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Analysis of Different Limnological Parameters and Cultural Eutrophication of Kalyani Lake, West Bengal, Nadia

Payel Chakraborty

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ABSTRACT
The present study deals with some limnological parameters of water of Kalyani lake in district Nadia, West Bengal to determine whether the water quality is suitable for fish culture or not. A total of nine physic- chemical parameters were measured for a period of one year (March'2011-February'2012) in three different seasons to assess the pollution load and present status of the lake following the standard method of APHA'1995. The parameters showed distinct temporal or seasonal variation. The low DO level and high level of nutrient values indicate the poor water quality of the lake for human consumption and fish culture also. The depletion of water quality is mainly due to the daily assemblage of huge amount of raw sewages from neighbouring sites, bathing of human and cattle, washing of cloths and utensils, dumping of solid wastes etc. This survey reflects the higher degree of pollution in Kalyani Lake.

KEYWORDS: Limnological parameter, Water quality, Kalyani Lake, Pollution, Cultural Eutrophication

I. INTRODUCTION

To understand the lake's physical chemical and biological properties which is very much essential to determine lake condition. In recent years almost half of the world's lakes are polluted, degraded and contaminated by various anthropological activities. The main causes of such pollution are domestic sewages,agricultural run-off, inflow of untreated effluents from different industries, habitat degradation, over-fishing, rapid rate of urbanisation etc**. Kalyani Lake of district Nadia** is a shallow type of freshwater lake and is used for carp culture (especially Indian major carps or IMCs).

Kalyani is a small industrial town of the state West Bengal, so usually there have some pollution problem due to rapid rate of industrialisation and urbanisation. The aforesaid lake is being polluted by a number of human activities such as bathing, washing their clothes, utensils etc. Moreover a huge amount of solid wastes and household sewages from the surroundings also reduce the water quality of the lake, which will be detrimental to the fisheries activities in near future of this area.

KALYANI LAKE ENTRANCE GATE

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II. LITERATURE REVIEW

GENERAL

Various technical papers on Assessment of water quality for lake have been presented at research level from which I referred many papers for study. These papers are presented below.

1. T. M. Heidtke, A. M. Asce and W. C. Sonzogni [05] have studied, results from a study of water quality planning and management alternatives for the Great Lakes are used to identify cost-effective pollution control strategies. Mathematical models and other systems analysis techniques are applied to estimate pollutional loadings, specific water quality problem areas, costs and pollutant reductions offered through alternative management strategies. A determination of how these alternatives may be expected to achieve water quality objectives for the Great Lakes is made. Data from a diversity of Great Lakes research efforts are compiled, integrated, and used to project local and lake wide water quality conditions over the next twenty years. A set of management tools, including a near shore water quality index and a series of environmental quality maps, are developed to promote communication and interpretation of Great Lakes water quality data among technical and nontechnical interests. Findings from the study support a staged approach to pollution control, whereby the most cost effective programs are implemented and their results assessed before more expensive control measures are undertaken.

2. Dr. M. K. Mahesh, B. R. Sushmitha, H. R. Uma [07] have explained, a water quality index (WQI) developed by the Canadian Council of Ministers of the Environment (CCME) was applied to Hebbal lake of Mysore, Karnataka State, India, to study its impact on aquatic life, livestock and to know whether it is suitable for recreation, irrigation and drinking. The index of the lake is rated as poor with respect to drinking, recreation and livestock, marginal with respect to Aquatic life and excellent for irrigation purpose. The overall water quality is rated as poor. The water quality is almost always endangered or deteriorated and the conditions often deviate from natural levels. Anabaena and Microcystis aeruginosa form blooms, Phacus pleuronectes is also recorded and the lake water is unsuitable to protect aquatic life.

3. R. M. Khan, M. J. Jadhav, I. R. Ustad [14] have explained, in order to understand the water quality of Triveni Lake, Physico-chemical parameters were studied and analyzed for the period of one year i.e. December 2010 to November 2011. Various physicochemical parameters, such as water temperature, air temperature, pH, humidity, conductivity, free Co2, total solid, dissolved oxygen, Total alkalinity, Total hardness, caco3, ca++, mg++ were studied. The results revealed that there was significant seasonal variation in some physicochemical parameters and most of the parameters were in normal range and indicated better quality of lake water. It has been found that the water is best for drinking purpose in winter and summer seasons.

