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Assessment of water quality of Kanwar Lake, Begusarai, Bihar, India

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Abstract
All life on earth depends on water, fresh water is a critical, finite, vulnerable, renewable natural resource on the earth and plays as important role in our living environment without it life is impossible. The present investigation has been planned for assessment and monitoring of water quality of Kanwar Lake Begusaria, Bihar. Monthly variation of water quality of Kanwar Lake was investigated during January to June 2017. The variation in physical and chemical parameters like pH, electrical conductivity, turbidity, total dissolved solids, alkalinity, chloride, total hardness, calcium hardness, biological oxygen demand, dissolved oxygen, chemical oxygen demand and iron were analysed. All parameters except biological oxygen demand and total dissolved solids were found under the permissible limits.

Keywords: Kanwar Lake, Pollution, Physio-chemical parameters, Aquatic ecosystem, Human Health.

Introduction
After air, water can be stated as the second most important resource which is important to sustain life. Water is the most abundant as well as a critical resource which is found in nature and covers approximately $^{3}/_{4}^{th}$ of the earth's surface. Although being so abundant many factors have contributed for its limitation to be actually utilized for human use. Ninety-eight percent of the planet's water comprises of the oceans which can't be used for drinking as the salt content is very high. The remaining 2 percent is fresh water out of which 1.6 percent is stored up in the polar ice caps and glaciers. Aquifers and wells contain 0.36 percent of world's water; Lakes and Rivers comprise of only about 0.66 percent of the planet's total water supply. The emergence of civilization and subsequent industrialization by man has caused a great damage to our ecosystem and disturbed the natural environment. Wastes in the form of solid, liquid and gaseous emissions are being continuously discharged. Pollutants come into lake from various types of sources like point sources (especially discharges of wastewater), non-points sources, and diffuse sources and also from atmospheric depositions. Lakes and ponds don't hold back as most of the lakes in major cities have been polluted. Water pollution has posed a serious challenge due to its effect on economic activities. The problem of water pollution holds greater relevance in the context of a developing country like India. Kanwar Lake is situated in the Begusaria district of Bihar, and a lot of people draw their employment from the lake in terms of agriculture, fisheries, tourism, etc. it connects a lot of people through the various activities and can be stated as a source of cultural heritage which holds a lot of importance in itself. But the same activities that provide revenue, employment, residence, food and recreation to the people become a threat to the Lake.

Study Area
The government of Bihar established the Kanwar Lake Bird Sanctuary in the year 1987 to protect different species of migrating birds in Bihar. The KLBS is geographically located in the marshes and grasslands spread around Kanwar Taal or Kabar Taal Lake, which is Asia's largest freshwater oxbow lake in Begusarai District. It is of area 67.5 sq. km (26.06 sq. miles) in Bihar. It is approximately three times the size of the Bharatpur Sanctuary. This sanctuary is covered by different water bodies, marshes and wet grasslands etc. The lake is surrounded by the river Burigandak and spreads over 6000+ ha in district Begusarai (Bihar). It has high curvature and circular bend ended into hook - like connection towards the river Burigandak. Kanwar lake is situated at 25°35' N latitude and 86 ° 10' E longitudes. It is one of the most important wetlands of upper Indo-Gangetic plain. The Kanwar Lake has been classified as wetland type 19 due to presence of habitat (Scott, 1989). Traditionally, the wetland has been used for water supply for irrigation and domestic purposes, fishing, netting of migratory waterfowl for sale, harvesting of wild rice, and gathering of the edible mollusc, *Pila globosa*.

It plays a significant role in lives of local people. More than 41 species of commercially valuable fishes have been recorded (Anon, 2004) [1].

Methodology

During the present research work ten spots of Kanwar Lake were selected for collection of sample. Water samples were collected at the monthly intervals for six months. One litre of water sample was collected in pre-treated plastic bottles and preserved till all analysis were completed. Water samples were analysed for physico-chemical parameters pH, electrical conductivity, turbidity, total dissolved solids, alkalinity, chloride, total hardness, calcium hardness, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand and iron.

Results and Discussion

The requirement of water in all lives, from microorganisms to human beings, is increased day-by-day, now days it is a serious problem to provide a safe drinking water because all water resources have reached to a point of crisis due to unplanned urbanization and industrialization.

pH is also an essential parameter of water quality which is governed by the carbon dioxide, bicarbonate equilibrium. The pH of Kanwar lake water varied from 6.80 to 7.93. It was observed minimum pH 6.80 at spot 10 and maximum pH 7.93 at spot 1 in the month of June. The water was slightly acidic to alkaline throughout the time period. All the samples were observed under the safe limit (6.5-8.5), suggested by BIS for surface water quality.

