

A Comparative Study of Water Quality Assessment of Kanke Dam, Hatia (Dhurwa) Dam and Getalsud (Rukka) Dam in Ranchi, Jharkhand, India

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INTRODUCTION

Jharkhand (The Land of Forest) is the 28th state of the Indian Union was brought into existence by the Bihar reorganization Act on November 15th 2000. It is a state in eastern India and the states shares its border with the State of Bihar to the North, Uttar Pradesh to the northwest, Chhattisgarh to the West and Odisha to the South and West Bengal to the East. Jharkhand has an area of 79,714 km² (30,778 sq. m). Jharkhand is the 15th largest state by area and is the 14th largest by population. The state is known for its beautiful Waterfalls and Hills. Jharkhand is famous for its rich minerals resources like Uranium, Mica, Bauxite, Granite, Gold, Silver, Graphite, Magnetite, Dolomite, Fireclay, Quartz, Field spar, Coal (32% of India), Iron, Copper (25% of India) etc. The forest and woodlands occupy more than 29% of the state which is amongst the highest in India. The total population of the state is 32, 988,134 as per the data of 2011 census, in which male population is about 16,930,315 and the female population is about 16,057,819. The state capital of Jharkhand is Ranchi. It is popularly known as “The City of Water Falls”. Ranchi is located in the southern part of the Chota Nagpur Plateau in the Indian states of Jharkhand. It is situated at a latitude of 23.35° N and a longitude of 85.33° E. it is at an average elevation of 651 meters (2,140 feet) above the sea level. The Ranchi city is known for its natural beauty. The climate of the city is moderate, with three well defined seasons: the cold weather season from November to February and it is the most pleasant part of the year. The high temperature in Ranchi is in December usually rise from about 50° F (10° C) into the low 70° F (low 20° C) daily. The hot weather season lasts from March to mid-June, May being the hottest month and is characterized by daily high temperature in the upper 90° F (37° C) and low temperature in the mid 70° F (20° C).



Fig 1. Showing the State of Jharkhand with its Capital Ranchi

There are three water bodies in Ranchi that supply drinking water. In Ranchi the Subarnarekha River and its tributaries constitute the local river system. The channels Kanke Dam, Rukka (Getalsud) Dam and Hatia (Dhurwa) Dam have been dammed to create reservoirs that supply water to the majority of the population. The Kanke dam area is a posh township with residential apartment and scores of commercial entities. Rukka (Getalsud) Dam, it is the largest dam in Ranchi which supplies water to about 80% of the total population in the city. Hatia (Dhurwa) dam supplies about 43 MLD water/day but has to resort to water rationing (supply thrice a week) during peak summer.

Water is addressed as a necessary resource and life preservative, it is required for most human activities like drinking, cooking, bathing, washing, agriculture, industry, recreation, navigation and fisheries etc. The water for human consumption and other domestic purpose should be free from disease causing organisms, poisonous substances and excessive amount of mineral and organic matter. It should also be free from colour, turbidity, taste and odour, (Rim- Rukeh, 2013). The water and water resources are very important for maintaining an adequate food supply and a productive environment for all living organisms. As there is increase in human population and economic grow, global freshwater demand has been increasing rapidly. Water is essential to life because it heavily influence public health and living standard. It is a very important required substance in order to sustain vital activities of human beings such as nutrition, respiration, circulation, excretion and even reproduction.(Akin, 2007). It is a biological solvents that provides both the transport and dissolution of vitamins and minerals in the body. The water is important in regulating body temperature, facilitates the work of the kidneys and other organs. It protect and act as a cushion and plays a fundamental role in moisturizing the skin, removing toxins and cleaning the body. It also supports the conversion of nutrients taken into the body in the form of energy and also helps the absorption of nutrients. It is the main ingredient of carbohydrate, fats and proteins in the human body. About 80 – 90% of our blood and about 75% of our muscles are made up of water.(Cepel, 2003). It is an indispensable element of life and we feel uncomfortable when we are dehydrated even for a very short time.so water is very precious and a very blessed gift from above.

MATERIALS AND METHODS

Hydrogen ion Concentration (pH)

The HANNA-pHep is a digital pH meter that can be used to estimate the hydrogen ion concentration or pH of solution. This device is designed to be portable and easy to use, making it suitable for field work. It has a pH range from 0.0 to 14.0, a resolution of 0.1 pH and an accuracy of ± 0.1 pH. The digital pH meter HANNA-pHep was utilized for estimating hydrogen particle concentration (pH) by plunging the electrode into experimental water in clean beaker at the sampling station. This pH meter was previously calibrated in the laboratory utilizing various buffers.

Dissolved Oxygen

The determination of dissolved oxygen content of lake waters the unmodified Winkler's technique gave the most satisfactory result. Water was sampled in a 250 ml measuring flask with least disturbance of surface water and no air bubble. The stopper of the bottle was carefully removed. One ml of manganous sulphate ($\text{MnSO}_4, 4 \text{H}_2\text{O}$) reagent and one ml of alkaline reagent (KOH and KI) was added by means of one ml pipette dipped to the bottom of the bottle and slowly drawing out as the reagents were added. The stopper was replaced and the bottle was inverted three or four times for a thorough mixing of the reagents, producing a flocculant precipitate of light brown colour. One ml of conc. Sulphuric acid was added to dissolve the precipitate, leaving a clear brown solution. To 50 ml of this solution .025 N sodium thiosulphate solutions was run drop by drop thereby changing the colour of the sample solution to pale yellow. One ml of starch solution (indicator) was added to it to give the solution a blue colour and the titration was completed by turning it colourless.

Number of ml of $\text{Na}_2\text{S}_2\text{O}_2$ solution X 4 = ppm of dissolved oxygen.

Free Carbon - di – oxide

50 ml of the water sample was taken and 2 drops of phenolphthalein indicator were added to it. It was titrated with N/ 44 sodium hydroxide solution which was standardised against sulphuric acid solution of equal strength with phenolphthalein as an indicator. The alkali was run slowly till the colour of the sample turned pink.

Number of ml of N/44 sodium hydroxide consumed X 2 was equal to parts per million of carbon – di – oxide present in the water sample.

Total alkalinity

100 ml of water sample was taken in a conical flask to which 0.1 ml of phenolphthalein was added to turn the colour to pink confirming the presence of phenolphthalein alkalinity. The sample was titrated with N/50 sulphuric acid till the pink colour just disappeared. The amount of sulphuric acid consumed was recorded as phenolphthalein alkalinity (P). To the same sample 0.1 ml of methyl orange indicator was added and titrated with N/50 sulphuric acid. The end point was the turning of the yellow colour into pinkish orange. The amount of sulphuric acid consumed was recorded as methyl orange alkalinity (T). the total alkalinity was obtained by adding these two values (P+T) and multiplying the same by 10 to express the term in parts per million.

Phosphate, Silicate, Organic matters, Nitrate, Nitrogen and Ammonia Nitrogen contents

There dissolved salts or chemicals in water was determined with the help of a Systronic's Digital Spectrophotometer 103. At first separate standard solutions for each of the abiotic factors (Table 1) were prepared.

Table-1

Sl. No.	Dissolved Nutrients	Standard Solution	Indicators
1.	Phosphate (inorganic)	Standard phosphate solution (.438% KH_2PO_4 solution)	Acid Molybdate reagent Stannous Chloride solution
2.	Silicate	Standard Picric acid solution (.1088%) or Standard Potassium Chromate solution (.284%)	10 % Ammonium molybdate solution 25 % Sulphuric acid (by volume)
3.	Dissolved organic matters (sample fixed with 2 drops of toluene)	Standard KMnO_4 Solution (.04%)	Standard Ammonium Oxalate Solution (.0888%) Dilute Sulphuric acid (1:3)
4.	Ammonia Nitrogen (sample fixed with few drops of sulphuric acid)	Standard Ammonium Chloride solution (.3819%)	Nessler's solution
5.	Nitrate Nitrogen	Standard KNO_3 solution (.0722%)	Phenol disulphonic acid Aluminium sulphate 10% 12 N Sodium Hydroxide solution.

Table 1: Showing different standard solution and the indicators used for determination of dissolved salt in lake water.

For each standard solution a calibration curve of different concentration of standard solutions and the respective extinction measurement (with the help of spectrophotometer 103) was established using necessary indicators. (Table 1). The extinction of the sample solution was then determined using same indicators and from the calibration curve the dissolved salt content of the sample in respect to its extinction measurement was determined.

For different analysis, following standard solutions and indicators were used (Michael, 1984).

Sulphates

Qualitative test showed that the water sample of Morvan Dam, Kanke Dam, Rukka Dam and Hatia Dam was richer in sulphate content. As such to 50 ml of the sample after necessary dilution was added 10 ml each of NaCl – HCl solution (250 gms NaCl and 20 ml of HCl to 900 ml of distilled water and diluted to 1 litre) and Glycerol – alcohol solution (1 Volume of Glycerol with 2 volumes of ethanol). The extinction was measured against a H₂O blank in the spectrophotometer at any wave length between 380 mμ and 420 mμ. 0.15gm of BaCl₂ was added to the sample and was stirred in an Electric stirrer for 30 minutes, shaken and the extinction was measured after 30 minutes. The extinction due to sulphate was obtained by the difference. A calibration curve was prepared in the range of 0.02 – 0.2 m eq/l SO₄²⁻ using dilution of standard H₂SO₄.

$$1 \text{ m eq. SO}_4^{2-} = 48.05 \text{ mg SO}_4^{2-} = 16.0 \text{ mg SO}_4 - \text{S}$$

Chlorides

The chlorides were estimated chemically by titration with silver nitrate using potassium chromate as an indicator with greater accuracy. To a 100cc of water sample a few drops of potassium chromate solution was added. The sample was then titrated against N/100 silver nitrate solution stirring constantly. The end point was reached when a permanent faint red colour of silver chromate appeared 1cc of N/100 silver nitrate = 0.000355 gm of Chloride.

RESULTS

Hydrogen ion concentration

The pH of the lake water tended to remain acidic throughout the period of investigation barring a few months in the beginning of the study. In September 2021 the pH value recorded was 6.4 in Kanke dam, 7.3 in Getalsud dam, 6.6 in Hatia dam which was subsequently found to be the maximum value during the entire course of the investigation. In the succeeding months of October and November the hydrogen ion concentration value remained alkaline but December onwards the pH value shifted again to the acidic range. A lower pH value in the cold season (December 2021, January and February 2022) was recorded in comparison to that of summer seasons. This was followed by a sharp decrease in the pH value during July 2022 that was 6.4 for Kanke dam, 6.2 for Getalsud dam and 6.7 for Hatia dam due to the onset of first heavy showers later on. In August a marked increase of 6.1 for Kanke dam, 6.9 for Getalsud dam and 6.1 for Hatia dam in the pH value was recorded followed by a fall during the month of September 2022 were 6.9 for Kanke dam, 6.7 for Getalsud dam and 9.7 for Hatia dam.

During the succeeding year of investigation the pH of the lake water remained acidic and the fluctuation of its value showed a regular rise and fall, the trend of which was the same to that of the previous year.

