Water quality analysis for domestic use public water supply in the case of Asella town at the source of Ashebekka River, laboratory based cross-sectional study design

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Research article

Keywords: Water pollution, Physico-chemical and bacteriological water quality, Escherichia Coli & coliform counts.

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Abstract

1.Abstract Background Water is essential for life. The objective of this research was designed to assess the physicochemical & bacteriological quality of drinking water come from Ashebeka river as a supply of Asella town. Methods A cross-sectional study design was implemented on the study sites. Water samples had been taken for laboratory analysis. Statistical analysis were carried out with Epi info 7 for data entry & STATA 15 for data analysis. Results The first round laboratory test results for:-BOD test result 4mg/L at site one, 2 mg/L at fourth site, & 6 mg/L at site eight. COD test result 40mg/L at site one, 20 at fourth sites, & 60 at site eight. The result of total & fecal coliform count greater than 180CFU/100ml & Escherichia Coli 40 CFU/100ml of sample for the first sites. The laboratory investigation during the second round test results for:- turbidity measure 162.06 NTU at site one, 5.84NTU at site two, 6.94NTU at site three, 5.48NTU at site four, 6.57NTU at site five & 8.76NTU at site six. The chemical analysis result had found that fluoride concentration 0.5mg/L at site one, 0.48mg/L at site two, 0.44 mg/L at site three & at site four, 0.43mg/L at site five, & 0.01mg/L at site six. Aluminum taste result nill at first site, 0.54mg/L at second site, 0.24 at third site, 0.48mg/L at fourth site, 0.39mg/L at fifth site & 0.110mg/L at sixth sites. the calcium concentration had found that 8 mg/L at first sites & third sites, 6.4 mg/L at the rest sites. The magnesium test results had found that 0.96mg/L at first & fifth sites, 1.92mg/L for the rest sites. The dissolved oxygen concentration at first site was 3.667mg/L, at second sites 5.333mg/L, at third sites 6.0mg/L, 4.667mg/L at fourth sites, 5mg/L at fifth sites & 2.667 mg/L at sixth sites. Conclusions Water quality was acceptable even though improvement will be required on chemical parameters. Keywords : Water pollution, Physico-chemical and bacteriological water quality, Escherichia Coli & coliform counts.

Background

Water is one of the fundamental substances that determines for the existence of live on the surface of the earth. For human beings adequate, safe & accessible supply of water is the basic requirements for all citizens in the developing countries. To satisfy the human needs of drinking water maximum effort should be implemented to improve the quality of water(1).

In addition to human beings water is also the raw materials for the industries to produce different products in their pressing systems. Agricultural actives also highly dependent on water for the growth of different crops for the supply of food security even though their quality parameter different from human water supply. Animal husbandry also requires some quantity of water to enhance the existence there life so as a source of food especially milk and meat husbandry for human feeding systems. Water is also essential for plant growth. Although 70% of the earth surface covered by water only 1% of water from surface & ground water sources used for domestic water supply (2).

The surface & ground water sources are highly exposing for pollutants that is generating by anthropogenic and natural activities. The result of Physico-chemical analysis sewage polluted ground water samples had found that EC, TH, COD, nitrate, sulphate and trace metals had high concentration determined from laboratory analysis (3).

Globally, in developing country water related diseases continued as a major public health problems. As literature pointed in the year 2000(4), 4 billion diarrheal cases happened to caused 5.7% of deaths among the disease that happened in the worldwide. The main causes of water borne diseases are fecal material contamination that discharges from human beings as a result of poor waste management practices.

Therefore, regular microbial testing of drinking waters a major task to confirm the absence diseases pathogen according to the report of WHO, 1996. The research done Inpakistan 2010 had shown that due to the sanitation & water line system damaged by flood wate, so that the laboratory investigation of Escherichia coli in swat & sukkur village were 76% & 96 % respectively(5). The access to potable water supply in developing countries is very low so that they relay up on unsafe water supply sources like shallow & bore wells besides to surface water sources like river water which is highly exposed for water pollution during their consumption of domestic purposes(6).

