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RESEARCH ARTICLE

Study of potable water quality in peripheral areas of Aizawl city in Mizoram

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Potable water quality and quantity is one of the most important topics of study in today's world. More and more techniques for efficient use of water are required throughout the world, especially in developing countries like India. The present study was conducted to analyse the quality of potable water sources use by the citizens of Aizawl district in the state of Mizoram, India. Number of samples was collected from surrounding areas of Greater Aizawl in pre cleaned polyethylene bottles as recommended in the WHO standards and recommendations. Various physico-chemical properties (pH, turbidity, total hardness, chloride, free chlorine, iron, nitrate and total dissolved solids) were studied. The samples were analyzed in the field using handheld meters for pH, turbidity, total hardness and TDS and were then also analyzed in the laboratory to confirm the field results. The other chemical parameters were tested in the laboratory using standard and recommended techniques. The pH values ranged from 6.48 to 7.54. TDS values ranged from 30 to 430ppm. Total hardness ranged from 30 to 60 mg/l. Chloride content in the samples was found to be between the values of 15.5 to 80 ppm. Iron and nitrate were found only in trace quantities in all the samples. In surrounding areas of the city, proper development of perennial springs would serve as the main source of water supply to the local population. Some samples which contained higher concentrations of chloride could have been contaminated from sewage water or waste water leakage. Other than that, the quality of water was within the limits of WHO standards.

Key words: chloride,physico-chemical, potable water, TDS, turbidity.

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Introduction

There is no need to exaggerate the vitality of water to save lives on earth. Knowledge of water usefulness and worth is becoming increasingly apparent day after day and many now believe that the Third World War will be fought over the water crisis.[1] Everything mankind comes from and thrives on the banks of the rivers. In reality, 'no water or growth' is true. This is true. Philosophers as well as geographers such as Aristotle have observed for a long time that plenty of water is closely associated with human happiness. Water is important for regional or country developments. For the growth

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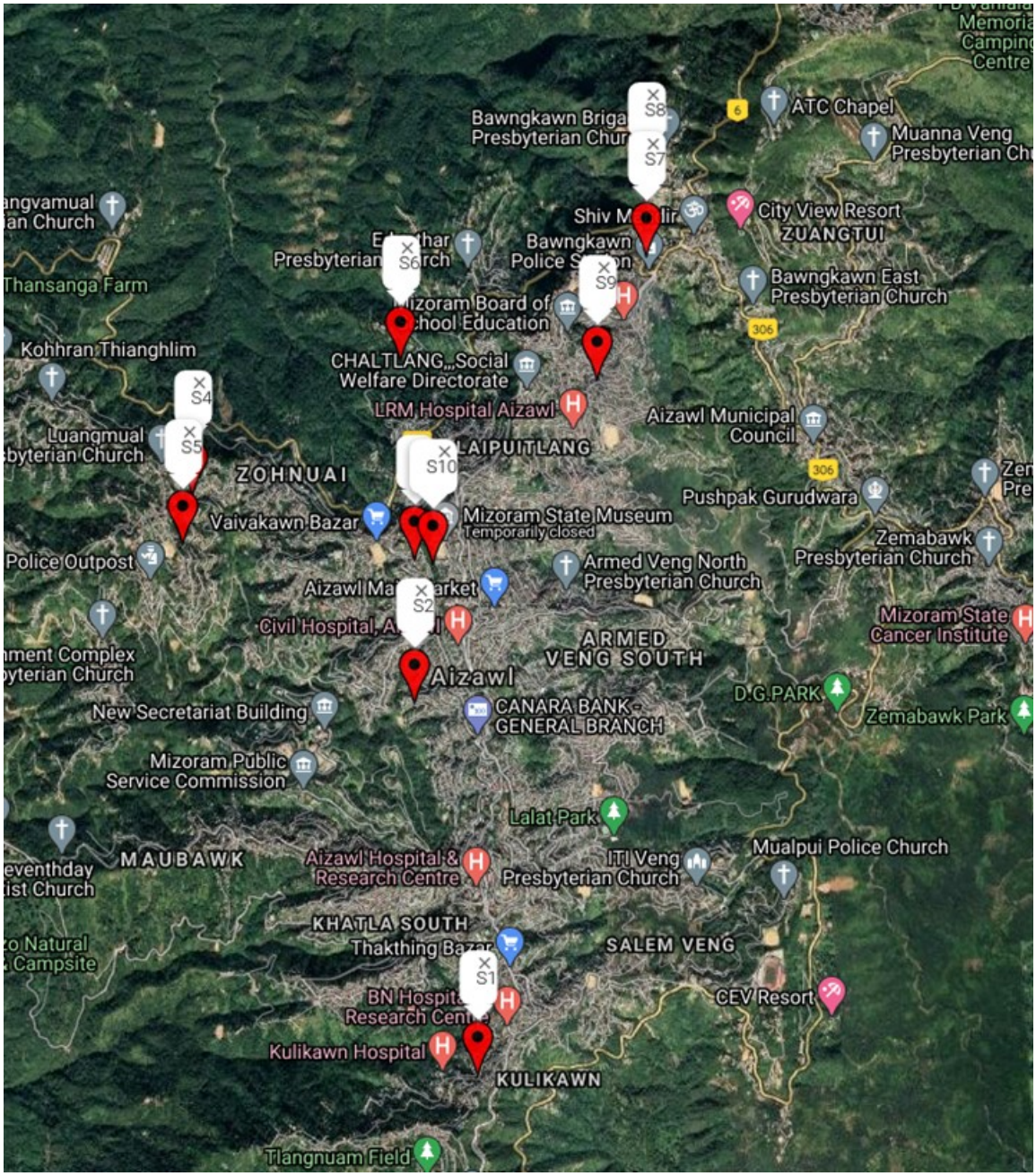

