Assessment of Microbial Quality of Drinking Water from Different Sources in Selected Districts of Bale Zone, Oromia Regional State, Ethiopia

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ABSTRACT

Background and Objective: Safe drinking water is a vital component of human diet. Thus periodic surveillance of the quality of drinking water is critically important for monitoring its safety status. The current study was initiated to assess the microbial quality of drinking water from different sources in the selected districts. **Materials and Methods:** Microbial analysis of total and faecal coliforms was done using most probable number (MPN) method. Samples were collected following a simple random sampling technique and a cross-sectional study design was employed. Each of the samples were investigated in triplicate. The data were analyzed using descriptive statistics and ANOVA was done at 5% level of probability to investigate the statistical difference among means of contamination between the different sources and localities. **Results:** A maximum of 6.396±0.010 log10 CFU/mL of SPC has been recorded in water samples from Tagona River in Goba District. The highest faecal coliform and *Escherichia coli* contamination of 1101 and 972.800±128.200 MPN/100 mL were recorded in rivers Bamo and Tagona in Goba and Haro Wanji of Dello Mana and Bamo River, respectively, showing similar trends across the three agro-ecologies. Rivers and ponds were categorized under high to very high risk classifications. **Conclusion:** Thus, society, as an emergency action, should take actions like filtration, boiling and treatment with some commercially available antimicrobial agents. The government is expected to establish facilities for the supply of safe drinking water to avoid the likely health burden to be posed on society from the highly contaminated water sources.

INTRODUCTION

Sustainability of life is ensured by the accessibility of safe drinking water[1] and satisfactory supply should be available to all[2]. Safe drinking water is recognized as that having no remarkable health threat to consumers. The use of multiple barriers should be planned carefully from catchment to point of use to

ensure prevention of microbial as well as physical contamination[3]. World Health Organization[4,5] reported that more than 80% of human diseases in the World are attributed to the use of unsafe drinking water or inadequate sanitary practices. Cholera, shigellosis and campylobacteriosis are among the important waterborne diseases easily contracted due to contaminated water sources serving. Recent WHO report briefed that about 1.1 billion people, out of which 42%[6], globally drink unsafe water and the vast majority of diarrhoeal diseases in the World, estimated to be nearly 88%, are attributed to unsafe drinking water, sanitation and hygiene. The consumption of unsafe water is responsible for 3.1% (1.7 million), of the annual deaths and 3.7% (54.2 million) of the annual health burden. In general, most waterborne outbreaks involve source contamination, breakdown of the treatment system, contamination of the distribution system and the use of untreated water[7].

It is estimated that about 75% of the health problems in Ethiopia are communicable arising from inaccessibility to safe and adequate water supply[8]. In the country, the number of companies engaged in production and trading of packaged/bottled water is increasing from time to time[9]. The Ethiopian water quality standard requires that no *E. coli* or thermoduric bacteria and coliform bacteria are detected in the treated water entering the distribution system and water in the distribution system[10]. Bacteriological analysis of drinking water (tap, spring and well) from around Dire Dawa City showed that all the samples (100%) from spring and tap were positive for indicator microorganisms (total coliforms, thermotolerant (faecal) coliforms. Whereas 50% of the tap water samples were found to be contaminated with the same organisms[11]. Assessment of the microbiological quality of drinking water in four districts of Addis Ababa City reported that 6% of tap water, 6% of reservoir samples and 24% of spring samples were contaminated with bacteria[12]. Likewise, microbial quality study of drinking water in Debre Zeyit Town found that 100% of the drinking water samples from underground sources were contaminated with total coliforms and 20% was found to be positive for faecal coliforms and faecal streptococci. Thus, regular examination of the drinking water resource with regard to microbiological and physicochemical quality is of crucial importance so that appropriate remedial actions can be forwarded to safeguard the community.

So far, quality of drinking water from different sources has not been investigated in Bale Zone in terms of microbiology. Therefore, this study was initiated to assess the microbiological quality of drinking water from different sources across the different agro-ecologies of Bale Zone of Oromia Regional State, Ethiopia.

