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Original Research

Assessment of Water Supply and Sanitation: The Case of Embacho Town, Gidan Woreda, Northern Ethiopia

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Abstract

Embacho town has undergone through various social and economic developments since its establishment. Population growth and urbanization which are confronting the Town has called for the expansion and improvement of water supply and sanitation services. Therefore, detailed study is necessary for the decision making on upgrading of the existing water sources, future water sources selection and designing for the future water demand and management options .To achieve this goal, household survey, Pressure map, population growth rate, Water quality samples were undertaken based on purposive sampling method. The pressure result showed that the water was not distributed equally at higher locations of the supply reservoir than lower elevations due to pressure variations. Based on population growth rate formula, the total water demand including domestic and non domestic uses was found to be 78liters per day which does not able to meet the United Nation recommendation of 50 liters per day. The demand was able to be increased to 210240 m^3/year in the year 2022 while average domestic water consumption of the households excluding nondomestic uses was 8.6 liters per person per day, which is less than half of the 20 l/p/d recommended by the WHO. The sanitary survey of 138 households showed also that Forty percent of the respondents use simple pit latrine while Sixty percent use open defecation and the laboratory result indicated that from 15 household water storage containers, all of those have shown from medium to very high risks of contamination by faecal matters. Therefore, the result leads to the conclusion that the water supply system of Embacho Town was not adequate interms of quantity and quality and did not satisfying the consumers' water demand.

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INTRODUCTION

Ethiopia is naturally endowed with abundant water resources that help to fulfill domestic requirements, irrigation and hydropower. Its current per-capita fresh water resources estimated at 1,924 m^3 $year^{-1}$ and the groundwater potential of the country is estimated to be 2.8 BM^3 (Ethiopian Geological Survey, 2012).

Even if the country is endowed with abundant water sources, the problem of getting adequate and reliable water supply still is the most challenging issue of the country. The problems are exacerbated by high population growth and mushrooming Towns in Ethiopia. For instance, in 1984 there were 629 locations classified as Towns and by 2000 the number had increased to 925, all in need of water supply and sanitation services (Birhan, 2011).

The UNICEF (2012) stated the coverage of water in Ethiopia to be 64.2%for country level, 61.8% for rural and 90.4% for urban. The MoWR (2008) stated that water coverage of Amhara region is 69.31% and the per capita per day water consumption ranged from 3 to 20 liters with median of 8.5 liters. Several studies have aso confirmed that water-related disease is expanding and the incidence of water-related microbial diseases is increasing (WHO, 2003). Diarrhea remains a major killer in children and it is estimated that 80% of all illness in developing countries is related to water and sanitation (WHO, 2004). Ministry of Health of Ethiopia estimated that 6000 children die each day from diarrhea (FDRE, 2004). Amhara region especially northern part of Ethiopia is not out of this reality. This study was conducted in Embacho Town, Gidan Woreda, Amhara Regional State in which accessibility to potable water and basic sanitation is the biggest challenge which negatively impacting the economic, environmental and social condition of people and still are untouched and unsolved problems. Therefore, this research work was aimed to examine the existing water supply and sanitation status and predict the water demand for the next ten years.

MATERIALS AND METHODS

Description of the Study Area

Embacho Town is located in Gidan woreda, North Wolo Zone of Amhara Regional State which was

established in 1955 previously known as Aregash Ketema. It is located at a distance of about 581km from Addis Ababa; 360 km from the regional capital of Bahir Dar; and about 180 km from the tourist attraction site, Lalibella (Figure 1).

The area under study has an average altitude of 2921 meters above sea level. The total population number of the Town is 6585 in the year 2012 with a total number of 850 with 4 persons per households (ANRSPB, 2010).

Spring water is the major source of Embacho Town. The current water source of pipe water system is supplied only from Rufael spring water. Water from Rufael spring is supplied through the pipe to the reservoir by gravity. The Town is geographically located between $12^0$55'49''N-$13^0$56'87''N and 39^0 21'17''E-$39^0$24'17''E.

