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Comprehensive Analysis of Physiochemical Parameters in Lake Goverdhan Sagar: A Study on Water Quality Assessment

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Abstract: ***This study presents a comprehensive analysis of the physicochemical parameters in Lake Goverdhan Sagar, aiming to provide valuable insights into its current environmental status. Water samples were collected from various predetermined sampling sites across the lake during Jan 2023 to April 2023 different sampling stations and depths. A set of physicochemical parameters including temperature, pH, dissolved oxygen (DO), electrical conductivity (EC), turbidity, total dissolved solids (TDS), and major ion concentrations (such as chloride, sulfate, calcium, and magnesium) were analyzed using standard methods and instruments. The average Temperature of water was 28.57 ℃, Colour and Odour disagreeable, and pH of lake was found with mean value of 8.7. During the study the mean value of BOD 3.96 ppm and COD 45.88 ppm was observed. The mean value of dissolved Oxygen (DO) 5.48 was found and satisfactory for the survival and growth of aquatic organisms. Similarly the mean value of nitrogen was determined as 7.24 ppm, which is under permissible limit. The hardness is mainly due to calcium and magnesium ions. During the study, mean value of total hardness, Calcium hardness and Magnesium hardness was observed as 30.82 ppm, 7.40 ppm and 23.43 ppm respectively, which are under permissible limits. Finding of lake water which recorded mean value of total alkalinity 253.58 ppm. During the study mean value of chloride content observed as 165.20 ppm which is below the permissible limit and Fluoride content 0.58 ppm was found as a mean value. According to study the high value of pH, EC and TDS characteristics of Goverdhan Sagar Lake shows its nutrient rich and alkaline nature. The water quality indicated that the water of lake is suitable for the fishery and gardening purpose. However, water of the lake was not found suitable for potable and domestic uses as the high value of bacterial load, bio-chemical oxygen demand and Chemical oxygen demand showed its high pollution status.***

Keywords: Lake Goverdhan Sagar, Physicochemical parameters, Water quality, Environmental monitoring. BOD, COD, DO etc.

I. INTRODUCTION

Large numbers of cases are reported annually due to consumption of unsafe drinking water because of lacks access to safe drinking water and poor sanitation (Hunter et al., 2001). The United Nations identifies improving water quality as one of the eight Millennium Development Goals (MDGs), and its target is to reduce the number of people without access to safe water by 50% in 2015 (Pandey et al., 2014). Even though waterborne outbreaks have been declining dramatically since the 1900s, the global burden of infectious waterborne disease is still considerable. Moreover, the numbers of outbreaks underestimate the real incidence of waterborne diseases (Leclerc et al., 2002). So there is an urgent need to take an action to control the cases of waterborne diseases. In India contaminated water consumption plays an important role in many waterborne diseases outbreaks occurrence. Coliforms are major contaminants in surface and ground water in developing countries and are the representative of important group of indicator bacteria as a measure of water quality, (Chitanand et al., 2010, Chauhan et al., 2017, Joseph et al., 2018). The major health risk from drinking water is caused by the presence or introduction of coliforms in the drinking water supply which may come from the nontreated sewage systems sited nearly the water source or distribution system as well as overflow from them. Water analysis mainly focuses on coliforms, thermo tolerant coliforms and E. coli is used as an indicator of fecal contamination of water. Fecal coliforms (or thermo tolerant coliforms) are coliforms which can ferment lactose at 44.5 °C, (Craun, 1978), (Grabow, 1996, Rompré et al., 2002, Payment et al., 2003). And the presence of faecal coliforms indicate recent contamination of water sources with human and animal wastes and this ‘indicator organisms’ indicate possible presence of other potential pathogens, (Cabral, 2010, Rodríguez et al., 2012). A lake is a large body of water surrounded by land, inhabited by various aquatic life forms, for all practical purpose, pure water is considered to that which has low dissolved or suspended solids and obnoxious gases as well low in biological life.

Such high quality of water may be required only for drinking purposes while for other uses like agriculture and industry, the quality of water can be quite flexible and water polluted up to certain extent in general sense can be regarded as pure. The health of lakes and their biological diversity are directly related to health of almost every component of the ecosystem. Lakes are also subjected to various natural processes taking place in the environment like the hydrologic cycle, with unprecedented development activities; human beings are responsible for choking several lakes to death. Each lake has its own characteristics, such as drainage, inflow and outflow, size, nutrient content, dissolved oxygen content, temperature, pH and productivity. The depth of the lake influences a variety of relationships. Definitions include the ratio of the surface area of the lake to the length of the shoreline, the proportion of the actual amount of water that is influenced by sunshine, and the ratio of the depth of the drainage basin to the depth of the lake. Such interactions influence how lakes work, such as weather factors, ecological sustainability and the capacity to cope with pollution.

II. LITERATURE REVIEW

B. N. Tandel, et al have studied, the water quality index is a single number that expresses the quality of water by integrating the water quality variables. Its purpose is to provide a simple and concise method for expressing the water quality for different usage. The present work deals with the monitoring of variation of seasonal water quality index of some strategically selected surface water bodies. The index improves the comprehension of general water quality issues, communicates water quality status and illustrates the need for and the effectiveness of protective practices. It is found that in all cases the change in WQI value follow a similar trend throughout the study period. The lake water is found of good quality (WQI - 67.7 to 78.5) during both seasons. However, it is found that water quality of lake deteriorates slightly from winter to summer season on account of the increase in microbial activity as well as increase in pollutants concentration due to water evaporation.