The effective measures to improve the quality of water obtained from varies sources is to treat water by the use of house hold water treatment system in addition to conventional water treatments that eliminate microbial contaminants of water to save the life of people from infection of water borne diseases mostly in developing countries(7).

As a principle sanitary system of excreta disposal & safe water access to the community is a basic human rights, though the majority of developing countries lack off this facilities so that they exposed to water borne diseases(8). In the world Eight hundred eighty four million people get their water from unimproved water sources. From this figures above one third found in sub-Saharan African countries. The population number in these countries increases from day to day so for their waste generated poorly managed then pollute their water sources (9).

Water which is contaminated with wastes especially which contain excreta of human & animal's at great risk to public health due the microbial concerns. Lots of pathogenic microbes found in human faeces which contain pathogens of intestines of the gastro-enteritis like dysentery, typhoid and cholera.

Diarrhea is the most predominant water borne diseases. The estimated incidence of diarrhea in each year is 4.6 billion episodes & causes every year 2.2 million deaths(10). Research had found that the main victims of diarrhea due faecal-oral rout of disease transmission. They also consider to be the main source of infections (11).

The microbial contaminant level of water is determined by the assessment of total & faecal coliform organisms(12). The laboratory analysis of these faecal & total coliform organisms is an indication of water contaminated by faecal pathogens for human faeces. Water sources from unimproved sources are more liable to these faecal pathogens than protected water sources(13).

Research that were identified the most common pathogens of Contamination water were the microbes of bacteria, Vibrio, Salmonella, bacterial and parasitic dysentery, and acute infection diarrhea causing E. coli (14). Water that were contaminated with microbial pathogens ingested cause death of children in developing countries(15).

One of the subs Saharan African countries which had low water & sanitation coverage is Ethiopia. More than 80% of communicable diseases in Ethiopia were hygiene related diseases results from lack of adequate & safe water supply & sanitation services. The human wastes discharge to the environment & contaminated water sources. Thus unimproved water sources was at risk of contaminated with disease causing pathogens. (16).

The rationale /Significance of the study

The Oromia regional state is one of the largest regions of the Federal Democratic Republic of Ethiopia. Asella, one of the towns found in this region, was exposed to a high risk environment in many aspects, like deficiency of pure water supply. Thus, this assessment is therefore essential and well-timed as public health issues like pure water supply are crucial in such environments especially among peoples in Asella town.

Finally, In line with those attributes & may have dual benefits to the concerned governmental authorities, stakeholders and communities at large. It helps to probe the grounds for the threat; helps to set and develop programs and strategies based on the study area's setup. It can also be used as a reference tool and base for further study.

General objectives

To assess the quality of water for domestic use of Asella town municipality public water supply from Ashebeka River at, Dosha treatment plant & selected public water supply sites (kebeles) in Asella town.

Specific objectives

To test physical quality of drinking water

To analyses chemical quality of municipality water supply

To examine bacteriological load of Asella town water supply

Methods

Study area and period

Asella is located 175km away from the Ethiopian Capital City Addis Ababa. The city has a latitude, longitude and Altitude of 7°57'N, 39°7'E and 2431m respectively [17], According to 2007 population census the city has a total population of 68,269 among which 33,826 were men and the rest 33,443 were women; 67.43% of the population worshiped Orthodox, 22.65% Muslim and 8.75% of the population were Protestant. Asella has 14 kebeles sited as high land areas. City population obtains water from Ashebeka River after passing Dosha treatment plant (figure 1). The study period were November, 2015 to april, 2016G.C.

Raw water coming from Ashebeka river at entrance site of water reservoir

Treated water leaving out from dosha site water treatment plant

Water reservoir at Asella kebele 01

Public water fountain at Asella kebele 06

Public water fountain at Asella kebele 14

Asella hospital

Public water fountain at Asella kebele 09

Public water fountain at Asella kebele 10

Site here (figure 1)

Study design

Laboratory based cross sectional study design had been carried out through out study period. Water samples were collected from at the inlet & out let site of Dosha water treatment plant, at the water reservoir found kebeles 01, at Asella kebele-04, 06,& 07 public water fountains (Birka) & Asella hospital.