MATERIALS AND METHODS

Sample collection: Drinking water samples were collected from purposively selected Districts of Bale Zone, namely, Goro, Goba and Dallo Manna, Oromia Regional State in consultation with Regional Bureau, Zonal and District Offices of Water Resources. The assessments were carried out on samples from three selected districts of the zones. A total of 135 samples of drinking water were collected randomly from different sources in the zone. Analyses were done in plant pathology laboratory of Sinana Agricultural Research Center in late October 2021 which is the last month of the heavy rainy season in the Zone.

Microbial analysis: Microrobial analysis for the determination of total coliforms, faecal coliforms and *E. coli* was performed employing most probable number (MPN) technique[6].

Further identification of coliforms was done by carrying out the appropriate biochemical tests like, indole production, methyl red, voges/proskauer, citrate utilization, motility, gram staining and gas production from lactose following techniques used by Arbab *et al.*[8].

Statistical analysis: All the microbial count data were subjected to descriptive analysis and means, minimum and maximum values and standard error were calculated using SPSS 20. Moreover, Analysis of Variance (ANOVA) was also performed using SAS 9.1.3 to investigate the significance of variability among the values obtained from different sources and agro-ecologies at 5% level of probability. Significantly different means were separated using Duncan Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Total bacterial count: All drinking water samples collected from the 9 kebeles of the three districts of Bale Zone from different sources (Fig. 1) were tested for their hygienic status in terms of total bacterial count. In Goro District, a total of 45 samples were collected out of which 42 were from tap and only 3 were from unprotected spring. There was statistically non significant variability between the kebeles of the district, with the samples from spring in Waltai Gobu scoring the highest log10 CFU/mL of 6.132 and the minimum value of 6.009 $\log_{10}$ CFU/mL was obtained from tapped drinking water from the same district (Table 1). Water samples from Garre and Chaffe Mana kebeles were non significantly different from those of Waltai Gobu.

A relatively higher $\log_{10}$ CFU/mL was recorded from samples collected from Goba District. The maximum count (6.396 $\log_{10}$ CFU/mL) was from samples of Tagona River in Waltai Sura kebele, whereas the least record (6.159) was from samples collected from households in Waltai Tosha kebele that fetched the water from Bamo River.

Fig. 1: Drinking water sample collection from different sources and laboratory analysis

Table 1: Total bacterial counts (log$_{10}$ CFU/mL) for drinking water samples obtained from different sources across the study districts

District	Kebele	Drinking water source	N	Minimum	Maximum	Mean	p<0.05
Goro	Waltai Gobu	Tapped	12	5.538	6.244	6.009±0.068[cd]	<0.0001
		Spring	3	5.925	6.239	6.132±0.104[c]	0.0003
	Garre	Tapped	15	5.621	6.244	6.014±0.050[cd]	<0.0001
	Chafe Mana	Tapped	15	5.834	6.436	6.026±0.044[cd]	<0.0001
Goba	Waltai Sura	River (Tagona)	4	6.368	6.410	6.396±0.010[c]	<0.0001
		River (Tagona-household)	4	6.301	6.417	6.349±0.024[c]	<0.0001
		River (Micha-household)	5	6.073	6.394	6.245±0.064[c]	<0.0001
		Bore hole (Burgullo)	2	6.354	6.382	6.368±0.014[c]	0.001
	Waltai Tosha	River (Bamo)	8	5.837	6.428	6.307±0.057[cde]	<0.0001
		River (Bamo-household)	7	6.135	6.436	6.159±0.080[c]	<0.0001
	Aloshe	Hand pump	13	6.089	6.401	6.238±0.037[c]	<0.0001
		Bore hole	2	6.089	6.401	6.231±0.097[c]	0.218
Dallo Manna	Haya Oda	River (Yadot-household)	6	5.842	5.851	5.847±0.004[cde]	<0.0005
		River (Erba)	4	5.374	5.718	5.516±0.104[de]	<0.0005
		River (Erba-household)	5	5.189	5.640	5.384±0.095[e]	<0.0004
	Barraq	Tapped	4	8.307	8.362	8.330±0.013[a]	<0.0001
		Pond (Haro Sora)	8	7.675	8.360	8.080±0.077[ab]	<0.0001
		Pond (Haro Wanji)	3	7.658	8.293	8.012±0.187[ab]	0.0005
	Gongoma	Tapped	4	6.403	8.348	7.810±0.469[b]	0.0005
		Spring	2	8.260	8.350	8.305±0.045[ab]	0.0034
		River (Gongoma)	9	7.882	8.393	8.204±0.081[ab]	0.0001

