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Studies on Physicochemical Properties of Water with Special Reference to Ichthyofauna at Rajghat Dam, Sagar (M.P.) India

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Abstract: Water is one of most important constituents of life support system. It is indeed a wonderful chemical medium which has unique properties of dissolving and carrying in suspension a huge variety of chemicals. Natural surface water bodies often have impurities from various sources. The impurities may be suspended particles, colloidal materials and may also be dissolved cationic and anionic substances. Various kind of natural and man-made activities, like industrial, domestic, agricultural and others, day by day creating water pollution challenges with new protections to give all our children the gift of clean and safe water in the 21st century

Keywords: life support system

I. INTRODUCTION

Water is one of most important constituents of life support system. It is indeed a wonderful chemical medium which has unique properties of dissolving and carrying in suspension a huge variety of chemicals. Natural surface water bodies often have impurities from various sources. The impurities may be suspended particles, colloidal materials and may also be dissolved cationic and anionic substances. Various kind of natural and man-made activities, like industrial, domestic, agricultural and others, day by day creating water pollution challenges with new protections to give all our children the gift of clean and safe water in the 21st century.

A study of fresh water habitat with special reference to its Physicochemical and biological characteristics is termed as limnology. However, Wetzel (1975) defined the term limnology as "The study of functional relationship and productivity of fresh water biotic environment parameters". Among the pioneers in the field of limnology, the earliest known work is that of F.A. Fogel(1841-1912), who was not only studied Geneva Lake in Switzerland but also published a book "Hand Buch der seen Kunde: Alkaline limnologic" in 1901. In this book the term limnologic was used for the first time by him. Since then, the term has gained a lot of currency and at present the limnology has become an important field in the Scientific investigations. For integrated geo-environmental management/planning remote sensing has providing useful in conjunction with ground truths data on soils, land use, vegetation, surface & groundwater, geology, landforms, topography, settlements, etc.

Dams interrupt stream flow and generate hydrological changes along the integrated continuous of river ecosystems (Vanneste *et al.*, 1980) that ultimately can be reflected in their associated fisheries. The most obvious effects of placing dams on rivers result from formation of new lentic or semi-lentic environments upstream from the dam and tail water environments downstream from the dam. Both environments can be conducive to the establishment and maintenance of fish stocks for exploitation by fisheries. Natural streams supported fish communities of high species diversity which were seasonally more stable than the lower-diversity communities of modified streams Joshi et.al (2014). The disturbances such as channelization, seasonal peaks in species diversity attain levels typical of undisturbed streams. Because seasonal changes in stream quality are high, the stability of the fish community is lower in modified than in natural streams. India's Rivers, riverine biodiversity and river dependent communities are facing major threat: from large dams and other developmental activities (Das 2008). India has possibly the biggest number of large dams under construction. Over 10.8 million people depend on riverine fisheries which are degrading and collapsing at an alarming rate. Large dams are planned and are under construction in and around and are affecting ecology (Wachowski et.al

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2013). Indigenous People are being hugely impacted by these. Nonetheless, dams are being permitted disregarding community concerns and ecology. he extent to which fisheries can be developed, sustained, or protected along riverine ecosystems modified by dams reflects basin topography, geological features, watershed hydrology and climate as well as engineering features of the dam itself (Sugunan1995).

The extent to which fisheries can be developed, sustained or protected along riverine ecosystems modified by dams reflects basin topography, geological features, watershed hydrology and climate as well as engineering features of the dam itself (Sugunan 1995). Dams alter the flow, temperature and sediment regime of lotic systems. The links between dam, hydrological changes and fisheries require urgent attention and more work. Hydrological modification, absence of water in rivers shows reductions in species' richness due to an overall reduction in habitat heterogeneity. So the objective of this investigation was to find out hydro-biological parameters of Bansagar Valley Project with ichthyofaunal biodiversity for period of 2012-2014.