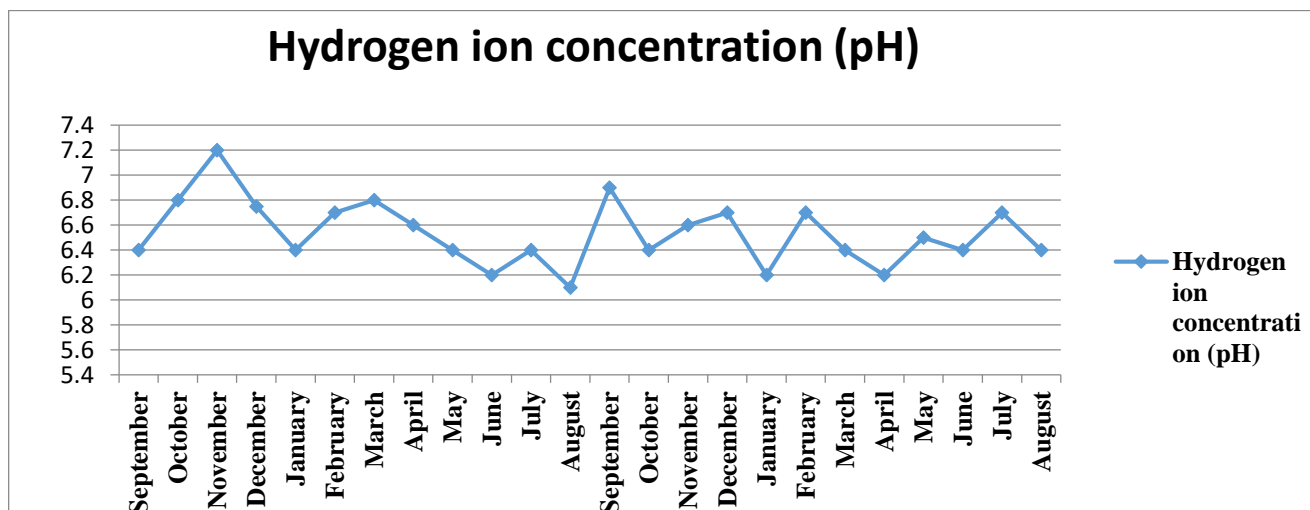


Fig 2(a)–Hydrogen ion Concentration of Kanke Dam

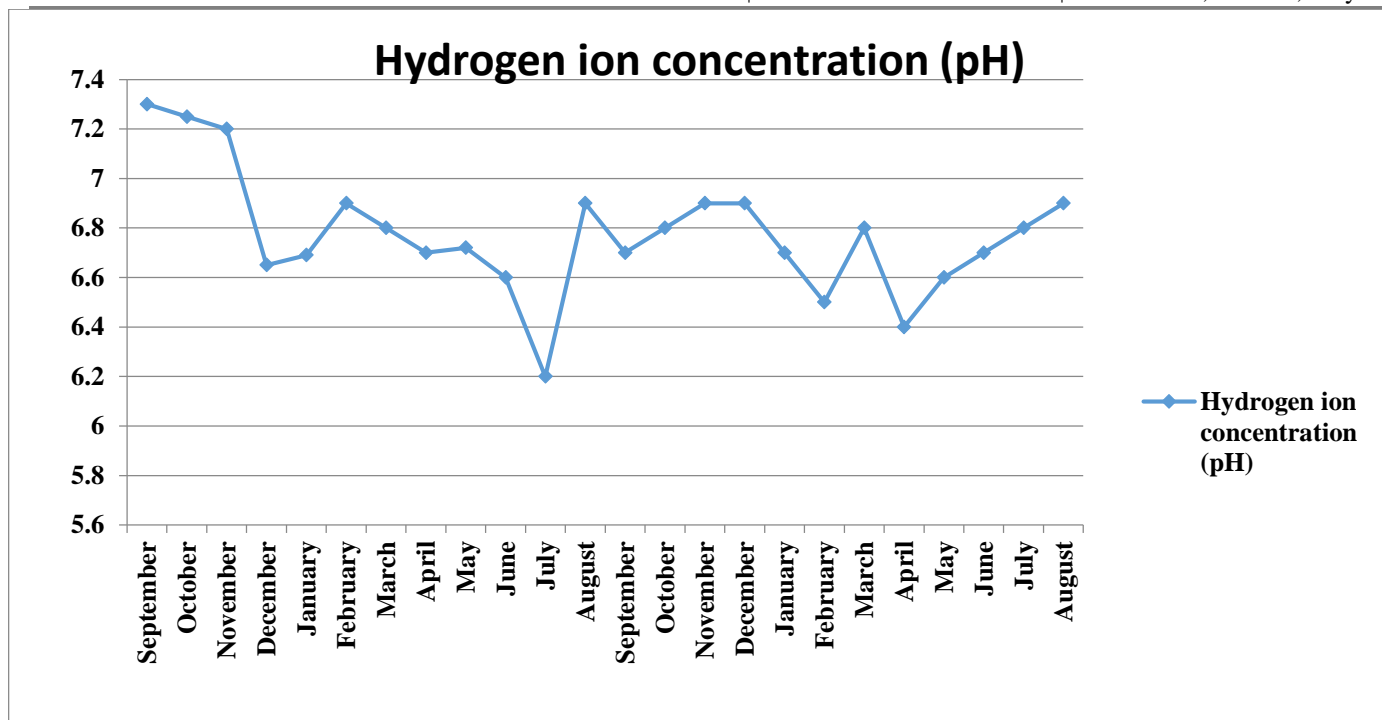


Fig 2(b) –Hydrogen ion Concentration of Getalsud Dam

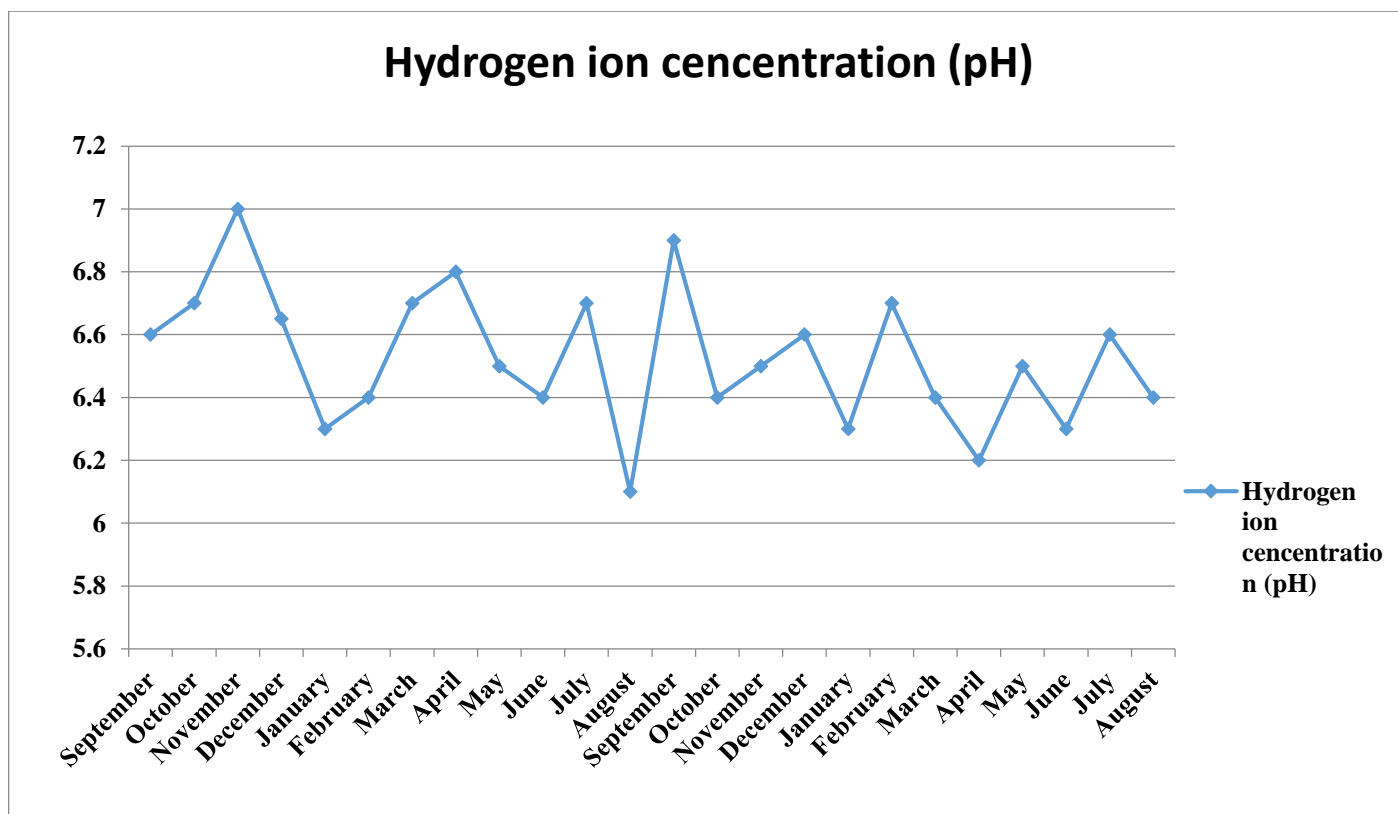


Fig 2(c) –Hydrogen ion Concentration of Dhurwa Dam

Dissolved Oxygen Content

The dissolved content of lake water varied from 4.2 ppm to 11.6 ppm during the period of investigation. During September 2021 the dissolved Oxygen content of water was 7.5 for Kanke dam, 7.4 for Getalsud dam and 7.7 for Hatia dam ppm, then a gradual increase in the oxygen content of water was observed till January 2022 which was followed by a decline in the months of March and April. The dissolved Oxygen content of lake water showed an increased value during the monsoon months.

In the succeeding year, the trend followed more or less the same pattern but the highest values of 10.9 for Kanke dam, 10.8 for Getalsud dam and 10.7 for Hatia dam ppm were recorded in the month November 2022 and lowest value was recorded in the month of May 2023.

The data also reveals that the dissolved oxygen was high during the winter months and low during the summer months. The periods of high dissolved oxygen content corresponded with the periods of low water temperature. It was further observed that the periods of high dissolved oxygen content of water corresponded with a decreased pH value.

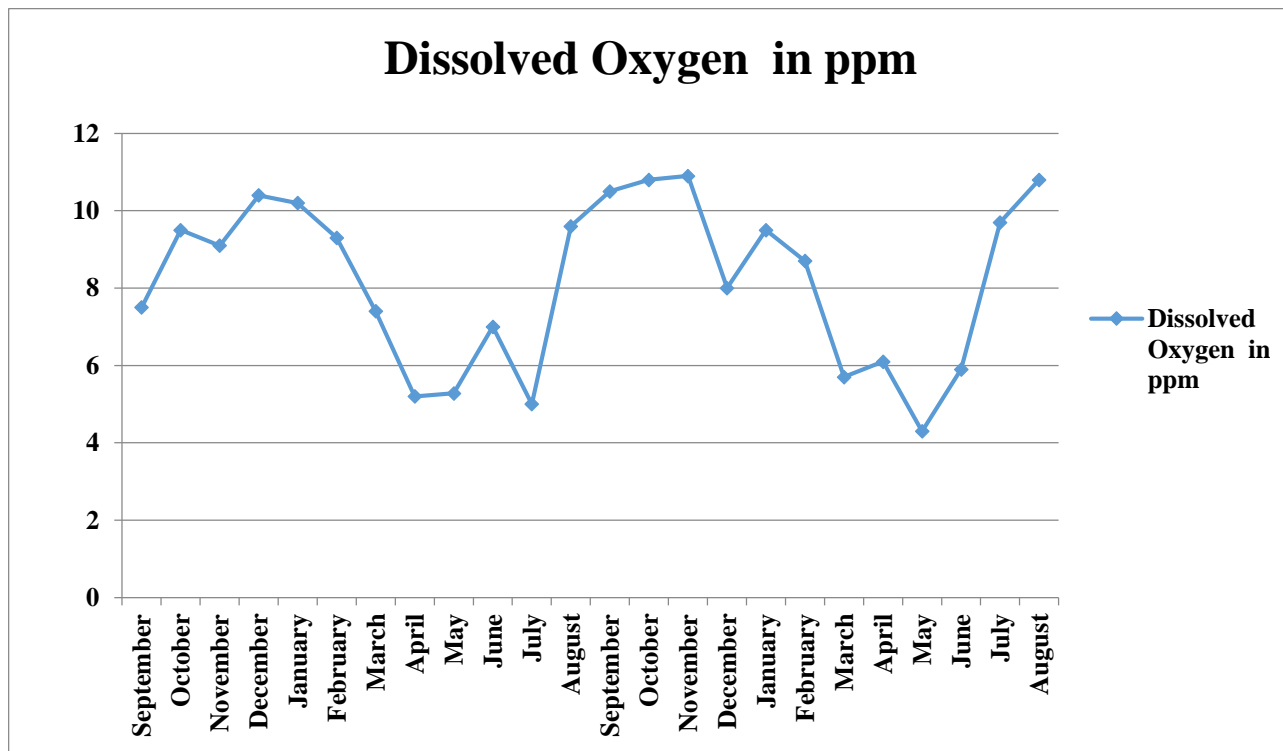


Fig 3(a)- Showing Dissolved Oxygen (O₂) in ppm in Kanke Dam

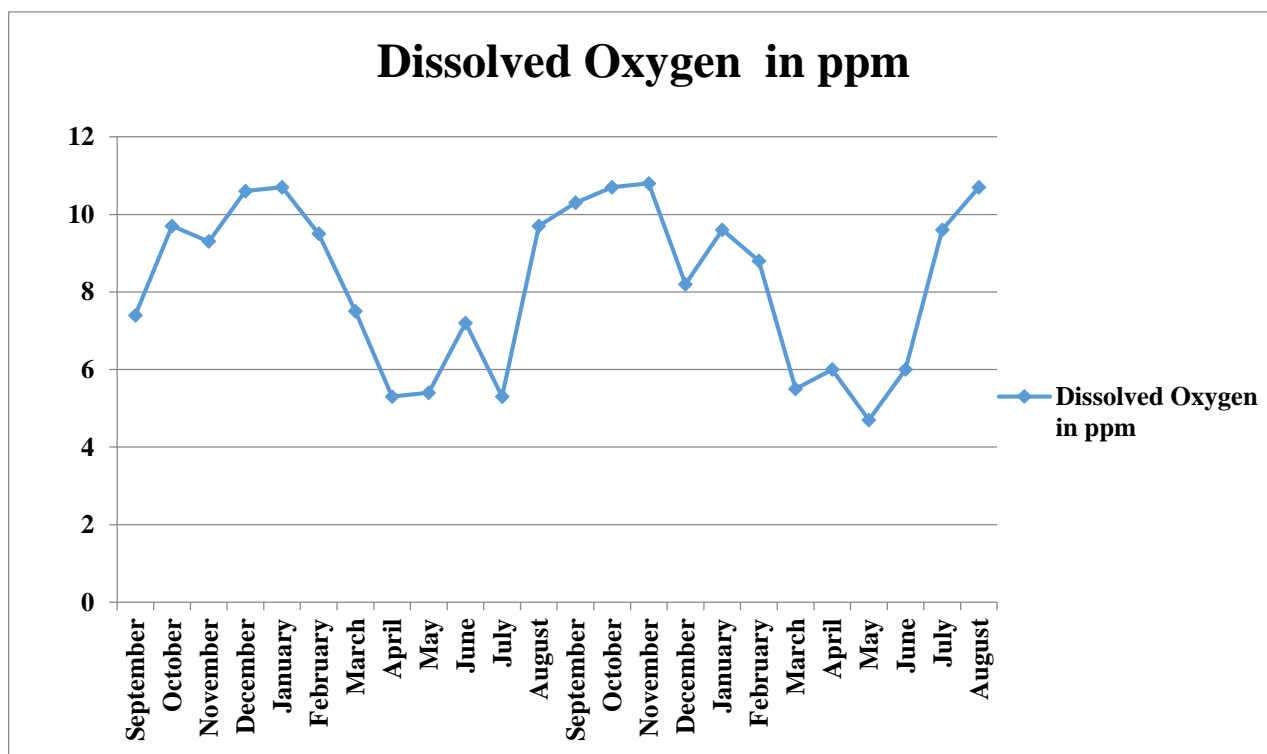


Fig 3(b)- Showing Dissolved Oxygen (O₂) in ppm in Getalsud Dam

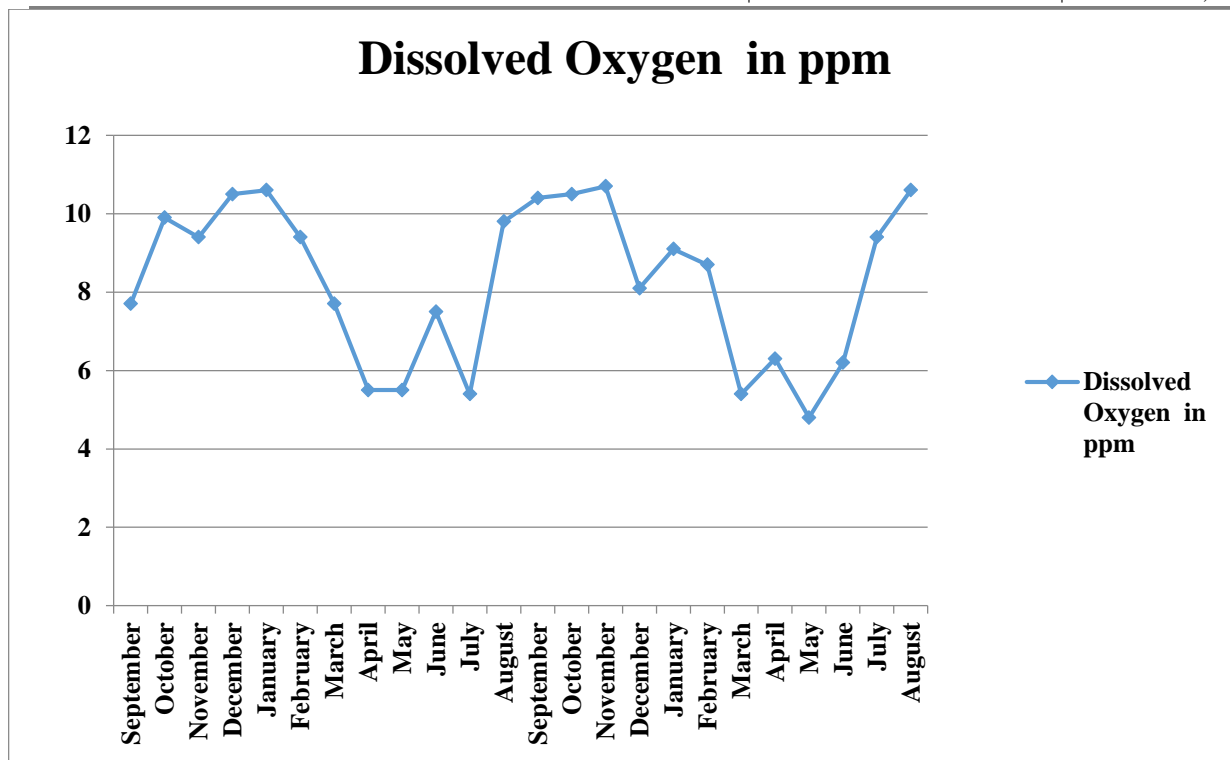


Fig 3(c)- Showing Dissolved Oxygen (O₂) in ppm in Dhurwa Dam

Free Carbon-di-oxide

The amount of free carbon-di-oxide recorded throughout the period of investigation was not very high, the maximum of 7.30 for Kanke dam, 7.38 for Getalsud dam and 7.37 for Hatia dam ppm bring in the month of January 2023. No free carbon-di-oxide was recorded during the month of April 2022, June 2022 and June 2023 for Kanke dam, October 2021, April 2022, June 2022 and June 2023 for Getalsud dam and for Hatia dam. Expectedly enough free carbon-di-oxide was observed to be absent when the Dam water was alkaline. A linear relationship was established between free carbon-di-oxide content and turbidity of water ($r = 0.85, p > .0001$).

