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Analysis of Water Quality Parameters at Tuensang Town, Nagaland, India

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Abstract: ***Present study is carried out to asses' different parameters (physiochemical) of water for public health safety. Important results of the physico - chemical analysis of the PHED Water supplied main reservoirs Tuensang town for a period of one year from 5st January 2022 to 3rd December 2022, continuous monitoring analysis at District Water Quality Testing Laboratory Tuensang (NABL Accredited lab). During these investigation some of the important parameters which determine the status of taste, color, odour, PH, Turbidity, TDS, Electrical conductivity, total hardness, calcium, magnesium, alkalinity, chloride, fluoride, nitrate and iron. It is found that the water sampling is found within the WHO and BIS: 10500: 2012 Permissible limits. However, Turbidity, hardness and PH goes higher during Monsoon season. Results indicate shows water tank is non - polluted and can be used for domestic and human consumption purpose.***

Keywords: Tuensang town, PHED Main reservoir, periodic water, Quality analysis, Physico - Chemical Parameters

1. Introduction

Safe drinking - water, sanitation and hygiene are crucial to human health and well - being. Drinking unsafe water impairs health through illnesses. Chemical contamination of water continues to pose a health burden, whether natural in origin such as arsenic and fluoride, or anthropogenic such as nitrate.

In this work, the physico - chemical analysis of drinking water quality was studied at PHED Supply water tank Tuensang town.

The main aim of this research was to carried out different physcochemical parameters of water samples collected from main reservoir and to recommend the whether it is potable or not.

The major water quality parameters considered for the examination in this study are color, odour, PH, Turbidity, TDS, Electrical conductivity, total hardness, calcium, magnesium, alkalinity, chloride, fluoride, nitrate and iron.

2. Related Work

Efe *et al*., (2005), in the study on seasonal variations of physico - chemical characteristics in water resources quality in Western Niger Delta region, Nigeria, had reported that maximum and minimum concentrations of the priority physico - chemical water quality parameters examined in the three water resources were either above or below the target water quality range for domestic use. The overall implication of this observation called for an urgent water resources management strategy in the area in order to circumvent the fast deteriorating water resources quality, which may pose associated health risk and environmental hazards.

In the study on assessment of seasonal variations in surface water quality, pollution of surface water and sediments with toxic chemicals, eutrophication of rivers and lakes with excess nutrients were of great environmental concern worldwide (Ouyanga *et al.*, 2006).

Physico - chemical analysis is of prime consideration to assess the quality of water for its best utilization like drinking, irrigation, fisheries and helpful in the understanding the complex processes, interaction between the climatic and biological processes in the water. Anthropogenic activities, namely, agricultural, had marked adverse effect on the physico - chemical characteristics of water (Gasim *et al*., 2007).

In the study on analysis of water quality of Bavani river near Mettupalayam, India (Shyamala, 2010), it was reported that there was increased pollution intensity with travel course of river in settlement areas.

Lalchhingpuii (2011) studied status of water quality of Tlawng river in the vicinity of Aizawl city, Mizoram, and reported that the intensity of pollutants was maximum in tributary water, indicating direct discharge of huge amount of wastes into water. Tlawng river water near upstream was least polluted, and intensity of pollutants was increased due course of travel of river; and more pollution stress was observed at the sites after meeting point with tributaries. The PHED supply water also contained traces of pollutants and was cleaner than river water. The DO content decreased with increase in pollution stress, as a result of this, values were low for tributary water. The river water showed higher DO content than PHE supply water; this could be linked with photosynthesis activity of producer organisms

Nohochem (2021) studied Physico - chemical and Bacteriological Analysis of Drinking Water Quality under

Tuensang District, Nagaland, India, reported many PHED water quality in the Tuensang is effecting by turbidity in the summer and monsoon season.

3. Methodology

For determination of Total Hardness, Calcium and Magnesium, was done by EDTA titrimetric methods. For Colour APHA 23rd Edition - 2120 - Platinum Cobalt Visual Comparison, and taste IS 3025 (Part 8), Alaklinity standard APHA 23rd (HB: 2017) Edition Procedure were used, for chloride APHA 23rd Edition - 4500 - Argentometric method. Iron, Nitrate, fluoride Palintest Photometer mode; P - 7100 were used.