Physicochemical Properties

Water is the most important object on the earth and physicochemical parameter study of water means the study of physical and chemical properties of water. Those properties includes physical properties like state, colour, odore, smell, taste, hardeness, electrical conductivity, B.P., M.P., Density etc. and chemical properties includes pH, TDS, TA., CL-, CO2-, NO3-, SO4-, Na-, SO4-, Na+, K+, Ca+, etc. Change in Physicochemical properties of water result into the change in quality of water that's why study of those properties are very important, While studying the physicochemical properties World Health Organization (WHO), United States Public Drinking Water Standard (USPH) and Indian Council of Medical Research (ICMR) have sets some standards. Results were compared with standards values. For the development of fisheries, adequate information related to the physical, chemical and biological conditions of the water body is very essential. The basic intention behind the present investigation was to unearth this vital information.

Ichthyofauna

The ichthyofaunal diversity is a good indicator of health of aquatic ecosystem. A good piscine diversity represents the balanced ecosystem. Fishes are aquatic creatures, perfectly adapted for life in water. Fresh-water bodies comprise variety of fishes. Fishes alone contribute about 2,546 species and the fishes of inland water bodies of Indian subcontinent have been subject of study since last century (Kalbande et al., 2008). Human being from time immemorial use fishes for various purpose. Millions of human are suffering from hunger and malnutrition while fishes from rich source of food and provide a meal to tide over a nutritional difficulties of man. Fishes have formed an important item of human diet from time immemorial and are primarily caught for this purpose (Sarwade and Khillare, 2010). In order to maintain sustainable development and stability of ecosystem, surveillance of fish faunal diversity of water bodies is needed.

Datta Munshi. J.and J. S. Datta Munshi (2006). Lakes and reservoir. In: Fundamentals of Freshwater Biology Chandra, K. and Sharma, R.M. (2007).Vyas. (2007) Mesosoma habitat mapping of Narmada River. Britannica(2008). "Benthos' 'Ichthyofaunal diversity of Madhya Pradesh and Chhattisgarh. Proceedings of the workshop on "Conservation Assessment of fresh water Fish Diversity (CAFF) for central India". Britannica(2008). Mishra A. K., Mathur R., Gupta R.B. and Arya M. (2010),Jayaram, Shrivastava *et al*., (2010) reported that the microbes used in EM technology are non- harmful, non-pathogenic, non-genetically engineered or modified and non-chemically synthesized. The bacterial consortium used has *B.subtilis, Cellulomonas*'., *Lactobacillus* sp*., Rhizo bacteria spheroids, Rhod pseudomonas palustris.* Microbes originated from their own environment previously exposed to organic substances have greater degradation ability of related waste in biodegradation process. Arora (2012). Study was for Physicochemical parameters causing pollution of God River.

Raghav et al., (2014) research work has been carried out to analyse the physicochemical characteristics of Yamuna River water and to reduce the load BOD, COD, hardness, alkalinity, acidity, dissolved solids, suspended solids, total solids by the process of bioremediation using bacterial consortium. The bacterial consortium treated water sample showed a sharp reduction in BOD i.e., 89% and 84% in COD. The result of the study indicates that Effective bacterial consortium helps in the reduction of water impurities. The observation revealed that the inoculation of bacterial consortium in water may release the nutrients through biodegradation of the organic/inorganic matter of water sources,

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which promote the plant growth. Electrical conductivity or salinity should increase with time in the reservoirs, as a result of salt built-up resulting from evaporation. Could eventually pose a threat for irrigation (Molema,2016).Temperatures prediction for reservoirs depend on geographical and meteorological criteria. The limited mean depth of the reservoirs means that a significant area of the reservoirs will consists of shallow waters which generally show higher temperatures (Loucks, 2017).

K.C. (2010) The freshwater fishes of the Indian region. Bose, A.K., Jha, V.R.B.C Suresh, Das A.K., Parashar, A. and Riddhi (2013). .

OBJECTIVES

The objectives of the present study are following:

1. The general survey of the Rajghat Dam Sagar was made in regard to history, geology, geographical, situation and local climatic condition.

2. Determine physicochemical properties of the worst affected water resource from dam structures and water diversions and to assess the fish food organisms, diversity and populations affected this system.

