

Potable water and their challenges in some rural areas of Lunglei

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Water is an essential commodity for survival and for the improvement of life quality. Although drinking water is a basic human right, many people do not have access to safe and adequate drinking water, and thus safe and reliable water supply is one of the most important things in rural areas today. The levels of natural contaminants such as fluoride and arsenic and man-made chemical pollutants such as pesticides and insecticides are high and still rising. The biological contamination of large number of drinking water sources is a serious problem, primarily due to prevalent open defecation and insanitary conditions around the drinking water sources in rural areas. To increase economic productivity and improvement in public health, there is an urgent need to immediately enhance access to safe and adequate drinking water. In this paper, we present the present-day status of potable water from the rural areas of Lunglei town, Mizoram, and the challenges they are facing and the solutions that lie ahead for safe potable water supply for every household in this rural hilly terrain.

Keywords: Potable water, rural areas, contaminants, water quality, Lunglei town.

INTRODUCTION

Potable water, the water which is used for human and animal consumption, is needed by all. Availability of quality consumable water and ensuring its sustainable supply to every household will be an agenda that we all would have to safeguard. With the ever increasing population, the demand for water has risen drastically. In rural hilly regions like Lunglei, where sub-surface water, groundwater and rainwater are the main suppliers of potable water, ensuring and maintaining their quality and adequacy pose a big challenge for governments and communities. In rural areas, where the need of water outweighs the mechanisms and safeguards for protecting their water sources, it is extremely difficult to abolish and put an end to systems that are harming the water sources. Legislating stricter laws and enacting them might not be the solution for the people, it is not just the government who is responsible for providing safe drinking water, it is also the communities and every household in the rural areas.

Biological contaminants of drinking water sources due to unhygienic and insanitary conditions are still com-

mon and prevalent in rural areas in India today. But now with the implementation of new schemes and programmes from the government which target the issues of sanitary related conditions for reducing the water-borne diseases such as typhoid, diarrhoea etc., such cases of water related diseases has significantly reduced in the past few years. In Mizoram, the results suggest that the water supplied by the PHED is better than that from the tuikhurs (sub-surface water); however, the quality of water from both sources, which are used for drinking and domestic purposes, were found to be more or less within the tolerance limits (Kumar *et al.*, 2010).

Studies of water samples from north and south Lunglei rural areas were collected and were analysed, evaluated under different physico-chemical parameters, and the results indicate the present water quality of potable water at these locations fall within the safety standards laid down by the BIS and are under permissible limits. In terms of Nitrate, Mizoram waters are very clean (Lalchhingpui *et al.*, 2011). From the available reports, it has been noticed that most of the arsenic affected flood-plains in Asia are by the side of the rivers that originate in the Himalayas or Tibet Plateau (Nickson *et al.*, 2005; Das *et al.*, 2008). Normally the tuikhurs and hand pumps in

the southern Mizoram are fit to serve as water source for domestic purposes (Blick *et al.*, 2016).

Study area

Lunglei is one of the eight districts of Mizoram in Northeast India. The district occupies an area of 4,538 km² and Lunglei town is situated on top of a ridge with the mean elevation is 722 m and is the administrative headquarters of the district. *As per 2011 census, the population of the district is 1,54,094 and slope cultivation locally called shifting or 'jhuming' is the main agriculture system in the district.* The present study is conducted on the northern and southern rural edges of the town. In northern rural Lunglei, four localities Ramzotlang (RZT), Zotlang (ZT), Serkawn (SER) and Pukpui (PKP) were studied. In total, 13 samples were collected in this part of the study area. Similarly, in the southern rural part of Lunglei town, three localities were studied having names Theiriati (TRT), Sethlun (STN) and Lunglawn (LLN) from which 11 samples from different water sources were collected. The mode and supply of potable water is mainly from the PHED, Gov't of Mizoram and from the traditional tuikhurs. However, since it is a rural area not many households depend on the PHED water connection rather most of them depend on the sub-surface water (tuikhurs) for drinking and cooking. The geology of the study area is mostly of argillaceous and arenaceous rocks. They belong to the rocks of Middle Bhuban from the Surma Group of rocks depicting Neogene age. The laminated shales are common and they range in colour from grey to brown. The sandstones too are mostly buff sandstones will occasional grey in colour too, and they are good bearers of water. Vertical jointing of rocks is quite common the rocks strike from N-S in general dipping between 30-45° due west.