STUDY AREA

Location of any place of the earth surface is mainly two types that are Absolute location & Relative location. Absolute location describes the location of a place based on a fixed point on Earth. The most common way is to identify the location using latitude and longitude.

Kalyani Lake is a shallow freshwater lake, located in the town Kalyani of district Nadia, West Bengal. It is positioned on 22º58′ N latitude and 88º26′ E longitude at an elevation of 8m. The total area of the lake is approximately 5 acres and the average depth is 2-5m.

Fig: 1

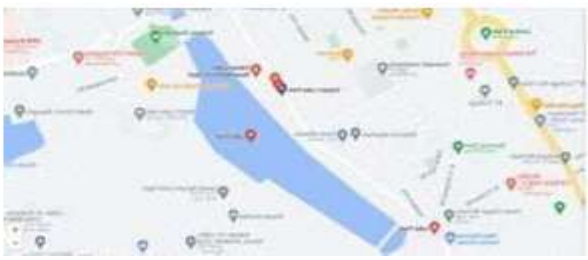

Fig:2

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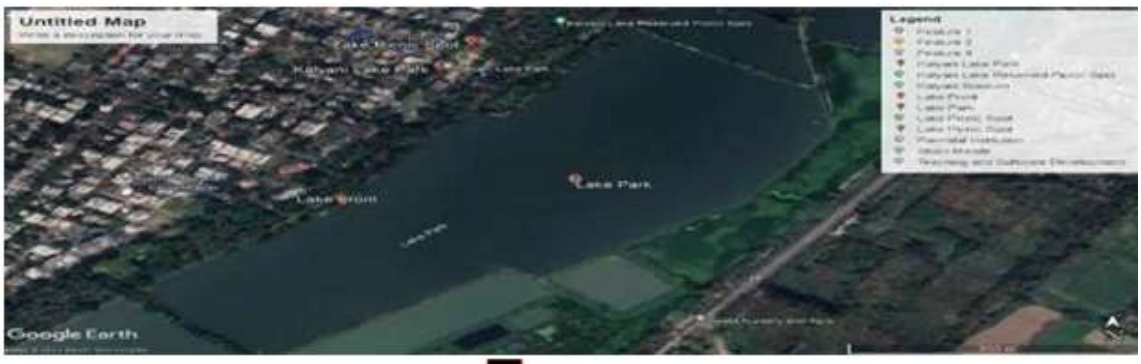

Fig :4

Fig: 4

Fig: 5

LAKE PARK, KALYANI

III. MATERIALS AND METHODS

Collection of water samples:

Water samples were collected in a 500 ml at a depth of 5 cm from two selected sampling sites for analysing different physic-chemical parameters of water. Preservation of water samples were done at 4ºC temperature.

Fig: 6

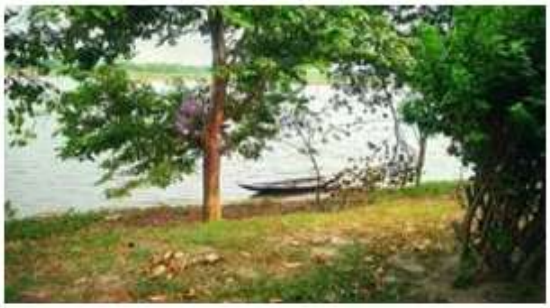

Fig: 7

Lake's physical chemical and biological properties are essential to determine lakecondition.

PHYSICAL PARAMETERS

1. WATER CLARITY

Water clarity is measured by using **Secchi disk** which is 8 inch diameter and had attached with a rope. The disk is lowered in to the water and at the depth at which it is no longer visible is recorded. Secchi disk measurement reveals how deep sunlight can reach into the water and thereby indicate general water quality condition. This measurement also helps to indicate the depth to which the lake contains enough oxygen to support fish and other aquifer life. Measurement are taken

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twice per month through May to October. It is the fundamental part of any lake monitoring. Department of public health suggest at least 48 inches of clarity for swimming safety.

