



PHYSICO CHEMICAL STUDY ON THE QUALITY OF SURFACE WATER OF KONDANGI LAKE IN KANCHIPURAM DISTRICT, TAMILNADU BEFORE AND AFTER 2015 FLASH FLOODS

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Abstract:

Lake water is the main source to maintain the water table in rural and urban areas of Tamilnadu. It is also the important source of drinking water for animals for their survival and growth. Unfortunately, because of contamination by industries through discharge of harmful chemicals, disposal of domestic wastes, the disposal of sewage water, plastic wastes etc., the quality of potable water exceeds the minimum desirable drinking water limit and hence not fit for consumption. In the present study the surface water quality of Kondangi lake in Kanchipuram District was analysed for its drinking water quality during the summer, monsoon and winter seasons of the year 2015. The various Physico-Chemical parameters like pH, turbidity, Conductivity, alkalinity, Dissolved oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand(COD) etc. were studied for the three seasons and were compared. Due to the unprecedented floods that hit Tamil Nadu during the monsoon, it was observed that the surface water quality after the floods was within the WHO permissible limit, it may be due to the excessive runoff of pollutants away from the lakes. The pH level stayed within the desirable limit throughout the year. The electrical conductivity reduced to a great extent, DO was found to be decreased in summers but has shown slightly elevated value during monsoon. Decreased DO level in summers can be attributed to increased temperature in summer. BOD was higher in all the three seasons but higher in monsoon and decreased during winter. COD was higher during summer which proves higher level of pollutants in the lake. But by monsoon the value started decreasing and in winter, still less value is observed. A high BOD value indicates the presence of microorganisms, large amount of algae, microbial activity and photosynthesis process is going on and hence DO level is very less. Water which does not have the required DO is called as waste water. So, in summer the water is not fit for consumption. But with the severe flash flood, the DO content increased and hence BOD and COD level has decreased. Thus during monsoon and also during winter the pollutant levels are very less and hence non harmful to the environment. From the results observed, Kondangi lake is less polluted.

Key Words: Surface Water, Physico- Chemical, BOD & COD

Introduction

Tamilnadu is a state which mainly depends on North east monsoon for its water requirement. Based on this from early days rain water is been stored in lakes, tanks and ponds. The stored water is been used for drinking, agriculture etc. So, the water table also depend on the amount of water present in these manmade storage. There are more than 30 lakes in and around Kanchipuram distict, which is the main source of ground water, drinking water, agricultural purpose, for industrial purpose etc. Hence the quality of water is to measured in a constant basis so that an awareness is created among the public and authorities regarding the status of the lakes. Surface water is collection of water on the surface of the earth that is water present inriver, lake,

wetland, or ocean. Surface water is naturally replenished by precipitation and naturally lost through discharge, through evaporation and sub-surface seepage into the groundwater. A lake is a large body of water surrounded by land and inhabited by various aquatic life forms. Lakes are subjected to various natural processes taking place in the environment, such as the hydrological cycle. Due to tremendous population growth and rapid urban development, lakes are facing various environmental problems resulting in deterioration of its water quality. The quality of water is usually described according to its physical, chemical and biological characteristics. The quality of surface water also depends on climate, land use, land cover, geographical and anthropogenic factors (1-5). Lakes are called as the ecological barometer of a city as they regulate the micro climate (6). Kondangi lake is one of the important lake in Kancheepuram District. 2015 being an El Nino year (7), the heavy rain followed by the flash floods lead to a greater disaster to the district of Kanchipuram. All the lakes reached above its maximum level. Hence this study is important because no other study has been reported on the quality of surface water for the three - summer, monsoon and winter seasons during the year 2015. This study will explain the effect of heavy rains on the physico-chemical parameters of Kondangi lake water.

Study Area:

Kondangi Lake is located 12°45'48"N 80°5'17"E in the Kancheepuram District of Tamil Nadu, India. It is located near the village of Marutheri.



Samples were taken from the lake during the summer, monsoon and winter seasons during the year 2015-16. The results of the various physico-chemical parameters were studied and the results between the different seasons were also compared.