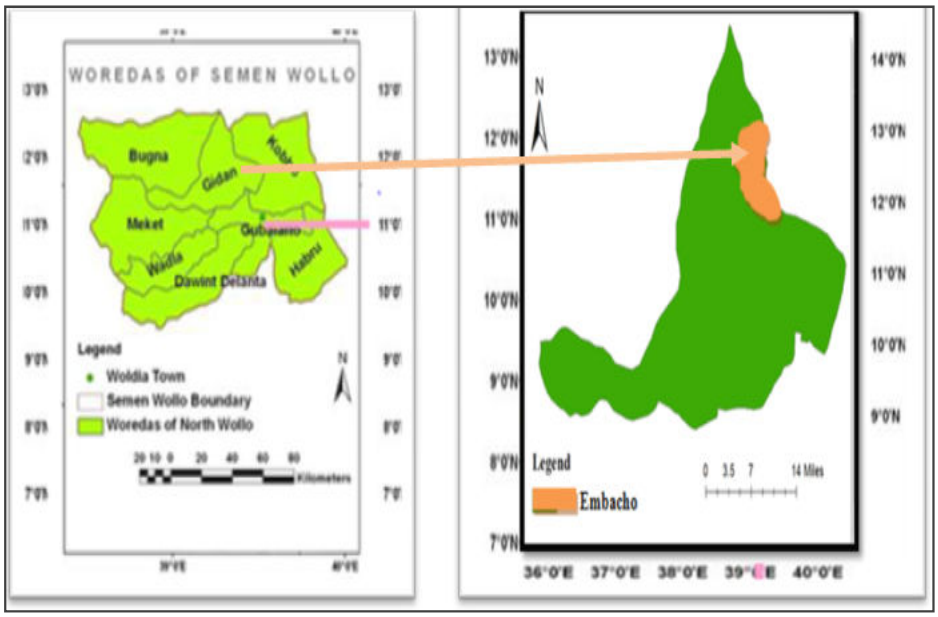

Figure 1: Location map of the study area

Type and Sources of Data

To get relevant information about qualitative and quantitative data both primary and secondary sources have been employed. The primary data about water use habit, existing sanitation condition, type of water source and the problems related with water quality were collected from, laboratory test, household survey, key informant interview, formal and informal discussions. Geographical positioning system (GPS) instrument was used to collect geographical coordinate data about, Reservoir, pipes and nodes which were missed from the water design map of the town.

Secondary data for quantitative study such as data about water pressure map, where demand and distribution system, location and pressure map, water source and discharge rate, and number of population description about the study area, location, topography, climate, population, and others data were collected from unpublished documents of Zone and District water offices.

Method of Data Collection and Sampling Procedures

Water Demand Projection

The quantity of water supplied, the total volume of water consumed, water production data, development activities of the Town were all collected from GWWDB. Based on the, ten year's past data the existing and future water demand of Embacho Town were analyzed by using geometric growth rate method (Chatterjee, 2005; Abreham, 2011 and Bryman, 2008). The geometric growth method is given by,

$$P = P_o\left(1+\frac{r}{100}\right)^n \quad \text{.....(1)}$$

Where,
P= projected population
P_0= base population
r= annual growth rate in percent
n= number of years (annual rate of growth)

Water Quality Sampling Points

To analyze the water quality in the laboratory, samples were taken from, water sources, main distribution systems, and sub-main distribution systems and from household water containers. Out of the six spring water sources, samples were taken from two sources (n=2), reservoir (n=1), tap (n=4) and household water containers (n=15). Therefore, a total of 22 water samples were considered for physico-Chemical and bacteriological examination. The samples were purposely five Small Kebeles called "GOTs" based on the current water supply sources and their geographical location. Water samples were collected labeled and transported to the North Wolo Water Resource Development Microbiological Water Quality Laboratory. To transport the samples to the laboratory, sterile glass bottles in a cold box containing ice freezer packs were used.

Data Analysis and Presentation

The existing water distribution was analyzed by using EPANET-2 SOFTWARE and to generate the pressure map SURFER-8 SOFTWARE was applied.

The location of sampling points was analyzed by Arc map 10.1 GIS SOFTWARE. Analysis of variance (ANOVA) was used to test the average counts of physico-chemical and bacteriological water quality parameters at 5% level of significance. LSD were used to identify among which water samples the significant is occurred. Pearson Correlation method was used to see the relationship between parameters at 1% significance level. Qualitative data collected from community, technical staff members, and water committees using questionnaire interviews and discussions were entered and analyzed in Statistical Package for Social Science (SPSS version 16.0). The data were presented using tables, percentages, graphs and mean values.

