

Abstract

Water, Health and Poverty in Gondar City

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Environmental problems are experienced in Gondar city today than any time before. Such an environmental problem is explained by water, air, land etc problems of which water problem is the one and much more serious than the other kinds of problems. Gondar is the third largest city of the country and the first leading populous city of the region. According to the data obtained from the municipality of the city, the current population is 201958 (100864 male and 101094 female). The main aim and objectives of this work is to come across the issue of water in Gondar town and specifically to examine the affordability of water to get connected, the customers' ability to pay for the government or private water supplies, accessibility of the lines to customers to get connected, availability of water even after connection, and the seasonal effect on water availability. To realize the above objectives both primary and secondary data have been employed from questionnaires administered and documents from pertinent sectors to the issues. As the results of the research, water is supplied to private and government customers through 8802 connections including commercial users. Among these, there are 22 public tap points constructed thorough out the city. Average household size of Gondar city is 6.2 persons. Only 27.02 percent of total populations (54572 persons) have access of supply water facilities. The rest of the population uses public taps, private water vendors and river water. People of Kabele five get lowest 6.5 liter and

highest in kabele eighteen 18.46 liters water per person per day. These consumptions have included bathing, cleaning and household use. People life is highly unhygienic as well people suffers serious health problem due to water problem. Gondar city have relation with water, poverty and health. There is affordability issue; many households do not have the financial capacity to have their own private taps, because the minimum charge for installation of water tap is USD-80 which is beyond capacity of poor people. The water scarcity seriously prevails in Gondar city.

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Introduction

Modern water supply system was introduced in 1930's during the Italian invasion. The first modern water supply was constructed from Korebreb River in 1938 Ethiopian Calendar (EC) without any treatment plant. Therefore, water quality was very poor. Because of its age, the ' Korebreb system'' has contributed to high rate of water loss as well. After two decades, the so-called Yugoslavia system was contribution its share to improve the service.

The government, from 1967 to 1986 E.C constructed a total of eleven deep wells. The continued effort has contributed to the increased water supply coverage of the city. All except the two deep wells constructed in 1986 E.C, were interconnected with the old korebreb system. The average discharge rate of each water source except Angereb reservoir was 6.6 liters per second.

Population had been increased and there was shortfall in water supply. The Government of Ethiopia conducted feasibility study of different alternatives to improve the water

supply of Gondar city in 1974 EC. Different options were identified during study. The first option was the prospect of using water from Lake Tana as a source. This would have meant the installation of 39 Km (from Gorgora to Gondar) pipeline and a power requirement of about 4000 KW to pump water up an elevation of 215 meters. Even though it has the prospect of a reliable water source, it was rejected because it demanded a total budget estimated of 59 million Ethiopia Birr with substantial foreign currency and high electric power requirement.

The second option was the construction of Megech dam across Megech River. This was also rejected because it required over 77 million Ethiopian Birr. The third option assessed was to continue sinking deep wells. This option was not selected because earlier deep wells were less than 120 meters deep and there was shortage of reliable data about ground water potential (Discharge of wells). The fourth option was the construction of Fenter dam across Fenter city. Thus, the reservoir could be potentially polluted from both solid and liquid waste disposal from the construction of a dam on the Angereb River was chosen as the most feasible option because it required less cost and power compared with the others. Hence, the construction of Angereb dam, across Angereb River within the Angereb watershed to alleviate the portable water deficiency of Gondar city, was approved. Thus, with a total budget of 77 million Ethiopia Birr the construction of the huge Angereb dam that commands a total watershed area 7624 hectares was begun in 1978 E.C to serve about 275000 people of Gondar for at least 20 years. Moreover, the scheme was expected to fulfill the demand of water for enhancing other economic activities of the city including the development of industries. Though planned to be finished within three Years, it was completed in 1986 E.C and was fully operation in 1994 E.C.