Means with different letter are significantly different at p<0.05 and Mean±Standard Error

Dallo Manna samples were collected from 4 sources (river (53%, tap 18%, pond 24% and spring 4%). Samples from tap collected from Barraq kebele exhibited the highest level of bacterial contamination with log$_{10}$ CFU/mL of 8.330. Samples from spring, Gongoma River and Haro Sora pond took the 2nd, 3rd and 4th places in bacterial contamination with values of 8.305, 8.204 and 8.080 log$_{10}$ CFU/mL, respectively (Table 1).

Total coliform count: A highly significant difference was observed in total coliform count among the drinking water samples of Goro District. Samples from spring at Waltai Gobu and tap water from Chafe Mana kebeles had the least coliform contamination of 32.663 and 60.661 MPN/100 mL, respectively, of water with non-significant statistical variation. On the contrary, a higher total coliform count of 95 CFU/100 mL was recorded from tap water samples in Nekemte Town[13]. However, tapped water from Garre kebele had coliform contamination of 549.933 MPN/100 mL (Table 2). A lower value ranging from 1.50±0.71 CFU/100 mL to 133.67±21.25 CFU/100 mL was reported by Amenu *et al.*[11], from unprotected well and tap water samples in Dire Dawa Administrative Council. A similarly lower level of contamination was reported in drinking water samples from spring (2-70 MPN/100 mL) and hand pipe (2-9 MPN/100 mL) by Negera *et al.*[14], in a study conducted in Shashemene rural districts. In Fiche town still, lower total coliform count range of 3.93 to 9.29 CFU/mL was recorded in dry and wet seasons, respectively from samples of piped drinking water[15].

Total coliform counts have been shown to radically increase in samples from Goba District. The test showed that samples from Tagona River (Waltai Sura), Bamo River (Waltai Tosha), hand pump and unprotected borehole (Aloshe) showed a coliform count range of 1101.0 to 1023.54 MPN/100 mL of sample. This finding agreed with the result of Helmi *et al.*[16], reporting a total coliform range of 270 to 1600 MPN/100 mL of drinking water samples from river. Similarly, a total coliform count range of 67 to 1366 MPN/100 mL of sample drinking water from wells. Household drinking water samples (rivers and unprotected bore hole) from Waltai Sura kebele had a cell number range of 670.000 to 756.000 MPN/100 mL (Table 2).

In Dallo Manna District, out of the 9 sources used for sampling, drinking water samples from the 7 sources had a total coliform cell count of 885 MPN/100 mL. Only samples of tap from Barraq kebele scored a

Table 2: Total coliform counts (log$_{10}$ CFU/mL) for drinking water samples obtained from different sources across the study districts

District	Kebele	Drinking water source	N	Minimum	Maximum	Mean	p<0.05	Detection (%)
Goro	Waltai Gobu	Tapped	12	2.990	1101.000	368.999±128.661[cd]	0.015	91.7
		Spring	3	2.99	75.000	32.663±21.730[d]	0.272	66.7
	Garre	Tapped	15	5.621	6.244	549.933±124.432[bc]	0.001	100
	Chafe Mana	Tapped	15	2.990	150.000	60.661±17.978[d]	0.005	46.7
Goba	Waltai Sura	River (Tagona)	4	1101.00	1101.00	1101.00±0.000[a]	0.000	100
		River (Tagona-household)	4	240.000	1101.00	670.500±248.549[abc]	0.074	100
		River (Micha-household)	5	240.000	1101.00	756.600±210.901[abc]	0.0230	100
		Bore hole (Burgullo)	2	240.000	1100.00	670.000±0.014[abc]	0.3632	100
	Waltai Tosha	River (Bamo)	8	240.000	1101.00	1014.90±86.100[ab]	<0.0001	100
		River (Bamo-household)	7	1101.00	1101.00	1101.00±0.000[a]	0.000	100
	Aloshe	Hand pump	13	95.000	1101.00	1023.54±77.378[ab]	<0.0001	100
		Bore hole	2	1100.00	1101.00	1100.50±0.500[a]	0.0003	100
Dallo Manna	Haya Oda	River (Yadot-household)	6	5.988	5.988	1100.67±0.333[a]	0.000	100
		River (Erba)	4	240.000	1101.00	885.750±215.250[ab]	0.0260	100
		River (Erba-household)	5	1100.00	1101.00	1100.80±0.200[a]	<0.0001	100
	Barraq	Tapped	4	23.000	1101.00	593.750±294.006[abc]	<0.0001	100
		Pond (Haro Sora)	8	1101.00	1101.00	1101.00±0.000[a]	0.000	100
		Pond (Haro Wanji)	3	1101.00	1101.00	1101.00±0.000[a]	0.000	100
	Gongoma	Tapped	4	1101.00	1101.00	1101.00±0.000[a]	0.000	100
		Spring	2	1101.00	1101.00	1101.00±0.000[a]	0.000	100
		River (Gongoma)	9	1101.00	1101.00	1101.00±0.000[a]	0.000	100

