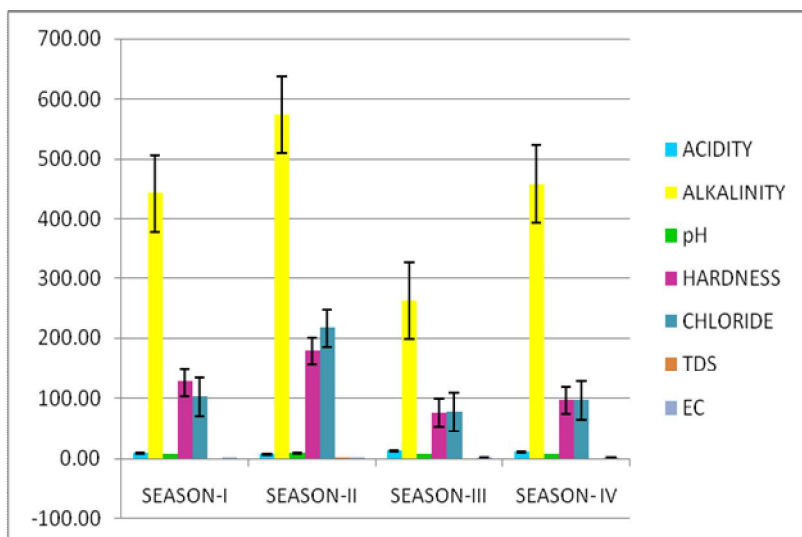
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← Fig. 2.2



← Fig. 2.3

Figs. 2.1; 2.2 & 2.3 - Standard Error calculated by plotting graph & using stastical data of Physico-Chemical parameters from 3 sites (S1,S2,S3) of Satpala lake

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