Study Area : Rajghat Dam Sagar:-

Rajghat Dam is an Inter-state Dam project of the Government of Madhya Pradesh and Uttar Pradesh being constructed on Betva River about 14 km from Historical place of Chanderi in M.P. and 22km from Lalitpur in Uttar Pradesh, India. The catchment area of Bewas River at the dam site is 472 Sq.Kms with 1700-hectare submergence area is located between 23° 23' 36" N to 23° 46' 22" N latitude and 78° 30' 32"E to 78°46'42" E longitude. The Bewas River originates from the northeast part of Raisen district located at about 720 meters near the Pipalia Katan. The dam site is situated in three rivers i.e., Bewas River, Parkul River, and Jamunia River junction at Hinota village, Sagar (M. P.). Bewas River is 53.03 Kms, Parkul River is 33.93 Kms, and Jamunia River is 18.05 Kms. long at the dam site. Objective of study was for duration of 2020-2021 to Rapid agricultural development and influx of municipal waste into the dam has increased during past few years. So, In this study macrophytes, plankton and fish faunal diversity of the dam has been recorded as bio-indicators for the water quality of the dam. The study was performed on the physicochemical parameters of water in Rajghat Dam in Bewas River of Sagar.

Fig. Map of Rajghat Dam in Bewas River of Sagar

Sample Collection:

Water samples were collected from four different sites (S1, S2, S3, and S4) of each lake (AS, DS, JD and MD) during the month of April, 2024. The samples were collected in plastic container between 10:00 am to 4:00 pm and brought to the laboratory in an icebox jar to avoid unusual change in water quality. Standard methods for sample collection and

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preservation were followed during the study (APHA, 2005). Some physical data like, temperature, pH were recorded in the field at the time of sample collection. Geo coordinates for the studied lakes were taken by the GPS system.

Analysis:

Water samples were collected from 16 different sites (4 sites in each lake) and are analysed for 17 different physico-chemical parameters of water quality, followed by standard methodologies of APHA (2005). That includes 7 physical and 10 chemical parameters such as pH, temperature, Electrical conductivity (EC), total dissolve solids (TDS), total suspended solids (TSS), dissolve oxygen (DO), biochemical oxygen demand (BOD), total hardness (TH), alkalinity, chloride etc. Obtained results of the different parameters are compared with standard value prescribed by BIS (1991) and WHO (1997).

II. RESULT AND DISCUSSION

Natural water body contains uniform water solution which undergoes unremitting physicochemical transformation due to circulation in the environment that greatly affects the water quality composition. Variation in results is found between different lakes as well as within different sites of the lakes. However there could be always a chance for difference in test result in different laboratories because of laboratory approach, sample preservation, quality of chemicals used and testing methods applied (Weldemarim, 2013). Results of the physicochemical parameters obtained from this study are discussed bellow-

Temperature:

Temperature is one of the essential physical parameter of water quality to measure because it influences the aquatic life by alter the dissolve oxygen (DO) concentration in the water making oxygen less available for respiration and metabolic activity of aquatic organisms (Tank and Chippa, 2013; Jalal and Sanalkumar, 2012). Water temperature is an affective factor to control the chemical reactions and its rate within the water body that determines the usefulness of the water (Metcalf and Eddy, 2003). Temperature of the studied water bodies were measured by digital thermometer during sample collection and average temperature is recorded between 28.25oC to 31.50oC. The standard temperature for sustaining aquatic life varies between 28.00oC to 30.00oC (Weldermeriam, 2013). The average water temperature is found highest (31.50oC) in AS whereas lowest average temperature (28.25oC) is recorded in MD. High temperature of AS among the studied lakes is might be due to contamination of municipality sewage which is supported by the study of Gopalkrushna (2011) in Rajghat Dam Sagar, Madhya Pradesh, India.