Electrical conductivity is reciprocal to electrical resistance. It is the numerical expression of the ability of water sample to carry electric current (Kumar and Sinha, 2010) [8]. The electrical conductivity of Kanwar lake water ranges between 0.11 to 0.36mS/cm. It was observed minimum EC 0.11mS/cm at spot 10 in the month of March and maximum EC 0.36mS/cm at spot 1 in the month of May. All the samples were observed under the safe limit (0.5-1.5mS/cm), suggested by BIS for surface water quality. The electrical conductivity of water is a measure to confirm the presence of different ions in it and also about its purity. It depends on the concentration of different ions, nutrients and dissolved solutes.

Turbidity is caused by wide variety of suspended and colloidal materials. Run-off from barren areas during rain is the most natural contributor of turbidity, particularly silt and clay. The discharge of untreated industrial and domestic effluents also adds great quantities of turbidity. The probability of presence of pathogenic organisms is also increased in turbid water (Kumar and Chopra, 2012) [9]. The turbidity of Kanwar lake water ranges between 0.1 to 5.1NTU. It was observed minimum turbidity 0.1NTU at spot 5, 6, 7, 8, 9 and 10 in the month of January to June and maximum turbidity 5.1NTU at spot 1 in the month of June. Except spot 1 in the month of June all the samples were observed under the safe limit (5NTU), suggested by BIS for surface water quality.

The total dissolved solids in water comprises mainly of inorganic salts and small amount of organic matter such as carbonate, bicarbonate, chloride, sulphate, nitrate, sodium, potassium, calcium and magnesium. The total dissolved solids in water originate from natural sources and depend upon location, geological nature of the Lake Basin, drainage, rainfall, bottom deposit and inflowing water (Kaushik and Saksena, 1999) [7]. The total dissolved solids of Kanwar lake water ranges between 108 to 570 mg/l. It was observed minimum TDS 108 mg/l at spot 9 and maximum TDS 570 mg/l at spot 1 in the month of May. Spots 1 and 2 were observed higher the safe limit (500mg/l) throughout the period of study as these points were highly affected by human activities like bathing, washing, cattle bath etc. During summer due to water shortage at spot 1 and 2 the anthropogenic activities increased till spot 3 and therefore TDS of spot 3 was above the safe limit in the month of May and June. Remaining spots 4, 5, 6, 7, 8, 9, and 10 were observed under the safe limit (500 mg/l), suggested by BIS for surface water quality.

Alkalinity of water is its capacity to neutralize acid and is characterized by the presence of hydroxyl ($OH^{-)}$ ions capable of combining with hydrogen (H^+) ions in solution (Kaushik and Saksena, 1999) [7]. Total alkalinity of Kanwar lake water was ranges between 5.0 to 20 mg/l. It was observed minimum alkalinity 5 mg/l at spot 10 in the month March and maximum alkalinity 20 mg/l at spot 1 and 3 in the month of January and June. All the samples were observed under the safe limit (200mg/l), suggested by BIS for surface water quality.

The chloride is present in all natural waters, mostly at low concentrations. Chlorine in the form of chloride ion (Cl^-) is one of the major anions in water. Presence of chloride in water could be due to various sources like, natural weathering of rocks, domestic waste and through artificial or natural chemical reactions. Salty taste of water is produced by Cl^- ions but the chemical composition and the abundance of some cations like Na^+, Ca^{2+} and Mg^{2+} in water generally govern the taste (Dikio, 2010) [3]. Chloride of Kanwar lake water ranges between 4.2 to 10.4 mg/l. It was observed minimum chloride 4.2 mg/l at spot 7 and 10 in the month of June and maximum chloride 10.4 mg/l at spot 1 in the month of May and June. All the samples were observed under the safe limit (250mg/l), suggested by BIS for surface water quality.

It has specified the total hardness of water to be within 300 mg/l of $CaCO_3$. Total hardness of Kanwar lake water ranges between 81 to 125 mg/l. It was observed minimum hardness 81mg/l at spot 10 in the month of June and maximum hardness 125 mg/l at spot 1 in the month of May. All the samples were observed under the safe limit (300mg/l), suggested by BIS for surface water quality.

Calcium Hardness of Kanwar lake water ranges between 41.8 to 69.1mg/l. It was observed minimum calcium 41.8 mg/l at spot 10 in the month of May and maximum calcium 69.1 mg/l at spot 2 in the month of January. All the samples were observed under the safe limit (75mg/l), suggested by BIS for surface water quality. Calcium is one of the elements which exist in divalent form Ca^{2+} ion in water. It is the main component of different aquatic shells and bones of vertebrates (Jhingran, 1975) [6].