2. COLOUR

Presence of suspended matter may give an apparent colour. Green, yellow-brown or red colour may be the result of presence of different microorganisms, particularly, algae. Presence of suspended, inorganic matter may also result in an apparent colour.

The colour of Kalyani lake blue green type which indicate plankton bloom.

3. ODOUR

Fresh water is odour free. Odour is caused by production of volatile organic compounds and inorganics, such as, NH3 and H2S. It is more pronounced when the dissolved oxygen in water is less than about 25% of its saturation value. Industrial wastes can also create odours directly

4. DESOLVED OXYGEN AND TEMPERATURE

Dissolved Oxygen measurement determine the amount of oxygen in the water available for fish and other aquatic life. Both desolved oxygen and temperature measurements are an integral part of a besic lake assesment.Lake temperature influence what type and how many fish will live andreproduce in the lake.Low oxygen levels may restrict where fish can go withen a lake and limit the types and number of fish in the lake's bottom waters.

Generally warm water fish needs 5 mg/L of dissolved oxygen to survibe while cold water fish require 6-7 mg/L.

For the protection of aquatic life water quality standards specify that dissolved oxygen to survive shall not be less than 6mg/L during atleast 16 hours of any 24 hour period , nor less than 5 mg/L at any time.

CHEMICAL PARAMETERS

I) Nutrients

Nutrients in lake help for plants grow. While some algae and other aquatic plants are essential part of healthy lake eco system.

Phosphorus and **nitrogen** are two nutrients of primary concern in lake. Phosphorus regulates algae growth. Because phosphorus is so important to the growth of algae and aquatic plants. Manylake and watershed management activities focus on phosphors availability in the lake water.

Phosphate is one of the major nutrients in water body. The main supply of phosphate in natural water is mainly from the leaching of soils of catchment area by rain. Cattle dung and raw sewages add phosphates to the water. The total phosphate in natural water varies from less than 1 mg/m^3 toa very high value as in a few closed saline lakes (Information on Phosphorus Amounts & Water Quality, page no 2).

Researcher are found the inorganic nitrogen concentration above 0.30mg/L. are able to stimulate algae growth.

II) Ions

The amount and type of ions(positively and negatively chaeged dissolved minarels.) in the water provide general information on the lakes overall ionic chemistry. It include alkalinity, conductivity, and PH . Mainly bicarbonates are responsible for the alkalinity of water bodies.

Alkalinity

For fish culture the overall ranges of alkalinity should be between 40 – 240 mg/l (Table 9.2. Drinking Water Quality Standards (IS: 10500)).

Total hardness in principle is the total of soluble Ca and Mg salts present in the water, expressedas its $CaCO_3$ equivalent. Total hardness above 60 ppm is desirable for fish culture (Table 9.2. Drinking Water Quality Standards (IS: 10500)).

pH

The pH scale ranges from 0 to 14. A pH of 7 is neutral, less than 7 is acidic and greater than 7 is Basic or Alkaline. pH will fluctuate in lake in each day and from season to season in response to photosynthesis by algae and other aquatic plants, watershed runoff and other factors. Like dissolved oxygen concentration. pH may change with depth primarily due to various chemical react in and decrease in photosynthesis. The standard pH value remain in between 6.5 to 9.

Hydrogen ion concentration (pH) in water is one of the important parameter for Lake Ecosystem as well as fish culture. The optimal range of pH for most aquatic life is 6.5 to 8.0. Prolonged exposure to pH less than 6 or greater than 9 can cause death for trout, salmon, and frogs. pH less than 5 causes death of most aquatic life, including insects and all fish.