Sample collection

Water samples had been collected from preselected sites at monthly intervals in the morning hours during November to March 2015 & 2016G.C. Samples had been collected in plastic containers, pre-cleaned by washed & rinsed in tap water, sanitize with 1:1 hydrochloric acid and finally with pure tap water. The actual sampling had been collected by taking from each sampling sites. The samples then transport in cold boxes containing ice to Water Works Design and Supervision Enterprise Laboratory. Two round water sample collection & analysis had been implemented on the laboratory analysis offices.

Sample size

Water samples had been collected from eight different sites with two rounds. $12 \times 4 = 48$ water quality parameter for first round & $24 \times 6 = 144$ water quality parameters for second round. A total of 192 water quality parameters had been carried out at Addis Ababa water & sewerage laboratory.

Reliability & validity

Water samples had been collected by health professional including medical laboratory technologist. All samples were transported to analysis laboratory before 4 hours.

Before starting any work three days sensitization training provided by principal investigators for data collectors..

Sampling Technique

The study had been repeated for two rounds. The study also supported by sanitary survey handling for four days to collect on site information by filling the proposed check list about the practice of peoples by BSc level health professionals.

Physicochemical analysis

Water quality parameters like pH, temperature, and dissolved oxygen had been analyzed in situ while the Total Hardness (TH), Turbidity, Electrical Conductivity, Nitrate Nitrogen, Nitrite-Nitrogen, Phosphate, Biochemical Oxygen Demand; Chemical Oxygen Demand & Ammonia had been analyzed at research laboratory Addis Ababa water & sewerage Laboratory. Preservation and analysis of the water samples done as per standard methods of (18, 19).

Bacteriological Analyses

The bacteriological quality of water samples had been assessed by the MPN test and Total Plate Count Method. Total coliform & E.coli also analyzed for the representatives of bacteriological water quality. Others, especially those which constitute natural micro flora of human and animal food tracts, can induce acute or chronic gastric diseases(20).

Data analysis

All results entered in Epi info version 7 for data entry & STATA version 15 for data analysis & interpretations including person correlations.

Results

Site here (table 1)

The first round laboratory analysis result had showed that BOD result was greatest at site eight & lowest at site seven. Similarly COD value was high at site eight while lowest at seven. The ammonia concentration was highest at one & lowest site seven. The total hardness measurements highest at site eight & lowest at site four. From metal analysis calcium concentration was highest at site eight & lowest at site four. The magnesium concentration fluctuates as we go through the sites that were highest at site four & lowest at site eight. The nitrite, nitrate & phosphate tests vary as we passed through water sampling sites.

For the bacteriological analysis of water sample taken from site one the tests were positive for total coliform, fecal coliform & E.Coli. But for the rest sites test i.e. after treatment plants no bacteriological tests were positive.

The second round laboratory analysis tests found that the colour tests were colourless for all six sites. Similarly for odour & taste parameters were also odourless & tasteless for all six sites respectively.

The turbidity measurement analysis was highest at site one & lowest at site four, but variations were recorded for the rest four water sampling sites.

EC test was highest at site six, then variations recorded with rest sites & lowest values were analyzed at site one.

The total solid analysis result was highest at site one & lowest at site three. The dissolved solid result was highest at site six & lowest at site one followed by significant variation for the rest four sites sampling points. The total hardness result was slight deviations with all areas of study in Asella water quality analysis (figure 2).

Site here (figure 2)

The dominant metal was sodium ranging from 2.7mg/L to 8.8mg/L. The concentration of sodium was highest at site one & lowest at site four of public water fountain, then vary for the rest sites.

The potassium tests were identical at four sites with slight variation at site four & site six. Total iron test were highest at site one & lowest at site three for the rest sites little variation were obtained.