Background: The concept of urban fringe refers to the periphery of towns and cities where the process of sprawling is taking place and characteristics of both rural as well as urban co-exist over a period of time. Researchers have used analogical terminologies like Institutional desert, Climax area, a geographical numeral land, an area of growth differentiation heterogeneous region, frontier of discontinuity between city and country, peri-urban, twilight Zone, and area of urbanization in their studies in different area.

Though the urban fringe has assumed an important place in urban studies and planning World Resource Institute (1994) considered urbanization is a phenomenon, which in the past decade has become increasingly intense in developing countries. Henderson (1996) mentioned cities in developing countries. Henderson (1996) mentioned cities are different from one another they are characterized by different functions and from different specializations.

Kailash (1999) considered its geographical location of the urban environment of port Blair seems to be directed by ecological and climatic factors. Capello (2000) raised the real issue is not optimal city size but efficient city size, which depends upon the functional characteristics. Bowman (2000) summarizes new vacant land survey and examines the conditions and causes. Enrich (2000) Analyze the scale and size distribution of US metropolitan areas.

Weaver (2000) studied socio-economic fiscal disparities and urban sprawl uncontrolled land development and leap frogging of USA. Singh (2001) explained rapid urbanization and industrialization impacting adversely on environmental quality. Singh (1999) studied the water quality and quantity using GIS and RS. Singh (2004) studied the ground water depletion and degradation.

Water supply and Distribution

The major sources of water supply in the past used to be Kereberb spring. This was constructed during the Italian occupation. It was the main source of water supply until Angereb Dam is constructed. 15 boreholes constructed at different periods are not presently functioning. Angereb Dam started its full service during 2002, is now the major source of urban water supply. Kereberb spring and other non-function-especially the six reserves bore holes-could boost production capacity of the city however, these sources have not been well rehabilitated and monthly average production is 84 thousand m³. Water production from dam is 5000 m³ to 7000 m³ a day. On average 6400 m³ of water is produced. This shows a net deficit of about 2000 m³ per day (WHO standard). This might be modest on Ethiopian standard. However, erosion from hillside and siltation in the dam will continue there will be water problem in the Gondar city. Further more the present water supply does not provide more water for industrial demand and other uses.

Gondar Population is likely to increase by two fold in the coming decade. Water shortage is likely to be the major problem in near future.

Table 1. Water requirement per person per day in the Gondar city.

| Purpose | Per Person per day (In liters) | Water for total population of Gondar city per day (in liters) |
|-----------------------------------------|-------------------------------------------|--------------------------------------------------------------------------|
| Drinking | 3 | 606000 |
| Cooking | 5 | 1010000 |
| Bathing | 15 | 3030000 |
| Other Purpose | 17 | 3434000 |
| Total | 40 | 8080000 |
| Population of Gondar city 202200 (2004) | | |

Sources: Estimation is based on WHO 2004

Wastage of water: - Water loss is major issue in the Gondar city. 40-percentage water goes wastage from every day production. This is serious problem that requires improving water governance. The most important cause of this problem is old pipes and its poor maintenance.

Water supply is distributed to customers through 7130 connection of which 6420 are private taps in the Gondar City. This implies that (average household size is 6.2 persons) Only 19.7 percent (39804 persons) have access to private tap water facilities. The rest of the population uses public taps and private water vendors. There are 22 public tap points constructed thorough out the city. Another problem is financial problem. Many households do not have the financial capacity to installed private taps. The minimum charge for installation of water tape per house is birr 700 , which are not affordable for poor people.

Cost of water treatment: Cost of water treatment is increasing. Storage capacity is rapidly deteriorating and quality of water is also becoming a serious issue. The cost of water treatment has increased in 2004 due to high silt at Angereb Dam. The depth of Dam has reduced by 1.5m during 2003-2004 and similar problems are expected to occur in 2005 in rainy season. The total depth of the dam at the pump site is nine meter (9m).

The rate of siltation is 1.5m per annum. The dam is likely to stop functioning in less than 10 years.