Means with different letter are significantly different at p<0.05 and Mean±Standard Error

relatively lower count of 593.75 MPN/100 mL of sample (Table 2). The analysis result showed that none of the samples comply with the WHO guideline[7].

Fecal coliform count: A maximum faecal coliform count of 107.183 MPN/100 mL was obtained from tested tap water samples of Waltai Gobu kebele. Samples from spring in the same kebele had the lowest faecal coliform count of 9.197 MPN/100 mL. Whereas tap water samples from Garre and Chafe Mana kebeles had shown a faecal coliform contamination of 26.075 and 56.693 MPN/100 mL, respectively (Table 3). Amenu *et al.*[11], reported that all water samples were found to be contaminated by faecal coliforms.

On the other hand, tests of water samples obtained directly from Tagona and Bamo Rivers and households in Waltai Sura and Waltai Tosha kebeles, respectively, who depend on the two rivers for drinking water indicated that the highest MPN of 1101 and above was obtained. Whereas, the highest faecal coliform value of 54 CFU/100 mL was reported from protected well[11]. Samples collected from hand pump and bore hole in Aloshe kebele showed the lowest faecal coliform contamination of 14.677 and 2.99 MPN, respectively (Table 3). But the lowest value of faecal coliform (0.34 CFU/100 mL) was obtained from tap water samples in Dire Dawa.

There was a significant statistical difference between the sources in faecal coliform count in Dallo Manna District with a range stretching from 14.1 to 1101.0 MPN across the three kebeles. Tap water samples from Gongoma and Barraq recorded lowered faecal coliform counts of 14.050 and 21.000 MPN (Table 3). Samples from Haro Sora Pond, Erba river and Haro Wanji Pond were found to have 725.125, 972.600 and 1100.67 MPN, respectively.

In general, according to risk classification for thermotolerant coliforms or *E. coli* for rural water supplies cited by Ashuro *et al.*[17], drinking water sources such as Bamo and Tagona Rivers at Goba District, Erba and Yadot Rivers at Delo Mana, some piped supplies in Goro District, ponds like Haro Wanji and Haro Sora at Dallo Mana have been found to be classified under "high" to "very high" risk categories. On the contrary, only samples from borehole in Aloshe kebele of Goba District seemed to conform with WHO guidelines[6].

Table 3: Faecal coliform counts (log$_{10}$ CFU/mL) for drinking water samples obtained from different sources across the study districts