Calcium test were highest at site one & site three, similar results were obtained for the rest four sites. Aluminum test was highest at site two & lowest at site one, followed by variation for the rest sites. The test result for zinc was highest at site four & lowest at site one. The heavy metal analysis result shows there was a variations when we had moved from one study sites to the others as had shown in figure 3.

Site here (figure 3)

Site here (table 2)

Alkalinity test were highest at site one, while for the rest five sites identical results were obtained. The bicarbonate maximum result was obtained at site one followed by similar results for the rest five test sites. The maximum chloride test was found at site six & lowest result was recorded at site one followed with identical result for the rest four sites.

The test for ammonia was highest at site one & lowest at site four, with slit variation for the other sites. The maximum nitrate concentration was obtained at site one & lowest result at site six with variation to other sites. The result for nitrite was highest at site five & lowest at site two & four. The dissolved oxygen test was raised at site three & lowest at site six then variation to other sites. The fluoride concentration was highest at site one & lowest at site six. The bicarbonate concentration was higher than from the respective test of others water quality parameters, while the least concentration was obtained ammonia as shown in figure 4 below.

Site here (figure 3)

Site here (table 3)

The statistical analysis result had shown that a strong pair wise correlation with their selected water quality parameters. For example, TURB. had strong positive correlation with pH & TS while negative correlation with ECs. E.Coli, Alk & Co_3^{2-} had a significant pvalue with strong correlation with. pH, ECs, E.Coli, TS, TURB, Na, NH_3 & Alk (table 3).

Discussion

The physical test result of Asella municipality water had shown that colourless, odourless & tasteless which meets WHO standard for drinking water had similar status for stated water quality indicators.

The turbidity measurement value was greater than WHO standard value of 5NTU. the test result of the first site was maximum, this may indicate you the need for treating effectively Ashebeka river water. The other remaining test result had turbidity values raise over WHO standards, this might be, even though treatment plant of Asella municipality works effectively the availability indicates treatment plant & water reservoir have to wash to reduce further turbidity substances. Water turbidity is very important because high turbidity is often associated with higher level of disease causing microorganism, such as bacteria and other parasites(21). Similar study in Nigeria turbidity value ranged 0.77-0.99 NTU(22), which was lower than Asella town municipality water supply from Ashebeka river.

The total dissolved solid was substances that were found dissolved form in water sources. (23) TDS are composed mainly of carbonates, bicarbonates, chlorides, sulphate, calcium, magnesium, phosphate, nitrate, sodium, potassium, and iron. The TDS is the term used to describe the inorganic salt and small amount of organic matter present in solution or water.

The principal constituents are usually calcium, magnesium, sodium and potassium metals, carbonate, hydrogen carbonate, chloride, sulphate and nitrate anion(24) . It has been reported that drinking water with extremely low concentration of TDS may be unacceptable because of its flat insipid taste(24, 25).

The highest value was recorded in Asella hospital water sample site. This may be due to solid settled in hospital water reservoir might be not washed with the appropriate time interval. The ISI standard for dissolved solids (23) is up to 500 mg/lit and the maximum permissible quantity is 1500 mg/lit(26). The sample test result with current study all were with the range of WHO & ISI standard of drinking water. Similar study done in Nigeria had found for total dissolved solid ranged 250-700mg/L (27) But the result of this finding ranged 34.4-76.6mg/L which was lower than the previous study. Total dissolved solids is an indication of dissolved metals in water(28).

The important test result was detected out fluoride & aluminum tests. The aluminum concentrations raise up above WHO standard 0.2mg/L at site two, three, four & five. This might be due to high dose of alum utilization by Asella water & sewerage authority office for coagulation process.