Figure 1 | Sample location map for study area.

and development of human society, availability of water supplies plays a crucial role. The prosperity and satisfaction of ample water is usually associated.

Aizawl is the capital city of the northeastern state of Mizoram. It is located between 23°44'12" N latitude and 092°43'04" E longitude attaining a height between 950 m to 1155 m above Mean Sea Level (MSL). It can be reached by road through National Highway 306 from Silchar in Assam and by Air from Kolkata, Imphal and Guwahati.

In 1980 Aizawl Water (Augmentation) Scheme was built near the current bungalow of the Speaker of Assembly. But the new 'Greater Aizawl Water Supply Scheme: Phase I' was begun before it materialized. Initially it was suggested by Mizoram's government that at least 1,60,000 people be fed and finally an approval of 80,000 people, which was well below the projected population, should remain in place in central government. Thus, in December 1988 work was finished. The following villages/ locations such as Melthum, Saikhamakawn, Hlimen, Chawlhhmun, Durtlang, Sihphir, Thuampui, Zemabawk and Rangvamual were not included under the Grand Aizawl Water Supply Scheme: Step

Figure 1 | Sample location map for study area.

S. No.	Station	Name of the Station	Source	GPS Coordinates	Elevation (in m)
1.	S1	Hmuifang Rest House	Rainwater	23°42'30" N 92°43'4" E	1484
2.	S2	Tuikual South Tuikhur	Spring	23°43'45" N 92°43'1" E	1000
3.	S3	Dawrpui Vengthar Tuikhur	Spring	23°44'14" N 92°42'50" E	1016
4.	S4	Luangmual Tuikhur	Spring	23°44'27" N 92°42'1" E	914
5.	S5	Zptuithiang Tuikhur	Spring	23°44'17" N 92°41'59" E	954
6.	S6	Rmarikawn Tuikhur	Spring	23°44'54" N 92°40'47" E	797
7.	S7	Bawngkawn Hand Pump	Groundwater	23°45'18" N 92°43'41" E	1001
8.	S8	Chaltlang-Saireng Tuikhur	Spring	23°45'25" N 92°43'25" E	1018
9.	S9	Taites Tuikhur	Spring	23°44'50" N 92°43'30" E	1015
10.	S10	McDonald Hill Tuikhur	Spring	23°44'13" N 92°42'54" E	1073

Table 2 | Quality results of the water samples

Station	pH	EC	Turbidity	TDS	Total Hardness	P-Alkalinity	M-Alkalinity	Total Alkalinity	Total Chloride	Total Iron	Fluoride
S1	7.5	140	<1.0	30	60	Nil	40	40	15.5	<0.01	<0.01
S2	6.8	240	<1.0	240	45	Nil	150	150	80	<0.01	<0.01
S3	6.9	280	<1.0	240	45	Nil	130	130	80	<0.01	<0.01
S4	7.1	366	<1.0	140	30	Nil	50	50	40	<0.01	<0.01
S5	6.8	660	<1.0	100	30	Nil	60	60	40	<0.01	<0.01
S6	6.5	727	<1.0	70	30	Nil	30	30	20	<0.01	<0.01
S7	7.2	580	<1.0	190	30	Nil	20	20	20	<0.01	<0.01
S8	6.8	374	<1.0	130	45	Nil	20	20	40	<0.01	<0.01
S9	6.9	246	<1.0	290	45	Nil	50	50	40	<0.01	<0.01
S10	6.7	315	<1.0	140	30	Nil	40	40	60	<0.01	<0.01

I. Greater Aizawl Water supply system: Phase I is one of the highest pump of water supply from Serlui/ Tlawng to Tuikhuahtlang, with an elevation of 1080 meters.