Hardik Vashishtha, et al have studied Physico-chemical parameters of lake were found to be moderate throughout the study period as per drinking water standards. The average water quality parameters of the lake during the study period were found to be, Temperature as 28.6 0C, Colour 7 and Odour disagreeable, pH as 9.0, EC as 735 ppm, BOD as 3.8 ppm, COD as 42.3 ppm, DO as 5.3 ppm, Nitrogen Content as 7.1 ppm, Alkalinity as 245.9 ppm, Total Hardness as 30.9 ppm, Calcium Hardness as 7.9 ppm, Magnesium Hardness as 23.0 ppm, Chloride Content as 161.7 ppm, Fluoride Content as 0.5 ppm, MPN coliform as 350 MPN/100 ml. High value of pH, EC and TDS characteristics of GSL shows its nutrient rich and alkaline nature. The water quality indicated that the water of lake is suitable for the fishery purpose. However, water of the lake was not found suitable for drinking and domestic uses as the high value of bacterial load, bio-chemical oxygen demand and Chemical oxygen demand showed its high pollution status. Nisha Jain, et al studied that groundwater quality assessment is a significant issue in ground water studies. Jaipur city experienced degradation of groundwater quality due to rapid urbanization and industrialization. Eighteen ground water samples were collected randomly from 6 different area of Jaipur City, from different hand pumps to study the physicochemical parameter, such as pH, Conductivity, TDS, Total Hardness, Chloride with the help of standard method of APHA during monsoon (1September to 30 September 2014). Present study shows that underground water quality of Jaipur city is not good.

Ambili M, et al studied that drinking water from northern districts of Kerala (Malabar) was carried out and also to detect the suitability of water for drinking purpose.Total coilforms can be detected by most probable number method and quantitative analysis through total Viable Count . Sixty drinking water samples were analysed both qualitatively and quantitatively.The total viable count varies from 90 to 8x106CFU/ml and three samples have MPN more than 1600/100ml. About 105 bacterial isolates obtained from 60 samples comprised of eight species such as Staphylococcus aureus (18.1%) Bacillus Spp. (18.1%), Pseudomonas Spp. (17.14%), Klebsiella Spp.(17.14%), Enterobacter Spp. (10.48%), Citrobacter Spp. (9.52%), E.coli (8.57%), and Shigella Spp. (0.95%) respectively. And the distribution of Escherichia coli in both public water supplies as well as in well water found to be 15.6% and 19.04% respectively. This reveals drinking water in this area is contaminated. So an urgent action is needed to eliminate this issue by conducting planned bacteriological assessment regularly and it helps to provide safe drinking water to public.

Taruna Juneja, et al to Achieving efficient, effective and cost effective water purification methods for the community is the key to human survival and development, as water management is a current global concern. Water is the basic resource necessary for sustaining all human activities, so its provision in desired quantity and quality is of utmost importance. Water pollution affects drinking water, rivers, lakes and oceans all over the world, which consequently harms human health and the natural environment. The present crosssectional study is focussed on measuring the quality of drinking water in rural areas of Jhunjhunu district, Rajasthan and its effects on human health as told by the people living in these areas. Various analyses including physical, chemical and microbiological assessment were carried out on the water samples collected from the villages. The samples were found to have high pH, indicating alkalinity of the water samples, and high chromium content. Microbiological quality was also questionable in most of the cases. On the contrary to these finding

III. METHODOLOGY AND WATER QUALITY PARAMETERS

A. *Area of Study*

Artificial Goverdhan sagar lake (GSL), are Located 2.5 km away from Udaipur in the southwest at 74042' E. Longitude, 24034' N latitude. It has an overall covering a total water spread area of 30, 81 hectares. It is one of the prominent attractions in the region and serves as an important water resource for the local populace. GSL was constructed with the primary objective of meeting the water needs of Udaipur city and the surrounding areas.

B. *Sampling Collection Stations*

Sampling Station 1 (near Swarnjayanti Park): This sampling station situated at Eastern shore of lake. This station was selected for sampling due to construction of Dam, this station is near the outlet of the lake and near this station there is Slum area.
Sampling Station 2 (near goverdhan sagar Park): This sampling station situated at Western shore of lake. This station was selected for sampling due there is lots of aquatic plants and due to park human interference is maximum and near this area cattle moving in the lake.
Sampling Station 3 (near Hanuman Temple): This sampling station situated at Northern shore of lake. This station was selected for sampling as due construction of Ghats near the temple. Where humans take bath and wash their cloths

C. *Water Sampling Method*

Grab or Catch sampling method is used for the present study. A sample collected at a particular time and place can represent only the composition of the source at that time and place. However, when a source is known to be fairly constant in composition over a considerable period of time over substantial distances in all directions, then the sample may be said to represent a larger time period or larger volume or both, than the specific point at which it was collected.

D. *Collection of Sample*

During the study period, Sample was collected in morning time. From all three sampling points manually using Grab method of sampling. Sample is collected in plastic bottle of 2.5 litter capacity with air tight cap for further analysis in the laboratory.