The total hardness result was lower than WHO standards 500mg/L(24). Water hardness in Asella water of Ashebeka river was grouped under soft water. Total hardness of water is due to the presence of bicarbonate, sulphate, chloride, and nitrates of Ca and Mg(29). Similar studies in Tanzania of temeke river ranged 50-710mg/L(30) The finding of this study lower than temeke rivers. According to ISI, the acceptance limit of total hardness (as CaCO_3) is 200 mg/lit which can be extended to 600 mg/lit(31). Ca^{++} & Mg^{++} are important ions contributing towards total hardness. Hardness has no known adverse effects. Hardness above 200 mg/lit of water is not suitable for domestic use in washing, cleaning and laundry(31).

The acceptable limit of Ca^{++} & Mg^{++} for domestic use is 75 mg/L & 200 mg/L respectively. Calcium & magnesium have important function for bone growth. Researches and studies proved that water with low magnesium can cause increased morbidity and mortality for cardiovascular disease, higher risk of motor neuronal disease, pregnancy disorders and preeclampsia. Water with low in calcium may be associated with higher risk of fracture in children, certain neurodegenerative diseases, preterm birth and low weight at birth. Lack of both calcium and magnesium in water can also cause some types of cancer(30). similar studies in India ranged 32-98mg/L for calcium & 10-89 mg/L for magnesium study done on Uttarakhand river(32). The finding of this study was too much lower than with Uttarakhand River. The stated metal analysis results of this study were found below WHO standard for each specific metal analysis.

The WHO standard for fluoride concentration is 1.5mg/L. the result of this investigation in all sites was below this standard. Low fluoride concentration causes tooth decay. Similar study on boreholes in Nigeria ranged 0.13-0.92 mg/L(22), which was higher than Asella municipality water supply. This indicates that ground water had greater fluorine concentration than river water.

Use full water quality test like alkalinity & electrical conductivity tests were performed, but the result was below WHO requirements which did not affect the health the costumers.

The WHO standard for dissolved oxygen 6.5mg/L & any value above this is acceptable for drinking water quality(33). But this study result had found only at site three near stated WHO standards, while the other site needs dissolved oxygen correction for accuracy. This might be Asella town water treatment plant had no aeration chamber. Similar study Wukro river water dissolved oxygen ranges 3.54-11.8mg/L(34).

The WHO standard for BOD & COD test standards 2mg/L & 50mg/L respectively(33). The test results for BOD & COD were above WHO standards at site one & site eight. This might be due to the water carrying pipe carried dissolved substances because of universal character of water & settled solid within pipe lines increase the concentration of stated water pollutants. The remaining test results were below WHO standards not affecting water quality. Similar study in Wukro river water ranges 2.5-6.6mg/L & 3.2-12.8 mg/L of BOD & COD respectively(34). The Asella municipality water result was higher than Wukro River.

The bacteriological analyses were carried out by the detection of coliform & E.Coli count tests. Both results had shown that the tests were above WHO standards before the treatment plants. The results show very high microbial counts for the various drinking water samples when compared with the WHO(24) standard of 1.0×10^2 CFU/ml. For those tests which had taken after the treatment plants the tests for fecal coliform & E.Coli tests were negative which lies with the range of acceptable standards. Similar studies in Nigeria(35) water supply the total coliform count bore holes 10-15MPN/100ml, which were lower than Asella municipality water supply before the treatment plant.

The ammonia concentration throughout the study sites above the WHO standards of 0.05mg/L. This may be due to the occurrence of organic pollution after water treatment plants. The presence of nitrite concentration above WHO standards 0.5mg/L at station five might be indication of pollutants appear after treatment plants may have health effects.

The statistical significance test result had shown that the pollution load may had a contribution for increasing the variety level of water pollutants due to natural & man made factors.

Conclusions

Asella town water supply had been assessed for the last one year for its quality with comparing of WHO water standard level. The physical quality of water after the treatment plants had been within the range of the standards. The turbidity result before the treatment plant above the expected standards. The chemical test result especially fluorine below the standards.

The aluminum concentration increases above WHO standards. The dissolved oxygen concentration was below the WHO standards. There was also increase BOD & COD concentration above the expected water quality standards. The bacteriological analysis by taking indicator of E.Coli. & coliform tests before treatment plant concluded above the standards. Over all the quality of Asella water supply from Ashebeka River after the treatment plant fit for drinking water with a correction measures.

