Physicochemical and Bacteriological Analysis of Drinking Water Quality under Tuensang District, Nagaland, India

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Abstract— **The present study was aimed to analyze the physicochemical and bacteriological properties of public drinking water (tank water, bore well water, supply tap water) of Tuensang District Nagaland, India. The methodology for physicochemical analysis of drinking water sample was followed by scientific manual (Adoniet al. 1985, APHA 2005 and HACH pH and TDS meter), and FTK Instrumental manual kits (Octopus Inc) It concludes that management of infrastructure is good. However lots of review and replacement of water pipe need to take in many villages, and water supplied in most of the places for public drinking purpose is not scientifically treatment,However, 90% of drinking water supplied to the public community is found to be healthy for drinking and free from bacteria and other harmful chemical contamination.**

pH more than 8.5 and less than 6.5 is not good for drinking purpose due to highly basic and acidic nature, Higher values of MPN, TDS, and Calcium made this water unfit for drinking. However, it is being found in the recent study that , sample studied in the reservoir tank in the collected villages under Tuensang District has been found to be free and fit for drinking purpose.

Index Terms— **Bacteriological,Physicochemical, PHED Water supplied, Heavy metals,BIS**

I. INTRODUCTION

Water quality is a term used to describe the physical, chemical and biological characteristics of water, usually with respect to its suitability for a particular purpose such as for drinking, washing or agriculture, All biological reactions occur in water and it is the integrated system of biological metabolic reactions in an aqueous solution that is essential for the maintenance of life. Most human activities involve the use of water in one way or other. It may be noted that man's early habitation and civilization sprang up along the banks of rivers. Although the surface of our planet is nearly 71% water, only 3% of it is fresh. Of these 3% about 75% is tied up in glaciers and polar icebergs, 24% in groundwater and 1% is available in the form of fresh water in rivers, lakes and ponds suitable for human consumption (Dugan, 1972).

NOTATION

S/N	SITE	SAMPLE STATION NAME	SAMPLE CODE
1	Chare Village	Main Reservior Tank(Nyonna)	TSG-1
2	Noklak Village	Main Reservior Tank	TSG-2
3	Longkhim	Main Reservoir Tank	TSG-3
4	Tuensang Town	Main Reservior Tank	TSG-4
5	Sutokur Village	Main Reservior Tank	TSG-5
6	Shamator Village	Main Reservior Tank	TSG-6
7	Chessore Village	Main Reservior Tank	TSG-7
8	Yangpi Village	Main Reservior Tank	TSG-8
9	Panso Village	Main Reservior Tank	TSG-9
10	Nokhu Village	Main Reservior tank	TSF-10
11	Chingmei Village	Main Reservior Tank	TSG-11
12	Sangsangnyu Village	Main PHED Water tank	TSG-12
13	Mangko Village	Main Reservior Tank	TSG-13
14	Thonoknyu Village	Main reservoir tank	TSG-14

Study Area

Tuensang is located in the eastern part of Nagaland. It is bounded by Mon and Longleng Districts in the north and north east respectively, Mokokchung in the northwest, Zunheboto in the southwest, Kiphire in the south, and Myanmar in the east. In the early seventies, at the instance of the Geographical Survey of India in collaboration with the Myanmar Government, 9(nine) RCC pillars touching Tuensang were erected all along the International Border demarcating India and Myanmar. The whole area of the district is 1,728 sq.km (Approximately). The present study aims to identify the quality of drinking water.(Fig. 1 and fig 2)

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Fig 1.Nagaland Map

Fig 2: Study area Map

II. METHODOLOGY

During the present investigation,the samples collected from 12 villages under Tuensang District as explained in notations in 3 liter prewashed and cleaned polyethylene bottles. The standard methods were followed for collection, storage, FTK Test during the collection and laboratory analysis of the water samples has been undertake at PHED Department District Water Quality Laboratory.Tuensang Nagaland. Temperature , pH and TDS were measured by HACH pen type digital meter. 11 14 However, total coliform identified by Standard Tube Count Method of APHA (2005). During the time of data collection, PH, Total Hardness,Chloride ,Iron Nitrate Fluoride and bacteriological test has been taken by FTK Kits manual Octopus INC. An ISO 9001:2015 Company,