Conductivity

It is measure of water ability to conduct an electric current. It is use full for estimating the concentration of total dissolved solid (TDS) in the water (TDS equals about 60 percent of conductivity).Because the measurement is made

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using two electrodes placed one centimetre apart. Conductivity is generally reportedas micromhos per centimetre. Lake with high alkalinity often have high conductivity and vice versa. **1000mg/L TDS equals to about 1700micromhos/cm conductivity.**

Suspended solid

Suspended material influence lake transparency, colour and overall eco system health. Total Suspended Solid measure actual weight of material per volume of water.

Turbidity measurement depends on how much light is scatted or absorbed by water sample

BOD

The BOD is an important parameter for assessing water quality. It deals with the amount of oxygen consumption (mg $O2\ L^{-1}$) by aerobic biological organisms to oxidize organic compounds. Sewage with high BOD can cause a decrease in oxygen of receiving waters, which in turn can cause the death of some organism.

BIOLOICAL PARAMETERS

ChlorophyII

General lake assesment criteria suggest that ChlorophyII a level Greater than about 55 microgramliter. Chlorophyll-a is tested in lakes **to determine how much algae is in the lake**. Algae is important in lakes because it adds oxygen to the water as a by-product of photosynthesis. On the other hand, if thereis too much algae in a lake it can produce a foul odor and be unpleasant for swimming.

Fecal coliform Bacteria

The presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of humans or other animals. At the time this occurred, the source water may have been contaminated by pathogens or disease-producing bacteria or viruses which can also exist in fecal material.

Some waterborne pathogenic diseases include typhoid fever, viral and bacterial gastroenteritis, and hepatitis A. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water. Fecal coliform bacteria may occur in ambient water as a result of the overflow of domestic sewage or nonpoint sources of human and animal waste

CULTURAL EUTROPHICATION OF KALYANI LAKE

In Kalyani Lake the phosphate ranged from 0.20 mg/l to 0.63 mg/l with it high and low values during monsoon and pre-monsoon respectively. It is shown that shown that high level of phosphate is responsible for eutrophication of water bodies by increasing the bacterial activities, increase in oxygen demand and increase in algal growth

Table 1: analysis of different limnological parameters of Kalyani Lake, Nadia District, West Bengal,India [PRM: Premonsoon, MON: Monsoon, POM: Post-monsoon; S^1-First sampling site, S^2-Secondsampling site.

(data collected from Studies on Water Quality With Special Reference to Limnological Characteristics of Kalyani Lake, West Bengal, India, Volume : 3 | Issue : 2 | February 2014 •ISSN No 2277 – 8179)

Limnological parameters	S1			S2			
	PRM	MON	POM	PRM	MON	POM	REMARK
Water temperature(ºC)	32.03	33.36	27.03	31.86	33.5	26.8	. Indian major carps (IMC) thrive well in the temperature ranging from 18.3ºC to 37.8ºC (). Temperature below 16.7ºC and 39.5ºC prove fatal to

							them .
pH	8.07	7.41	7.91	8.08	7.45	7.86	The pH values of Kalyani lake during study period ranged from 7.16 to 8.37 showing little alkaline nature of its water. Swingle (1967) showed that in the pH range of 6.5 to 9.0 recorded before daybreak are most suitable for pond culture. Low pH indicates high levels of dissolved carbon-di-oxide and pH more than 9 is stressful for carp culture, moreover Fish dies at about pH 11
DO(mg/l)	3.75	3.96	5.61	3.73	4.01	5.69	In the study period the range of DO varies between 2.76 mg/l to 6.10 mg/l from the both sampling sites. The meanvalue of DO remained high in the post monsoon months and its mean value remained comparatively low in the pre-monsoon months. The

							recommended range of DO for carp culture is from 4 mg/l. Very low and very high values of DO have an adverse effect

							over fish production and other faunal communities
BOD (mg/l)	2.57	2.51	4.29	2.68	2.50	4.21	The Biological oxygen demand (BOD) value of Kalyani lake showed its range from 1.75 mg/l to 4.90 mg/l. Its average peakvalue (4.29 mg/l) was seen in S^1 during post-monsoon and its average lowest value (2.50 mg/l) was recorded from S^2 during monsoon months. The recommended BIS standard for BOD value of water is 5 mg/l