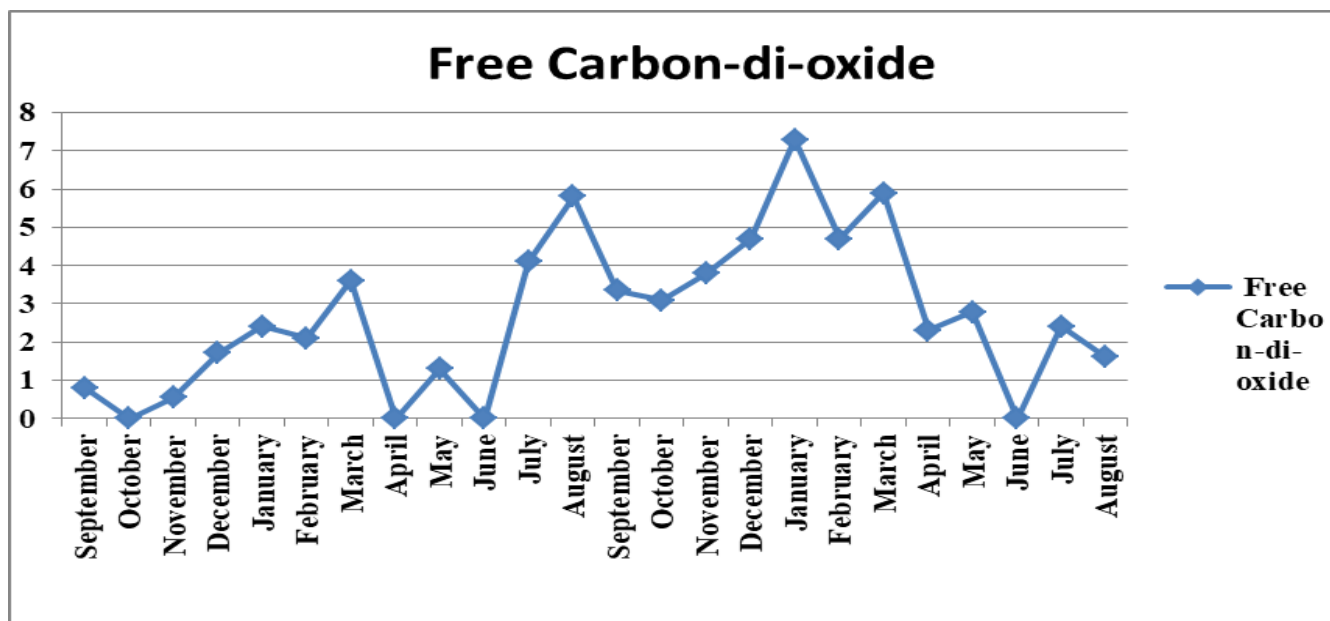


Fig 4(a) – Showing Free Carbon-di-oxide of Kanke Dam

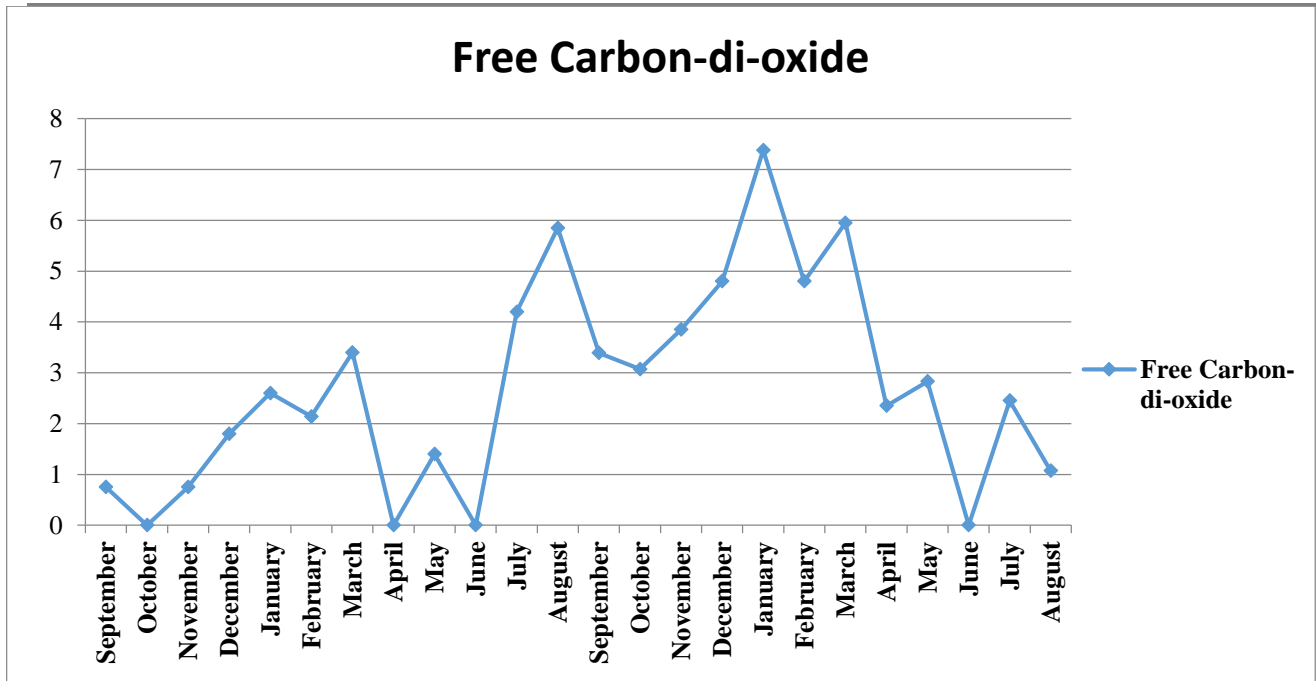


Fig 4(b) – Showing Free Carbon-di-oxide of Getalsud Dam

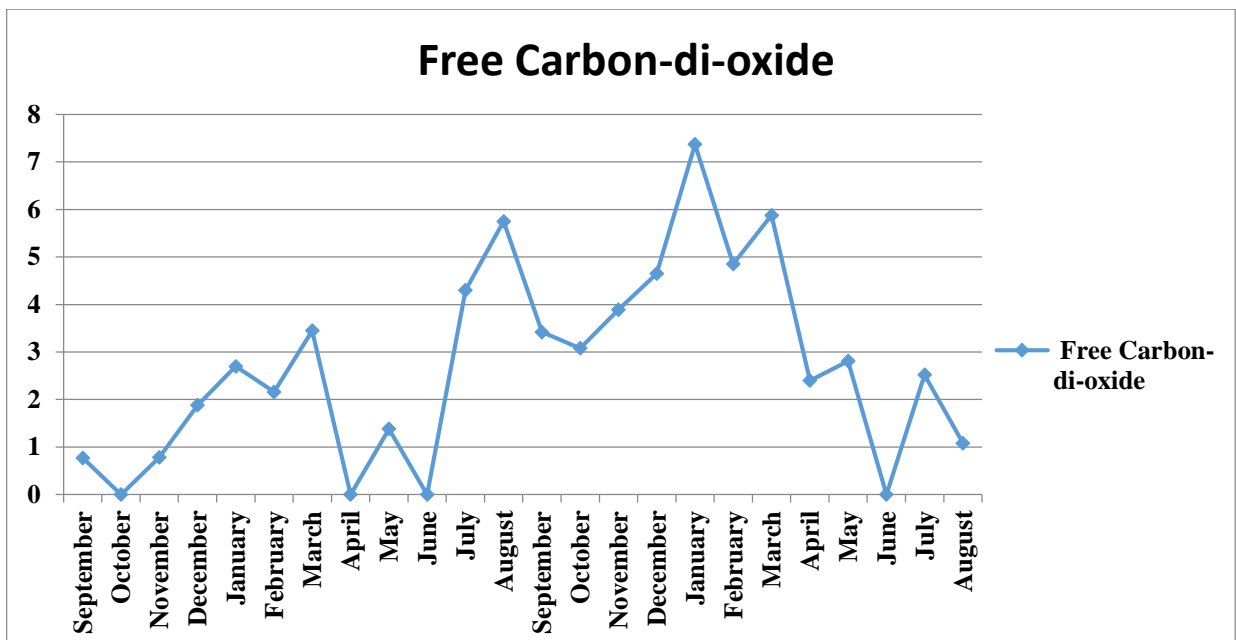


Fig 4(c) – Showing Free Carbon-di-oxide of Dhurwa Dam

Total Alkalinity

Alkalinity value of lake water was primarily due to the presence of bicarbonates and the surface bicarbonate alkalinity value ranged from 29.4 ppm (August 2022) to 83.8 ppm (July 2023) for Kanke dam, 28.8 ppm (August 2022) to 83.8 ppm (July 2023) for Getalsud dam and 28.6 ppm (August 2022) to 82.7 ppm (July 2023) for Hatia dam. The carbonate alkalinity was recorded in small amount only during the month of November 2021 was 45.5 for Kanke dam, 46.8 for Getalsud dam, 45.9 for Hatia dam ppm, April 2022 was 90.5 for Kanke dam, 91.8 for Getalsud dam, 90.7 for Hatia dam ppm, June 2022 was 48.7 for Kanke dam, 48.6 for Getalsud dam, 48.5 for Hatia dam ppm and June 2023 was 59.7 for Kanke dam, 58.5 for Getalsud dam, 59.4 for Hatia dam ppm and no free carbon-di-oxide was detected during the period as the pH of lake water was more than the neutral value. The seasonal curve of total alkalinity value distinct fluctuations throughout the period of investigation. In September 2021, the total alkalinity value was found to be 32.0 for Kanke dam, 36.0 for Getalsud dam, 35.0 for Hatia dam ppm. After a sudden rise in October 2021 and fall in November 2021, the alkalinity value tended to

increase steadily from the month of February 2022 and reached the peak in April 2022 which was 90.5 for Kanke dam, 91.8 for Getalsud dam, 90.7 for Hatia dam ppm. The bicarbonate contents of lake water then tended to go down and reached the minimum in August 2022 was 29.4 for Kanke dam, 28.8 for Getalsud dam, 28.6 for Hatia dam ppm. The second year of observation also confirmed the earlier data with slight deviations. The highest value was recorded in the month of April 2023 and July 2023 which was 88.6 and 83.8 for Kanke dam, 87.5 and 82.7 for Getalsud dam, 88.2 and 83.2 for Hatia dam ppm and the minimum value was recorded in the month of November 2022 which was 26.2 a for Kanke dam, 25.8 for Getalsud dam, 25.9 for Hatia dam ppm.

An inverse relationship with the free carbon-di-oxide with bicarbonate alkalinity was established ($r = -0.94$, $P.0.001$). The increase of free carbon-di-oxide value corresponded with the decreased value of bicarbonate alkalinity and the reverse was also observed to be true. The absence of free carbon-di-oxide showed the presence of carbonate content of lake water thereby implying an inverse relationship between them.