pH:

pH that maintain the acidic or basic property, is a vital characteristic of any aquatic ecosystem since all the biochemical activities and retention of physico-chemical attributes of the water are greatly depend on pH of the surrounding water (Jalal and Sanal Kumar, 2013) . Most of the similar study suggested that water samples are slightly alkaline due to presence of carbonates and bicarbonates (Tank and Chippa, 2013; Gopalkrushna, 2011; Verma et al., 2012). The higher range of pH indicates higher productivity of water (Gopalkrushna, 2011) because availability of carbonates and bicarbonates in water enhance dissolve carbon dioxide level by dissociation and acts as a raw material for photosynthesis. The pH value of all the studied water samples is measured by digital pH meter and average pH is recorded between 8.12 to 8.66 which was found very approximate to the high limit (6.5 to 8.5) prescribed by the BIS (Bureau of Indian Standard). The highest and lowest pH is recorded in DS (8.66) and AS (8.12) respectively.

Colour:

Colour is an optical parameter that absorbs a fraction of visible spectrum and is reflected by the dissolved substances, colloidal substances and suspended particles present in the water. Colour of any water body is depended on the natural vegetation (decay of plant matter, algae, plankton etc.) and also altered by different anthropogenic sources viz. effluents from industries and mills. Colour of water in not an important parameter for health effect but responsible for humiliate aesthetic value. Colours of the studied lakes are found yellowish green to pale green and average value is measured between 1.73 to 3.93 HU.

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Turbidity, Total Suspended Solids (TSS) and Total Dissolve Solids (TDS):

Turbidity of water is the expression of optical property by which light is scattered by the colloidal particles present in the water. Phytoplankton, microscopic organisms, clay, slit and other organic matter makes a lake turbid (Das and Shrivastaba, 2003). High turbidity signify presence of large amount of suspended solids (Verma et al. 2012), this is again indicate the high rate of siltation so as to decrease the depth of the water body. Turbidity of the studied lakes are measured by the Turbidity meter and average value is recorded between minimum 7.57 NTU in MD to maximum 62.55 NTU in AS. Obtained turbidity is very high in all the studied lakes and found above the prescribed limits by BIS (10500-91). Comparatively high turbidity in AS may be due to the contagion of large amount of sewage water and organic pollutants from the surrounding locality. The increase in turbidity by organic pollutants resulting eutrophication of water bodies which consequently dwindle the light transmission into water and thus gradually condense overall productivity. Total suspended solids (TSS) are the composition of carbonates, bicarbonates, chlorides, phosphates, nitrates of alkali and alkaline earth metals, organic matter, salt and other particles. Water with high suspended solids is not suitable for bathing (Trivedy, 1990; Gay and Proop, 1993). Among the studied lakes average TSS is recorded 5 mg/l, 10 mg/l, 18 mg/l, 71.5 mg/l and in MD, JD, DS and AS respectively which are within the standard limit (150 mg/lit) prescribed by WHO in terms of inland surface water. Type and quantity of TDS define the color and electrical conductivity of the water body (Tank and Chippa, 2013). The amount of total dissolve solids (TDS) in water indicates salinity of water and may also be used as an indicator for rapid plankton growth and sewage contamination. In this study average TDS value is measured 162 mg/l, 336 mg/l, 348.5 mg/l, and 428.5 mg/l in DS, JD, MD and AS respectively.

Electrical Conductivity (EC):

EC is the measure of the ability of an aqueous solution to transmit an electric current. Conductivity depends upon the presence of cations and anions, their total concentration, mobility, valence and temperature of water which is a good measure of total amount of salt present in water. In the present study the average EC is recorded as 14.43 µS/cm, 14.68 µS/cm, 16.95 µS/cm and 20.60 µS/cm for JD, MD, AS and DS respectively.

Alkalinity:

Alkalinity express the buffering capacity of the water which appreciably maintain the pH by absorbing access H+ ions and protects the water body from pH fluctuation. The main species responsible for alkalinity are carbonates, bicarbonates, hydroxide ions, ammonia, organic acid etc. Alkalinity acts as a buffer against rapid pH change. Alkalinity is recorded within prescribed range and found to be related with hardness of the water because water contains metallic carbonates (mostly CaCO3) is high in alkalinity as well as hardness because metals like Ca, Mg are the main contributor of water hardness. Whereas carbonates and bicarbonates associated with sodium and potassium contribute only alkalinity not hardness because of incapability of sodium and potassium to form complex with electron donor ligands. Average value of alkalinity is obtained 60.68 mg/l, 76.72 mg/l, 97.33 mg/l and 116.79 in MD, JD, DS and AS respectively.