PH has been determine by using Digital PH meter Eutech Instrument (SI. NO: 2975695 Model PH - 700. For Electrical conductivity, and TDS using Digital conductivity meter - Hanna Instruments Si. No.864362, model type, Chemical properties of water like hardness was determined as mg CaCO3/L, by EDTA titrimetric method, using eriochrome black - T indicator and standardized solution of ethylenediaminetetraacetic acid (EDTA.

4. Experimental Results and Discussion

The physic - chemical characteristics of the various parameters have been shown in table

Table 1: PHED Supply Water Tank

Month	Color	Odour	P^H at 25'	TDS	Turbidity NTU	Total Hardness ($mgCaCO_3/L$)
Jan 2022	Colourless	Agreeable	7.5	187	2.09	98
Feb 2022	Colourless	Agreeable	7.5	177	2.5	88
March 2022	Colourless	Agreeable	7.8	167	3.2	93
April 2022	Colourless	Agreeable	7.3	177	3.0	99
May 2022	Colourless	Agreeable	7.9	183	3.2	89
June 2022	Colourless	Agreeable	7.5	180	2.5	94
July 2022	Colourless	Agreeable	7.6	190	5.06	100
Aug 2022	Colourless	Agreeable	8.6	194	5.2	102
Sep 2022	Colourless	Agreeable	8.3	192	5.03	90
Oct 2022	Colourless	Agreeable	7.8	180	3.7	86
Nov 2022	Colourless	Agreeable	7.5	178	2.03	88
Dec 2022	Colourless	Agreeable	7.5	179	2.09	85

Table II: I1 PHED Supply Water Tank

Month	Fe (mg/L)	Ca (mg/L)	Mg (mg/L)	Cl (mg/L)	Alkalinity ($CaCO_3$/Mg/L)	F (mg/L)	Nitrate	Residual chlorine
Jan 2022	0.02	25	12	22	97.3	0	0.2	0
Feb 2022	0.01	24	10	24	88.9	0	0.1	0
March 2022	0.02	21	9	33	99	0	0.2	0
April 2022	0.01	29	7	35	95	0	0.1	0
May 2022	0.02	42	12	44.5	100	0	0.5	0
June 2022	0.01	44	14	41	98	0	0.6	0
July 2022	0.05	49	14	39	99	0	0.5	0
Aug 2022	0.05	42	12	34	96	0	0.3	0
Sep 2022	0.02	41	9	33	96	0	0.2	0
Oct 2022	0.01	38	10	32	81	0	0.3	0
Nov 2022	0.02	27	8	29	89	0	0.4	0
Dec 2022	0.01	29	8	25	88	0	0.2	0

Colour
All samples are colourless

Adour:
All sample and odorless and are agreeable

pH
As per the IS 10500: 1012, the acceptable limit of PH is 6.5 to 8.5 and there is no relaxation. The hydrogen ion (H^+) concentration affects the taste of water. The PH value of natural water changes due to the presence biological activities, temperature and disposal of industrial wastes as well as due to the acid mines drainage waste. The pH of study sampling water varied from 7.5. to 8.6 which shows slightly alkalinity of water. The maximum PH recorded in the month of August 8.6 in Monsoon season and minimum PH recorded is 7.5 in the winter