District	Kebele	Drinking water source	N	Minimum	Maximum	Mean	p<0.05	Risk category
Goro	Waltai Gobu	Tapped	12	2.990	1100.00	107.183±90.343[ef]	0.2605	HR
		Spring	3	2.990	21.000	9.197±5.904[f]	0.2596	LR
	Garre	Tapped	15	7.300	240.000	59.693±15.962[f]	0.0022	IR
	Chafe Mana	Tapped	15	2.990	210.000	26.075±13.609[f]	0.0760	IR
Goba	Waltai Sura	River (Tagona)	4	1100.00	1101.00	1100.75±0.250[a]	<0.0001	VHR
		River (Tagona-household)	4	1101.00	1101.00	1101.00±0.000[a]	0.000	VHR
		River (Micha-household)	5	43.000	1101.00	515.600±241.172[cd]	0.0993	HR
		Bore hole (Burgullo)	2	460.000	460.000	460.000±0.000[cde]	0.000	HR
	Waltai Tosha	River (Bamo)	8	1100.00	1101.00	1100.80±0.133[a]	0.000	VHR
		River (Bamo-household)	7	1101.00	1101.00	1101.00±0.000[a]	0.000	VHR
	Aloshe	Hand pump	13	2.990	150.000	14.677±11.282[f]	0.2177	IR
		Bore hole	2	2.990	2.990	2.990±0.000[f]	0.000	IC
Dallo Manna	Haya Oda	River (Yadot-household)	6	93.000	210.000	151.000±33.778[def]	0.0466	HR
		River (Erba)	4	93.000	1100.00	633.250±271.144[bc]	0.1016	HR
		River (Erba-household)	5	460.000	1101.00	972.600±128.150[ab]	0.0016	HR
	Barraq	Tapped	4	15.000	23.000	21.000±2.000[f]	0.0018	IR
		Pond (Haro Sora)	8	240.000	1101.00	725.125±144.800[abc]	0.0016	HR
		Pond (Haro Wanji)	3	1100.00	1101.00	1100.67±0.333[a]	<.0001	VHR
	Gongoma	Tapped	4	9.100	23.000	14.050±3.292[f]	0.0236	IR
		Spring	2	20.000	210.000	115.000±95.000[ef]	0.4396	HR
		River (Gongoma)	9	11.000	1101.00	356.778±148.387[cdef]	0.0429	HR

IC: In conformity with WHO guidelines, LR: Low risk, IR: Intermediate risk, HR: High risk, VHR: Very high risk, means with different letter are significantly different at p<0.05 and Mean±Standard Error

***Escherichia coli* count:** Samples from each of the different sources were also tested for the detection of *E. coli.* It is in the spring water samples that the lowest MPN/100 mL of *E. coli* cells (8.863) was recorded in Waltai Gobu kebele of Goro District. Tap water samples from the same kebele had an *E. coli* count value of 12.098 CFU/100 mL. With non-significant variability, 11.055 CFU/100 mL were counted in samples from the similar source from Chafe Mana District. The maximum MPN/100 mL (42.607) was recorded in tap water samples from Garre District (Table 4). A comparably lower *E. coli* value of 6.0±0.54 was reported in Kenya in tap water samples[18].

However, in Goba District, the highest MPN of *E. coli* of 972.800 was obtained from samples collected from households that fetched the water from Bamo river for drinking. Unprotected borehole (Burgullo) and Bamo River samples took the 2nd (780.500) and the 3rd (696.800) places in terms of MPN of *E. coli*. A similar report showed that the highest contamination level of 160.0±14.14 CFU/mL was detected in rainwater samples in a study published in Kenya[18]. Water samples with almost no *E. coli* (2.99 cells/100 mL) were obtained from a protected bore hole in Aloshe kebele of the district (Table 4). Similarly, an equivalent value of 3.554 cells was recoded in samples from hand pumps in the same kebele. Drinking water samples form Tagona and Micha Rivers (both household and source) showed relatively lower MPN of *E. coli* ranging from 328.5 to 514.0 (Table 4).

Water samples from Erba River drinking households were found to host the highest number of *E. coli* cells (884.400) per 100 mL. However, samples directly taken from the river showed a significantly lower MPN of *E. coli* (398.250). At Barraq kebele, samples from Haro Wanji pond and tap showed a lower *E. coli* cell population of 12.663 and 20.000 per 100 mL, respectively. Gongoma and Yadot Rivers exhibited an MPN of 60.566 and 84.333, in Gongoma and Haya Oda kebeles, respectively (Table 4).