E. *Parameters to be Analysed*

Water Quality parameters like Temperature of water, pH will determine on field itself and for the analysis of the Alkalinity, Nitrogen content, Hardness, Dissolved oxygen (DO), Chemical oxygen demand (COD), Bio-chemical oxygen demand (BOD) sample were brought to the laboratory in polyethylene bottle of 2.5 litter capacity and analysed as soon as possible. The water quality of Goverdhan Sagar Lake was analysed using standard methods as mentioned in the Manual on Water and Wastewater analysis

IV. RESULT AND DISCUSSION

A. *Test Result of Temperature*

Temperature plays an important in influencing the characteristics of water. When temperature gets high it reduces the solubility characteristic of water which in turn affects the quality of water and shows the level of contamination/pollution. Notable fluctuations were observed in water temperature at all the three stations during the period. Surface water temperature ranged from 28.3˚C - 31.2˚C. The highest 30.1˚C value of water temperature was noted at station 2 and the lowest 27.2˚C temperature was noted at station 1. The highest 30.1˚C mean value of temperature was observed in the month of April and the lowest 27.2˚C mean value of temperature was observed in the month of January.

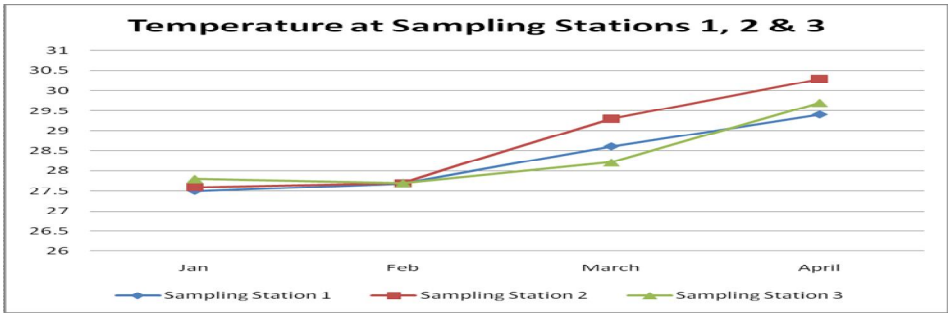

Figure No 4.1:-Graphical representation of Monthly variation of Temperature at Sampling Station 1, 2 & 3

B. Test Result of pH

The water of lake Goverdhan sagar remained alkaline throughout the study period. Variation in pH is between 8.6- 9.0, 8.9- 9.4, 9.0- 9.2 at collection station 1, Collection station 2 and Collection station 3 respectively. The highest mean value of pH 9.4 was found at station 2. The lowest mean value of pH 8.6 was found at station 1. In present study, the pH of lake water was found between 8.6 - 9.4 at all three sampling stations. The pH of Goverdhan sagar lake was found to be alkaline which is suitable for supporting good aquatic productivity but if the average value increases beyond recorded values then it will not suitable for aquatic productivity.

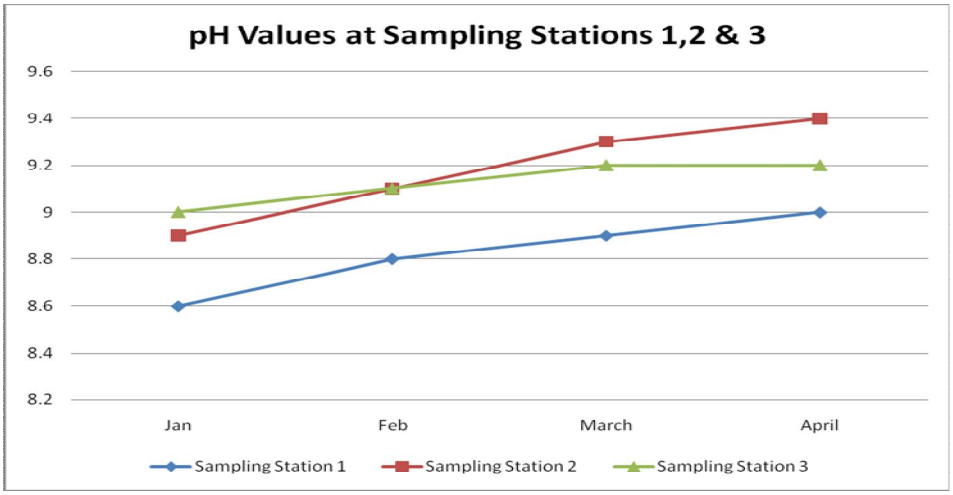

Figure No 4.2:- Graphical representation of Monthly variation of pH value at Sampling Stations 1, 2 & 3

C. Test Result of Electrical conductivity (EC)

The electrical conductivity represent total ionic load in water due to dissolved substance. In present study the EC of water was recorded between 793 – 799 mS/cm at all three sampling stations. The total ionic load in water is evident from the value of electrical conductance. The electrical conductance value at station 1 ranges from 790 microsiemen/cm to 805 microsiemen/cm. At station 2 value ranges from 786 microsiemen/cm to 799 microsiemen/cm and at stationt 3 value ranges from 787 microsiemen/cm to 797 microsiemen/cm. The lowest mean value of EC 787 microsiemen/cm was recorded in the month of Feb at point 3 and the highest mean value of EC 805 microsiemen/cm was recorded in the month of march at sampling point 1.