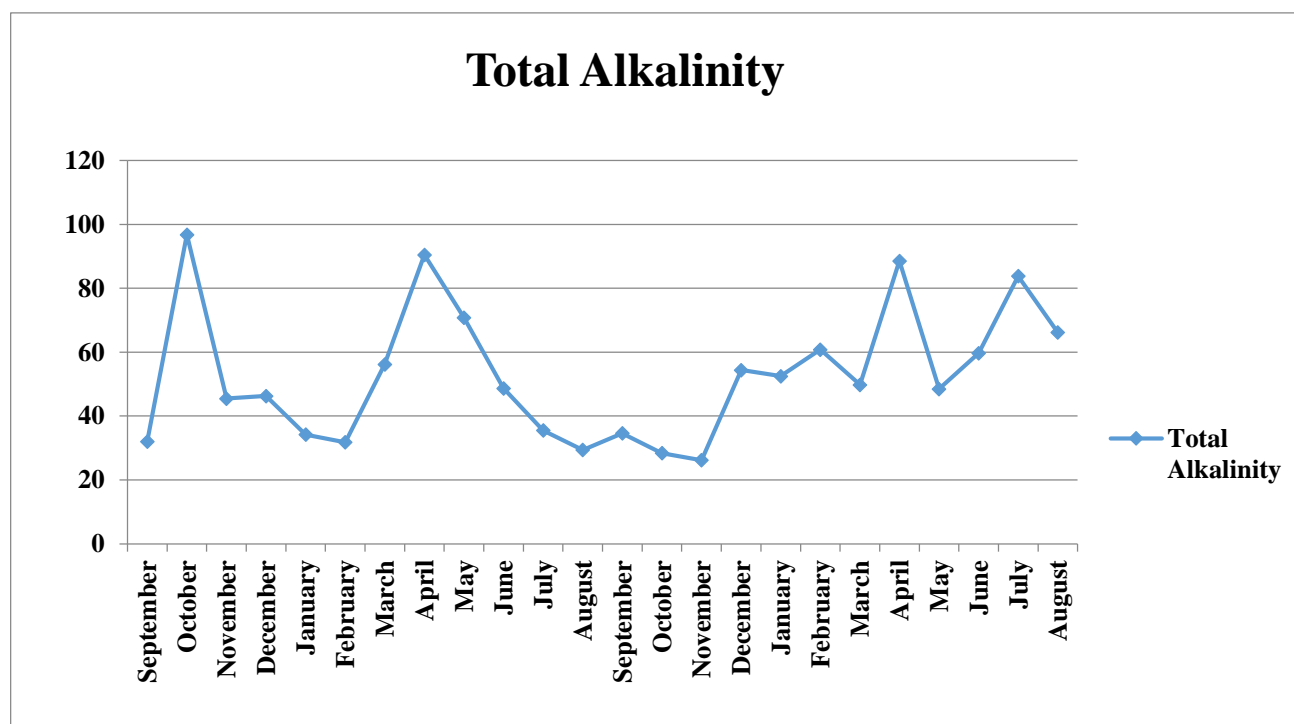


Fig 5(a) – Showing and Total Alkalinity of Kanke Dam

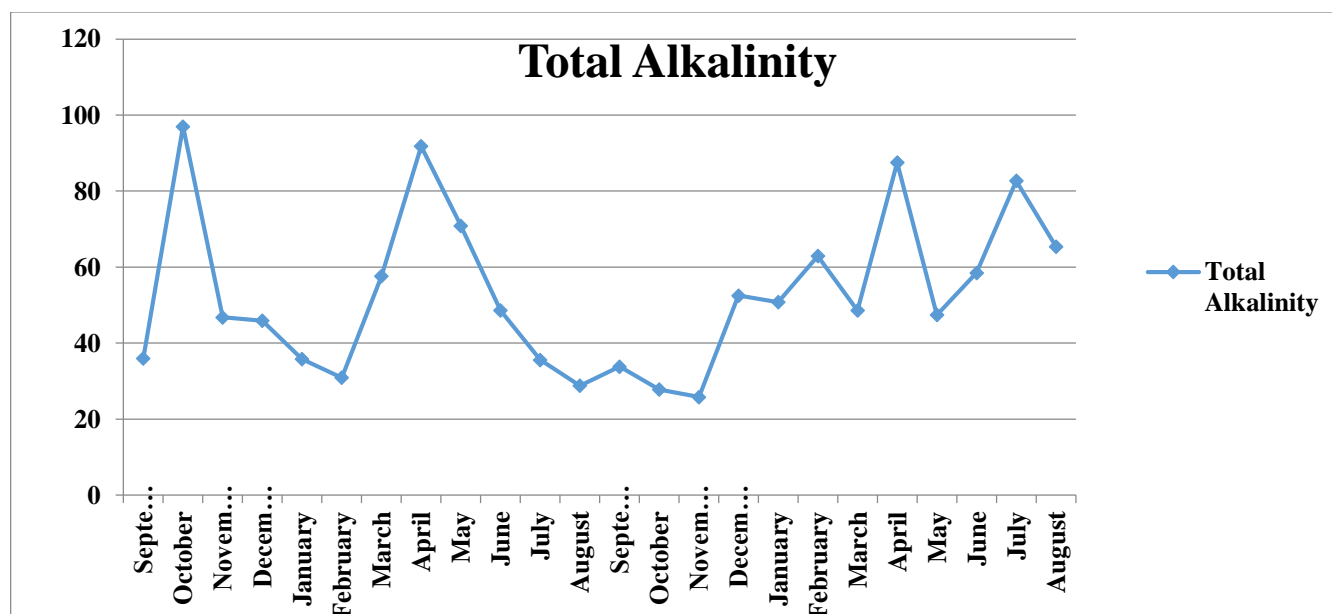


Fig 5(b) – Showing Total Alkalinity of Getalsud Dam

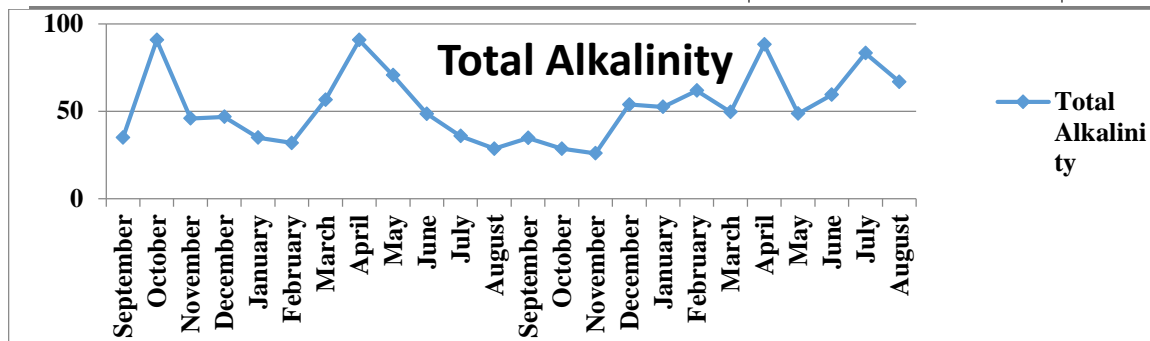


Fig 5(c) – Showing Total Alkalinity of Dhurwa Dam

Chloride contents

The Chloride content was found to vary from a minimum of 9.7 for Kanke dam, 9.5 for Getalsud dam, 9.6 for Hatia dam ppm in September 2021 to a maximum of 78.9 for Kanke dam, 74.4 for Getalsud dam, 76.7 for Hatia dam ppm in July 2023. The chloride content was found to be very high during the early monsoon and rainy seasons (June, July and August) which was mainly due to washing down of organic matter from the surrounding catchment area. Afterwards there was a sharp downward trend to chloride content of the lake water up to October. From May onwards there was a steady increase of chlorides in water which may be attributed to the low water level caused by surface water evaporation due to summer heat. During the second year more or less similar trend was observed. A direct correlation was observed between the chloride content and bicarbonate alkalinity ($r=0.98, P>0.001$) and also between the chloride content and pH ($r=0.75, P>0.001$).

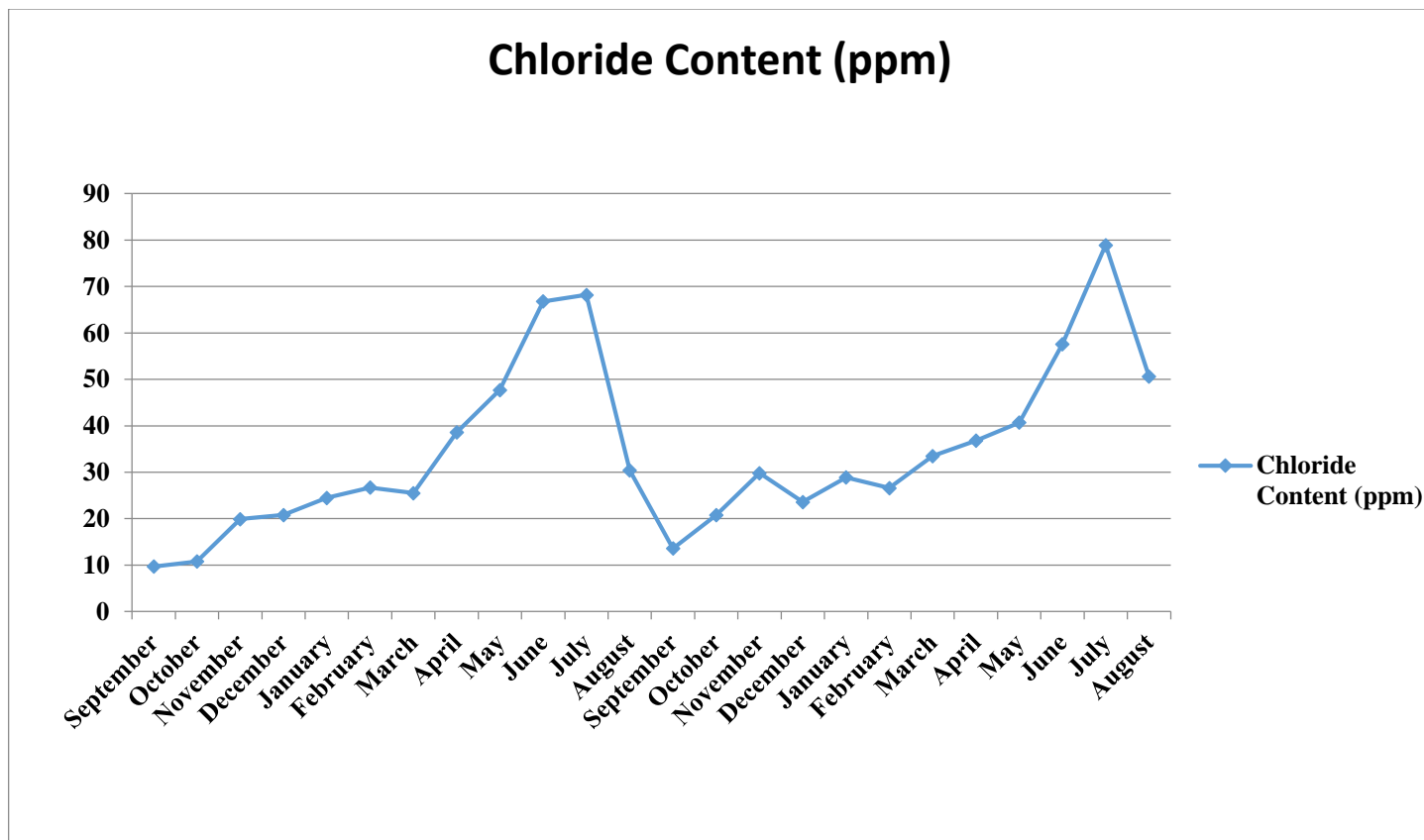


Fig 6(a)–Chloride Content of Kanke Dam

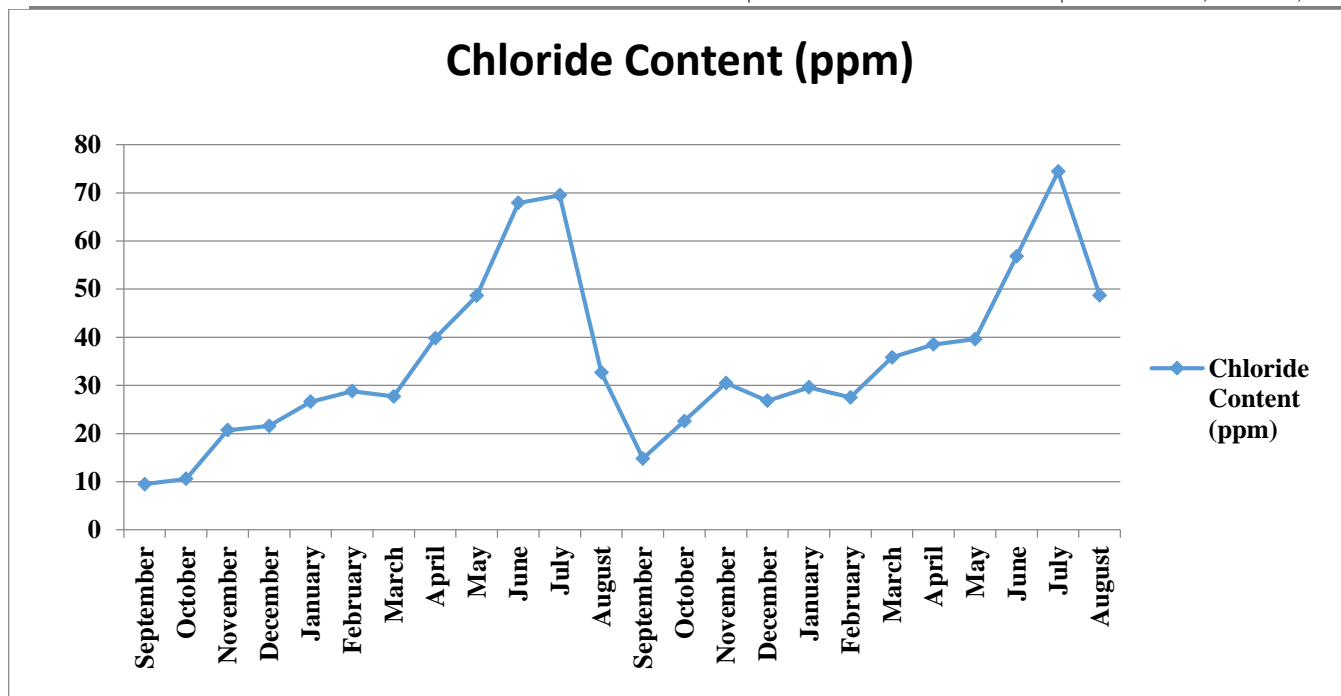


Fig 6(b)– Chloride Content of Getalsud Dam

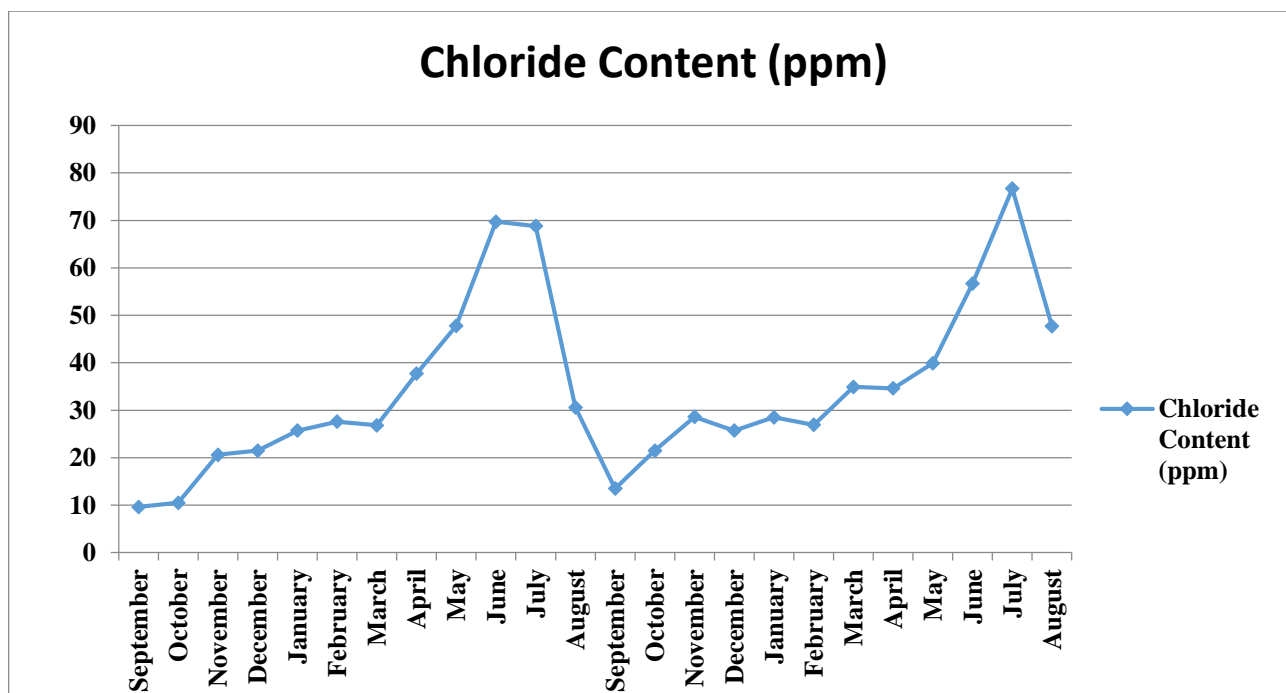


Fig 6(c)– Chloride Content of Dhurwa Dam

Sulphate contents

Sulphate was chiefly contributed from biotic sources and its concentration varied between a minimum of 18.60 for Kanke dam, 17.75 for Getalsud dam, 18.70 for Hatia dam ppm to a maximum of 36.00 for Kanke dam, 36.45 for Getalsud dam, 36.55 for Hatia dam ppm. The fluctuation of sulphate content of the lake water showed a high value in the rainy as well as colder months throughout the period of observation. In warmer months, the sulphate content value was observed to decline to the lowest in the month of April during all the years of investigation (19.80, 19.55 for Kanke dam, 20.60, 18.80 for Getalsud dam, 19.85, 19.75 for Hatia dam ppm) respectively. The decrease and increase of the sulphate content of lake water was not observed to be in any relation with the other abiotic components of the lake.

