Assessment of Water Quality in Ramgarh Tal at Gorakhpur, U.P.
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Abstract—For the proper conservation and management of a lake it is very important that the water quality of the Lake is monitored and assessed on a regular basis. Water quality monitoring and analysis of the Ramgarh Tal was carried out for various physico-chemical, and bacteriological parameters i.e. pH, total dissolved solids, turbidity, acidity, alkalinity, total hardness, chloride, DO, BOD, COD, faecal coliform, during January-2015 to June-2015. These parameters have been determined by collecting 48 water samples from the different sampling stations of the lake during the six months that is 8 samples have been collected per month from eight sampling stations which reveal the monthly variation in water quality in the lake. There is variation for pH (7-11), TDS (240-347mg/l), Turbidity (9-22), Alkalinity (166-325mg/l), Total Hardness (126-256mg/l), Chloride (64-176mg/l), DO (1.0-14.8mg/l), BOD (5.1-9mg/l), COD (35.7-164mg/l), Fecal Coliform (220-2400).

Key words: Water Quality Assessment, BOD, COD, MPN

I. INTRODUCTION

The whole world is facing a serious problem of natural resource insufficiency, principally that of water in view of high population growth rate and industrial development [1]. Most of the fresh water bodies all over the world are getting polluted, thus decreasing the potability of water [2]. The whole living things are depend on water which exists in environment in different forms like ground water (aquifers), surface water (ocean, river, lake), precipitation (rain), moisture (in air, in soil), and snow etc. Besides groundwater, Surface water is a vital renewable resource for human beings and it is important for industrial, recreational functions and energy production. Assessment and monitoring programs of surface water are needed for the Sustainable use of water resources with decision making and management tools [3]. The water quality is ascertained by means of its physical, chemical and biological parameters [4]. The surface water quality is also affected by the chemical properties of soils on which run its.

A lake is an immense water body enclosed by soil, inhabited by various aquatic life forms, for any use of water, the pure water is considered to that which has the quality parameters within their permissible limit. Such high quality of water may be required only for drinking purposes while for other uses like agriculture and industrial, the quality of water can be quite flexible and water polluted up to certain extent in general sense can be regarded as pure[5]. The health of lakes and their biological diversity are directly related to health of almost every component of the ecology [6, 7]. Lakes are dependent of several component of environment occurring in the environment like the hydrologic cycle, with unparalleled developmental activities, directly and indirectly human beings are liable for degradation several lakes to death. Point and non-point sources of water pollution in lakes are the common causes by which different nutrients enter the aquatic ecology ensuing in their death. Eutrophication is a great water quality issues for water bodies. Eutrophication of lakes defined as the excessive nutrients in a lake or other body of water, usually caused by runoff of nutrients (animal waste, chemical wastes from industries, municipal wastewater) from the outside of the lake, which causes a intense growth of plant life, the Putrefaction of the plants exhaust the supply of oxygen, leading to the death of animal life. It depicts the biological reaction of aquatic ecosystems to excess nutrient, consequently responsible for the development of primary production to nuisance proportions. The major reason is extremely accumulation of phosphorus and nitrogen resulting in high algal biomass, dominance by cyanobacteria and loss of macrophytes [8].

Ramgarh Lake is an important natural lake of Gorakhpur District (Uttar Pradesh). The various activities such as sewage disposal, poor sanitation, waste dumping etc. are deteriorating the lake water quality. It has been found that the Ramgarh lake undergo from assorted problems viz., declension of lake water quality, soil erosion & siltation of the lake causing contraction of the lake. The restoration of the lake has been proposed under natural lake conservation plan along with the Mansi Ganga tal of Goverdhan Mathura, Laxmi tal of Jhansi and Madan Sagar of Mahoba.

II. STUDY AREA

The lake is located between the latitude of 26\textdegree 42'30'' to 26\textdegree 44'42'' and longitude of 83\textdegree 23'42'' to 83\textdegree 24'54'' in Gorakhpur, U.P. and the area of the lake is approximately 678 Ha. Eight sampling stations that is S1,S2,S3,S4,S5,S6,S7 and S8 named as SPS Kunraghan, Chaudhari Charan Singh Ramgarh east pump canal, Bharat mata temple sahara city, STP near Zoo, Naukavihar Tara Mandal, STP Padleyganj, RKBK Mohaddipur and center of the lake respectively are selected along the lake.

Fig. 1: A satellite image of Ramgarh Tal.

III. MATERIAL AND METHODS

The water samples were collected in the polyethylene bottles and stored in ice box. The samples were collected...
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(IJSRD/Vol. 3/Issue 6/2015/244)

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from eight different sampling stations. The water sample quality would be changed due to the occurrence of different physical and chemical reactions between the time interval of sample collection and laboratory analysis, therefore the chemical preservatives are added to the sample. This study was carried for a period of six months (January 2015 to June 2015). A total number of 48 samples were collected for the analysis of various physico-chemical and bacteriological parameters such as pH (universal method), turbidity (Nephelometric Method), total dissolved solids (Digital meter), dissolved oxygen (Winkler’s Method), biochemical oxygen demand (5 days incubation method), chemical oxygen demand (Dichromate reflux method), Acidity, Alkalinity, Chloride (Argentometric method), Total Hardness (EDTA method), and MPN of Fecal coliforms (Multiple dilution Method).