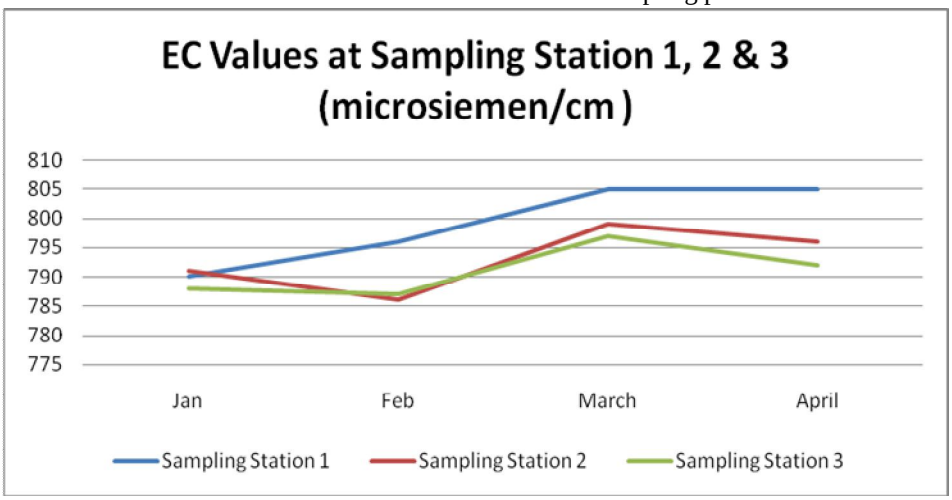

Figure No 4.3:- Graphical representation of Monthly variation of EC value at Sampling Stations 1, 2 & 3

D. Test Result of Total Dissolved Solids (TDS)

The total dissolved solids (TDS) at sampling station 1 lies between 510ppm – 521 ppm, at sampling station 2 it varied between 512ppm- 521 ppm, at sampling station 3 TDS varied between 509ppm – 518 ppm. The highest mean value of TDS 521 ppm was observed in the month of march at sampling station 1 and the lowest mean value of TDS 509 ppm was recorded in the month of Feb at sampling station 3. Overall mean value of TDS was recorded as 515.16 ppm.

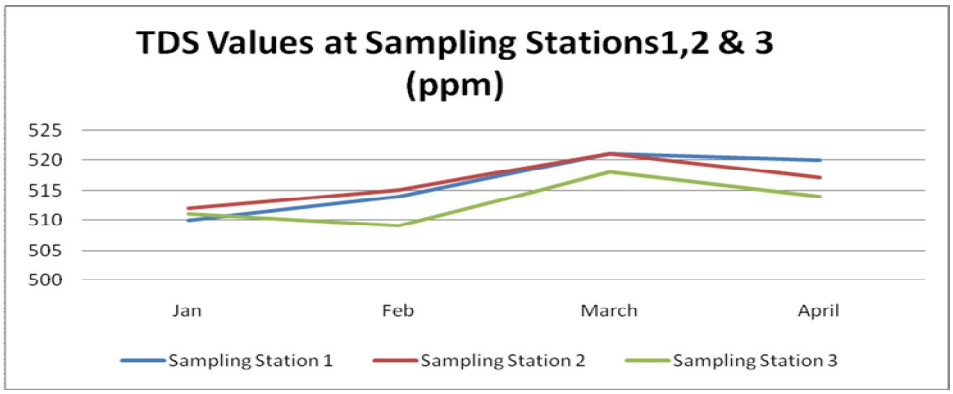

Figure No 4.4:- Graphical representation of Monthly variation of TDS value at Sampling Stations 1, 2 & 3

E. Test Result of Bio-chemical oxygen demand (BOD)

BOD is a measure of quantity of oxygen required by bacteria and other microorganisms under aerobic condition in order to biochemically degrade and transform organic matter present in the water body. High BOD is considered as a limiting factor for the living organisms, it is an indirect indicator of organic pollution of water body. In present studied the values of BOD were recorded with care as per the sampling procedure and it was found between 3.62 - 4.19 mg/l at all three sampling stations. Bio-chemical oxygen demand (BOD) is considered to be indicator of sanitary condition of water which influences well being of living organism. It is a measure of the quantity of oxygen used by micro-organisms in the oxidation of organic matter. In present study the BOD values varied from 3.49 mg/l -4.09 mg/l, 3.99 mg/l -4.19 mg/l, 3.79 mg/l – 4.1 mg/l for sampling station 1, sampling station 2 and sampling station 3 respectively. The highest mean value of BOD 4.12 mg/l were observed at sampling station 2 and the lowest mean value of BOD 3.805 mg/l were recorded at sampling station 1. Overall mean value of BOD was recorded as 3.96 mg/l