Materials:

Sample Collection:

Samples of water were collected from the Kondangi lake in three different seasons (summer, monsoon and winter). Collections were carried out using plastic bottles. The cleaned bottles were immersed below the water surface and filled till the top and properly sealed. The samples were taken to the laboratory for analysis.

Methods:

Analysis was carried out for the measurement of various Physico-Chemical parameters such as appearance, colour, turbidity, Total Dissolved Solids (TDS), Electrical Conductivity (EC), total alkalinity, total hardness, Calcium (Ca), Magnesium (Mg²⁺), sodium, potassium, iron, manganese, free ammonia, nitrite, nitrate, chloride (Cl⁻), fluoride (F⁻), Sulphate, phosphate, COD, BOD, DO using standard method. Appearance,

Colour and Odour were noted at the sample point based on basic physical examination. The pH was measured at the source itself using pH paper. Chloride, Alkalinity, Hardness, Calcium, Magnesium, Phosphate, Sulphate, Iron content were tested in the laboratory using the water testing kit provided by CPR Environmental Education Centre, Chennai. Conductivity was measured using a Conductivity Meter. Sodium ion content was measured with the help of Flame Photometer. Turbidity, Manganese, Free Ammonia, Nitrite, Nitrate, Fluoride, TDS, DO, BOD and COD were measured at the Tamil Nadu Water Supply and Drainage Board, Chepauk, Chennai.

Result:

Table 1: Seasonal comparison on the Physico Chemical parameters of Kondangi lake

Physico-Chemical Parameters	Summer	Monsoon	Winter	Desirable Values
Appearance	Clear	Turbid	Turbid	--
Colour	Colourless	Green	Green	--
Odour	None	None	None	--
Turbidity NT Units	1.4	42.1	9.9	5
Total Dissolved Solids mg/L	275	127	174	500
Electrical Conductivity/Micro mho/cm	393	182	249	1500
pH	6.84	7.74	7.67	6.5 – 9.5
Chloride mg/L	14	21	13	250
Alkalinity mg/L	152	56	92	200
Total Hardness mg/L	120	50	67	300
Calcium mg/L	34	15	22	75
Magnesium mg/L	9.0	3	3	30
Manganese mg/L	0	0	0	<0.05
Free Ammonia mg/L	0.38	0.22	0.30	--
Nitrite mg/L	0.03	0.05	0.04	0.3
Nitrate mg/L	7	4	6	45
Fluoride mg/L	0.52	0.24	0.36	<1.5
Potassium mg/L	4.0	2	2	10
Sodium mg/L	34	18	24	100
Phosphate mg/L	0.07	0.05	0.09	0.30
Sulphate mg/L	17	2	8	<200
Iron mg/L	0.30	0.25	0.17	0.30
Tidys test 4 hrs as O ₂ mg/L	1.2	1.2	1.0	--
COD mg/L	13.8	11.3	11.6	10.0
BOD mg/L	4.0	6.0	4.2	3.0
DO mg/L	5.8	5.6	6.5	6.0