III. RESULTS AND DISCUSSION

Table 1 :Physico-chemical and Bacteriological parameters in drinking water samples

Sample Code	PARAMETERS													
	Dissolve Oxygen	Bacteriological Test	Chlorides 250 mg/L)	Free Chlorine (0.2 mg/L)	Iron (0.3 mg/L)	Nitrate (45 mg/L)	pH (6.5-8.5)	Total Hardness (300 mg/L)	Turbidity (5 NTU)	Calcium (75 mg/L)	Fluoride (1 mg/L)	Magnesium (30 mg/L)	Total Alkanity (200 mg/L)	Total Dissolved Solids TDS (500 mg/L)
TSG-1	6.4	-VE	56.70	0	NIL	1	6.6	50	0	2.16	0	6	30	106
TSG-2	5.4	-VE	28	0	NIL	5	8	60	0.1	9.24	0	9	15	90
TSG-3	7.4	-VE	40	0	NIL	0	7	75	0	9.8	0	5	60	120
TSG-4	9.4	-VE	20	0	NIL	10	6.9	60	2	10.88	0	8	19	123
TSG-5	5.2	-VE	27	0	NIL	0.2	6.5	45	0	13.08	0	3	21	346
TSG-6	7	+VE	20	0	NIL	0.5	6.8	30	0	8.72	0	2	24	102
TSG-7	4.8	-VE	40	0.1	NIL	0	7	32	0	5.44	0	4	65	98
TSG-8	6.3	+VE	65	0.1	NIL	28	8	30	0	5.44	0	4	2	238
TSG-9	6.4	-VE	20	0.1	NIL	0.1	7.0	45	0	9.8	0	5	75	105
TSG-10	6.7	-VE	32	0.1	NIL	0	7.8	49	0	9.8	0	5	75	106
TSG-11	8.8	-VE	20	0	NIL	0.5	7	30	0.5	2.2	0	6	66	170
TSG-12	9.1	+VE	60	0.1	NIL	18	7	45	0	2.96	0	5.5	59	155
TSG-13	5.2	-VE	21.9	0.1	NIL	0	6.6	125	0	2.96	0	5.5	59	405
TSG-14	6	-VE	51	0.1	NIL	0	8.2	60	0	19.08	0	3	74	152