MATERIALS AND METHODS

Sample collections

The rural areas of Lunglei were chosen for the study, from the seven localities spanning in the northern and southern outskirts of the town. Field surveys were conducted during pre-monsoon in March 2017. In total, 24 samples were collected from sub-surface and groundwater from which 13 samples were from northern rural Lunglei and 11 samples were from southern rural Lunglei. The collection of water samples was done in Tarsons bottles and were washed with distilled water after sampling collection to avoid contamination and retention of readings from previous uses. They are used again for detailed physico-chemical analyses which include and pH levels, turbidity (NTU), total dissolved solids (TDS), electric conductivity (EC), total alkalinity (Mg/L), chloride (ppm), iron (ppm), hardness, free chlorine (ppm), nitrate

(ppm), flouride (ppm) and arsenic (Mg/L) content. Sampling was performed according to the recommendations of the APHA, AWWA and WEF. Digital instruments made by Eutech Instrument were used to test pH, total dissolved solids and electrical conductivity. Total hardness, total chlorides, total iron, total chlorine and nitrate were measured using the water testing kit made by Transchem Agri-tech Limited. Turbidity values of the samples were measured using the Digital Nephelo Turbidity Meter-132 (Systronics) using formazine as standard. Arsenic concentration was measured using an arsenic test kit made by Merckoquant Chemicals, Germany (Blick *et al.*, 2016).

RESULTS AND DISCUSSIONS

Results of all the water sources in the study area have been classified into physical and chemical properties represented in the tables given. Based on the norms of the Bureau of Indian Standards (BIS) IS 10500-2012 and WHO from the results, we can see that the pH varies from 6.5-7.4 which are acceptable under the BIS and WHO. The electric conductivity varies from a minimum of 35.5 to a maximum 549. The EC values are high in the tuikhurs. The total dissolved solids vary from a 17.7 mg/l to a maximum of 274 mg/l. Higher values of TDS may be attributed mainly because of the geochemical rock-water interaction in the area giving rise to higher number of electrolytes to the water bodies. For turbidity all the samples have values less than 5 NTU making them fit for potable water. In terms of hardness of the water, they have values between 45-120 mg/l where 200 mh/l is the maximum permissible limit. In terms of chloride, BIS (2002) and WHO permissible levels are 250 mg/l and all the water samples show values between 20-160. It is safe to say that all the water are samples collected from different localities in and around the northern and southern parts of rural Lunglei town are fit for drinking and cooking.

Problem

1. During monsoons when there is huge downpour of rains, natural hazards such as flash-floods and landslides are common. These contribute to the point sources of the tuikhurs (sub-surface water) resulting in acute shortage in potable water even during the monsoons.
2. Available water is not sufficient for livestock and agriculture.
3. Acute cases of water borne diseases are reported in the area.
4. Open defecation in some areas.
5. Unplanned waste dumping in open areas. In some areas garbage are burnt near the open sources of water.

Table 1: Water samples collected from southern Lunglei town.

SI No	Area	Location and Elevation	Source of Water
1	Chhunnaga Tui Theiriat (TRT-1)	N22°55'26.28'' E92°47'21.69''	Sub surface water
2	Vengchhak Tuikhur, Theiriat (TRT-2)	N22°52'41.08'' E92°47'8.23''	Sub surface water
3	Venglai Tuikhur, Theiriat (TRT-3)	N22°52'1.8'' E92°47'4.01''	Sub surface water
4	Melli Tuikhur Theiriat (TRT-4)	N 22°53'7.03'' E92°46'48.04''	Sub surface water
5	TKP Tuikhur, Theiriat (TRT-5)	N22°53'7.03'' E92°47'21.10''	Sub surface water
6	Tuithawveng Tuikur, Theiriat (TRT-6)	N22°51'53.49'' E92°47'2.08''	Sub surface water
7	Theiriat Vengpui (TRT-7)	N22°52'6.03'' E92°45'47.08''	Sub surface water
8	Neka Vau Sethlun (STN-1)	N22°51'54.94'' E92°46'9.9''	Sub surface water
9	Khurhnai Tuikhur, Sethlun (STN-2)	N22°52'12.95'' E92°45'59.90''	Sub surface water
10	Khurpui Tuikhur, Sethlun (STN-3)	N22°52'10.66'' E92°46'10.90''	Sub surface water
11	Lunglawn Tuikhur, Lunglawn (LLN-1)	N22°52'10.59'' E92°45'29.84''	Sub surface water

Table 2: Water analyses of southern Lunglei (physical characteristics).