Figure 1: Kondangi lake during Summer season

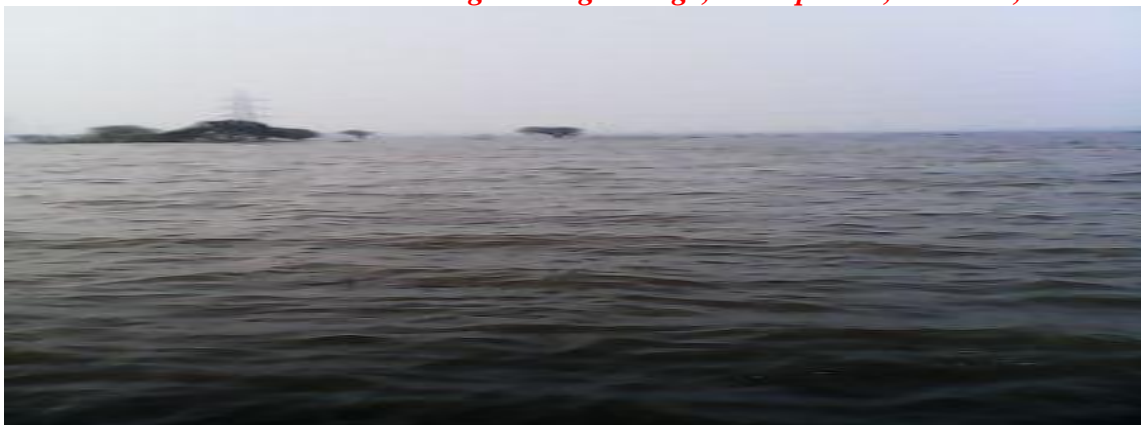


Figure 2: Kondangi lake during Monsoon season



Figure 3: Kondangi lake during Winter season

Discussion:

pH is a measure of the hydrogen ion concentration in water and indicates whether the water is acidic or alkaline. The measurement of alkalinity and acidity of pH is required to determine the corrosiveness of the water. The standard values of pH for drinking water by BIS is between 6.5-8.5. For Kondangi lake it is well within the desired limit

Electrical Conductivity:

Conductivity is the ability to carry electrical charge by an electrolyte. This ability mainly depends on presence of anions and cations and also depend on mobility, valency of ions and temperature. It signifies the amount of total dissolved salts. Conductivity measurement gives rapid and practical estimate of the variations in the dissolved mineral contents of water. One of the reasons of salinity is the high concentration of cations such as sodium, calcium and magnesium whereas chloride, phosphate and nitrate have a high concentration of anions(8). The average electrical conductivity value of water samples during the course of investigation shows a maximum in summer and a minimum in the monsoon and winter season. The low values in monsoon could be due to heavy runoffs by rain and also shut down by the industries because of flash floods. But whether in summer, Monsoon or winter the conductivity value was within the desirable limit.

Total Alkalinity:

Alkalinity of water is a measure of its capacity to neutralize acids. Natural alkalinity to water sources is imparted mainly by salts of weak acids such as bicarbonates, carbonates, borates, silicates, phosphates. Few industrial effluents also

contribute to the water alkalinity. Total alkalinity is the combined activity of the values of carbonates and bicarbonates in water. The observed values of alkalinity in all the three lakes ranged between 152 mg/l during summer, 56mg/l during monsoon and 92 mg/l during winter season. Alkalinity was high during the summer season followed by steep fall in the monsoon periods. High value is due to the exchange of atmospheric CO₂. Turbidity indicates the amount of suspended solids -either mineral (such as soil particles) or organic (like algae). The turbidity analysis is a measure of the amount of light scattered in water. Presence of large amount of suspended particles cause greater scattering and thus high turbidity value. Turbidity values vary for two main reasons. One reason is physical such as heavy rains and fast-moving water which causes erosion. The other is biological reason due to algae growth and bacterial degradation of organics in the water column. It was found to be well within the desirable limit during summer and winter season, but very high value during winter season. It is because during monsoon, water from the surrounding lakes (Maruderi, Karumbur, Karunilam) flow into Kondangi lake causing heavy run off. The heavy rainfall and flash flood is also a reason for the very high value.

Total Dissolved Solids:

The mineral constituents dissolved in water constitute dissolved solids. TDS indicate the total amount of inorganic chemicals in solution. Concentration of dissolved solids in water decides its applicability for drinking, irrigation and industrial purposes. During the monsoon and winter seasons TDS value is within desirable level. TDS value of Kondangi lake in Summer, monsoon and winter seasons showed values within desirable limit prescribed by WHO. High TDS makes water hard. High TDS is because of the soil developed from rocks.