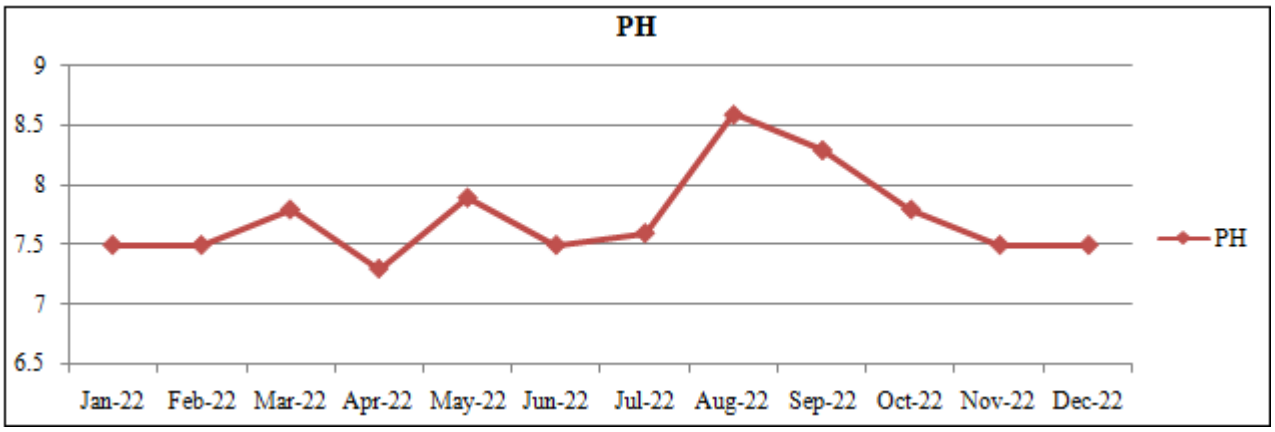

Figure 1: Graph of pH

Turbidity:

Turbidity is measure of the relative clarity or cloudiness of water. Turbidity is caused by particles suspended in water that scatter light making the water appear cloudy or marky. Particulate matter can include sediment - especially clay and silt, fine organice and inorganic matter, soluble colored organic compounds, algae and other microscopic organism. As per IS 10, 500 - 2012. Maximum permissible limit is 5 NTU. In the present study, the minimum turbidity is 2.03 NTU has been recorded November 2022 and Maximum 5.2 NTU in the month of August 2022 crossed beyond Indian standard of drinking water, in the month of July it has been recorded 5.06 NTU and September 5.03 NTU. Which may be due to heavy rainfall.

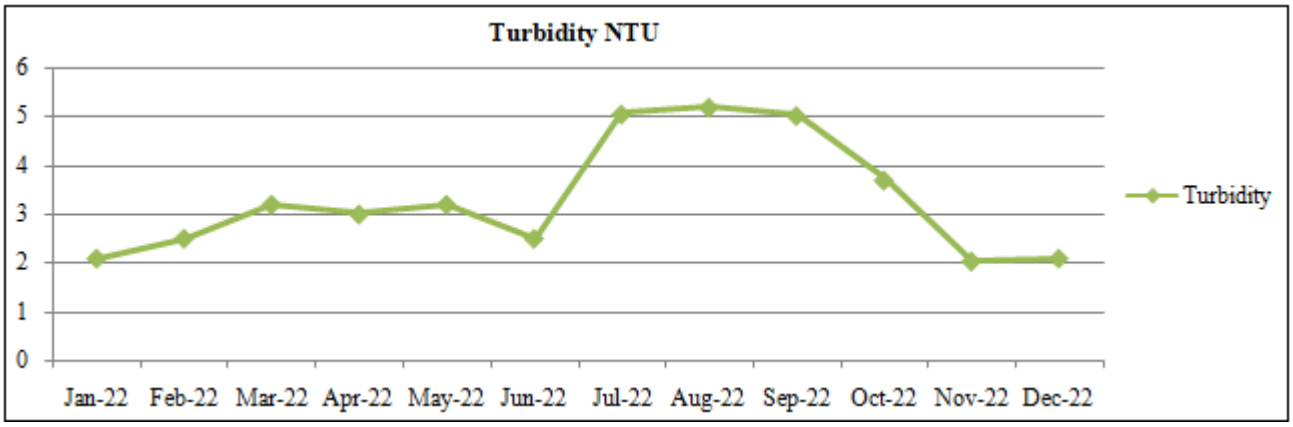

Figure 2: Graph of Turbidity NTU

Total Dissolved Solids (TDS)

TDS is an approximation of organic and inorganic salts that are soluble in water. It is strongly recommended to test and treat water before drinking (Baig et al.2011; Mehmood et al.2012). It is the totality of cations (Ca+2, Na+, K+, and Mg+2) and anions (CO_3^{-2}, SO_4^{-3}, Cl^-, NO^{-3}, and HCO^{-3}) as the principal inorganic constituents (NSDWQ 2008). Fawell et al. (1996) asserted that TDS is the combination of inorganic salts and organic materials assimilated in water, and the best level is 300 t0 600mg/l. Walker and Newman (2011) enforced the assessment of water before consumption. Hence, TDS are the measurable constituents that are used to measure water quality and measured by water purity measuring devices. Total Dissolved Solids as a measure of the amount of materials dissolved in water. The water with high TDS value indicates that water is highly mineralized. The maximum permissible limit of TDS is 2000mg/l (IS: 10500: 2012). Gastointestinal irritation is caused due to higher concentration of TDS. The TDS values from 167mg/L to 194mg/L in the study water reservoir. The TDS recorded maximum in August 194mg/L and minimum in March 167mg/L. The changes of TDS concentrations can be harmful the density of the water determines the flow of water into and out of an organism's cell (Mitchell and Stapp, 1992). Higher TDS can often leads to bad taste and higher water hardness and may results in a laxative effect.