RESULTS AND DISCUSSION

The blue colour (Figure 2) at node 17 indicated Negative pressure value (-2.02m) which does not meet the standard water pressure of >15m (MoWR, 2006). This indicated that water is not adequately reaching to the households at those water supply points. The pressure map (Figure3) proved that more satisfactory pressure is produced at lower elevations while low water pressure is generated at relatively higher locations.

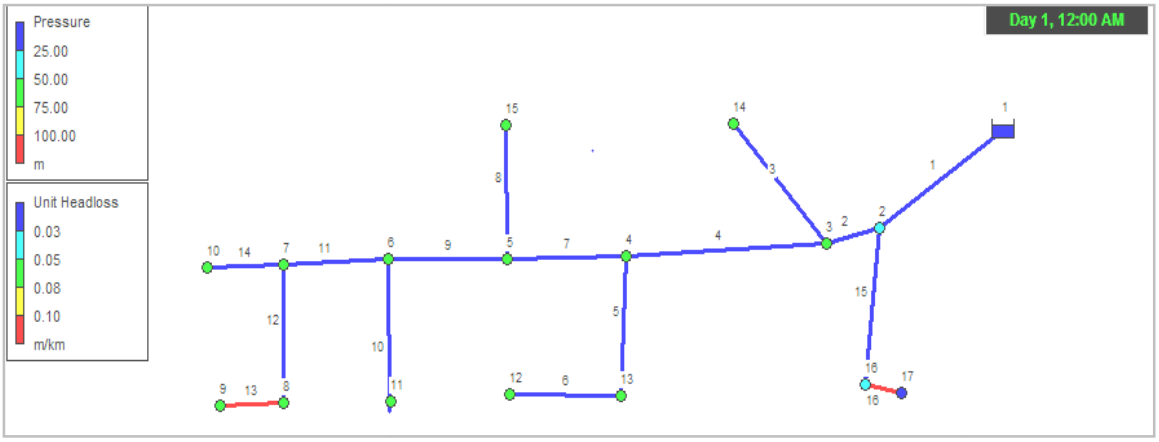

Figure 2: Water distribution network, EPANET result

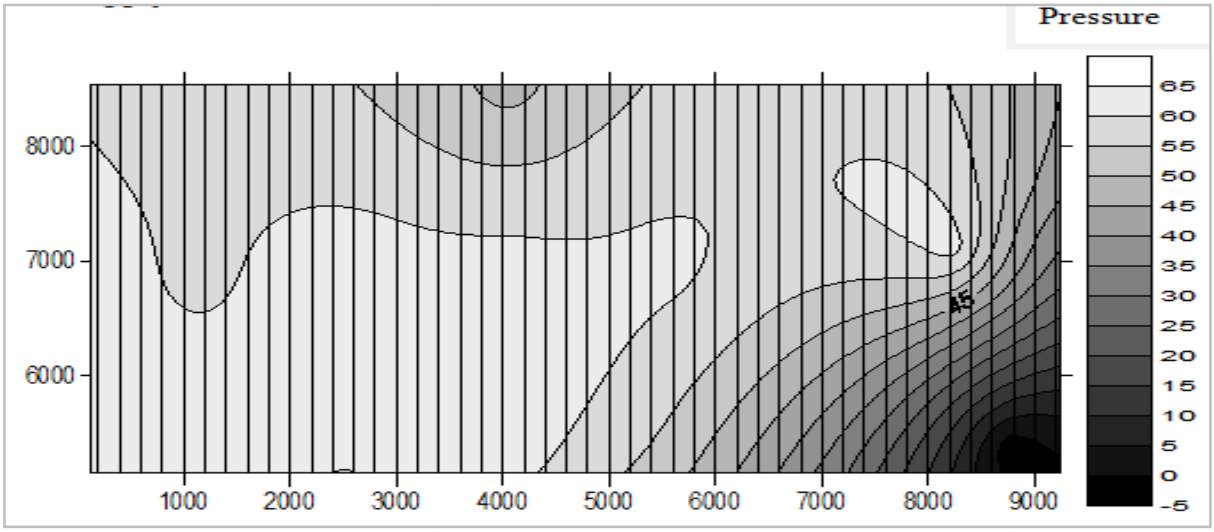

Figure 3: Pressure map, SURFER-output

When the height of the reservoir increased by 4m (from 2870m to 2874m), the distribution network indicates pressure between 15m and 70m and the negative pressure (-2.02m) was improved to (15.63m) which is satisfactory pressure to supply water (Table 1).