Water Situation in rural Gondar: Water supply and sanitation services are very poor in rural Gondar. Rural peoples depend on springs, rivers and dug wells as source of water for domestic uses. The current use of water source within the watershed (Angereb Watershed) mediates that 86 percent of the volume of water is from springs while 12 percent and 2 percent are from rivers and dug wells. Respectively, moreover, 87 percent of the sources are not developed and protected. Similarly community members fetch their water from seasonal sources, which account for 13 percent and the rest 87 percent is from perennial sources. Although 87 percent is also from perennial sources, the volume of water they get significantly decreases during dry seasons and the peak shortage is during March to May.

Women and children are responsible for fetching water to their household. The distance of water sources from residences ranges from 75 meter to 1000 meters. That makes the average distance of water sources from residences is 420 meters. People travel on average 2 to 3 times a day to the water sources to fetch water and this makes the average distance they travel to and from water sources is 2500 meters (2.5 Km) and in terms of time it is 1 to 2 hours a day.

The study also indicated that 86.2 percent of fetched water consumed at households is used for drinking and food preparation while only 3.6 percent is used for bathing, cloth washing, which indicates less attention and practice of community member's personal hygiene. However study revealed that 10.2 percent of the total volume of water consumed at household level is shared for backyard irrigation and live stock watering.

Location: - North Gondar is one among the eleven administrative Zones in the Amhara National Region. The city of Gondar; Founded by Emperor Faisledas in 1636 A.D is also the current capital of the Administrative Zone. It was once the capital of Ethiopia for more than 100 years. Gondar city is located 745 Km by road north of Addis Ababa. The main highway connects Addis Ababa with Gondar Via Bahir Dar. It is situated in the foothills of Seimen Mountains at average elevation of 2300 mean sea level .

Sanitations System: The sanitary condition of the city is very low. Defecation and domestic solid waste disposal in any available open field and watercourses are common. More than 51.7 percent of the residents do not have toilet facilities.

Poor water and sanitation management of Gondar city

Rivers have high erosion and sediment load from the upper watershed cultivated lands that seriously affect the quality of incoming water. This implies that there is a high burden to the treatment plant in the rainy season. This has caused the use of high of chemicals during the rainy season, which in turn caused high treatment cost.

The data obtained from Gondar water supply and sewerage service indicated the fact that the use of chemicals during rainy season significantly increases due to high turbidity.

The study indicated that also the average nitrate concentration of the selected sites is 19.6 mg/lit and 34.2 mg/lit in dry and rainy season respectively. It is shown in table that the nitrate concentration of the water bodies of the catchment's is with in the acceptable (WHO and Ethiopia requirement for drinking water).

However, the maximum concentration obtained at the inlet of the reservoir is 30.8mg/lit and above 50 mg/lit in dry and rainy season respectively, while the minimum is 1.32mg/lit and 9.9 mg/lit in dry and rainy season at the out let of the reservoir respectively.

Maximum phosphorous concentration is 2.99 mg/lit at the inlet of the reservoir in rainy season and minimum was 0.03 mg/lit at the upper part of the river in dry season. Where as average concentration of phosphorous at the inlet and outlet of the reservoir is 0.41 mg/lit, into the dry season and 2.4 mg/lit the rainy season.

The average ammonia concentration at the inlet and outlet of the reservoir is 0.043 mg/lit, 0.38 mg/lit in dry and rainy season respectively. It is less than the acceptable (WHO) requirement for drinking water of 2mg/lit.

Water Supply: Water loss is through leakage and unaccounted. The actual measurement of the water loss from the existing system has reached 46.05 percent in 2003. 65 percent populations of the city have accessible of the supply water (Water

supply board, Gondar City). This result has been obtained by comparing production and consumption. The result indicated that the trend of water loss is increasing and it is by far higher than the anticipated design for loss. The main reason for the currently loss is the existing distribution net work does not follow proper pattern. This is as the new master plan of the city. On the other hand, improper connections are usually made. As a result there is high water loss and head or energy loss with in the system.

Even with the assumption that the allowable water loss of 20 percent and average tariff of 2 birr per cubic meter, show that Gondar water supply and Sewerage service on average is losing 787,661 birr annually due to water loss.