Total alkalimity(mg/l)	38.03	43.84	30.22	37.28	45.76	31.43	For fish culture the overall ranges of alkalinity should be between 40 – 240 mg/l . The value of total alkalinity in Kalyani lake ranged from 27.05 mg/l to 53.58 mg/l with its mean highest value (45.76 mg/l) in S^2 during monsoon and the mean lowest value (30.22 mg/l) was recorded in post monsoon months from S^1. The increase in total alkalinity during summer and rainy season was due tothe concentration of nutrients in the lake water and in winter the values remained low due to slow decomposition of organic matters, CO_2 production was less (Patra et. al., 2010). Alkalinity is commonly influenced by bicarbonate and thus it reported as calcium carbonate(CaCO3) in the water.
							Total hardness in principle is the total of soluble Caand Mg salts present in the water, expressed as its $CaCO_3$ equivalent. Total

Total hardness(mg/l)	117.94	110.89	100.54	117.04	110.92	101.87	hardness above 60 ppm is desirable for fish culture . The maximum values of total hardness(with mean peak value 117.94 mg/l in S^1) were recorded during pre-monsoon months in Kalyani lake, which had a decreasing trend in monsoon months and in post-monsoon the total hardness value reached its lowest value (mean lowest value-100.54 mg/l in S^1). Studies revealed that the dilution of hardness depends with the introduction of monsoon (Chakraborty et.al.,1959; Goldmanand Wetzel,1963) and its value increases withthe decrease in water levels(Subho Rao and Govind,1964).

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Nitrate(mg/l)	0.87	1.55	1.03	0.86	1.52	1.12	nitrates are the prime index of immediate fertility of water. The values of nitrates ranged between 0.75 mg/l and 1.79 mg/l throughout the year in the study area. Nitrate values were low in summer months and remain high inrainy season in both sampling sites. The high values were due to the activities of denitrifying bacteria which break up nitrates into nitrites and ammonia (Hutchinson,1967).For fish production in the Kalyanilake, the values of nitrates are much higher than its limit. Super saturation of nitrogen can occur at the air-water interface, which at times causes 'gas-bubble disease' to fishes .

Phosphate(mg/l)	0.33	0.59	0.35	0.35	0.59	0.40	In Kalyani Lake 0.20 mg/l to 0.63 mg/l with it high and low values during monsoon and pre-monsoon respectively. High level of phosphate is reason for eutrophication of water bodies by increasing the increase in algal growth

Sulphate(mg/l)	13.61	14.46	14.49	13.87	14.30	16.70	Lakes receive sulphates dissolved in rain water and through the dissolution of sulphate co mpounds present in the sedimentary rocks of catchment area. Inlakes sulphate values have been found to vary from >1 mg/l to 30 mg/l depending upon the geology of the drainage (Jhingran, 1991). In Kalyani lake the values of sulphate ranged from 9.72 mg/l to 18.72 mg/l with its average lowest (13.61 mg/l in S^1) and average highest (16.70 mg/l in S^2) value during summer and winter months respectively

IV. CONCLUSION

As we know that the wetlands such as lakes are one of the most productive ecosystem and they play an important role to maintain the socio-economic condition of concerned region through various fisheries activities. On the other hand the lakes contain a huge amount of floral and faunal communities, thus they also play a vital role in maintaining this enormous biodiversity. On the basis of above findings it may be concluded that the water of Kalyani lake is not good enough for human consumption, irrigation more over the lake water is very much prone to eutrophication, as it receives massive amount of raw sewages from the neighbouring sites and various human activities. The nutrient levels become very high which is unsuitable for fish culture also. So we should take some effective measures immediately to control this aquatic pollution, to restore the biodiversity and to enhance the production potentials in the lake.

V. ACKNOWLEDGEMENT

I would like to express my special thanks of gratitude to my teachers who gave me the golden opportunity to do this wonderful project on the topic, Analysis of different limnological parameters and Cultural eutrophication of Kalyani Lake, west Bengal, Nadia, which also helped me in doing a lot of Research and I came to know about so many.

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