Total Hardness:

Total hardness in water is the sum of concentration of alkaline earth metal cation such as Ca²⁺, Mg²⁺. The total hardness is the total soluble magnesium and calcium salts present in the water in the form of its carbonates. Total hardness is also includes sulphates and chlorides of calcium and magnesium. In this study the hardness value was within the range of 300 mg/L in all the three seasons

Chloride:

Chloride concentration in water indicates presence of organic waste particularly of animal origin, increase in chloride concentration on discharge of municipal and industrial waste. In Kondangi Lake the chloride content was in the desirable level in all seasons. The high content of chloride ion in surface water does not have any ill effects.

Sodium and Potassium:

Sodium and potassium are important cations occurring naturally in waters. Their major sources in water are the weathering of rocks. Both the sodium and potassium are highly soluble in nature and do not form any precipitating salts. They have a strong tendency to remain absorbed on soil particles, but can be easily exchanged by divalent cations like calcium and magnesium. In humans, a higher concentration of sodium can lead to the cardiovascular disorder and in women; toxemia can be associated with pregnancy²⁸.

The sodium and potassium level is well within the desirable limit, When comparing the monsoon and winter results with the summer sodium level value of all the three lakes the sodium level gets decreased.

Calcium and Magnesium:

Calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions are both common in natural waters and both are essential elements for all organisms. Calcium and magnesium, when combined with bicarbonate, carbonate, sulphate and other species, contribute to the hardness of natural waters. The effect of this hardness results in deposition of scales when such waters are heated. Normally hardness due to calcium predominates although in certain regions, magnesium hardness can be high.

Calcium is an important element influencing flora of ecosystem, which plays important role in metabolism and growth too. The values were within the desirable value. The magnesium content also was found to be within the desirable limit.

Chemical Oxygen Demand:

COD is the measure of pollution in aquatic system. High COD may cause oxygen depletion on account of decomposition of microbes to a level detrimental to aquatic life. It is the amount of oxygen present in the water that is required or used in various chemical reactions (mainly oxidation) occurring in the water. Chemical oxygen demand (COD) is used as a measure of oxygen requirement of a sample that is susceptible to oxidation by strong chemical oxidant. Most applications of COD determine the amount of organic pollutants found in surface water making COD a useful measure of water quality. In the present investigation, the chemical oxygen demand values fluctuated according to the seasons. The high value of COD in summer could be due to higher decomposition activities and low levels of water. Since the DO value is very less in summer, the COD value stays high in summer. However minimum chemical oxygen demand in winter is due to low temperature, low decomposition activities and dilution effect.

Biochemical Oxygen Demand:

Biochemical oxygen demand (BOD): Biochemical oxygen demand (BOD) is a chemical procedure for determining the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period. It is not a precise quantitative test, although it is widely used as an indication of the organic quality of water³⁰.

The highest biological oxygen demand was recorded during summer season, 4 mg/L for which can be attributed to the high bacterial activity and heavy input of organic matter in the lake water. When BOD is high, it means that there a lot of organic contaminants in the water and the microbes are consuming organic contaminants. Thus they consume the oxygen, hence BOD is high and DO level is low. The BOD values observed during monsoon and winter seasons were almost equal and found to lie within desirable limit. The lowering value of BOD in monsoon and winter is due to less vegetation, dilution of the effluent and low decay of organic matter at low temperature.

Dissolved Oxygen:

DO is one of the most important parameter. Its correlation with water body gives direct and indirect information e.g. bacterial activity, photosynthesis, availability of nutrients, stratification etc.³¹In the progress of summer, dissolved oxygen decreased due to increase in temperature and also due to increased microbial activity. In the present investigation DO levels of all the three lakes during summer shows relatively equal to desirable value.

The highest amount of dissolved oxygen recorded during the winter season was near 6.5 mg/L because of the increased solubility of oxygen at lower temperature and high photosynthetic activities whereas the lowest dissolved oxygen was recorded during the summer season which can be related to the high temperature and the addition of sewage and other wastes and drastically reduced the dissolved oxygen content. Since dumping of animal waste, drainage waste and plastic garbage is high the DO concentration is comparatively higher during winter.

Sulphate:

The sulphate content is observed to be below the maximum allowable concentration for drinking water prescribed by WHO which is 200 mg/L.