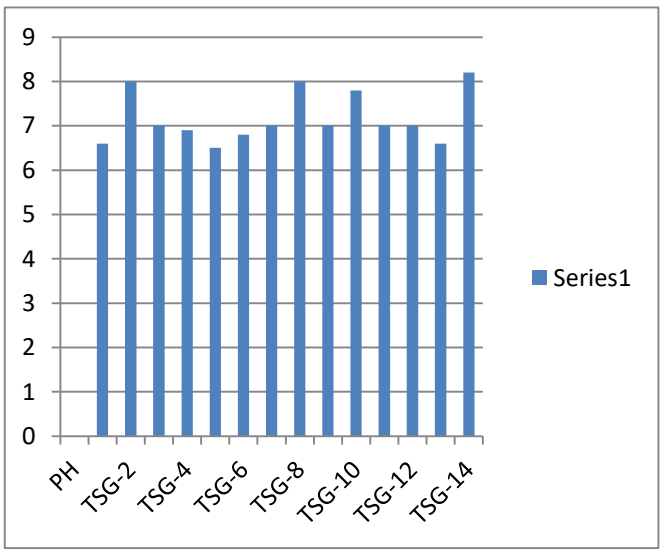

Fig 3. PH of water Sample

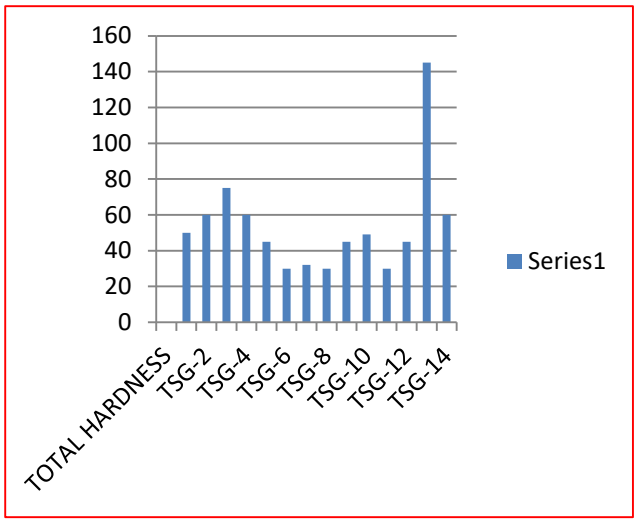

Fig 4 : Total Hardness

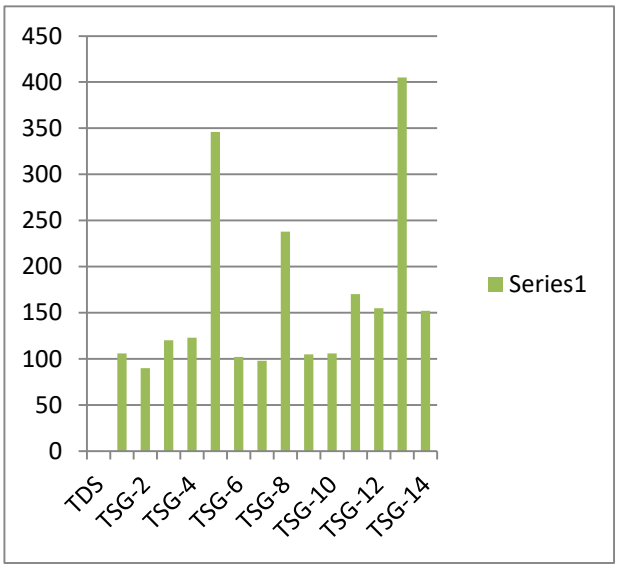

Fig 5: Total Dissolve Solid

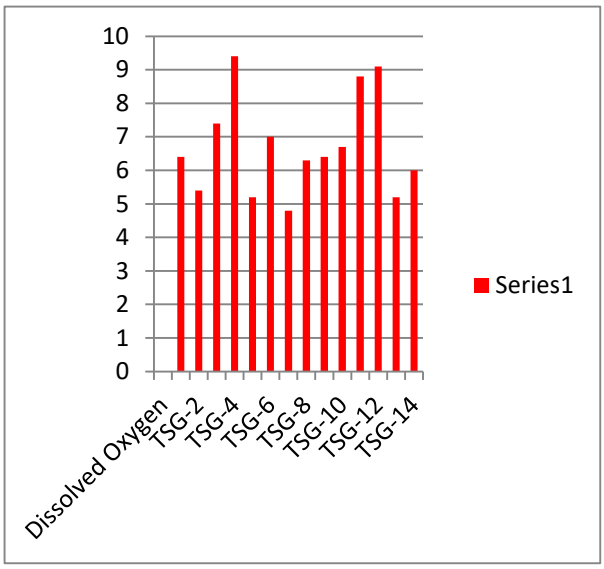

Fig 6: Dissolved Oxygen

pH: The pH is pure water is 7,drinking water and natural water exhibits a PH range because it contains dissolved minerals and gases. Surface waters typically range from PH 6.5-8.5 while groundwater ranges from PH 6-8.5.

Water with a pH less than 6.5 is considered acidic. This water typically is corrosive and soft. It may contain metal ions, such as copper, iron, lead, manganese and zinc. The metal ions may be toxic, may produce a metallic taste, and can stain fixtures and fabrics.

Water with a PH higher than 8.5 is considered basic or alkaline. This water often is hard water , containing ions that can form scale deposits in pipes and contribute

Analysis report are indicated in Table 1 for all water samples. Based upon it, individual parameter can be explained. Observation indicated explains that the pH value of 14 water samples was found to be under acceptable limit (6.5-8.5) prescribed by Bureau of Indian Standards (BIS), 10500- 2012 whereas pH of 2 sample namely TSG-2 and TSG-4 is found to be slightly acidic (6) and 6.3 as shown in (Table1 and fig 3)

MPN Counts: The most probable number (MPN) is best indicator of bacterial contamination in water samples. According to the standards given by BIS, 2012 and APHA, the presence of Total Coliforms has been given water samples indicated that the water is highly polluted and not at all fit for potable purpose. In present study, all samples sample has been found to be within the limit of permissible. Only 4 sample TSG-6,TSG-8,and TSG-12 out of 14 samples namely are reported Total Coliform contamination. This clearly indicates most of the drinking water sample supplied in the villages is found suitable for direct drinking purpose except TSG-6 and TSG-8.and TSG-12.