The actual average annual water production capacity of the existing system is 1,514,734 m³. But the annual projected average water demand of the city is 3,963,024m³. Difference between the estimated average annual water demand and present water supply capacity is 2,448,290 m³. The service coverage is only 38.2 percent. The figure indicates that the water supply coverage of the city is very low and far from sufficiency which is due to very high leakage problem and low capacity of the existing system. The result reveals that also most of the population are using adequate amount of water from the system, and most of them are also using other unprotected sources that are liable to cause different waterborne diseases (MCG).

Currently Gondar Water supply and sewerage service is responsible for the overall management of the water supply system. The service has limitation of manpower and equipment to handle the system effectively. The Service is operating with a total of 35 employees out of those 12 are technical employees and 23 are support staff. The level of education of the manpower of the water service is not satisfactory to effectively accomplish its mandate. One of the staff has degree four of the staff have college diploma and a limited number of the employees have completed high school. There is no any system that encourages staff by providing training and incentives.

There were different major sources of water supply to the city of Gondar in the past. Of those sources, the first source was koremrem spring. This was constructed during the Italian Invasion and was the main sources of water supply

until Angereb dam is constructed. Besides this, 15 boreholes were constructed at different periods that are not presently functioning. Angereb dam began its full service during 2002, and is now the only and major source of urban water supply. At the dam site the daily production could run from 5000 m³ to 7000 m³ a day.

How ever, the dam is located at a foot hill where silt deposit is a major problem. As unpublished document from water office of the city prevails in 2002/2003 rain season a meter and half (1¹/₂ meter) depth reduction was observed because of silt deposition. Despite these facts the water supply in the town has to be a primary focus to be seen from availability, affordability, and accessibility.

Rainfall of Gondar city is erratic and characterized by fluctuations. Under normal condition it deviates from mean value. The mean annual rainfall in Gondar city is 1025mm in the past 26 years. In these years, rainfall shows no increasing or decreasing trend. However, there were great variations in between years for example the annual rainfall in between 1980-1992 was 977.3mm while in between 1993-2005 was 1073.6mm. For past 26 years the highest rainfall record was in 1980, about 1312.7mm recorded while the lowest rainfall value was observed in 1992 accounted for 719.9mm, which is approximately about half value difference in between the two years. It is on this clear picture of the city that this research is designed to be undertaken.

Table:2- Water Supply in Gondar City

| Year | Supply in m³ | Consumed in m³ | Wastage in m³ |
|-------------------|--------------------------------|----------------------------------|---------------------------------|
| 2000 | 655,182.2 | 587,386.9 | 67,798.3 |
| 2001 | 645,868 | 546,859.7 | 98,908.3 |
| 2002 | 1,244,283 | 735,901 | 508,382 |
| 2003 | 1,634,804 | 1,017,192 | 617,612 |
| 2004 | 1,770,000 | 1,230,516 | 539,484 |
| Percentage | | 69.52 | 30.48 |

Source; Water supply office of Gondar and compiled by the researcher

As it is shown in the table 1, there is an increasing pattern in water supply with in the years 2000 to 2004. Except a minor reduction in year 2001, the supply of water has increased from 655,182.2 m³ in year 2000 to 1,770,000m³ in 2004. This is more than double (2.7times) supply observed with in four years time duration. How ever, the water supply increment pattern declined from 598,415m³ in the year 2002 to 390,521m³ and 135,196m³ in the years 2003 and 2004 respectively.

In spite of the over all increase in supply of water, all supplied amount of water was not properly utilized. For instance, from the total amount of water supplied in year 2000, only 89.65 per cent was used and a significant amount that accounts for 10.35 per cent was not in use. Similarly in the years 2001, 2002, 2003, and 2004, from the total water supply for each year 84.67 percent, 59.14 percent, 62.22 percent, and 69.52 percent of the water respectively was consumed by private, commercial, government, and industrial customers and quite significant amount of water 15.33 percent, 40.86 percent, 37.78 percent, and 30.48 percent for the years 2001, 2002, 2003, and 2004 respectively was calculated wastage.