According to risk classification for thermotolerant coliforms or *E.coli* for rural water supplies cited by Ashuro *et al.*[17], all the rivers in Goba being used as sources of drinking water for the local society were under "high risk" category. Similarly, Erba River, Haro Sora pond and spring at Dallo Mana have fallen under "high risk" classification (Table 4). Bore hole sourced drinking water have conformed with WHO
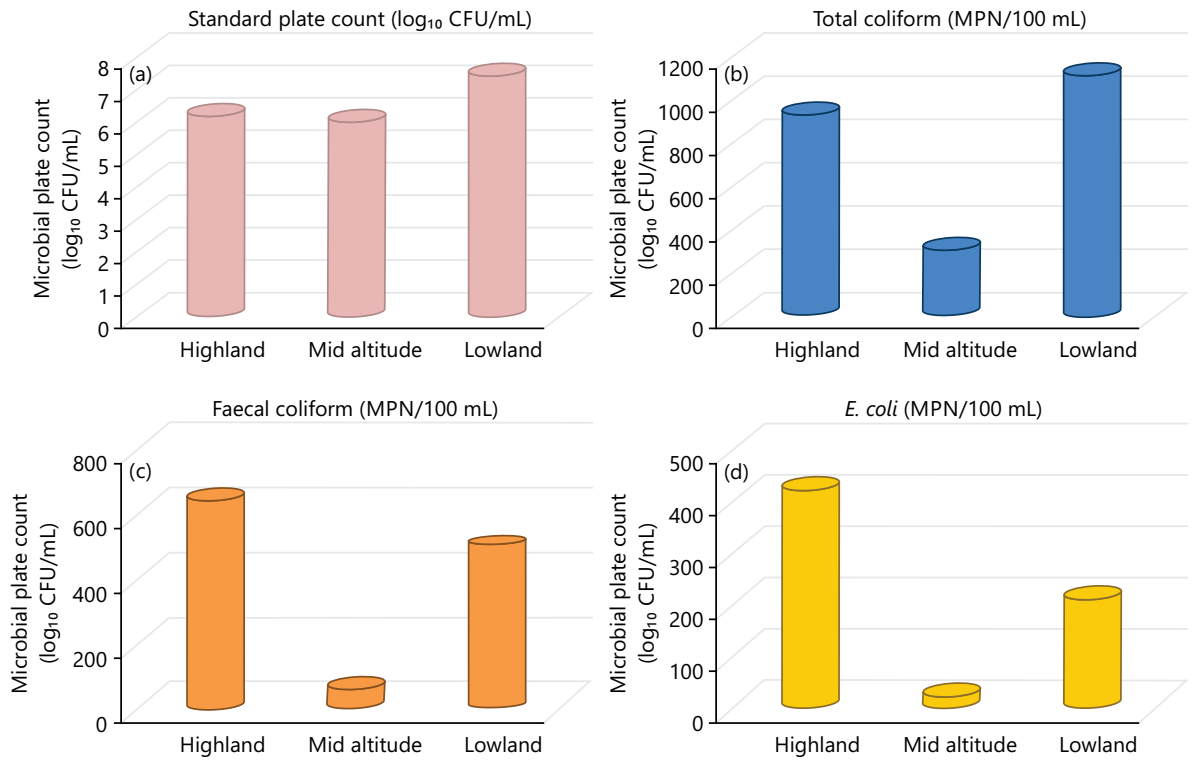
Fig. 2(a-d): Microbial contamination level of drinking water across different agro ecologies of Bale Zone in the study districts, (a) Standard plate count, (b) Total coliform, (c) Faecal coliform and (d) *Escherichia coli*

Table 4: *Escherichia coli* counts (log_{10} CFU/mL) for drinking water samples obtained from different sources across the study districts