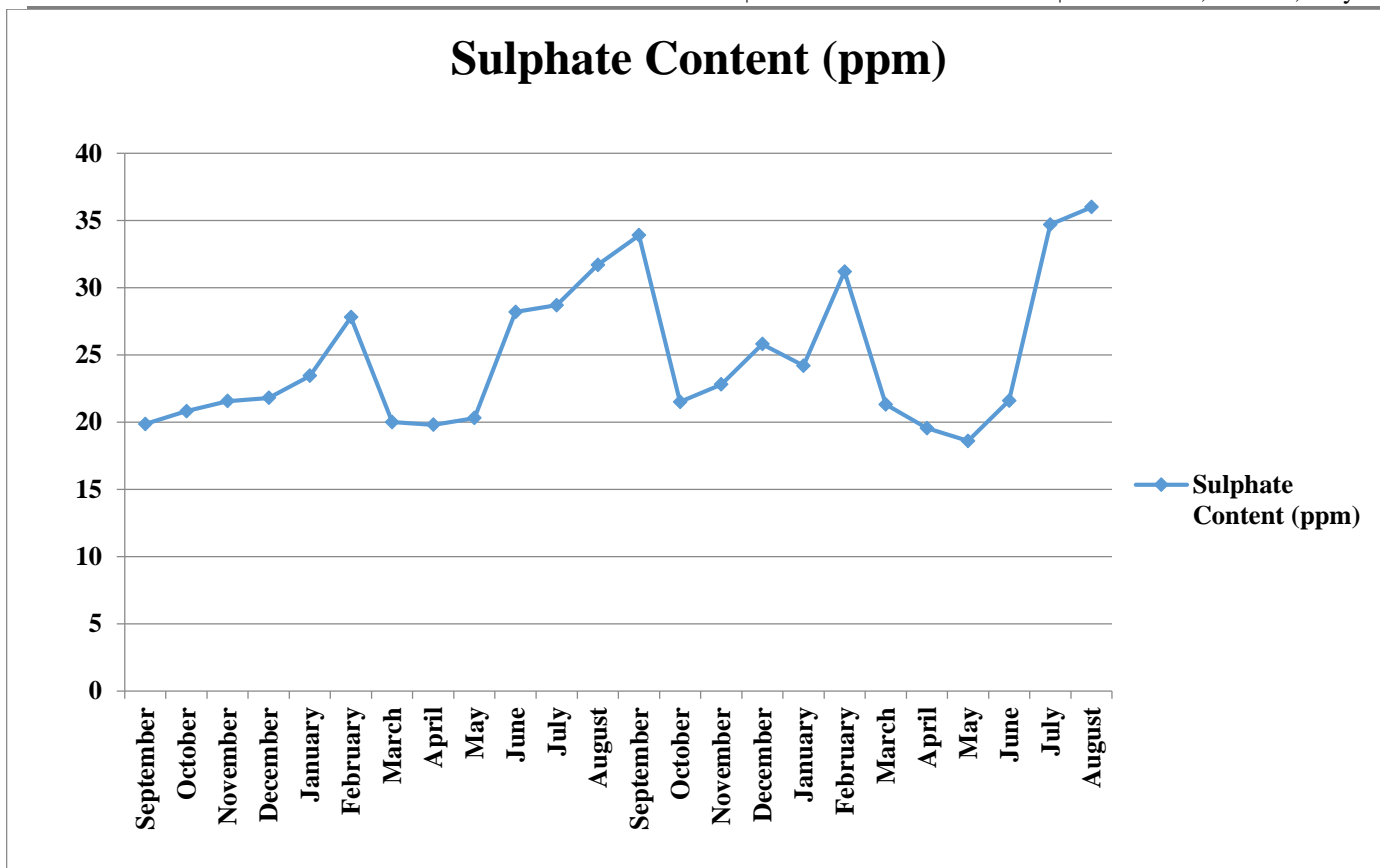


Fig7(a)– Sulphate Content of Kanke Dam

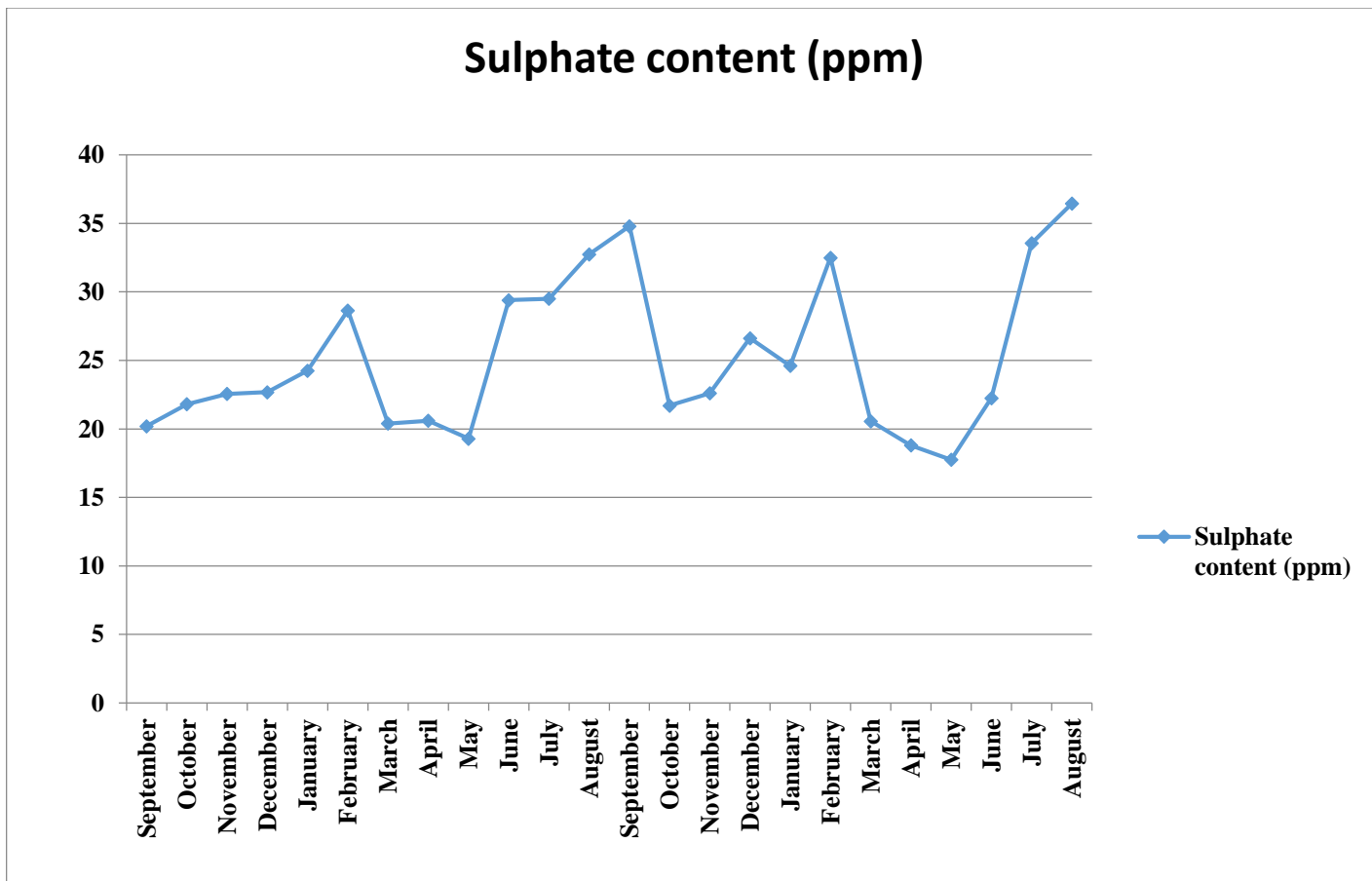


Fig 7(b)– Sulphate Content of Getalsud Dam

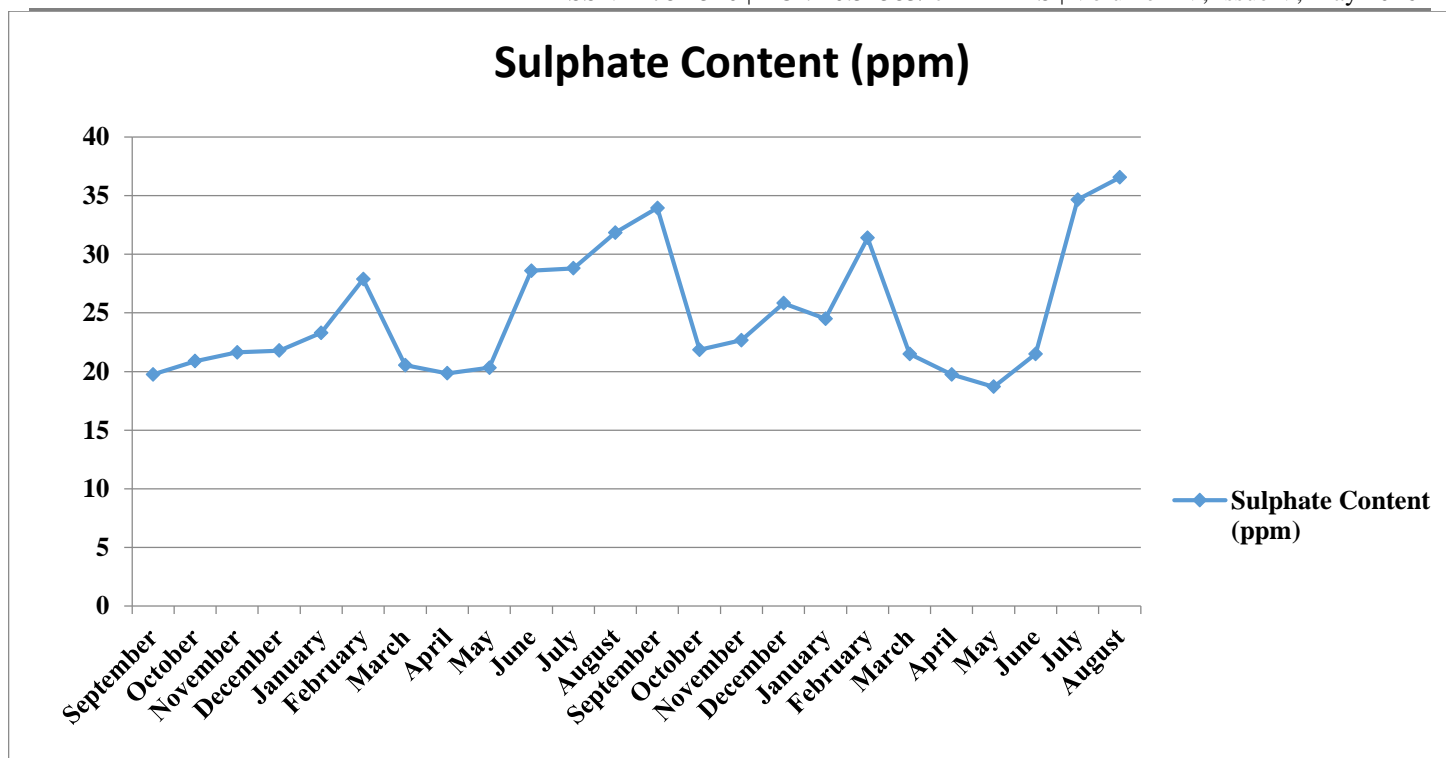


Fig 7(c)– Sulphate Content of Dhurwa Dam

Inorganic Phosphate contents

The present study revealed a distinct seasonal, unimodal fluctuation of phosphate content in the lakes water. In September 2021 the phosphate content value was 0.680 for Kanke dam, 0.660 for Getalsud dam, 0.670 for Hatia dam ppm. In the following month it decreased to 0.475 for Kanke dam, 0.468 for Getalsud dam, 0.459 for Hatia dam ppm, in September 2021 which was subsequently observed to be the peak for the phosphate values of the first year of investigation. From September onwards, a gradual decrease of phosphate value was observed till it reached the minimum during the month of August 2022 (0.104 for Kanke dam, 0.110 for Getalsud dam, 0.106 for Hatia dam ppm). In the succeeding year, the value fluctuated in the same way, but the peak was observed during the month of December, which was incidentally the highest value observed ever (0.520 for Kanke dam, 0.530 for Getalsud dam, 0.540 for Hatia dam ppm). The minimum value for the second year was observed to be during the month of August, 2023(0.170 for Kanke dam, 0.150 for Getalsud dam, 0.165 for Hatia dam ppm) which was again the lowest of all.