Dissolved Oxygen of Kanwar lake water ranges between 2.2 to 5.6 mg/l. It was observed minimum DO 2.2 mg/l at spot 1 in the month of January, February, April, May and June because it was affected by human beings activities. Maximum DO 5.6 mg/l was observed at spot 7 in the month of January because it was not affected by human beings activities. All the samples were observed under the safe limit (>6.0 mg/l), suggested by BIS for surface water quality. Dissolved oxygen is one of the important parameters of water which directly effects the survival and distribution of flora and fauna in an ecosystem. It is one of the most reliable parameters in assessing the trophic status and the magnitude of eutrophication in aquatic ecosystem (Edmondson, 1966) [4].

Biochemical Oxygen Demand (BOD) is an indicator of organic pollution. The high value of BOD is an indicator of high pollutant load drained from urban areas to the water

bodies (Pathak *et al.*, 2012) [11]**.** Reason of high values of BOD may be due to agricultural and domestic discharge in the water (Mullar *et al.*, 2012) [10]. Biochemical Oxygen Demand of Kanwar Lake ranges between 1 to 5.2 mg/l. It was observed minimum BOD 1 mg/l at spot 10 in the month of May and June because it was not affected by human beings activities. Maximum BOD 5.2 mg/l was observed at spot 3 in the month of May because it was affected by human beings activities. Samples of spot 1, 2, 3 and 4 were observed above the safe limit (<2.0 mg/l), and samples of spot 5, 6, 7, 8, 9 and 10 were observed within the safe limit (<2.0 mg/l) suggested by BIS for surface water quality.

The increase in Chemical Oxygen Demand is mainly attributed to the increase in the air and water temperatures, facilitating the decomposition and oxidation of organic matter and higher the COD is the indication of increased organic loads due to increased household wastewater and waste discharges (Mullar *et al.*, 2012) [10]. Chemical Oxygen Demand of Kanwar lake water ranges between 1.10 to 7.40 mg/l. It was observed minimum COD 1.10 mg/l at spot 10 in the month of June and maximum COD 7.40 mg/l at spot 1 in the month of January. All the samples were observed under the safe limit (250mg/l), suggested by BIS for surface water quality.

The high Iron concentration could be attributed to anthropogenic activities and land runoff. The high level (>200 mg/l) of iron can cause hemochromatosis with symptoms such as chronic fatigue, arthritis, heart disease, cirrhosis, thyroid disease. The iron concentration in water causes conjunctivitis, choroiditis and retinitis if in contacts and remains in the tissues (Huang 2003; Kayode *et al.* 2006) [5]. The presence of high concentration of iron may also increase the hazard of pathogenic organisms; since most of them need Fe for their growth (Tiwana *et al.* 2005) [13]. Iron of Kanwar lake water ranges between 0.12 to 0.23 mg/l. It was observed minimum Fe 0.12 mg/l at spot 10 in the month of May and June and maximum Fe 0.23 mg/l at spot 1 in the month of January, February and Mach. All the samples were observed under the safe limit (0.3mg/l) suggested by BIS for surface water quality.

Conclusion

It is concluded that water quality parameters of ten selected spots of Kanwar Lake shows that pH, EC, Turbidity, Alkalinity, DO, COD, Fe, Chloride, Total Hardness and Calcium Hardness were found under the permissible limits given by BIS. The BOD and TDS were above the permissible limit.