Total Hardness (TH):

Hardness is caused due to presence of cations like Ca+2, Mg+2, Fe+3 etc. This is the property of water to precipitate soap by formation of complex with calcium, magnesium present on water. TH of the studied lakes are found within prescribed limit and the average value is recorded 27.08 mg/l, 28.15 mg/l, 28.63 mg/l and 36.64 mg/l in DS, MD, JD and AS respectively which is the measure of total amount of Ca+2 and Mg+2 ions.

Calcium (Ca+2) and Magnesium (Mg+2):

Calcium and magnesium are exists in surface and ground water mainly as carbonates and bicarbonates. Lake water contributed calcium as due to higher proportion of calcium in the surrounding rocks and soils which is essential for plant precipitation of lime, bone building etc. The main source of magnesium is sewage inflows and minerals generate from soil erosion and are important for enzyme activation, growth of chlorophyll and phytoplankton (Ramesh and

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Seeta, 2013; Verma et.al, 2012). According to the result obtained in the present study calcium and magnesium content is found within the permissible limit given by BIS.

Dissolved Oxygen:

Dissolve oxygen which indicates the health of the ecosystem refers to the volume of oxygen present in water body. It is an important water quality parameter to be measure because it prevail biological and physicochemical attributes of surrounding water. Oxygen enters into the water by aerial diffusion and as a photosynthetic byproduct of aquatic plants and algae. The DO depends upon the temperature, salinity and pressure of the water. The DO value indicates the degree of pollution in the water bodies (Gupalkrushna, 2011). The aquatic life distressed when DO levels drops to 4-2 mg/lit. (Francis and Floyd, 2003) and as DO level falls undesirable changes in odor, taste and color reduce the usefulness of water (Tank and chippa, 2013). In this study the average DO is measured between 5.27 to 6.96 mg/lit whereas the highest concentration in MD is found 7.56 mg/ lit. and lowest concentration in DS is 4.77 mg/ lit.. DO level of studied water bodies are found within the prescribed range of BIS.

Biochemical Oxygen demand (BOD):

Biochemical oxygen demand (BOD) is an important parameter of water quality which measures the quantity of oxygen consumption by microorganisms during decomposition of organic matter. BOD is usually used for determining the oxygen demand of municipal or industrial discharge. High BOD indicates high scale contamination of organic matter in the water. Though high BOD is always accompanied by low DO level, counter result is obtained in our study which is comparable to the study of Anhwange on river Benue, Nigeria (Anhwange et al. 2012). High BOD than the prescribed value is found in all of the studied lakes where the maximum average value is found 22.90 mg/l in AS and lowest is found in MD (3.20 mg/l). Water can only hold a limited supply of dissolve oxygen in a water body and is fluctuate with diurnal cycle of the aquatic ecosystem. The probable reasons for high BOD as well as normal DO in the studied lakes suggested that there is high nitrogenous oxygen demand (NOD) than carbonaceous biochemical oxygen demand (CBOD). NOD is the result of the breakdown of proteins into ammonia, which is readily converted to nitrate in the environment. The conversion of ammonia to nitrate requires more than four times the amount of oxygen as the conversion of an equal amount of hydrocarbons to carbon dioxide and water. Agricultural practice and sewage runoff in AS increase nutrients such as nitrate and phosphate in the water which endorses the growth of aquatic plants eventually, leads to an increase in plant decay and a greater move to and fro in the diurnal dissolved oxygen level. We collected the samples between the mid hours of a day (1000 to 1600 hrs), so normal DO despite high BOD is acceptable in the studied lakes where sewage runoff and agricultural runoff as well as domestic waste contamination are the main problem.