Recommendations

Asella water & sewerage office should build water aeration chamber. The fluorine concentration needs addition of fluorine to solve dental problems. The calcium, magnesium & zinc concentration must be corrected for better municipal water supply. The aluminum concentration also must be reduced to the standard levels by implementing jar tests after coagulation process. The organic pollutant load must be reduced to the standards by performing regular washing of water treatment plant & water reservoir within Asella town. The old water carrying pipes of metal type changed to plastic pipes may reduce the pollution load. The municipality water office also should develop to have physical, chemical & bacteriological analysis by having standard instrument laboratory office. The consumer of Asella town water supply urban community also applies homemade water treatment besides municipal water treatment plant to reduce further cross contamination of water quality pollutants.

Limitations

Due to shortage of resources water samples were not carried out from all Asella town kebeles. This study also had not included commercially prepared bottled water supply for urban consumers. The study also limited about the house hold water storage tankers.

Abbreviations

ALK Alkaline

APHA American Public Health Association

BOD Bio-Chemical Oxygen Demand

COD Chemical Oxygen Demand

EC Electrical Conductivity

E.Coli Escherichia Coli

IDPS Internally Displaced Person

MPN Most Probable Number

NTU Nephelometric Turbidity Units

TURB Turbidity

TH Total Hardness

TS Total solid

UNICEF United Nations Children's Emergency Fund

WHO World health organization

Declarations

Ethics approval and grant

Since the study was carried out on water sample analysis in Asella town the sample was not taken from humans or animals including plants. Therefore "Not applicable"

Consent to publish

To come to visualize the scientific world the status of water quality in Asella town for serving of the underdeveloped world population in case of Asella town how much exposed to water borne diseases.

Availability of data and materials

Physicochemical & bacteriological water quality parameters of laboratory investigation results were available at the hand of principal investigator & Addis Ababa water & sewerage laboratory office for the safety of mishandling data not to occur for avoiding public violence process. If the journal needs it I will attach with email address separately;

Competing Interests

The authors declare that I have no competing interests

Funding

Adama & Arsi University were the source of financial support for the data collection & laboratory analysis including for covering cost of laboratory reagent & chemical while handling laboratory investigation process of this research project

Authors' contributions

Authors handle all water quality investigation process presented in this manuscript preparation for this study. It is my original work. I am accountable for any question raised concerning my work.

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Authors' information

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As I have tried to indicate on the subject of this application; I am very happy to apply to prepare manuscript for publication especially public Health Courses of Environmental health for any department. Previously I had two publication on waste water quality analysis found on reputable international journals.

Having gained a Bachelor of Science in Environmental Health(BSc) Degree from Jimma institute of health sciences in 2006 and Master Degree in Environmental Science & technology/environmental technology spatiality/ from Jimma University October 12, 2010, for the past ten years I had been lecturer on environmental health in health science Colleges in Arsi University.

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Tables

Table 1:-First round results of chemical & bacteriological water quality laboratory analysis, April, 2015 G.C.

PARAMETERS	Site three	Site Four	Site Seven	Site Eight
BOD ₅	4	2	TRACE	6
COD	40	20	TRACE	60
AMMONIA	1.87	0.62	0.48	1.63
TOTAL HARDNESS	60	50	60	68
CALCIUM	14.4	9.6	16	20
MAGNESIUM	5.76	6.24	4.8	4.32
NITRITE	0.09	0.03	0.02	0.02
NITRATE	1.12	1.41	1.33	1.35
PHOSPHATE	0.87	0.32	0.11	0.06
TOTAL COLIFORM CFU/100ml	180	0	0	0
FECAL COLIFORM CFU/100ml	180	0	0	0
ESCHERICHIA COLI CFU/100ml	40	0	0	0

Table 2:-Physical & Chemical laboratory analysis result of second round tests, March, 2016 G.C.