Total hardness.: Hardness is not a specific constituent of water; It is due primarily to the presence of ions of calcium and magnesium in water. Hardness is expressed in terms of calcium carbonate(CaCo3). Hard water is not a health risk, but a nuisance because of mineral buildup on plumbing fixture and poor soap and /or detergent performance.
Total hardness of water is caused by the presence of Ca and Mg salts present Study shows 14 all the sample TSG-1 to TSG-14 Show the permissible limit ranges from 30-125 (shown in fig 4) ,which is acceptable limit as per the Indian standard of drinking water as per IS 10500-2012.

Calcium : Calcium in groundwater is more often which can come from rocks such as limestone, from dolomite and calcite leachates in the soil and also due to its higher solubility. In present study, the mostly samples crossed acceptable limit set by BIS, 2012. Only three sample are found within the acceptable range of BIS24-26

Alkalinity: Alkalinity is another parameter in water quality study. It is the acid neutralizing capacity of water and a function of all titratable bases. Total alkalininty are reported within of water determines suitability of water for drinking purposes. All 14 water sample are reported within the range of acceptable limit of BIS[28] .

Dissolved oxygen: Dissolved oxygen observed was 4. 8 to 9.4 Mgl-1 (Fig. 6). The standard permissible limit for dissolved oxygen in drinking water should be 4 Mgl-1 or more after conventional treatment as per norms of CPCB, 2017. At all

sampling points, Dissolved oxygen is found within the range of CPCB standards.18,19

TDS: The Total Dissolved Solid in water are due to presence of sodium, potassium, calcium, magnesium, manganese, carbonate, bicarbonate, chloride, phosphate, organic matter and other solid particles.15-17 The range of total dissolved solid in water samples was found to be 98 to 408 mg/l. However, the standard acceptable limit is 500 according to BIS, 2012. Therefore, TDS of all the sample water are found to be well within the limit.

Iron: The primary sources of iron in drinking water are from natural geological sources and corroding distribution systems and household pipes.Ingesting iron from drinking water is not directly associated with adverse health effects although, trace impurities and microorganisms that are absorbed by iron solids may pose health concerns. High concentrations of dissolved iron can results in poor testing, unattractive water that stains both plumbing pictures and clothing

The heavy metals like Iron is absent in all the water Sample tested. Excess iron is an endemic water quality problem in many parts of India. Iron is an abundant element in the Earth's crust, but exists generally in minor concentrations in natural water systems and water have adverse health effect either directly or indirectly2.

Fluoride : Ingestion of excess fluoride, most commonly in drinking water, can cause fluorosis which affects the teeth and bones. Moderate amounts lead to dental effects, but long term ingestion of large amount can lead to potentially severe skeletal problems. Paradoxically, low level of fluoride intake help to prevent dental caries. In almost all the test sample,the fluoride is found to be zero.as per the IS 10500-2012 the permissible limit of fluoride is 0.3mg'l.therefor all the water 14 sample are reported to be acceptable for drinking purpose.

Nitrate: Nitrate can reach both surface and groundwater as a result of agricultural activities(including excess application of inorganic nitrogenous fertilizers and manures, from wastewater treatment and from oxidation of nitrogenous wastes products in human and animals excreta,including septic tanks.
In infants under 6 months of age ingestion of nitrate can reduce the blood ability to carry oxygen.In severse cases it can cause a condition that doctors call methemoglobinemia.The condition is also called"blue baby syndrome"In present study, all the 14 sample ranges the 0.1 to 28mg/l which is under permissible limit of drinking water as per BIS, 2012. The Nitrate permissible limit is 45mg/l

Turbidity: Turbidity is a measure of the relative clarity or cloudiness of water. Turbidity is caused by particles suspended in water that scatter light making the water appears cloudy or murky. Particulate matter can include sediment-especially clay and silt fine organic and inorganic matter,soluble colored organic compounds ,algae, and other microscopic organisms.