Phosphate:

Phosphate may occur as a result of domestic sewage, detergents, agricultural waste due to fertilizers and industrial waste water. The phosphate content in the study area was found within the desirable limit.

Fluoride:

Fluoride with lower concentrations at an average of 1.5 mg/L is regarded as an essential constituent of drinking water mainly because of its role in prevention of dental cavities.³³, the fluoride content was found to be within the desirable limit.

Iron:

Water containing iron does not show deleterious effect on human health, however, its presence in drinking water is nor desirable for various reasons. Excessive iron content makes the water turbid, discoloured and imparts an astringent taste to water. It is found to be within the WHO desirable limit.

Nitrate and Nitrite:

The nitrate concentration in surface water is normally low (0–18 mg/l) but can reach high levels as a result of agricultural runoff, refuse dump runoff or contamination with human or animal wastes. The concentration often fluctuates with the season and may increase when the river is fed by nitrate-rich aquifers. Nitrite levels in drinking water are usually below 0.1 mg/l.

The nitrate and nitrite level in Kondangi was within the desirables limits as issued by WHO (45 mg/L for nitrate and 0.3mg/L for nitrite)

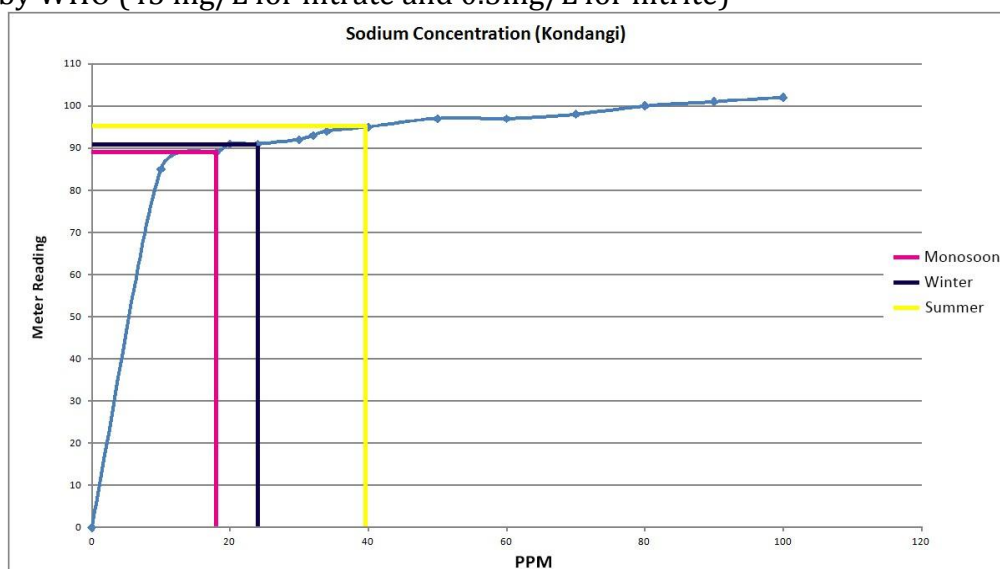


Figure 4: Flame Photometric response of Sodium ion Concentration in Kondangi Lake for the three seasons

Conclusion:

The present study has shown clearly through the physicochemical analysis of the Kondangi lake for the 3 seasons that the water is hard and hence non potable. The BOD COD and phosphate values is observed to be high in all the 3 lakes during summer ,which means a large amount of algae, microbial activity and photosynthesis process is going on and hence DO level is very less. Water which does not have the required DO is called as waste water. So, in summer the water is not fit for consumption. But with the severe flash flood, the Do content increased and hence BOD and COD level has decreased. Thus during monsoon and also during winter the pollutant levels are very less and hence non harmful to the environment.

From the results observed, Kondangi is the less polluted. Thus, it is found that the panchayats and the municipal authorities are taking measures to take care of the environment of the lake. The absence of industrial development around the lake has kept the lake clean and the water can be used for agriculture and treated before using for drinking purpose...

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