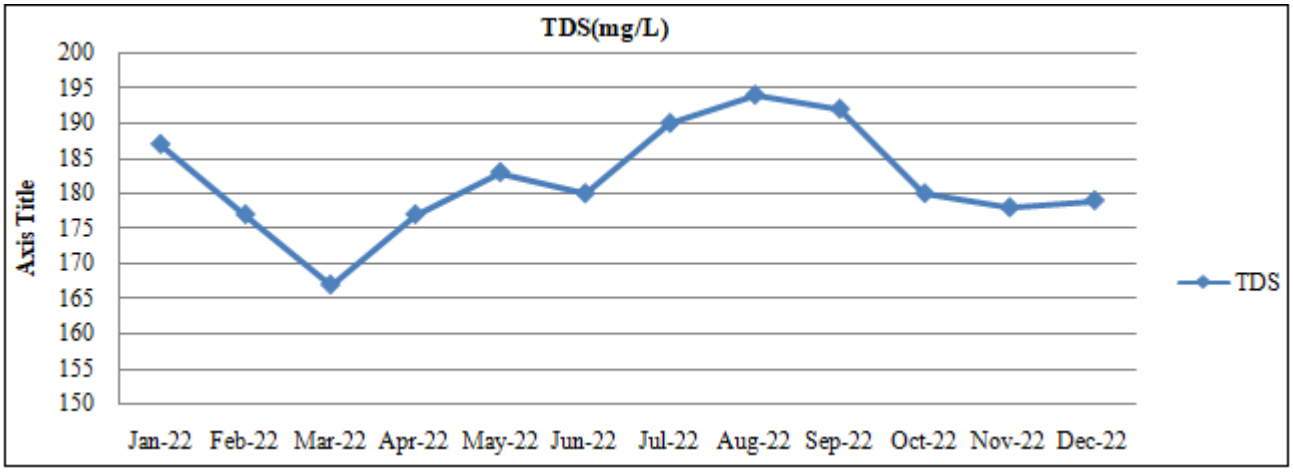

Figure 3: Graph of Total Dissolved Solid (mg/L)

Total Hardness

The hardness is measure of polyvalent cations (ions with charge greater than +1) in water. The hardness of water reflects that nature of geological formation with which it has been in contact. Hardness generally represents the concentration of calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions because these are the most common polyvalent cations. Hardness is expressed in terms of calcium carbonate ($CaCO_3$). Hard water is not a health risk, but a nuisance because of minerals building on plumbing fixtures. In the present study case the total hardness varied from 95mg/L to 102mg/L. The maximum permissible limit as per IS: 10500: 2012, is 600mg/L. Thus, none of the water samples cross the maximum permissible limits and are within the acceptable range and is safe.

Calcium

Calcium cause water hardness in natural water and originate from natural process, on a mineral containing Ca and other sources can be industrial wastes and agricultural waste. It is non - toxic. Maximum permissible limit of Calcium as per WHO and BIS 10500: 2012 is 200mg/L. In the study sample the calcium are found between 21mg/l to 49mg/l. The minimum in the month of March and maximum in the month of July.

Magnesium

The maximum permissible limit of Magnesium as per WHO and BIS 10500: 2012 is 50mg/L. In nature magnesium originate from natural process that is as dissolvent of mineral containing Mg and other sources can be industrial waste and some times agricultural waste. Magnesium has been considered as non - toxic to human at the concentration expected in water. In the present study, magnesium hardness ranges from 7mg/L to 14mg/L.