Out of 14 water sample study ,only 4 sample is found to be NTU ,TSG-2,TSG-4,TSG-5, is found to be 0.1,2 and o.5 respective, At all sampling points, Turbidity is found within the range of IS-10500-2012 Standard .

Chloride: There are not known health effects associated with chloride. However, the sodium often associated with chloride can be a concern to people suffering from heart disease or kidney disease. In water, chloride has no smell or color, but it can give water a salty taste at a concentration higher than 250mg/l.
In recent study has found out ,all the sample collected form tasted the chloride contamination is found within the ranges of permissible limit, which is acceptable for drinking purpose.

CONCLUSION

Water samples from all 14 sources were assessed on portability parameters. Water is found fit for direct drinking purposes. Iron is not found in almost all the water sample. MPN values are found very less across the Samples. The present study suggests that water quality found in the most of the region under Tuensang District is pure and can be used for drinking and other commercial purpose and However, in the field of data collection is has been found most of the water treatment and infrastructure not done scientifically, in future there is a chance of contamination the treated water, lots of infrasturement and scientific treatment of water is need to be done to improve the water quality. However other physico-chemical parameter like Total Hardness,Iron,Fluoride,Nitrate,chloride, Calcium, Total Alkalinity and DO in the study area are observed well within the acceptable limit recommended by the BIS-10500-12.

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REFERENCES

1. Harichandan A., Patra H. S., Sethy K. M., Evaluation of Water Quality of Local Streams at Gandhamardan Iron Mines, Suakati, Keonjhar District of Odisha, India, J. Poll. Effec. Cont., 5, 199, (2017).
2. Hassan A. S., Abubakar I. B., Musa A., and Limanchi M. T., Water Quality Investigation by Physicochemical Parameters of Drinking Water of Selected Areas of KurekenSani, Kumbotso Local Government Area of Kano,Int. J. Mineral Proc. Extrac. Metall, 2(5), 83-86, (2017).
3. Alam M. F., Dafader N. C., Sultana S., Rahman N. and Taheri T., Physico-Chemical Analysis of the Bottled Drinking Water available in the Dhaka City of Bangladesh, J. Mat. Environ. Sci., 8(06), 2076-2083, (2016).
4. Toure A., Wenbiao D. and Keita Z., Comparative Study of the Physico-Chemical Quality of Water from Wells, Boreholes and Rivers Consumed in the Commune of Pelengana of the Region of Segou in Mali, Environ. Sci. Ind. J., 13(6),154, (2017).
5. Negera E., Nuro G., and Kebede M., Microbiological assessment of drinking water with reference to diarrheagenic bacterial pathogens in Shashemane Rural