PARAMETERS	Site one	Site two	Site three	Site four	Site five	Site six
COLOUR	COLOURLESS	COLOURLESS	COLOURLESS	COLOURLESS	COLOURLESS	COLOURLESS
ODOUR	ODOURLESS	ODOURLESS	ODOURLESS	ODOURLESS	ODOURLESS	ODOURLESS
TASTE	TASTLESS	TASTLESS	TASTLESS	TASTLESS	TASTLESS	TASTLESS
pH	6.18	4.27	4.12	4.21	4.28	4.14
ELECTRICAL CONDUCTIVITY (µS/cm)	57	107	104	121	104	118.00
TOTAL SOLIDS (mg/L)	198.	72	71	78	72	85
TOTAL DISOLVED SOLIDS (mg/L)	34.4	64.4	62.4	72.8	62	76.6
TURBIDITY (NTU)	162.06	5.84	6.94	5.48	6.57	8.76
SODIUM (mg/L)	8.80	3.10	3.00	2.70	3.00	2.80
POTASIAM (mg/L)	1.70	1.70	1.70	1.80	1.70	1.80
TOTAL IRON (mg/L)	2.58	0.09	0.07	0.23	.18	.12
AMMONIA (mg/L)	1.63	0.84	0.80	0.71	0.78	0.78
TOTAL HARDNESS (mg/L Caco3)	24	24	28	24	20	24
CALCIUM (mg/L)	8.00	6.40	8.00	6.4	6.40	6.40
MAGNESIUM (mg/L)	0.96	1.92	1.92	1.92	0.96	1.92
ALKANITY (mg/L Caco3)	16.00	4.00	4.00	4.00	4.00	4.00
BICARBONATE (mg/L)	19.52	4.88	4.88	4.88	4.88	4.88
CHLORIDE (mg/L)	3.98	5.96	5.96	5.96	5.96	7.95
NITRATE (mg/L)	6.42	1.65	1.92	5.44	4.58	0.01
NITRITE (mg/L)	0.038	0.007	0.008	0.007	5.584	0.009
FLUORIDE (mg/L)	0.5	0.48	0.44	0.44	0.43	0.01
ALUMINIUM (mg/L)	TRACE	0.54	0.24	0.48	0.390	0.110
ZINC (mg/L)	0.01	0.25	0.03	0.93	0.660	0.02
DISSOLVED OXYGEN (mg/L)	3.667	5.333	6.000	4.667	5.00	2.667

Table 3:-Physico-Chemical & bacteriological selected water quality Pearson two tailed statistical correlation, April, 2017 G.C.

	PH	EC	TS	TURB	Na	NH ₃	ALK	CO ₃ ²⁻	ECOL
PH	1								
EC	-0.9529	1							
	0.0033								
TS	0.9876	-0.9165	1						
	0.0002	0.0102							
TURB	0.9957	-0.9488	0.9954	1					
	0	0.0039	0						
Sa	0.9967	-0.9654	0.9876	0.9978	1				
	0	0.0018	0.0002	0					
NH ₃	0.9908	-0.9694	0.9817	0.9929	0.9974	1			
	0.0001	0.0014	0.0005	0.0001	0				
ALK	0.9967	-0.9496	0.9944	0.9998	0.9981	0.9927	1		
	0	0.0037	0	0	0	0.0001			
CO ₃ ²⁻	0.9967	-0.9496	0.9944	0.9998	0.9981	0.9927	1	1	
	0	0.0037	0	0	0	0.0001	0		
ECOL	0.9967	-0.9496	0.9944	0.9998	0.9981	0.9927	1	1	1
	0	0.0037	0	0	0	0.0001	0	0	

Figures

Figure 1

Water sampling station in Asella town, 20176 G.C. Since the sketch map was drafted manually to show from where water sample was collected I was not prepared legend

Figure 2

Concentrations of solids in water quality analysis in Asella town, march/2017G.C.

Figure 3

Analysis of metal concentration in water quality of Asella town, March /2017G.C.

Figure 4

Water quality analysis of Asella town at different sites, March /2017G.C.