Sample	pH	Odour	Taste	Colour	Turbidity (NTU)	TDS (ppm)	Conductivity
T-1	7	Odourless	Tasteless	Colourless	3	18.1	36.2
T-2	6.8	Odourless	Tasteless	Colourless	4	18.7	37.3
T-3	6.5	Odourless	Tasteless	Colourless	4	17.7	35.5
T-4	6.5	Odourless	Tasteless	Colourless	4	60	119.9
T-5	6.8	Odourless	Tasteless	Colourless	3	57.1	114.1
T-6	6.5	Odourless	Tasteless	Colourless	3	67.1	134.1
T-7	7.4	Odourless	Tasteless	Colourless	4	54.3	108.7
S-1	6.5	Odourless	Tasteless	Colourless	3	51	101.9
S-2	6.5	Odourless	Tasteless	Colourless	3	118	236
S-3	7	Odourless	Tasteless	Colourless	4	42.9	85.8
L-1	6.5	Odourless	Tasteless	Colourless	3	45.9	91.6

Table 3: Water analyses of southern Lunglei (chemical characteristics).

Sample	Total alkalinity (mg/l)	Total chloride (mg/l)	Total hardness (mg/l)	Total iron (mg/l)	Free chlorine (mg/l)	Nitrate (mg/l)	Fluoride (ppm)	Arsenic (mg/l)
T-1	14	60	90	0.0	0.5	Trace	1.5	0.01
T-2	10	140	105	0.0	0.2	Trace	1.5	0.02
T-3	14	60	90	0.0	0.5	03	1.5	0.01
T-4	18	120	60	0.0	0.5	03	0.5	0.02
T-5	18	140	75	0.0	0.5	02	1.0	0.03
T-6	18	120	70	0.0	0.2	Trace	3.0	0.01
T-7	20	160	60	0.0	0.5	01	1.5	0.01
S-1	14	100	75	0.0	0.2	Trace	1.5	0.01
S-2	12	140	75	0.0	0.2	Trace	3.0	0.01
S-3	14	160	60	0.0	0.5	0.0	1.5	0.1
L-1	8	100	60	0.0	0.5	0.0	3.0	0.2

Table 4: Water samples collected from northern Lunglei town.

Sl No	Area	Location and elevation	Source of water
1	C.Thangzuala tui (RZT-1)	N22°54'23.8" E92°45'41.5"	Subsurface water
2	Pawih tui (RZT-2)	N22°54'28.5" E92°45'38.2"	Subsurface
3	Sap Tui (SER-3)	N22°54'24.3" E92°45'34.5"	Subsurface water
4	Waterpump/Handpump (SER-4)	N22°54'31.7" E92°45'26.3"	Groundwater
5	Tui Uih (SER-5)	N22°54'36.6" E92°45'29.7"	Subsurface water
6	Serkawn Venglai (SER-6)	N22°54'42.5" E92°45'26.1"	Subsurface water
7	Lamhnai (ZT-7)	N22°54'45.7" E92°45'25.1"	Subsurface water
8	Pu Khuma tui (ZT-8)	N22°54'50.3" E92°45'23.5"	Subsurface water
9	Huantui (ZT-9)	N22°54'55.7" E92°45'22.07"	Subsurface water
10	Phultui (ZT-10)	N22°54'56.9" E92°45'13.4"	Subsurface water
11	Chartui (PKP-11)	N22°56'16.1" E92°44'47.8"	Subsurface water
12	Puk-in-Khar (PKP-12)	N22°56'9.7" E92°45'3.9"	Subsurface water
13	Vai-buk (PKP-13)	N22°55'57.9" E92°45'11.2"	Subsurface water

Table 5: Water analyses of northern Lunglei (physical characteristics).