Considering the year 2004, the average daily water production was 4836.06m³ which is equivalent to 4,836,060 liters per day. However, on an average 1,478,038.36 liters of water was wasted daily.

If we see the five years water production amount, from 5950137.2m³ total production, only 4117855.6m³ water or 69.52 per cent was consumed and the remaining 1832184.6m³ or 30.48 percent of the water was wasted.

Table:3- Number of Households with and with out water supply connection by kebele in Gondar City in 2006.

| Kebeles | Total Number of house holds in kebele | Number of House holds with connection | Number of House holds with no connection |
|--------------|---------------------------------------|---------------------------------------|------------------------------------------|
| 1 | 1163 | 474 | 689 |
| 2 | 812 | 257 | 555 |
| 3 | 1272 | 522 | 750 |
| 4 | 974 | 361 | 613 |
| 5 | 707 | 177 | 530 |
| 6 | 860 | 234 | 626 |
| 7 | 986 | 253 | 733 |
| 8 | 391 | 70 | 321 |
| 9 | 1538 | 527 | 1011 |
| 10 | 1425 | 601 | 824 |
| 11 | 1495 | 383 | 1112 |
| 12 | 806 | 289 | 517 |
| 13 | 795 | 285 | 510 |
| 14 | 1187 | 434 | 753 |
| 15 | 682 | 184 | 498 |
| 16 | 2271 | 688 | 1583 |
| 17 | 702 | 327 | 375 |
| 18 | 3572 | 1279 | 2293 |
| 19 | 2096 | 270 | 1826 |
| 20 | 1831 | 311 | 1520 |
| 21 | 939 | 2 | 937 |
| Total | 26504 | 9207 | 18576 |

Source; Water supply office of Gondar and Gondar municipality office and compiled by the researcher

As indicated in table 2, from the total 26504 house holds of the 21 kebeles of Gondar city, 9207 or 34.74 per cent of the total house holds are connected with water supply and the largest majority 18,576 or 65.26 per cent of the house holds are with no water supply connection. Kebele wise of all kebeles, kebele 17 has the largest 46.58 per cent house holds with water supply connection followed by kebele 10, 3, and 1 with 42.17, 41.04, and 40.78 percent respectively.

On the contrary, of all kebeles the least percentage of households with water supply connection of 0.2 percent followed by 12.88, 16.98, and 17.9 percent was observed in kebeles 21, 19, 20, and 8 respectively. This means 99.8 percent,

87.12 percent, 83.02 percent, and 82.1 percent of the house holds are with no water supply connection in those kebeles.

Table:4- Households without supply water Connection

| Monthly Income(In Birr) | Kebele 05 | % | Kebele-08 | % | Kebele-11 | % | Kebele-19 | % | Kebele-20 | % | Kebele-21 | % |
|-------------------------|-----------|----|-----------|----|-----------|----|-----------|----|-----------|----|-----------|----|
| Upto100 | 03 | 6 | 03 | 06 | 04 | 08 | 04 | 08 | 09 | 18 | 05 | 10 |
| 100-200 | 08 | 16 | 13 | 26 | 10 | 20 | 12 | 24 | 12 | 24 | 14 | 28 |
| 200-300 | 23 | 46 | 20 | 40 | 24 | 48 | 21 | 42 | 21 | 42 | 22 | 44 |
| 300-400 | 09 | 18 | 10 | 20 | 06 | 12 | 09 | 18 | 05 | 10 | 06 | 12 |
| Upto-500 | 07 | 14 | 04 | 08 | 06 | 12 | 04 | 08 | 03 | 06 | 03 | 06 |
| Total | 50 | | 50 | | 50 | | 50 | | 50 | | 50 | |

Source: Primary survey

Kebeles with least percentage of house holds with no water supply connection were further surveyed to answer why they are not connected. Accordingly, the house holds monthly income was assessed from 300 households of kebeles, 05, 08, 11, 19, 20, and 21. As field survey results reveal, from 300 total households surveyed with no water supply connection, 50 households from each kebele, 28(9.3%) were found with monthly income less than hundred birr, 69(23%) were found with monthly income between 100 and 200 birr, 131households(43.6%) were found with monthly income between 200-300 birr, 45households(15%) with monthly income of 300-400, and 27 households(9%)were found with monthly income of up to 500 birr.