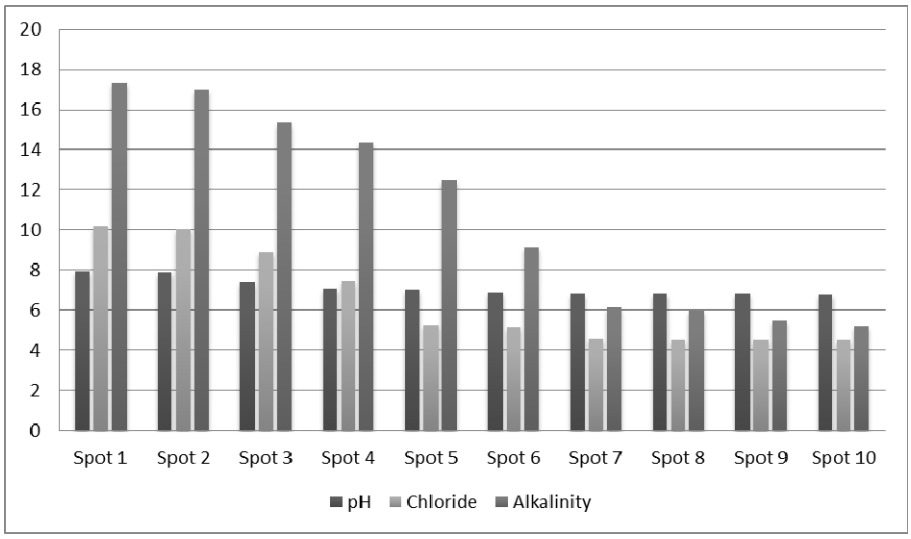

Fig 1: pH, Chloride and Alkalinity of Kanwar Lake during experiment**.**

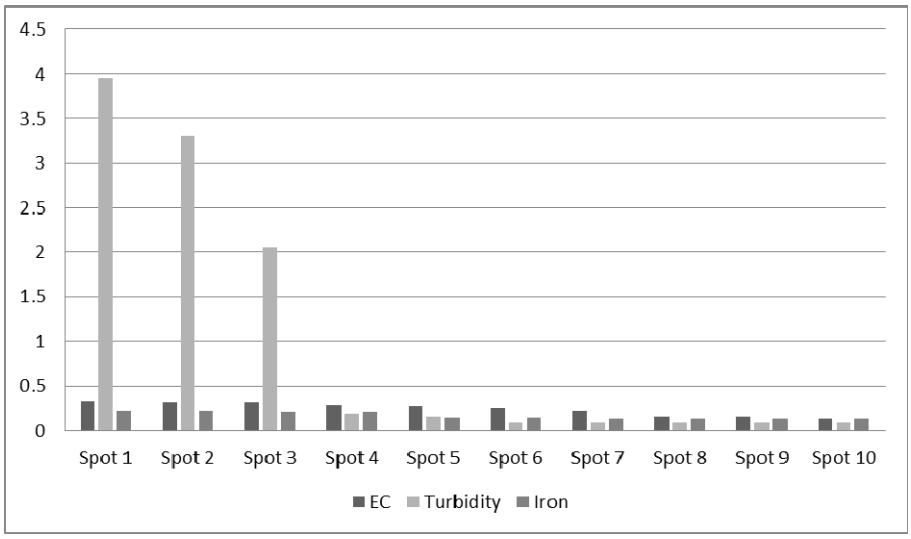

Fig 2: EC, Turbidity and Iron of Kanwar Lake during experiment.

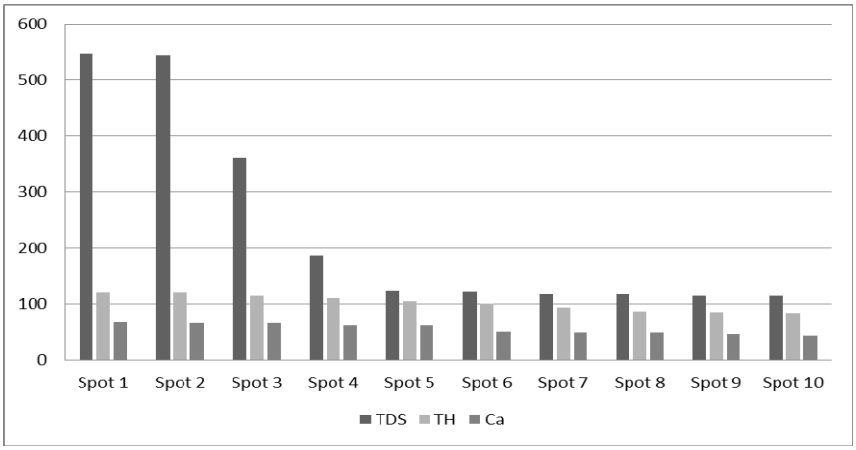

Fig 3: TDS, TH and Ca of Kanwar Lake during experiment.

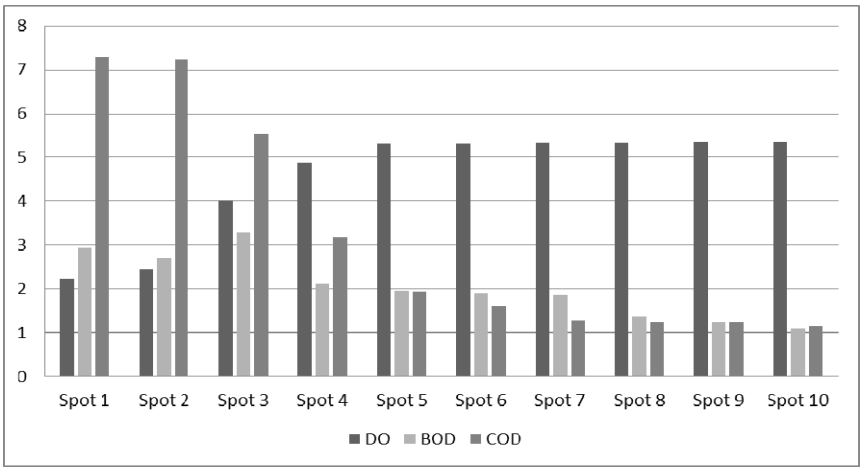

Fig 4: DO, BOD and COD of Kanwar Lake during experiment**.**

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