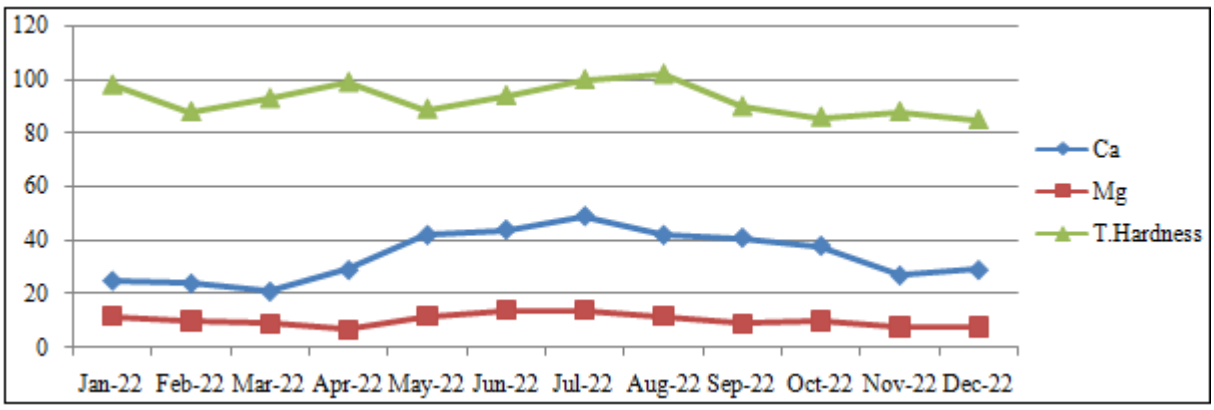

Figure 4: Graph of Total Hardness, Calcium and Magnesium (mg/L)

Chloride

There is no directly health effect associated with chloride. But, the sodium often associated with chloride can be concern to people suffering from heart disease or kidney disease. In water, chloride has no smell or colour, but it can give water a salty taste at a concentration higher than 250mg/L.

In the present sample maximum chloride 44.6 was recorded in the month of May (summer) and minimum value (22 mg/l) in the month of January.

As per Indian standard of drinking water acceptable limit of chloride is 250 mg/L and maximum permissible limit is 1000mg/L.

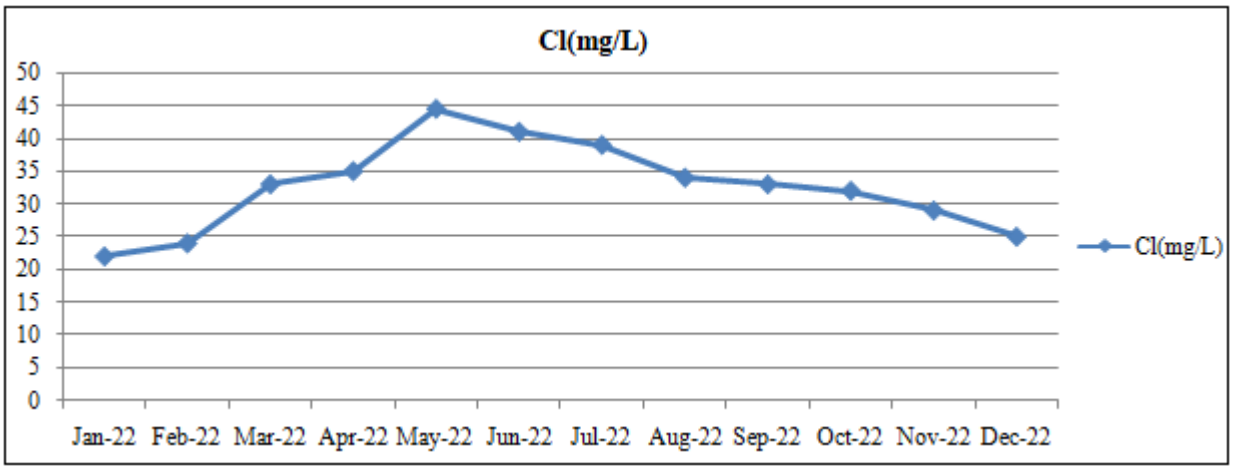

Figure 5: Graph of Chloride (mg/L)

Residual Chlorine: None of the water samples analyzed contain any residual chlorine. This could be due to non chlorination of the drinking water.

Alkalinity

The acid neutralizing capacity of water is known as alkalinity. The higher alkalinity in any area is attributed to presence of chlorides, sulphates and carbonates (Khan et al.2013)

Total alkalinity ranges from 88 mg/l to 100 mg/l the maximum value (100 mg/l) was recorded in the month of May (summer) and minimum value (88 mg/l) in the month of December (winter). The alkalinity was maximum value in April (summer) may be due to increase in bicarbonates in the water. Hujare, M. S.2008) also reported similar results that it was maximum in summer and minimum in winter due to high photosynthetic rate.