Ammoniacal Nitrogen (NH3-N):

Ammonia in surface water can be of various sources like organic origin, inorganic origin and the air deposition. This is one of several forms of nitrogen and considered as most important indicator for soil contamination (excessive use of ammonia rich fertilizer), excretion of nitrogenous wastes from animals, and sewage contamination in aquatic environments. Although ammonia is a nutrient required for life, it is toxic for aquatic organism and excess of ammonia can accumulate in the organism cause alteration in metabolism or increase body pH. NH3-N of the studied lakes are found higher than the prescribed value of BIS and average value is ranges between 0.06 to 3.20 mg/l. Highest value in AS is recorded 4.20 mg/l whereas lowest in MD is obtained 0.00 mg/l. High NH3-N level in AS and DS evidently signify the affect of remarkable sewage contamination as well as significant organic effluence into the lakes.

Chloride (Cl-):

Chloride is present in all natural surface and ground water from as low concentration to high concentration. Chlorides are mainly come from inorganic salts like NaCl, KCl and CaCl2 etc. which are generally provided by soil, natural layers of chloride salts, municipal and industrial sewage and animal wastes (Gopalkrushna, 2011). Chloride is not harmful to humans but high concentration of chloride increase the corrosive property of water. The chloride content of

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studied water samples were within permissible limit prescribed by BIS and average values are recorded as 26.13 mg/l, 28.40 mg/l, 30.67 mg/l and 36.35 mg/l, for JD, MD, DS and AS respectively.

Nitrate (NO3-):

Inorganic nitrogen that present in water as Nitrate (NO3-) is the main nutrient that accelerates the growth of hydrophytes and algae. Nitrate occurs in water from various natural sources and due to human activities like food production, agriculture and manure disposal of domestic and industrial sewage. High level of nitrates is found in rural areas because of extensive application of nitrogenous fertilizers in agriculture. In urban areas sewage water rich in nitrates contaminate surface water thus increases the nitrate amount. (Tank, 2013; Gopalkrushna, 2011). A small amount of nitrate is common in all kinds of surface water. In this study relatively larger amount of nitrate is found in the studied lakes though obtained levels are within range prescribed by BIS. Nitrate stimulates the growth of hydrophytes and phytoplankton that consequently increase the nutrient in water body leading to eutrophication. The average nitrate value in studied lakes is found between 9.82 mg/lit to 48.30 mg/lit where minimum and maximum is obtained in MD and AS respectively.

Phosphate (PO4-3):

Phosphate has a limited source in nature and also acts as a limiting factor for productivity of water body. Phosphate may occur in lake as result of domestic waste, detergent and agricultural run off containing fertilizer (Gopalkrusna, 2011). The average value of phosphate recorded in the studied lakes ranges between 0.05 to 0.37 mg/l. Comparatively high amount of phosphate is recorded in AS (0.37 mg/l) and in DS (0.11 mg/l) which is might be due to discharge of municipality sewage and dumping of domestic waste into the lakes (Benjamin et al, 1996).

Sources of Pollution in the Lakes:

During the study so many pollution sources are found which are badly affecting the water quality of the studied lakes. Four number of municipality drains were found discharging municipality sewage in the AS on western side of the lake. In northeastern corner agriculture practice was also evidenced in a dry plot of AS. Local peoples are found depositing domestic waste into all of the studied lakes. On the west corner of DS the biomedical waste is discharge into the lake from the district hospital. Anthropogenic pressure is found moderate in JD and MD.

III. CONCLUSION

The results obtained from this study revealed that BOD, NH3 –N and Turbidity are above desirable limit suggested by BIS. The results show that the lakes of Rajghat Dam Sagar receives very high amount of pollutants from the surroundings and the lake water is highly contaminated by sewage effluents. Local peoples are ignorantly polluting the lakes and the dreadful conditions of the lakes are also visible from the satellite photo. Due to high organic matter contamination hydrophytes are growing drastically and deposited into the lake after death which consequently reducing the depth of the lake day by day. If present condition is continue for the longer period, very soon the lakes will become ecologically barren. So concern authority should take firm decision on urgent basis to resolve the problems of the Rajghat Dam Sagar. Madhya Pradesh.

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