Moreover, the Greater Aizawl Water Supply Scheme, Phase-II began in 2007, and successfully launched water provision in Aizawl, including the above, excluded localities of Aizawl, under many financial and administrative constraints. The average daily supply per capita is 70 litres (lpcd). It is now projected that the overall water supply to Aizawl City amounts to 34 million litres a day. SIPMIU (State investment program management and implementation unit) is currently in the process of renewing all the water sources and treatments in Aizawl under the Capital Cities Development Programme, (NERCCDIP). The Tlawng River near the Industrial Growth Hub of Tanhril is also planning for an extra water supply in the town of Aizawl, 37 million litres per day[2].

Besides the city of Aizawl, water supply schemes were implemented, particularly after the 1990s, into different districts. The central government has implemented several schemes to provide all residents with secure supplies of drinking water until now. However, the existing status of water sources in Mizoram continues to be marginal in terms of progress and political commitments.

This document seeks to investigate regional water inequalities in the state with an emphasis on rural urban variations, the divisions in blocks or sub-districts and inter-district variations in Mizoram[3-4]. This analysis is hopefully useful to understand the current Mizoram water supply scenario and the

associated problems which divide regional districts. It is also an effort to make water one of the most important development parameters for the public, and particularly for the academies, behind the scene.

Materials and Methods

For this analysis, a range of examples have been selected in the peripheral areas of the city of Aizawl. Most samples have been taken from Tuikhurs (local springs), which are also used by the local population as a drinking water source. In Figure 1 you can see the positions of samples in the diagram. A total of 8 specimens were taken from Tuikhurs, a hand pump and a rainwater tank. In the map in Figure 1, you can view the sample positions and the coordinates in Table 1. The tests were collected in Polyethylene tubes, thoroughly washed and rinsed with distilling water, following the APHA[5] regulations, and were rinsed again with sample water which was collected immediately before the sample was collected.

Every sample has been collected in two 250 ml bottles each, one of them with 2-4 ml of diluted HNO_3 being acidified and the other as it is being collected. Samples for basic physico-chemical properties such as pH, Turbidity, Electrical Conductance (EC) and total dissolved solids have also been tested in situ at the site (TDS). These measurements have been made using Eutech Oakton digital machines. The Optical Nephelo turbidity metre 132 was tested for turbidity (Systronics). The research methods used in the laboratoire were P-alakilinity M-alkalinity, total alkaliinity, total hardness and overall chloride. Spectroquant was used to assess iron and fluoride concentrations (NOVA 60).

Results and Discussion

At the time of collection, all samples obtained were considered colourless, odourless and tasteless. Table 2 summarises the findings of the laboratory study. The pH values for the samples ranged from 6.5 to 7.5. Both samples were within the limitations prescribed for drinking[6].The EC varies from 140 µS/cm to 727 µS/cm. The TDS has ranged from 30 mg/l to 290 mg/l. The hardness total ranged from 30 mg/l to 60 mg/l. All samples are healthy and are subject to the ISI recommended water hardness limits of 300 mg/l.

There has been no P-alkalinity seen in any collected samples where the M-alkalinity was between 30 mg/l and 120 mg/l in the samples. The total value of sample L9 was found to be a little higher than all samples within the BIS limit of 200 µg/l prescribed. In their analysis, Appelo and Postma[7] showed that the concentration of chloride is an indicator for the evaluation of spring water input. The chloride level ranged from 25 mg/l to 100 mg/l in our samples. The values are relatively low and will not influence the taste of the water[8].

In all samples the concentration of fluoride was only in trace and was far below BIS. This shows that soluble fluoride minerals are not present in the area's geology[9,10,11]. In all the samples obtained in this analysis, iron concentration was similarly just a trace source. Iron existence can be due to drainage and wastewater leaks into the area's subsequent water supplies[12,13]. Heavy metals in soil may also be released[14]. There is no such leakage in the region studied due to the lack of substantial amount of iron.

Conclusion

The physico-chemical analyses of Tuikhur settings from different sections indicate that all samples are safe to use for drinking and that all testing parameters are in compliance with BIS regulations for drinking water supply. However, since tuikhurs are natural and untreated resources of water, it is recommended that basic treatments be done before this water is used for drinking purposes. The water is perfectly healthy for all other human uses.

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