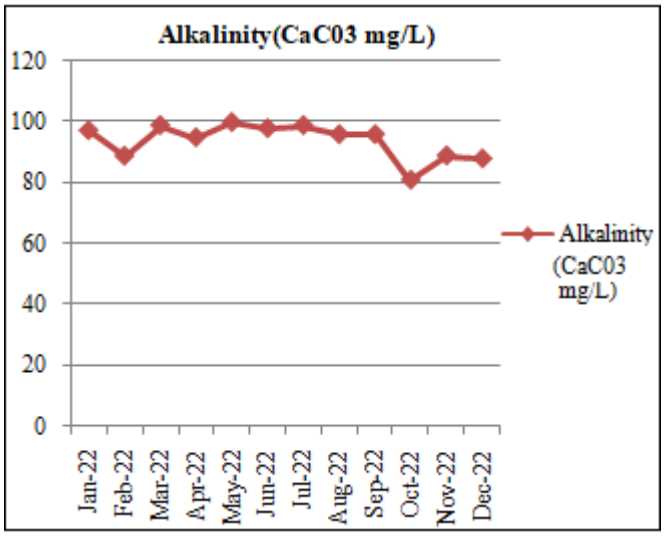

Figure 6: Graph of Alkalinity (mg/L)

Iron

Iron is an essential in human nutrition. Although iron has got little concern as a health hazard, it is still considered as a nuisance in higher concentrations. Long time consumption of drinking water with higher concerntration of iron can lead to liver diseases (hemosiderosis). Higher concentrations may also impart colour to pipe fitting and promotes the growth of iron bacteria.

The total iron concentration ranges from 0.0mg/L to 0.005mg/L with a mean value of 0.07mg/L. The total

Concentration of iron was within the range of 0.0 - 0.3mg/L as per WHO standard and BIS. Thus, the water from all the samples is considered to be satisfactory for human consumption.

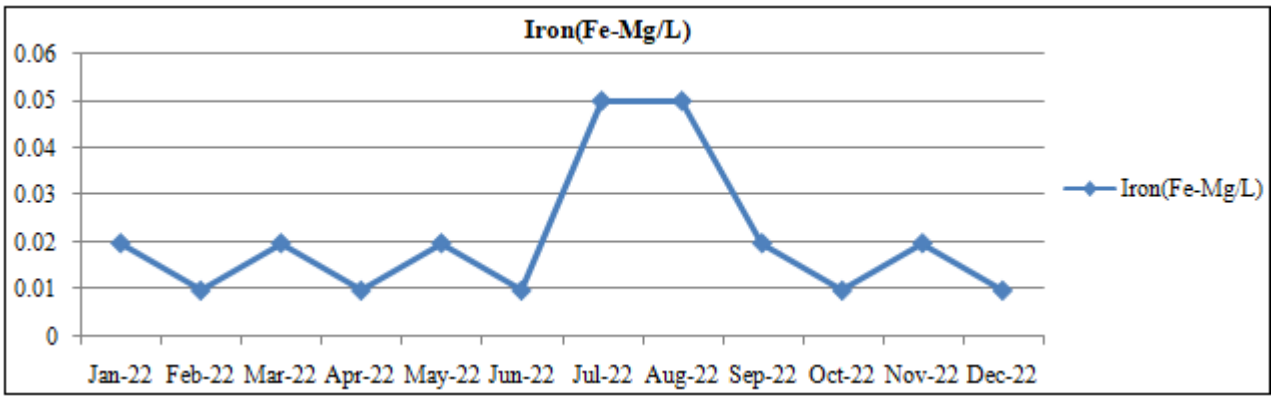

Figure 7: Graph of Iron (mg/L)

Fluoride

As per the BIS 10500: 2012, acceptable limit of fluoride is 1.0mg/L and maximum permissible e limit is 1.5mg/L. None of the month water samples analyzed contain any fluoride.

Fluoride is the highest member of the halogen family is the most electronegative among all chemicals elements (Hodge and smith, 1965) in ions inhabit a variety of enzymes often by forming complexes with magnesium ions and other metals ions (NAS, 1971). In law concentration fluoride prevents dental caries and higher concentration of fluoride also causes respiratory failure fall of blood pressure and general paralysis.