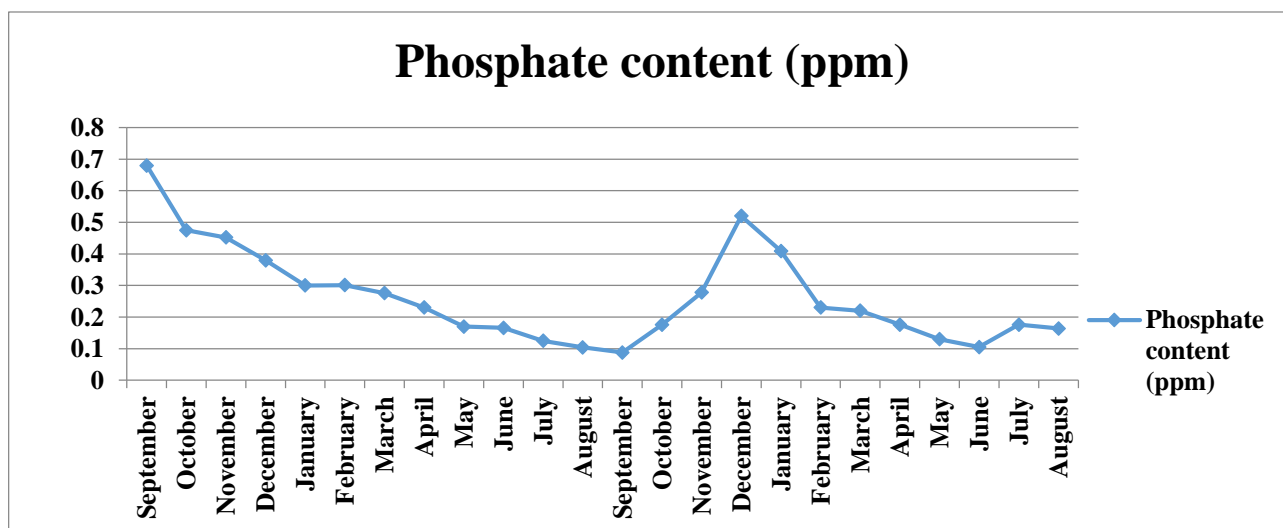


Fig8(a)– Sulphate Content of Kanke Dam

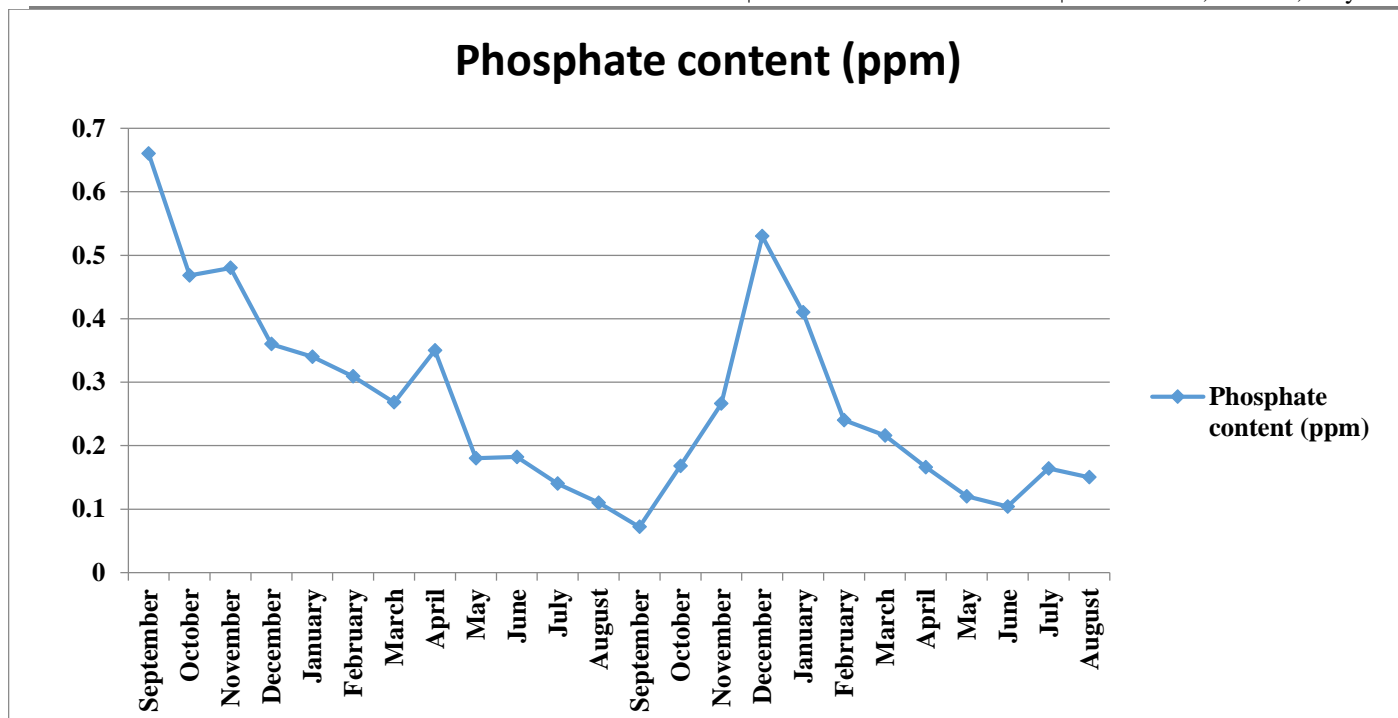


Fig 8(b)– Sulphate Content of Getalsud Dam

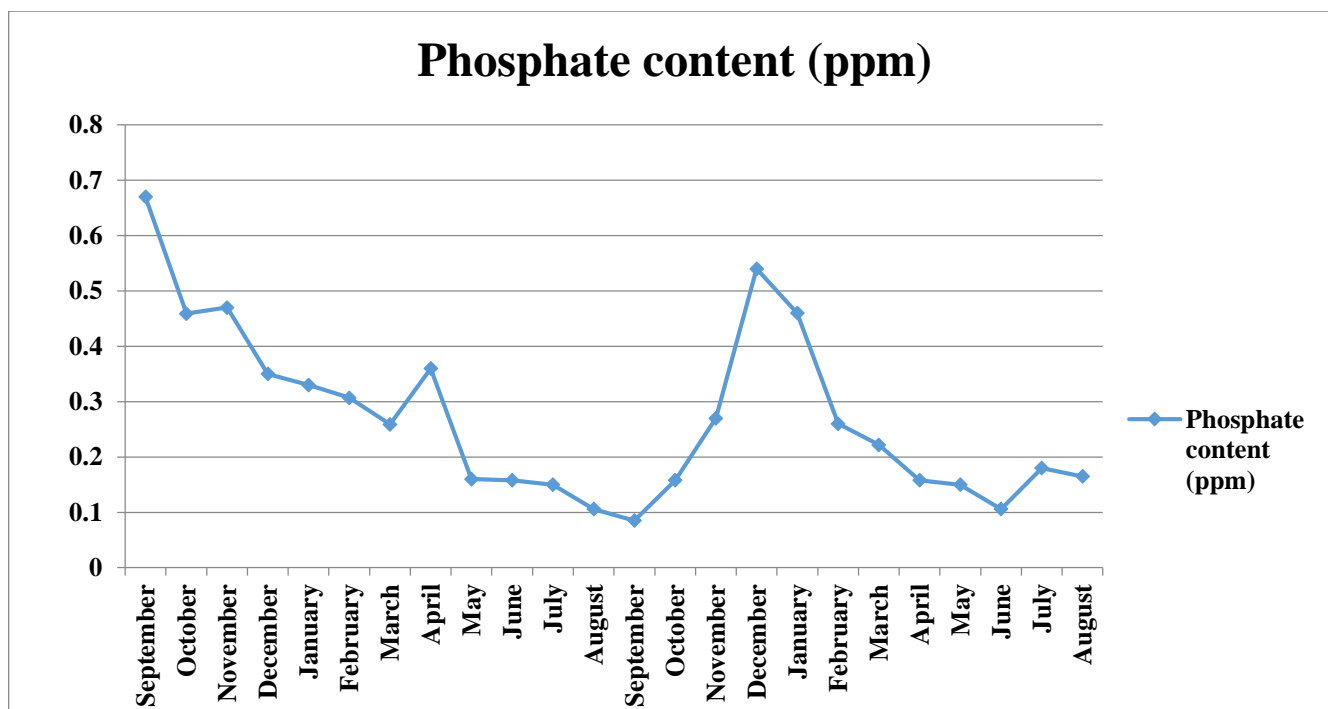


Fig8(c)– Sulphate Content of Dhurwa Dam

Organic matter content

The organic matter content of the lake was found to be 0.680 for Kanke dam, 0.650 for Getalsud dam, 0.670 for Hatia dam ppm in the month of September, 2021 which gradually decreased then onwards and the minimum value of 0.150 for Kanke dam, 0.148 for Getalsud dam, 0.146 for Hatia dam ppm was reached in December 2021. This abiotic component gradually increased as the monsoon approached and the highest value of 0.640 for Kanke dam, 0.650 for Getalsud dam, 0.670 for Hatia dam ppm was obtained during the month of heavy shower (June 2022). The post monsoon period also showed the increased value. The amount of organic matter content decreased in the lake water in early winter months. The second year of study also revealed the same pattern, where the highest value was in the month of June 2023(0.610 for Kanke dam, 0.612 for Getalsud dam, 0.613 for

Hatia dam ppm) and lowest value was during the month of January 2022 (0.180 for Kanke dam, 0.184 for Getalsud dam, 0.185 for Hatia dam ppm) A pronounced increase in the organic matter content of the lake water was observed in the rainy months. This may be due to the influx of organic matter from the surrounding catchment area along with rain waters into the lake. The decay of diatoms and phytoplankton also contribute to the increase of organic matter content in water.