District, Ethiopia, Afr. J. Microbiol. Res., 11(6), 254-263, (2017).
6. Singh S. K., Kanth M. K., Dhirendra Kumar, Raj R., Kashyap A., Jha P. K., Anand A., Kumari P., Kumari S., Ali Y., Lokesh R. S. and Kumar S., Physicochemical and Bacteriological Analysis of Drinking Water Samples from Urban Area of Patna District, Bihar, India, Int. J. Life Sci. Sci. Res., 3(5), 1355-1359, (2017).
7. Adoni A.D., Joshi G., Ghosh K., Chaurasia S. K., Vaishya A. K., Yadav M. and Verma H. G., Workbook on Limnology, Pratibha publication, Sagar, M.P.,India, (1985).
8. APHA, Standard methods for the examination of water and wastewater. 21th Edn, American Public Health Association, Washinton DC, (2005).
9. Jamir Tiakaba T., Impact of coal mining on water quality in Mangkolemba region under mokokchung district Nagaland,India, J. Environ. Res. Develop., 10(03), 436-444, (2016).
10. Sandeep Carpenter, Abhilasha Bhawsar and Manzoor Ahmad Bhat., Comparative study of physicochemical characteristics of ground water and surface water in Bhopal city, India, Int. J. Cur. Res. Life Sci., 7 (02), 923-92(2018).
11. Bureau of Indian Standard,Indian Standards (IS 10500) Drinking water specification :New Delhi, (2012).
12. Narwaria Y.S., Kushwah K. and Saksena D.N., Study of groundwater quality at Karera block of Shivpuri district, Madhya Pradesh, India, J. Environ. Res. Develop., 9(03), 562- 576, (2015).
13. Jackson R. B., Carpenter S.R., Dahm C.N., McKnight D.M., Naiman R,J. Postel S. L., and Running S. W.,Water in a Changing World, Issues in Ecology, 9, 1-1, (Spring 2001).
14. Kataria H.C, Gupta M, Kumar M, Kushwaha S, Kashyap S, Trivedi S, Bhadoriya R, Bandewar K. Study of physico-chemical parameters of drinking water of Bhopal city with reference to health impacts. Curr. Wor. Environ., 6(1), 95-99, (2011)
15. Shenoy K. N., Ananya H. M., and Inchara R., Quality of open well water in Udupi ISSN 0973 – 6921 ; E – ISSN 2319 – 5983 J. Environ. Res. Develop. Journal of Environmental Research And Development Vol. 13 No. 01, July-September 2018 67 municipal area, Karnataka, India, J. Environ. Res. Develop., 11(01), 43-51, (2016).
16. Chourasia L.P., Assessment of ground water pollution in and around Korba city, Chhattisgarh, India, J. Environ. Res. Develop., 10(03), 469-475, (2016).
17. Shenoy K. N., Ananya H. M. and Inchara R., Quality of open well water in Udupi municipal area, Karnataka, India, J. Environ. Res. Develop., 11(01), 43-51, (2016).
18. Khwaja M. Anwar and Aggarwal V., Studies on seasonal variation in ground water quality : A statistical approach, J. Environ. Res. Develop., 11(01), 123-131, (2016).
19. Nirbhavane G. and Khobragade K., Ground water quality of India : Status and challenges, J. Environ. Res. Develop., 11(02), 360-370, (2016).
20. Hemangi D. and Payal G., A study on the effect of landfill leachate- pollution on ground water and surface water quality and leachate treatment with activated carbon adsorbent, J. Environ. Res. Develop., 11(03), 471-481, (2017).
21. Jeya Prakash P., Sreenivas V., Dash P. P., Chandrakala B. S., Prakash N., Vinaya Kumar K. H., Vipin S. and Kakkar R.,Water safety plan at consumer level : An initiative in Halasuru, Bengaluru, India, J. Environ. Res. Develop., 11(03), 500-510,(2017).
22. Pani S., Menace of waste water in urban cities: A case study of Patra Nalla, Bhopal with reference to vegetable crops, J.Environ. Res. Develop., 11(03), 546-557, (2017).
23. Dubey M., Seasonal variations in surface water quality of river Narmada due to sewage effluent from different sources at mandla town, near Jabalpur city, India, J. Environ. Res. Develop., 11(03), 568-577,(2017).
24. Kaur Harpinder and Hundal S. S., Physicochemical characteristics of some ponds and haematological parameters of labeorohita inhabiting these ponds of district Ludhiana, Punjab, India, J. Environ. Res. Develop., 11(04), 672-679, (2017).
25. Parihar Surendra Singh and Pandey Anish C., Microbiological water quality study of Madhav Lake and human health, J. Environ. Res. Develop., 11(04), 699-707, (2017).
26. Narwaria Y. S., Assessment of groundwater quality of narwar block of Shivpuri District, Madhya Pradesh, India, J. Environ. Res. Develop., 11(04), 708-711, (2017).
27. Soni Talukdar and Goswami D. C., Correlation analysis and linear regression of water quality in Pitkati Wetland, Assam, India, J. Environ. Res. Develop., 12(01), 15-19, (2017).
28. Soni Talukdar and Goswami D. C., Multiple regression modelling of water quality in Hohka Wetland, Assam, J. Environ. Res. Develop., 12(01), 41-46, (2017
29. Physiochemical and Bacteriological analysis of drinking water quality of public places of Bhopal ,India Carpenter Sandeep*, Jawalkar Manglesh1 and Pandey Subhash C.2 ISSN 0973 – 6921 ; E – ISSN 2319 – 5983 J. Environ. Res. Develop.
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