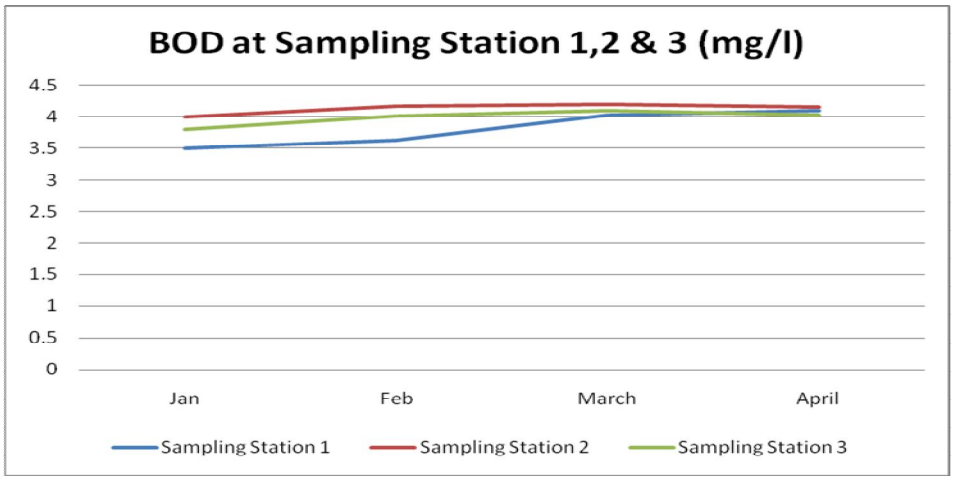

Figure No 4.5:- Graphical representation of Monthly variation of BOD value at sampling Stations 1, 2 & 3

F. Test Result of Chemical Oxygen Demand (COD)

COD gives a measure of organic strength of domestic and industrial wastes. The higher value of COD indicates the presence of undesirable organic matter, demanding investigation of the cause before the water is pronounced potable. In present study the values of COD were recorded with care as per the sampling procedure and it was found between 43.74 - 49.41 ppm at all three sampling stations. COD has indicating the pollution level due to oxidisable organic matter present in water. During the study work, Chemical oxygen demand (COD) at sampling station 1, sampling station 2, sampling station 3 were lies between 43.74 mg/l – 49.41 mg/l, 47.95 mg/l – 43.79 mg/l, 46.65 mg/l -42.65 mg/l respectively. The highest value of COD 49.41 mg/l were observed in the month of january at sampling station 1 and the lowest value of COD 42.65 mg/l were recorded in the month of April at sampling station 3. Overall mean value of COD was recorded as 45.88 mg/l.

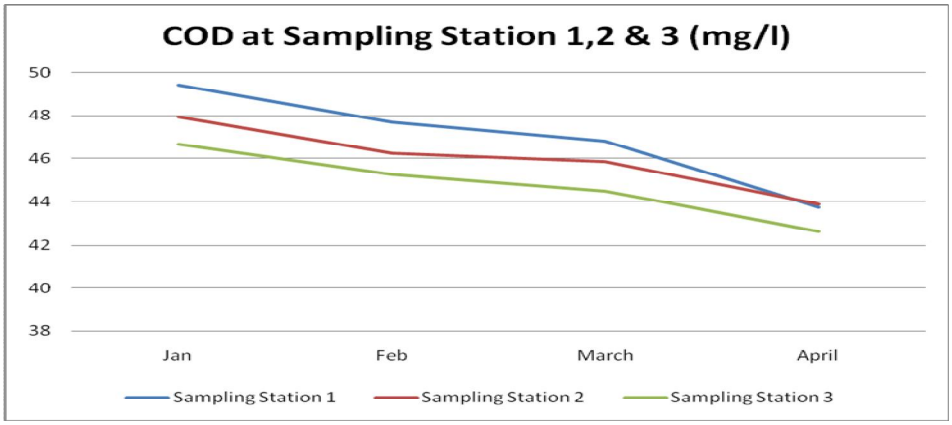

Figure No 4.6:- Graphical representation of Monthly variation of COD value at sampling Stations 1, 2 & 3

G. Test Result of Dissolved Oxygen (DO)

Dissolved oxygen is the most critical water quality variable in aquatic ecosystem. It is of primary importance both as regulator of metabolism of plant and animal communities and as an indicator of water condition. In present work the values of DO were recorded with care as per the sampling procedure and it was found between 5.1 – 5.8 mg/l at all three sampling stations. Dissolved oxygen in water is of great importance to all aquatic organisms and was considered to be the factor that reflects the biological activity taking place in a water body and determines the biological changes. The Dissolved oxygen content at sampling station 1, sampling station 2 and sampling station 3 were observed between 5.4 mg/l – 5.8 mg/l, 5.3 mg/l – 5.7 mg/l, and 5.1 mg/l – 5.5mg/l. The highest value of Dissolved oxygen 5.8 mg/l were observed at Station 1 and the lowest value of Dissolved oxygen 5.1 mg/l were recorded at sampling station 3. Overall mean value of Dissolved oxygen was recorded as 5.48 mg/l.