District	Kebele	Drinking water source	N	Minimum	Maximum	Mean	p (<0.05)	Risk category
Goro	Waltai Gobu	Tapped	12	2.990	43.000	12.098±3.227[g]	0.0032	IR
		Spring	3	2.990	20.000	8.863±5.571[g]	0.2526	LR
	Garre	Tapped	15	6.200	240.000	42.607±19.329[fg]	0.0447	IR
	Chafe Mana	Tapped	15	2.990	43.000	11.0553±3.571[g]	0.0079	IR
Goba	Waltai Sura	River (Tagona)	4	28.000	1101.00	328.500±259.0143[defg]	0.2942	HR
		River (Tagona-household)	4	35.000	1101.00	514.000±219.818[bcde]	0.1014	HR
		River (Micha-household)	5	3.600	1101.00	443.660±268.360[cdef]	0.1736	HR
		Bore hole (Burgullo)	2	460.000	1101.00	780.500±320.500[abc]	0.2481	HR
	Waltai Tosha	River (Bamo)	8	93.000	1101.00	696.800±139.014[abcd]	0.0007	HR
		River (Bamo-household)	7	460.000	1101.00	972.800±128.200[a]	0.0016	HR
	Aloshe	Hand pump	13	2.990	9.100	3.554±0.466[g]	<.0001	LR
		Bore hole	2	2.990	2.990	2.990±0.000[g]	0.000	IC
Dallo Manna	Haya Oda	River (Yadot-household)	6	15.000	210.000	84.333±62.945[fg]	0.3123	IR
		River (Erba)	4	93.000	1100.00	398.250±237.896[cdefg]	0.1927	HR
		River (Erba-household)	5	20.000	1101.00	884.400±216.100[ab]	0.0149	HR
	Barraq	Tapped	4	11.000	23.000	20.000±3.000[g]	0.0069	IR
		Pond (Haro Sora)	8	35.000	460.000	267.500±63.259[efg]	0.0039	HR
		Pond (Haro Wanji)	3	2.990	20.000	12.663±5.047[g]	0.1289	IR
	Gongoma	Tapped	4	9.100	23.000	12.575±3.475[g]	0.0363	IR
		Spring	2	11.000	210.000	110.500±99.500[fg]	0.4667	HR
		River (Gongoma)	9	2.990	210.000	60.566±28.388[fg]	0.0654	IR

IC: In conformity with WHO guidelines, LR: Low risk, IR: Intermediate risk, HR: High risk, VHR: Very high risk, means with different letter are significantly different at p<0.05 and Mean±Standard Error

guideline. Samples from spring in Goro and hand pump in Goba were under "low risk category". Almost none of the samples have complied with WHO guidelines and Ethiopian standards for drinking water quality[19] except that of bore hole in Goba District.

Microbial contamination across the different agro-ecologies: Microbial contamination of the drinking water samples looks different for the different agro ecologies across the zone. Standard plate count showed an increasing trend with decreasing altitude (Fig. 2a). However, total coliform was lower at mid altitude as compared to high and low lands with still being highest at lowlands (Fig. 2b). Feacal coliform contamination of drinking water followed a opposite looking trend with the highest contamination being at the highland agro ecologies. Similar to that of coliforms, the lowest population was observed at the mid altitude districts (Fig. 2c). Similarly, *E. coli* distribution followed the same trend as that of faecal coliforms with the highest level being highlands and the second pick being observed at lowlands and the least reported at mid altitude areas (Fig. 2d).

RECOMMENDATION

Thus, the society, as an emergency action, should take actions like filtration, boiling and treatment with some commercially available antimicrobial agents following manufacturers' instructions. Furthermore, the water sector should take an immediate action in performing appropriate treatments (chlorination) at the source/reservoirs for piped distribution. In addition, the distribution lines should be periodically inspected and maintained for proper functionality. For majority of our farmers/pastoralists who depend on polluted river and highly turbid ponds for drinking water, the sector should make great endeavor to establish facilities for the supply of safe drinking water to avoid the likely health burden to be posed on the society from the highly contaminated water sources.

CONCLUSION

Most of the samples from river are seriously contaminated by total coliform, faecal coliform and *E. coli* showing high sewage discharge and disposal of urban waste into the rivers. High microbial contamination of fenced ponds are most probably from animal dung carried on foot steps of those fetching water. Moreover, inadequate periodic maintenance of the entire distribution system led to detection of total coliforms in tap water samples making it riskfull for consumption.

SIGNIFICANCE STATEMENT

This study was initiated to assess the microbiological quality of drinking water samples taken from different sources. The investigation made it clear, for the first time that local people including those living surrounding towns and the rural people were consuming drinking water from highly dirty rivers into which urban wastes and household trash were being thrown and not protected totally. Nearly all the samples from the different sources didn't comply with the national and international microbiological standards hence classified as high risk. Thus, this study brought into the knowledge and attention of the scientific society and the policy makers, the possible health hazard the society is suffering from due to consumption of highly contaminated drinking water from those sources.

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