Sample	pH	Odour	Taste	Colour	Turbidity (NTU)	TDS (ppm)	Conductivity
RZT-1	6.5	Odourless	Tasteless	Colourless	3	45.8	91.2
RZT-2	6.5	Odourless	Tasteless	Colourless	3	46.6	92.9
SER-3	7	Odourless	Tasteless	Colourless	4	48.8	96.6
SER-4	6.5	Odourless	Tasteless	Colourless	3	206	411
SER-5	6.6	Odourless	Tasteless	Colourless	3	44.4	89.2
SER-6	7	Odourless	Tasteless	Colourless	4	30.5	61.2
ZT-7	6.6	Odourless	Tasteless	Colourless	4	194	388
ZT-8	7.2	Odourless	Tasteless	Colourless	4	274	549
ZT-9	6.6	Odourless	Tasteless	Colourless	3	89.8	179.6
ZT-10	6.8	Odourless	Tasteless	Colourless	3	82.9	165.7
PKP-11	6.8	Odourless	Tasteless	Colourless	4	60.9	122.2
PKP-12	6.5	Odourless	Tasteless	Colourless	4	72.1	144.1
PKP-13	6.6	Odourless	Tasteless	Colourless	4	63.4	126.9

Table 6: Water analyses of northern Lunglei (chemical characteristics).

Sample	Total alkalinity (mg/l)	Total chloride (mg/l)	Total hardness (mg/l)	Total iron (mg/l)	Free chlorine (mg/l)	Nitrate (mg/l)	Fluoride (mg/l)	Arsenic (mg/l)
RZT-1	14	100	60	0	0.2	Trace	0.5	0.01
RZT-2	18	60	60	0	0.2	Trace	0.5	0.01
SER-3	16	40	45	0	0.2	Trace	0.5	0.01
SER-4	36	100	90	0.5	0.5	Trace	1.0	0.02
SER-5	20	60	90	0	0.2	Trace	0.5	0.02
SER-6	10	20	120	0	0.2	Trace	0	0.02
ZT-7	18	100	105	0	0.2	Trace	0	0.01
ZT-8	30	100	150	0	0.2	03	0.5	0.01
ZT-9	10	60	105	0	0.2	02	0.5	0.01
ZT-10	14	80	60	0	0.2	Trace	0.5	0.01
PKP-11	12	80	120	0	0.2	Trace	0.5	0.01
PKP-12	10	40	75	0	0.2	Trace	0.5	0.01
PKP-13	10	60	90	0	0.2	05	0.5	0.01

Solutions

- The water available can be segregated judiciously for use. For drinking and cooking, water from the groundwater or rainwater can be collected and stored, treated or non-treated as the case may be, these can be stored for later use during non-monsoonal months.
- Harvested untreated rain water and harvested tuikhur (sub-surface water) can be used for washing and bathing. Reused water from these can be used again for toilet water. Thus judicious use of water can solve water scarcity even during such times.
- Untreated water should be boiled which leads to water borne diseases.
- During monsoons, when there is excess of rainwater, both at the household and community level should make arrangements for harvesting the excessive water. In hilly terrains like rural Lunglei, having larger storage tanks for later use is the key. This can be both achieved at the household and community level.
- Planned waste management is necessary. Open defecation should be stopped.
- Planting more trees and protecting them wherever applicable. To meet the ever increasing demand for water supply because of the increasing population, forests in the catchment areas for groundwater sources have to be protected and reserved.
- Managing our water resources should incorporate demand, supply, ensuring the quality of water from both social and technical aspects.

CONCLUSIONS

The water quality in rural Lunglei and their Physico-Chemico analysis from different water sources indicate the status of potable water is still safe for consumption from the different sources. However, many of the perennial springs have already dried up or have become seasonal and at many locations residents are currently facing acute water shortage for drinking and other domestic purposes. Scarcity of water during non-monsoonal seasons can be solved with active participation from the household, community and government levels and having large water tanks can solve the inadequacy for water. Microbiological contamination of the water can be treated by boiling the water. In rural hilly areas, the management of water resources must be addressed with better supply and demand of potable water.

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