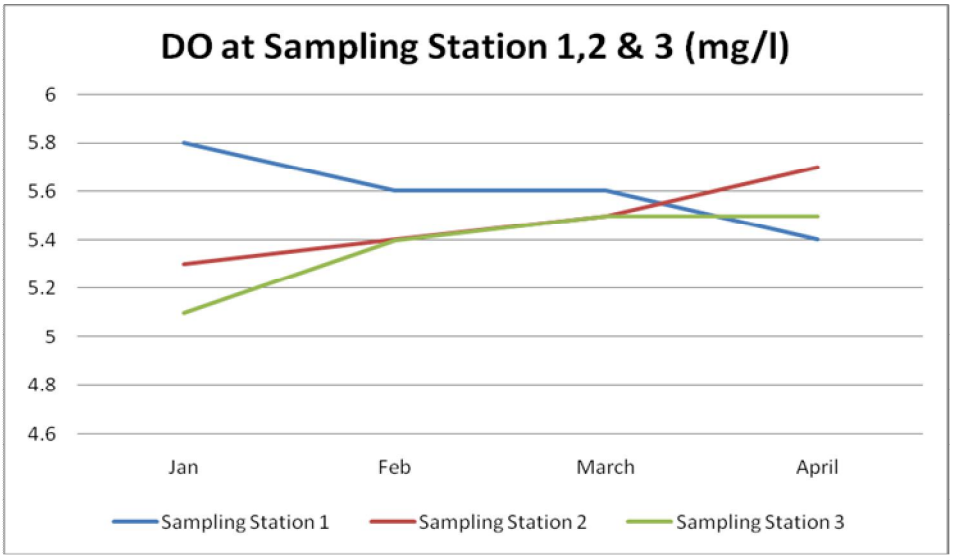

Figure No 4.7:- Graphical representation of Monthly variation of DO value at sampling stations 1, 2 & 3

H. Alkalinity

Natural water bodies show a wide range of fluctuation in total alkalinity values depending upon the location, season, plankton population and nature of bottom deposits. It is a measure of buffering capacity of the water and is important for aquatic life in a fresh water system because it acting as a stabilizer for pH. In present study the Alkalinity of water was found between 241 - 269 ppm at all three sampling stations During the study duration, Alkalinity at sampling station 1, sampling station 2, sampling station 3 were recorded between 265 mg/l -273 mg/l, 243 mg/l - 252 mg/l, 241 mg/l - 250 mg/l respectively. The highest value of Alkalinity 273.0 mg/l were observed in the month of march at station 1 and the lowest value of Alkalinity 241.0 mg/l were recorded in the month of April at station 3.

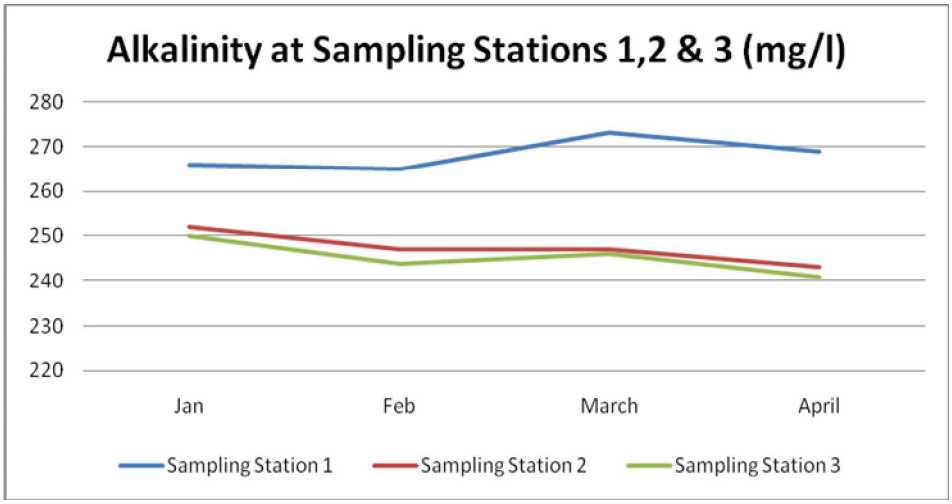

Figure No 4.8:- Graphical representation of Monthly observation of Alkalinity value at sampling stations 1, 2 & 3

I. Test Result of Total Hardness

The value of total hardness varied between 29.9 mg/l -31.9 mg/l, 30.54 mg/l - 31.7 mg/l, and 30.1-31.1 mg/l for sampling station 1, sampling station 2 and sampling station 3 respectively. The highest value of total hardness 31.9 mg/l were observed at sampling station 1 and the lowest value of total hardness 29.9 mg/l were recorded at sampling station 1. Overall mean value of total hardness was recorded as 30. 82 mg/l