Water Quality

There were no significant difference of temperature and PH among all the water sources (F calculated < F (ratio) tabulated, P<0.05). The increased TC and FC counts in stored water may be due to bacterial re-growth or recontamination of water through dipping with hands and stored water container. The presence of biofilm on the inner surfaces may also offer a suitable medium for contaminating good quality water.TC, FC and Turbidity were significant among water sources samples (P<0.05). These might be because of lack of controlling temperature at disinfection points, which leads to the re-growth bacteria and no regular chlorination was adopted. The increased TC and FC counts in stored water may be due to bacterial re-growth or recontamination of water through dipping with hands and stored water container. The presence of Biofilm on the inner surfaces may also offer a suitable medium for contaminating good quality water (Table 1).

Table 1: Water quality analyses results of sampled water sources

Parameters	Zewudu Spring	Rufael Spring	Disinfection point	Tap waters	Containers	WHO Guide line	Ethiopian Standard
Temp (^{o}c)	20.1±	18.45±	19.4±	20.2±	23.9	<15	<15
Turb (NTU)	7.5±	2.71±	1.02±	1.2±	3.4	<5	<7
PH	6.95±	7.3±	7.0±	8.2±	6.59	6.5-8.5	
Fluoride (mg/l)	0	0	0	0	0	<1.5	
TC cfu/100ml	15±	0	0	0	46	<10	
FC cfu/100ml	11±	0	0	0	34	0 /100	
FCR (mg/l)	0	0	0.01	0	0	0.2-0.5	0.2-0.5

Water Demand Projection

The projected total water demand will increase by 108 m^3/day from 2012 to 2017 and it will be increased by 168 m^3/day during 2017 to 2022 period. In order to reach the water supply coverage of the Town at least 75% by 2022, the water supply should be 157680 m^3/year (Figure 4).

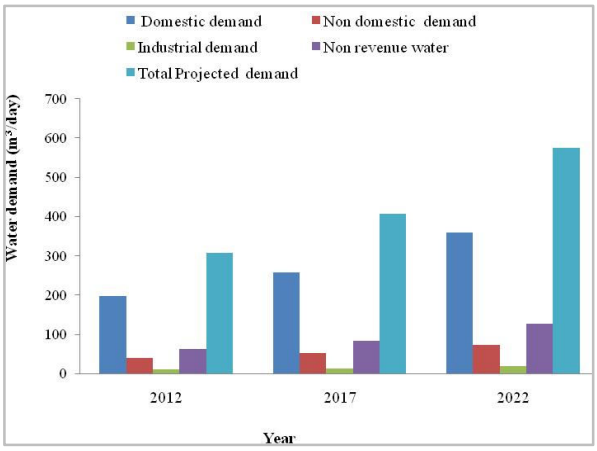

Figure Error! No text of specified style in document.**:** projections of water demand by category (2022)

Water and Sanitation Accessibility

With regarded to sanitation, 40 %of the respondents use simple pit latrine, these is due to the enforcement of health extension workers,60% of the respondents use open defecation. Public toilets and privet toilets are common in the study area. About 30 people use in one common public toilet. Three types of latrines were constructed in the study area. Pit latrine with closed wall and roof, Open pit latrine/without house and Pit latrine with walls but without roof. All the latrines were not clean and safe for defecation aggravated by water supply service problems. Water for hygienic activities like wash their hands (65%), washing of clothes (79%), washing of body (66%), washing their children's body (24%), washing their children's hand (11%) and 10% washing utensils and washing hands after defecating (0.2%) but 70% wash hands after defecation . More than 50% of respondents were neither using soap nor ash for hand washing.

CONCLUSION

The result of this work showed that the water supply system of Embacho Town has now serious problem to give satisfactory service to the community. Topographic variation and pipe damages were the underlined causes for inadequacy of water pressure to supply the required demand at the current condition. Therefore, exploration/searching of new water sources and increasing the water supply efficiency are necessary engagements of concerned bodies and voluntary service providers to minimize the problem.

The total coli form and Faecal coliforms counts were higher in household water samples compared to that of tap water. High counts of total coliform and faecal coliform at the house hold drinking water indicates that the water has been faecal contaminated. Poor sanitation and poor hygiene in household were the main factors for the contamination water during transportation and after storage at home. The average per capita domestic water consumption of more than 75% of the sample households is less than 20 l/c/d. Compared to WHO standard for basic access (20 l/c/d), this is low.

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Conflict of Interest

Conflict of interest none declared.

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