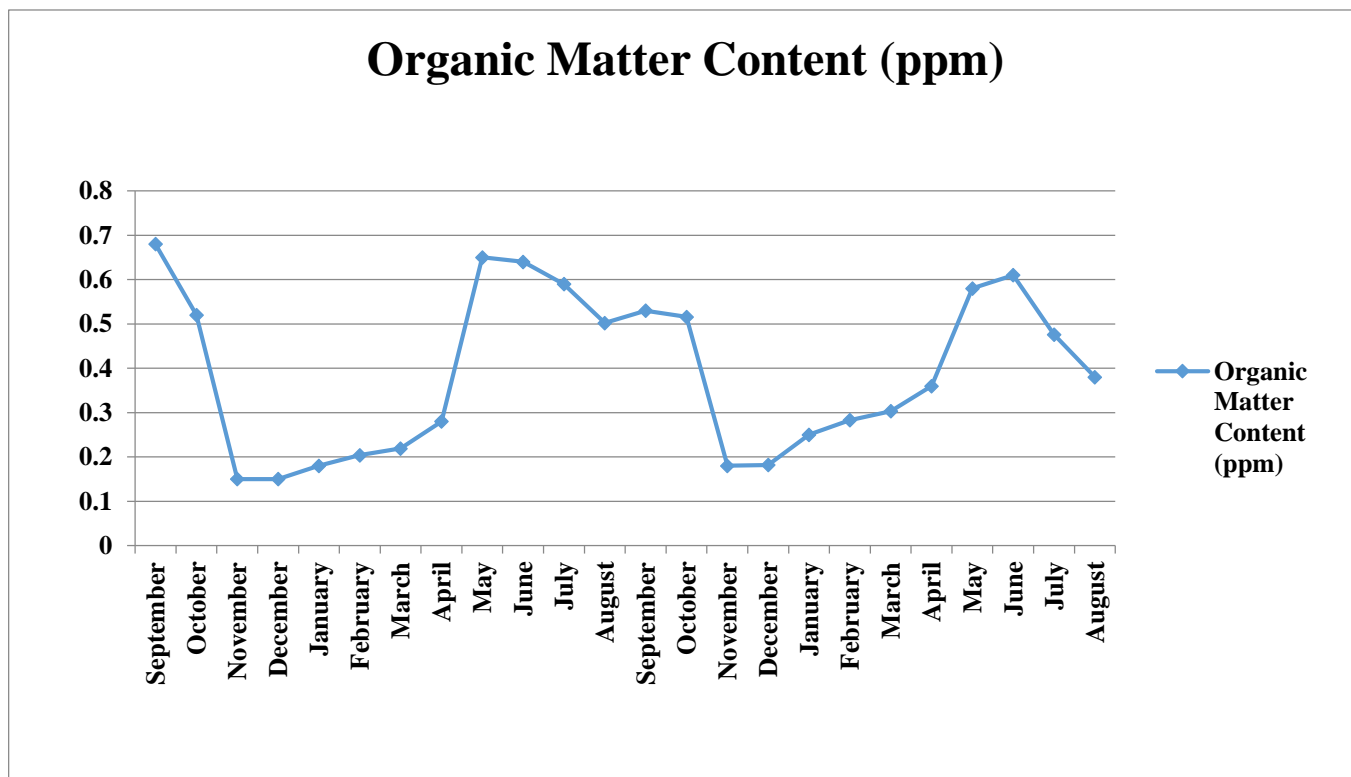


Fig 9(a)– Organic Matter Content of Kanke Dam

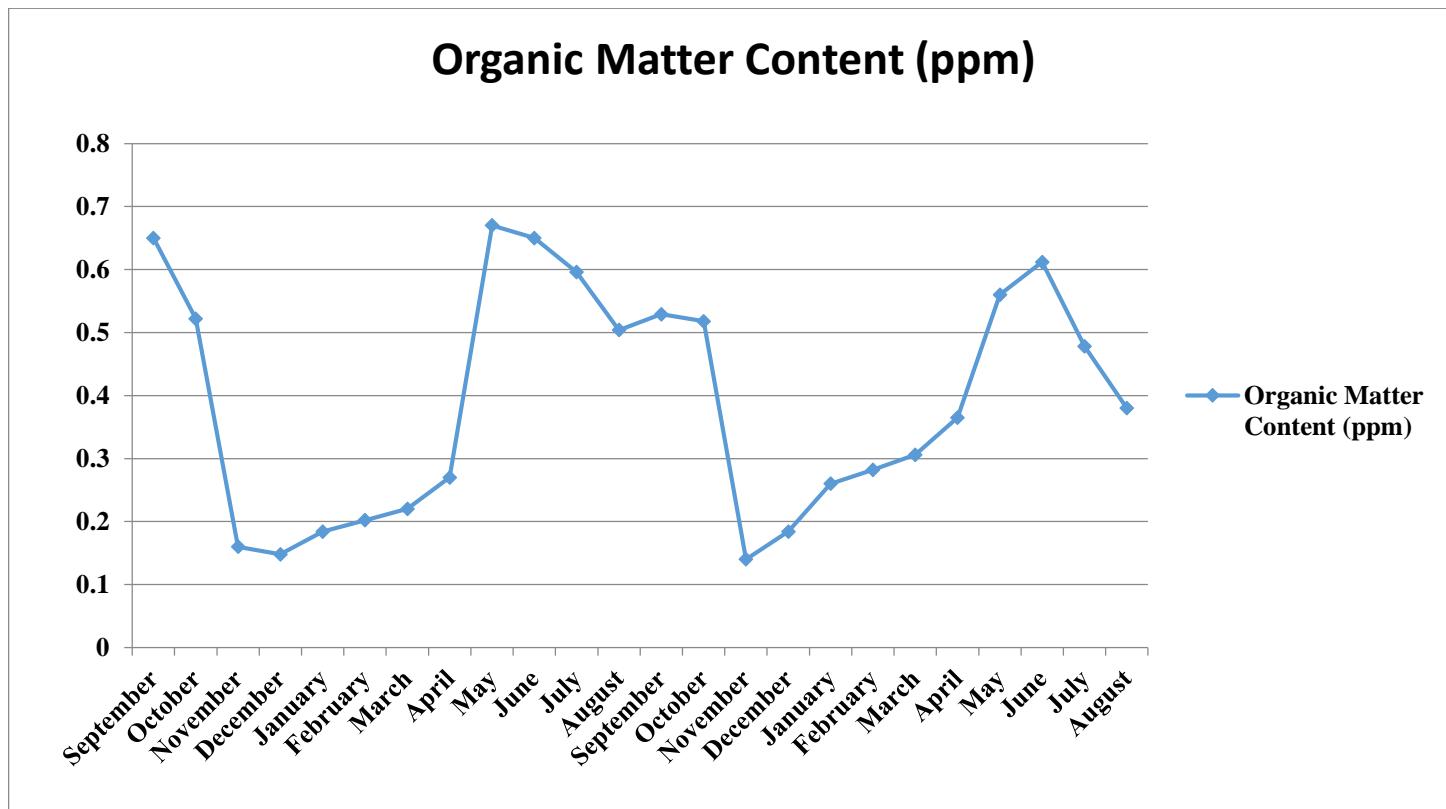


Fig 9(b)– Organic Matter Content of Getalsud Dam

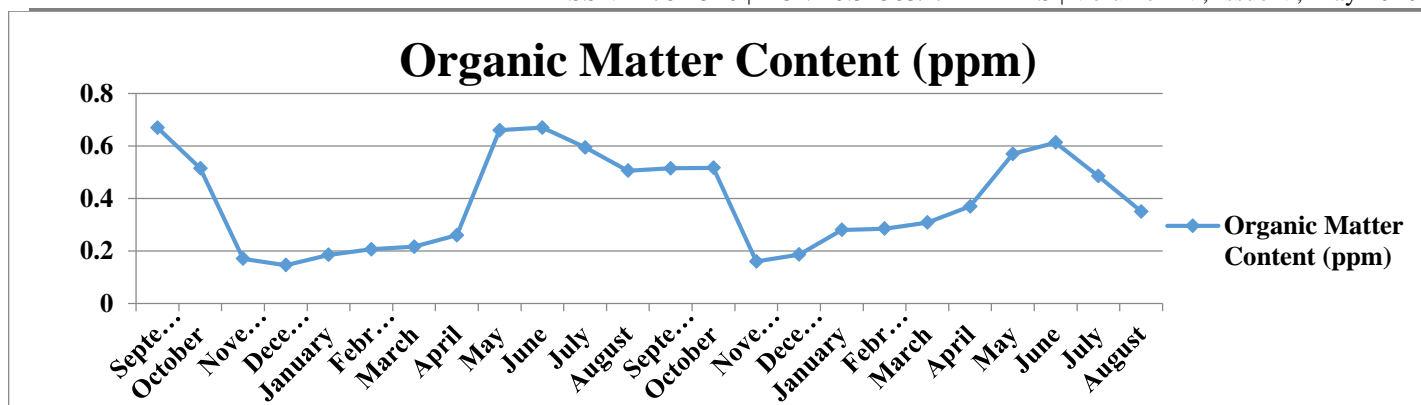


Fig 9(c)– Organic Matter Content of Dhurwa Dam

Nitrate contents

The chemical analysis of water samples of the lake revealed the presence of both Nitrate Nitrogen (NO₃-N) and Ammonia Nitrogen (NH₃-N); though the latter was found only in traces.

Nitrate Nitrogen (NO₃-N)

A distinct seasonal fluctuation of Nitrate Nitrogen content of the lakes. During the first year of investigation the minimum value was recorded to be 0.116 for Kanke dam, 0.114 for Getalsud dam, 0.115 for Hatia dam ppm in the month of April 2022 and the maximum value was observed to be 0.366 for Kanke dam, 0.365 for Getalsud dam, 0.363 for Hatia dam ppm in the month of August 2021. A steady decrease in the Nitrate Nitrogen content of water was observed during the month of summer, followed by a steady increase of the values in the monsoon i.e., June, July, August and September and post –monsoon periods i.e., October, November and December. .

In the succeeding year (2021-2022) the minimum value was observed to be nil in the month of April 2023 and maximum value was recorded in the month of September 2021 (0.450 for Kanke dam, 0.449 for Getalsud dam, 0.448 for Hatia dam ppm). The supply of the Nitrate to the lakes appeared to be regulated by the drainage and surface run-off of water during the monsoon months.

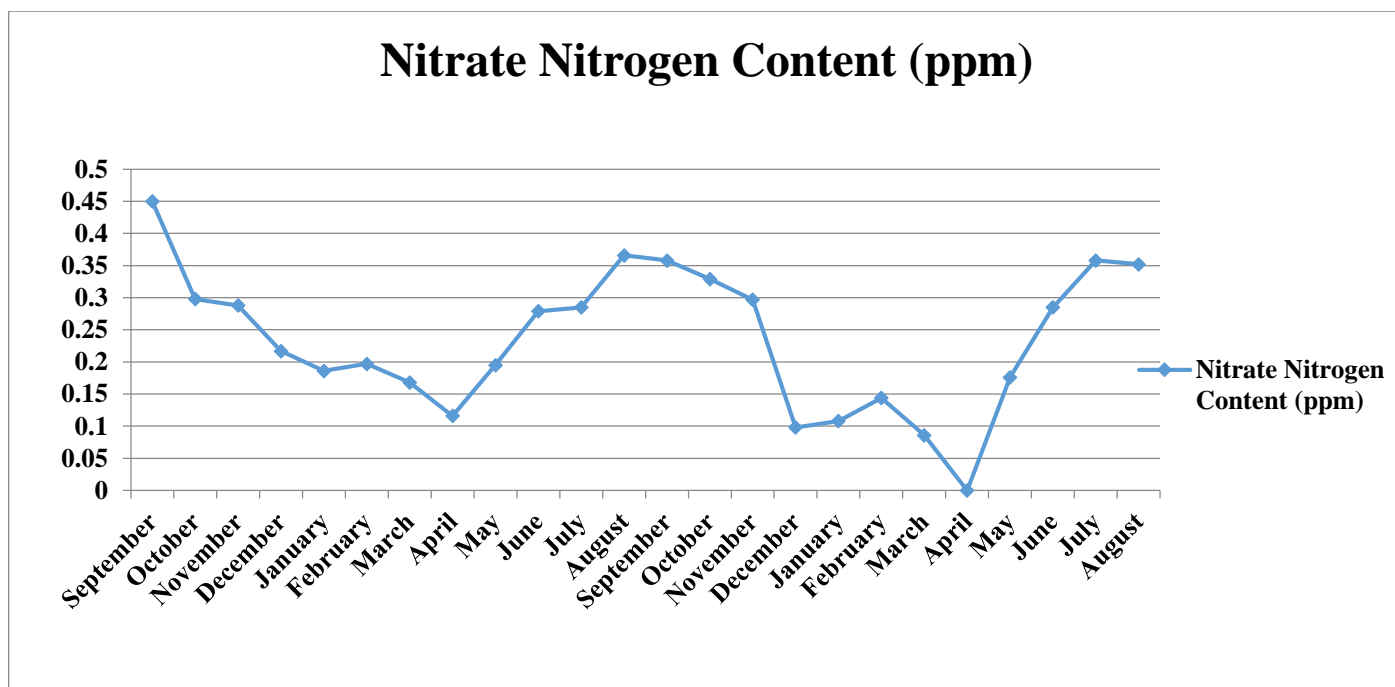


Fig10(a)– Nitrate Nitrogen Content of Kanke Dam

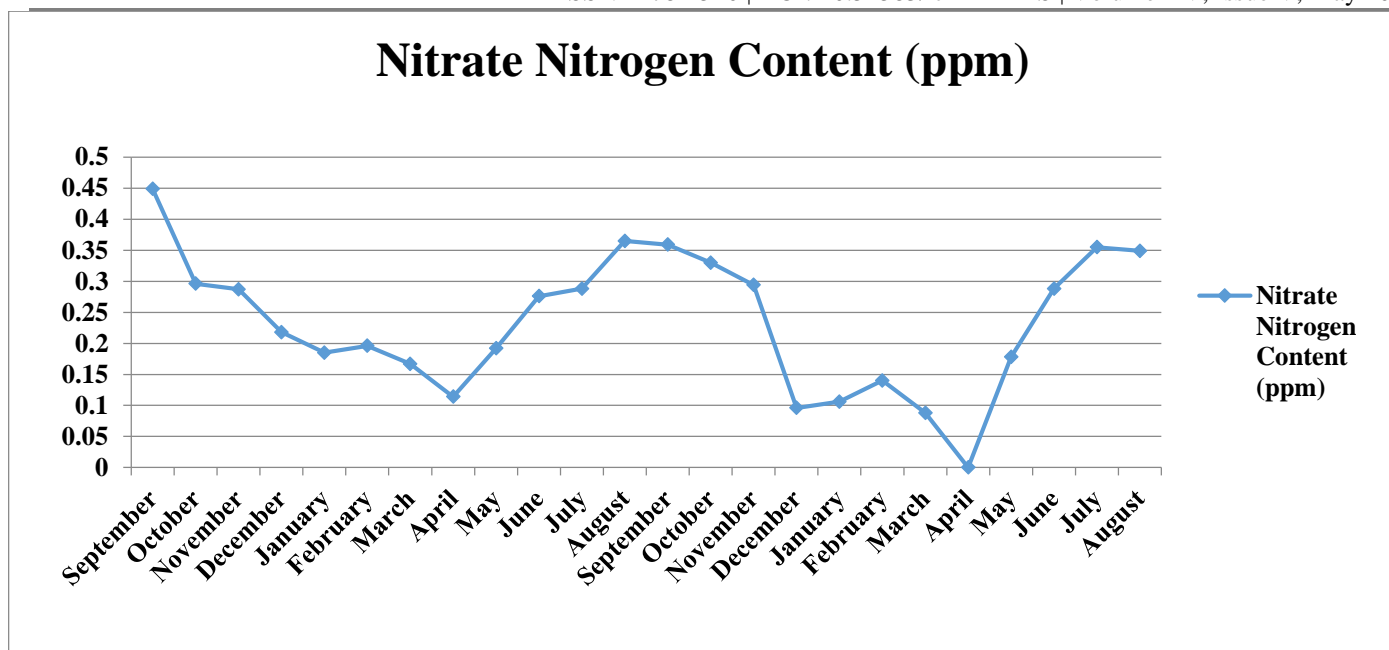


Fig 10(b)– Nitrate Nitrogen Content of Getalsud Dam

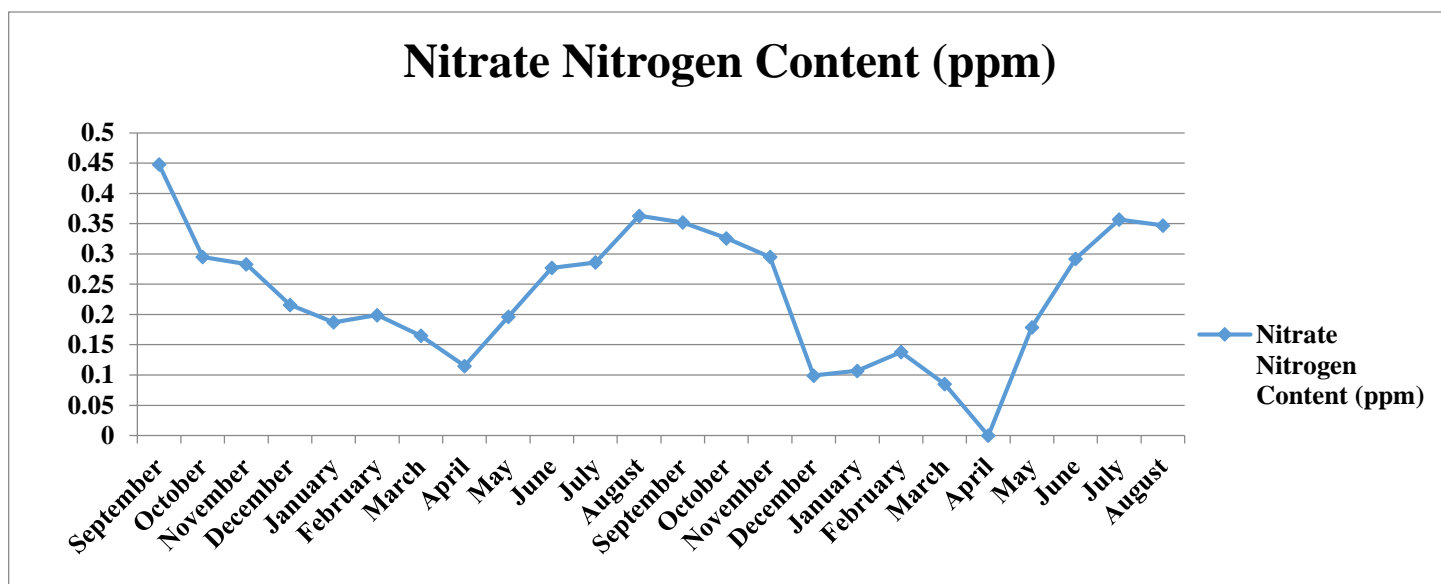


Fig 10(c)– Nitrate Nitrogen Content of Dhurwa Dam

Ammonia Nitrogen (NH₃-N)

During the present investigation, the minimum value recorded for the Ammonia Nitrogen of the lakes was 0.013 for Kanke dam, 0.014 for Getalsud dam, 0.015 for Hatia dam ppm. Throughout the period of observation the seasonal fluctuation followed more or less the same pattern, which was evidenced by lower value in the colder and warmer months. During the first year of investigation, higher value was obtained in the post monsoon months, whereas in the second year of investigation, the higher values were obtained during the monsoon months. The results of the first year's observation may well be caused by the abundance of decaying organic matter in the lakes.