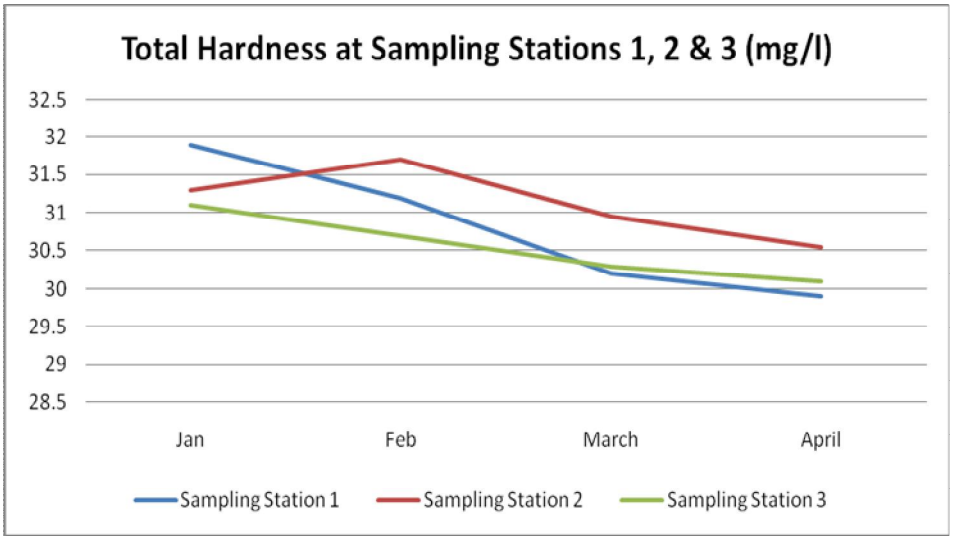

Figure No 4.9:- Graphical representation of Monthly variation of Total Hardness value at sampling stations 1, 2 & 3

J. Test Result of Total Nitrogen content

The value of Total nitrogen content values lies between 7.2 mg/l – 7.4 mg/l, 7.1 mg/l – 7.4mg/l, and 7.0 mg/l – 7.3 mg/l for sampling station 1, sampling station 2 and sampling station 3 respectively. The highest mean value of Total nitrogen content 7.4 mg/l were observed in the month of April at station 2 and 1, and the lowest value of Total nitrogen content 7.0 mg/l were recorded in the month of January at sampling station 3. Overall mean value of Total nitrogen content was recorded as 7.24 mg/l. In the ecosystem of lake the major input of nitrogen is through run off, but this may also be contributed from the decomposition of nitrogenous matter and its further oxidation (Goldman and Horne, 1993). Nitrogen is essential for many photosynthetic autotrophs. Presence of Nitrogen in water indicates presence of organic matter. Nitrogen present in water on four forms which are as: Free ammonia; Indicates recent pollution, Organic ammonia; Indicates quantity of nitrogen before decomposition has started, Nitrite (NO2 -); Indicates partly decomposed condition, Nitrate (NO3 -); Indicates old pollution (fully oxidised).

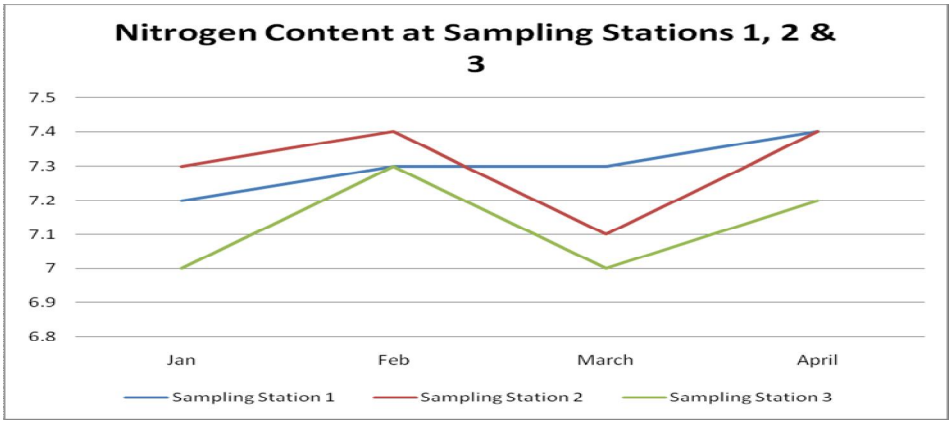

Fig No 4.10:- Graphical representation of Monthly variation of Nitrogen Content value at sampling stations 1, 2 & 3

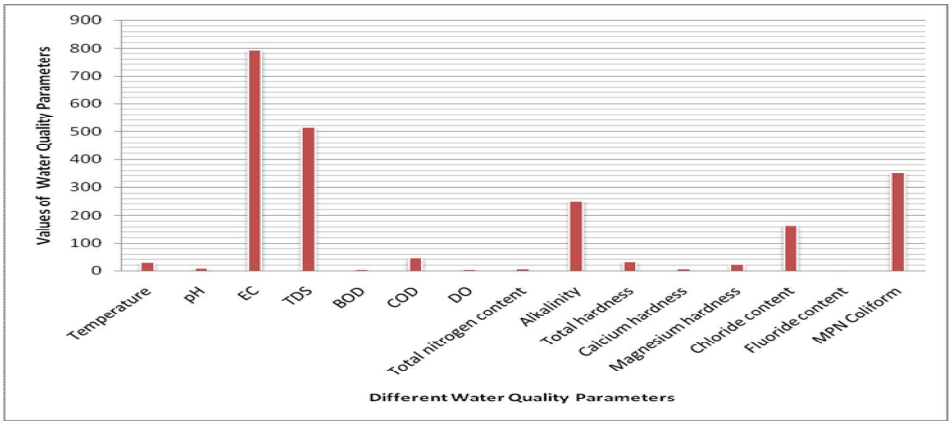

Fig No 4.11:- Graphical Representation of different water quality parameters at sampling stations 1, 2 & 3

V. CONCLUSION

The present work was conducted to find out the physico-chemical parameters and biological parameter of Goverdhan Sagar Lake Udaipur in southern Rajasthan. From this study, following conclusions have been made.

1) The present study discloses that the water temperature was determined as mean value of 28.45° C.