Ingestion of excess fluoride, most commonly in drinking water can cause fluorosis which affects the teeth and bones. Moderate amounts lead to dental affects, but long - term ingestion of large amount of fluoride can lead to potentially severe skeletal problems. Paradoxically, low levels of fluoride intake help to prevent dental caries.

Nitrate

Nitrates generally occur in trace quantities in surface waters, but may attain high levels in ground waters. In excessive limits, it contributes to the illness known as methenoglobinemia in infants.

Nitrate is one of the most, important elements in aquatic systems, as it helps in synthesis and maintenance of proteins and productivity of the water.

Nitrate concentration of the water bodies all influenced with the geochemical conditions organic load the rate of their mineralization, the rainfall is to be responsible for increasing the amount of nitrate in water. Nitrate is generated by heterotrophic microbes as a primary and product of decomposition of organic matter either directly from protein or from the organic compound. The presence of excessive nitrate in water is due to man made domestic activities and fertilizers from fields. Nitrate represent huge load all cause of eutrophication of the aquatic body. Nitrate stimulate the growth of plankton and water needs that provide food for fish. It may increase the fish population. However, if argue grow too wildly, oxygen levels will be reduced and fish will die. (USEPA, 1986, Knepp and Arkin).

As per the India standard permissible limit of Nitrate is 45mg/L. In the recent study nitrated was recorded from 0.01 to 0.07 Mg/L is within the permissible limit.

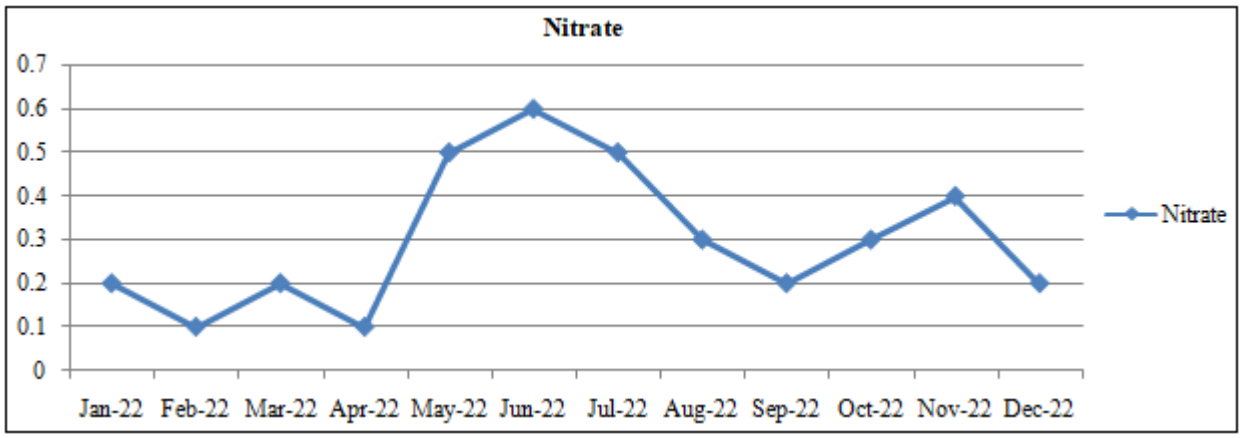

Figure 9: Graph of Nitrate (mg/L)

5. Conclusion

The result obtained during the study was compared with WHO and BIS 10500: 2012 guideline. The study assessed the water quality in the main reservoir tank for regular assessment for a period of one year from January 2022 to December 2022. And was carried out by checking the certain important physico - chemicals parameters like color, odour, PH, Turbidity, TDS, total hardness, calcium, magnesium, alkalinity, chloride, fluoride, nitrate and iron. It has been found out, during monsoon turbidity and PH goes higher as per the, this may be due to heavy rain.

In the recent study, it has found out that the tested parameters are within the permissible limits as per BIS recommendation. Thus, is safe enough to be consumed by humans or used with low risk of immediate or long term harm.

However, It is recommend that, the main reservoir water tank must wash and clean regularly to avoid plankton and algae growth which consumed oxygen in the water and to reduce bacteriological contamination especially in the Monsoon season and also proper filtration unit must be installed with more scientific approach to help more effective water filtration before delivering to the common public.

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