IV. RESULTS AND DISCUSSION

A. pH

The intensity of acidity and alkalinity of water is measured in terms of pH. The presence of carbonate and bicarbonate ions and chemical buffering in water may be responsible for the alkaline state of pH. The pH values ranges between 7 to 11. The maximum pH was recorded in June and minimum pH was recorded in January and February. The pH value more than 8 in natural water are produced by photosynthetic rate that demand more CO2 than quantities furnished by respiration and decomposition. The change in relative concentration of calcium, carbonate and bicarbonate in natural water may change the pH value in water. The pH value in natural water may also depend upon the decomposition activities because the decomposition of organic matter and vegetation CO2 is liberated which eventually reduces the pH value.

![Fig. 1: Monthly variation in pH](image)

C. Turbidity

Turbidity is mainly due to the presence of suspended solids such as clay particles, silt, organic material, phytoplankton and other microorganisms. Thus the turbidity is directly proportional to the amount of suspended solids. This suspended solids causes cloudiness of water and its measurement is the turbidity which can be measured by passing light beam through the water sample. A diminution in turbidity is related with a decline in microbial growth and suspended solids. Turbidity in Ramgarh Tal ranges between 9-22 NTU. The maximum turbidity in water was found in February. The lowering of volume of water and increase in growth of aquatic vegetation in water body affect the turbidity.

![Fig. 2: Monthly variation in TDS](image)

D. Alkalinity

The alkalinity of water depends on the concentration of carbonate and bicarbonate ions which depend upon the amount of CO2 liberated through the respiration of living organisms. The rate of photosynthesis in water body may be affected by the addition of wastewater into the water body consequently the plants and living organisms tend to death. The concentration of carbonates and bicarbonates is increased by the degradation of plants, organic material and living organism which results in increase in alkalinity of water body. The amount of alkalinity in Ramgarh tal ranges between 166-325 mg/l. The minimum value of alkalinity was reported in March and maximum value was reported in January.

![Fig. 3: Monthly variation in turbidity](image)
E. Chloride

The main sources of Chloride in water bodies are domestic wastewater and industrial wastewater. The chloride in water may be result from the salts of sodium, potassium and calcium. The Chloride value ranges between 64-176 mg/l. The maximum chloride was found in June and minimum was found in January.

F. Hardness

Hardness of water is mainly due to the presence of bivalent cations such as calcium and magnesium ions. Hardness of water does not have any adverse effect on human health and high value of Hardness of water causes high consumption of soap. The Hardness of lake water ranges between 126-259 mg/l. The maximum Hardness was found in January and minimum was found in June.

G. Dissolved Oxygen

One of the most important water quality parameter is dissolved oxygen. The concentration of dissolved oxygen affects the biological and physical process occurring in water body. Its presence is important for the aquatic life for their survival. The value of Dissolved oxygen in lake water varies between 1-14.8 mg/l. The maximum dissolved oxygen was found in April and may minimum was found in January.

H. Biochemical Oxygen Demand

The measurement of BOD of water gives an idea about the biodegradability of the organic wastes present in the water. The pollution strength in water body for which the main pollution sources are the municipal and industrial wastewater, is measured by the determination of biochemical oxygen demand in the water body. The BOD of the lake water ranges between 5.1-9.0 mg/l. The maximum BOD was reported in March and minimum was found in June.

I. Chemical Oxygen Demand

COD measurement is the determination of oxygen required for the oxidation of all the substances (biodegradable and non-biodegradable). COD of water is directly proportional to the concentration of organic materials present in water. The COD of the lake water varies between 35.74-164 mg/l. The maximum COD was found in month of February and minimum COD was found in January.
The presence of fecal coliforms indicate the bacteriological pollution in water bodies. Fecal coliforms bacteria are present in human and animal excreta which is carried by the sewage and discharged into the water bodies. In this study the fecal contamination in the lake water is found to be at high extent. The value of MPN of the fecal coliforms in the lake water ranges between 220-2400 MPN/100ml. The maximum MPN was reported in January and minimum MPN was reported in May.

![Fig. 10: Monthly variation in MPN](image)

### V. CONCLUSIONS

A detailed study of water quality of lake water in terms of various physico-chemical and bacteriological parameters shows that the status of lake water quality is found to be polluted in terms of pH, Turbidity, Organic material and fecal contaminations. The lake water is found turbid and alkaline in nature. BOD and COD of the lake water show high level of organic pollution. High MPN value of fecal coliforms shows the bacteriological contamination in lake water. A comparison of the lake water quality with respect to the water quality criteria for the designated best use of the surface water reveals that the water quality in lake does not satisfy the criteria of any class of water in terms of pH and BOD. The remediation methods for Lake should focus on the reduction of the level of organic matter in the lake water and the reduction of the fecal contamination.

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