2) For Goverdhan Sagar Lake pH was determined with mean value of 8.7, which is moderately alkaline; high electrical conductivity and total dissolved solids supports fairly good aquatic productivity indicates initial eutrophication.

3) As far as organic loading in study area the mean value of BOD 3.96 ppm and COD 45.88 ppm was observed during the study period which is somewhere between reasonable and tolerable category of water.

4) Study also reveals that mean value of dissolved Oxygen (DO) 5.48 is satisfactory for the survival and growth of aquatic organisms.

5) Higher value of nitrogen tends to increase net productivity of aquatic ecosystem. Presence of Nitrogen in water indicates presence of organic matter and also indicates polluted status of lake. In present study the mean value of nitrogen was observed as 7.24 ppm, which is under permissible limit.

6) Property of hardness of water is due to a complex mixture of ions. The hardness is mainly due to calcium and magnesium ions. During this study period, mean value of total hardness, Calcium hardness and Magnesium hardness was observed as 30.82 ppm, 7.40 ppm and 23.43 ppm respectively, which are under permissible limits.

7) This study has supports the finding of lake water which recorded mean value of total alkalinity 253.58 ppm, hence fall under moderate to high productive water body.

8) High chlorine concentration is pollution indicator. During the study mean value of chloride content observed as 165.20 ppm which is below the permissible limit.

9) Fluoride content of study area was found 0.60 ppm as a mean value which is under the permissible limit.

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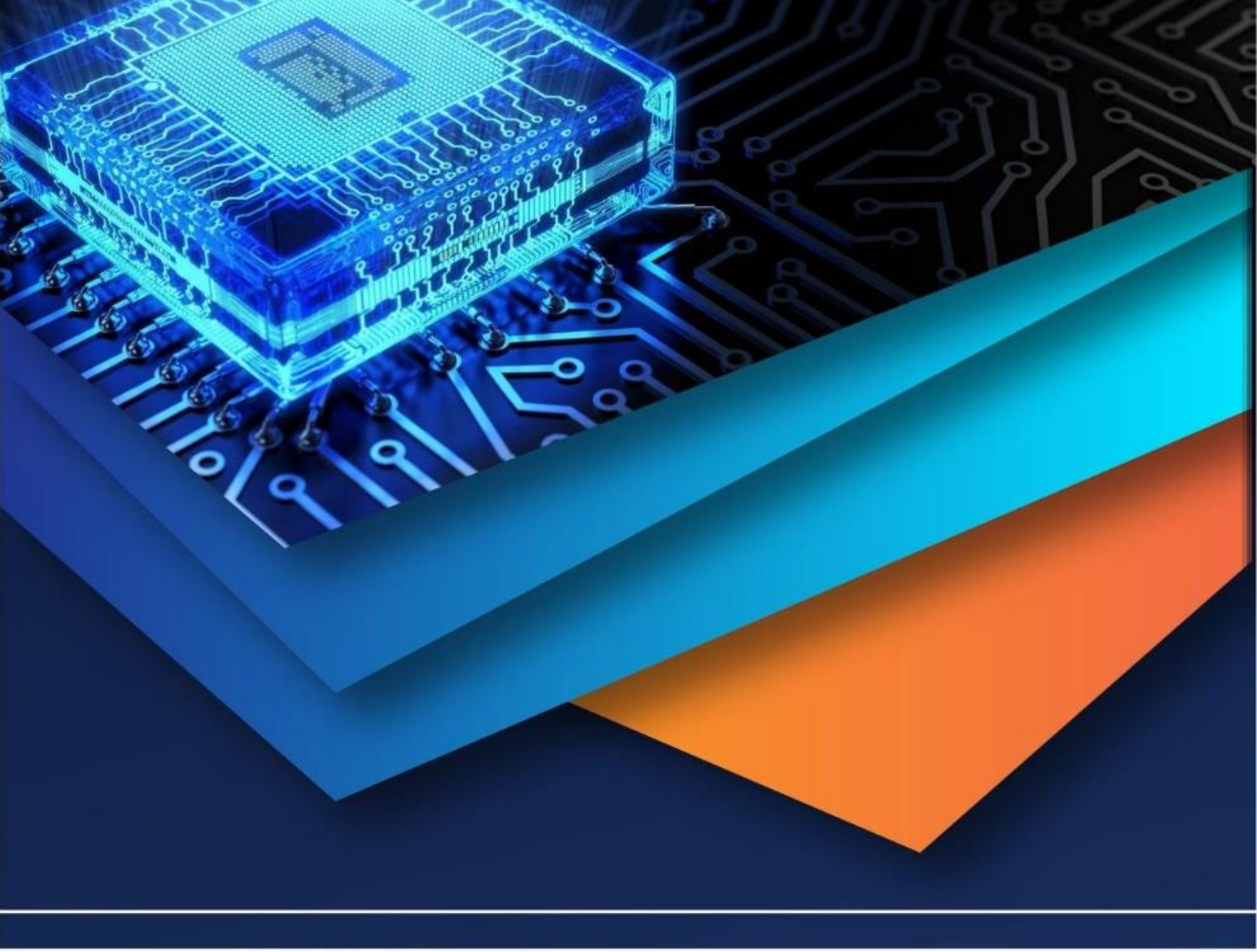

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