The inflow of organic matter through the drainage and surface run-off of water was also observed to influence the Ammonical Nitrogen concentration.

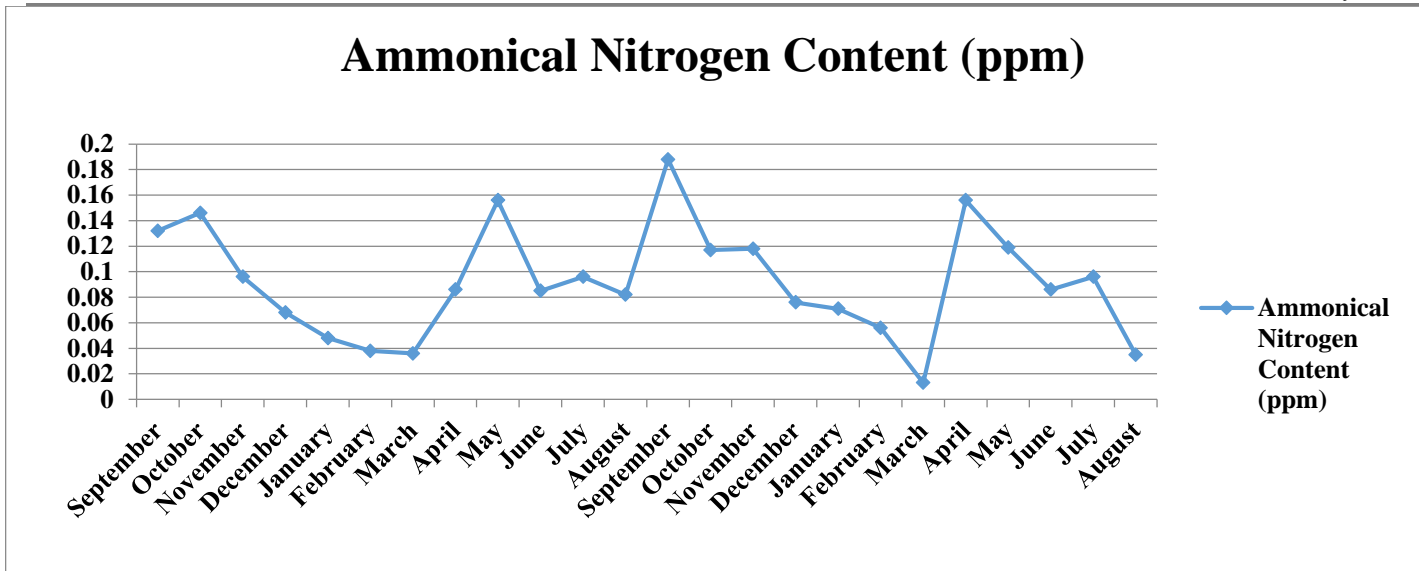


Fig 11(a)– Ammonical Nitrogen Content of Kanke Dam

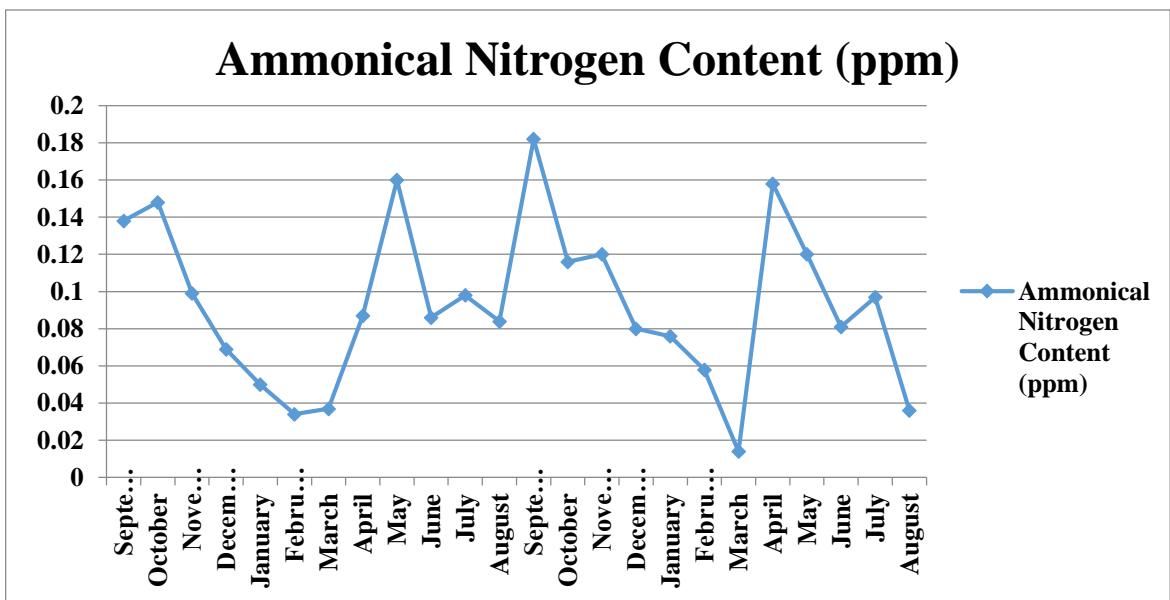


Fig 11(b)– Ammonical Nitrogen Content of Getalsud Dam

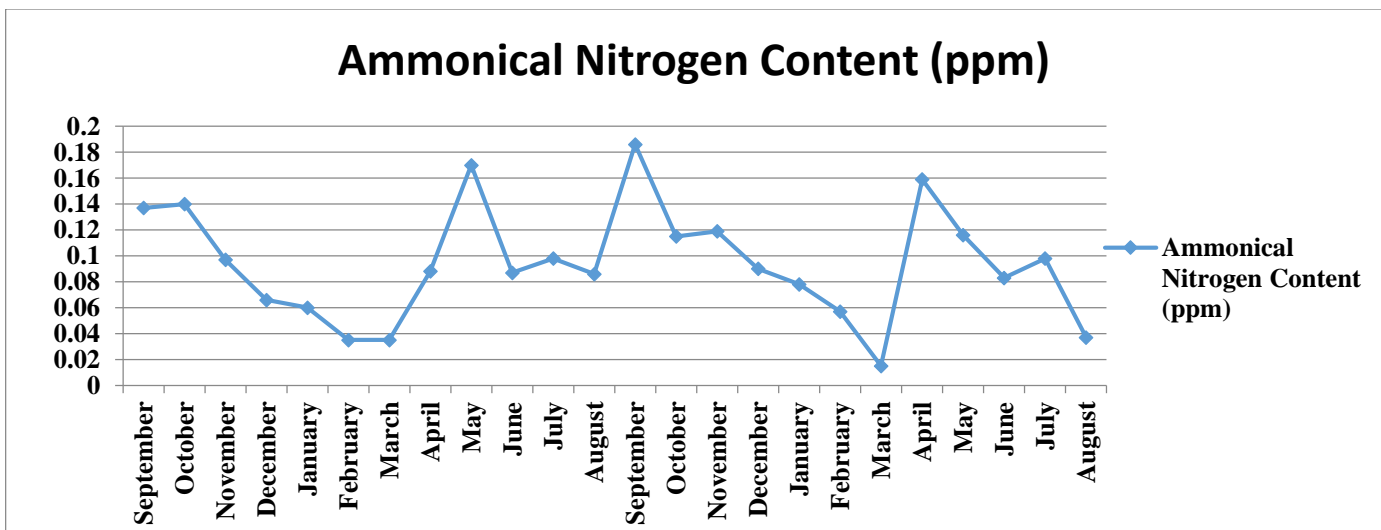


Fig 11(c)– Ammonical Nitrogen Content of Dhurwa Dam

Silicate contents

During the first year of study, the silicate value of 0.20 for Kanke dam, 0.21 for Getalsud dam, and 0.24 for Hatia dam ppm was found to be the minimum whereas the maximum value was 0.98 for Kanke dam, 0.96 for Getalsud dam, 0.97 for Hatia dam ppm. The silicate value showed distinct seasonal fluctuation. It was evident, that silicate value of lake water was minimal in cold weather and post monsoon seasons, whereas it increased during the hot weather and pre-monsoons. During the second year of study, more or less a similar trend was found, whereas the minimum value was obtained to be 0.12 for Kanke dam, 0.14 for Getalsud dam, 0.16 for Hatia dam ppm (January 2023) and the maximum value was found in the month of April 2023 (0.96 for Kanke dam, 0.97 for Getalsud dam, 0.99 for Hatia dam ppm).

A positive significant correlation between the pH value and the silicate value was observed as when pH tended to be alkaline, the silicate value also increased and vice-versa ($r = 0.84, p > 0.001$).

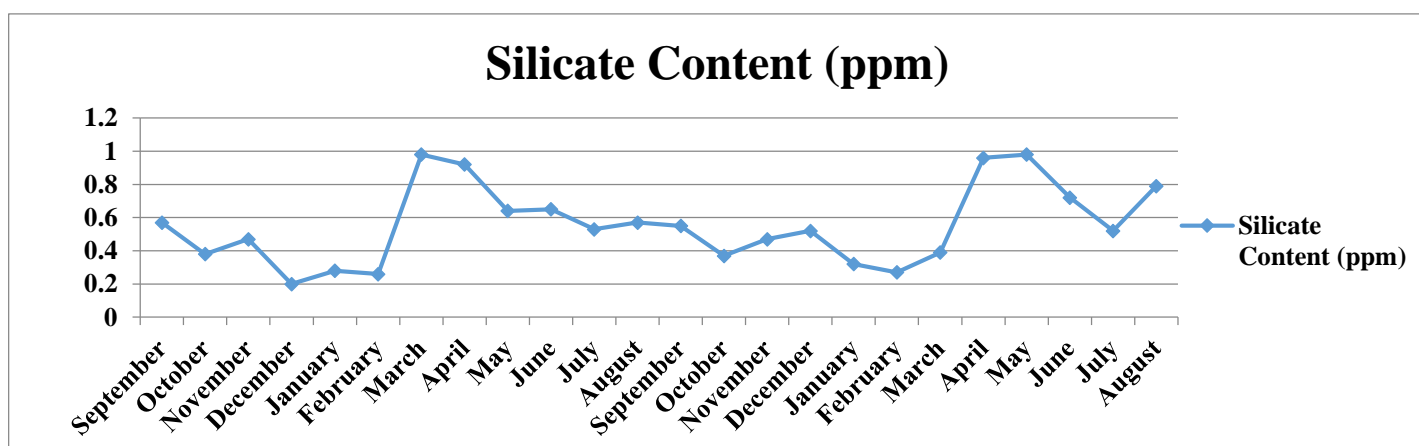


Fig 12(a)– Silicate Content of Kanke Dam

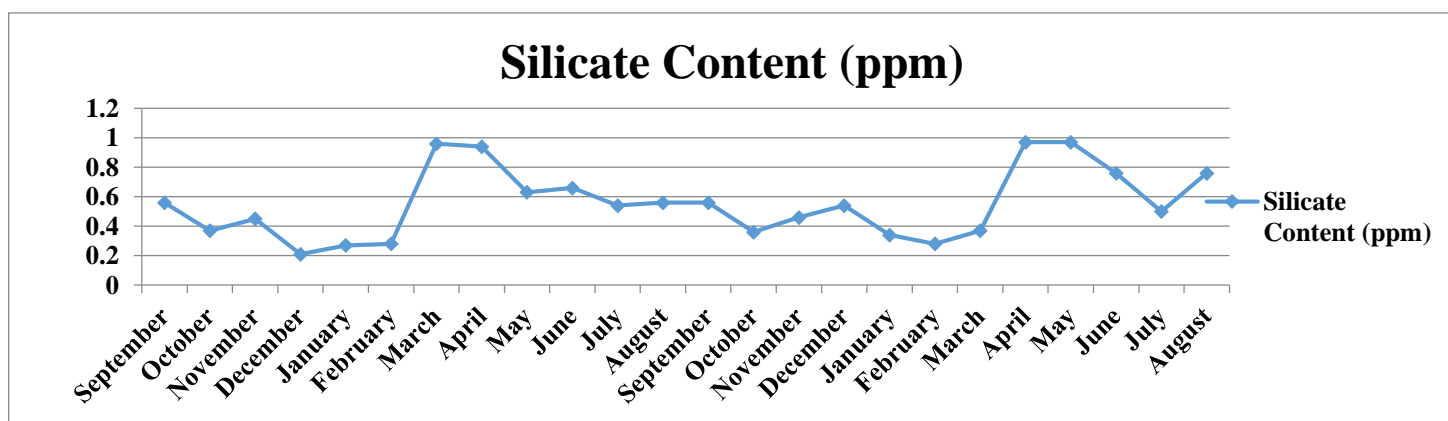


Fig 12(b)– Silicate Content of Getalsud Dam

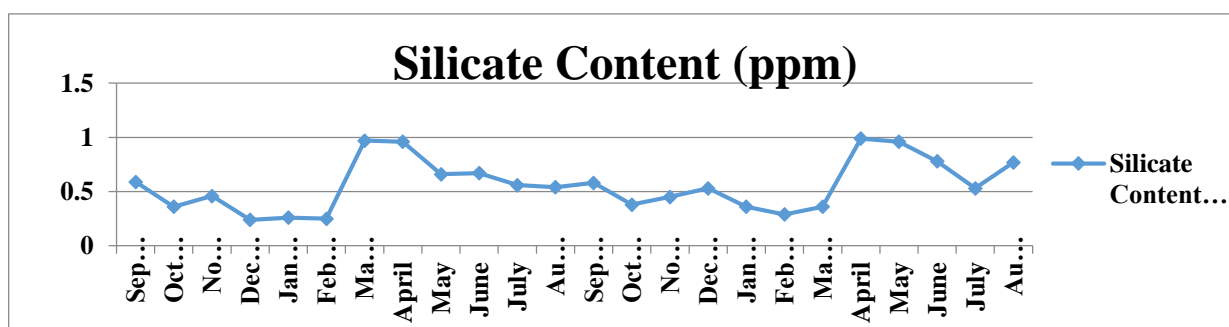


Fig 12(c)– Silicate Content of Dhurwa Dam

Summary

The study suggests that all the three water bodies away from the main population of Ranchi is in good condition and has a positive trend during several months and seasons as far as the parameters studied in the research work is considered with significance correlation between the water level and monsoon rainfall. The study shows that as the distance increases for the treatment of reservoir to distribution points, the cross contamination rate also increases and care should be taken for good hygienic practice while transporting, storing and using water. The outer skirt of the dam is shunk considerably due to the aggressive and rapid urbanization process and uncontrolled encroachment, we need to spread awareness among people in order to maintain pollution. Hence the finding are crucial for water resource management and planning in the Ranchi region.

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