Water is supplied to the whole private and governmental customers of the city through 7130 tap line connections, of which 6420 are private taps and the remaining 710 are governmental offices' taps, and 22 public tap points constructed through out the city (Gondar water supply office). This implies that (average house hold size of 6.2 persons) only 19.7 percent or 39804 persons from the total 201958 population size of the city have access to private tap water facilities. The rest of the population use small number of public tap points and private water vendors. This makes access is affordability issue.

Table:5- Water Supply Available in Gondar City by Kebele

| Kebeles | Population | Consumption/ day in m³ | Litters/ person/ day |
|----------------|-------------------|----------------------------------------------|---------------------------------|
| 1 | 9426 | 101.00 | 10.72 |
| 2 | 6005 | 53.80 | 8.96 |
| 3 | 10563 | 106.00 | 10.04 |
| 4 | 8484 | 79.00 | 9.32 |
| 5 | 5828 | 38.60 | 6.62 |
| 6 | 7960 | 59.70 | 7.50 |
| 7 | 8878 | 75.33 | 8.49 |
| 8 | 3305 | 30.90 | 9.35 |
| 9 | 17372 | 146.83 | 8.45 |
| 10 | 12999 | 95.30 | 7.33 |
| 11 | 11576 | 94.30 | 8.15 |
| 12 | 7008 | 62.90 | 8.98 |
| 13 | 5996 | 71.13 | 11.86 |
| 14 | 8514 | 99.26 | 8.57 |
| 15 | 5855 | 34.87 | 5.95 |
| 16 | 11383 | 186.27 | 16.36 |
| 17 | 6004 | 95.56 | 15.91 |
| 18 | 17165 | 316.97 | 18.47 |
| 19 | 16505 | 100.87 | 6.11 |
| 20 | 14372 | 112.50 | 7.83 |
| 21 | 6760 | 3.43 | 0.51 |
| Total | 201959 | 1964.52 | 9.73 |

Source; Water supply office of Gondar and Gondar municipality office and compiled by the researcher

As it is clearly depicted in table 4, excluding commercial, governmental, and Industrial water consumptions, 1964.52m³water is consumed daily by private consumers. The total population of the city of Gondar is 201,959 in all the twenty one kebeles. On average 9.73 liters of water is consumed per person per day.

Besides this, the amount of water consumption per person per day is not uniform among all kebeles. The largest water consumption, 18.47 liters per person per day, is calculated for kebele 18 followed by 16.36, 15.91, 11.86, 10.72, and 10.04 liters per person per day for kebele 16, 17, 13, 1, and 3 respectively. The least water consumption that is 0.57 liters per person per day is observed in kebele 21

followed by 5.95, 6.11, 6.62 liters per person per day in kebele 15, 19, and 5 respectively.

Negative Impacts of the Angereb Reservoir

The environmental impact assessment has been conducted by Municipal Corporation of Gondar city revealed the following major negative impacts of the reservoir are prevalent;

Impact on Impediment to movement

There was footpath that connected the upper stream villagers (Defeha and Dib Abo) to Gondar city before the dam was constructed. Currently, the dam and its buffer caused obstacle for pedestrian/ Livestock free movement, which in turn is causing accident both human beings and livestock.

Impact on Public Health

Experiences show that new health problems may arise due to the construction of huge dams like that of the Angereb dam. Factors that cause these problems include change in the water velocities, temperature and of other physical qualities of water, in this situation the water in the dam stay stagnant for a long period and the inundated area will be ideal site for breeding of disease hosts and their vectors. This turn causes drastic change of the local environment to the residents of the area.

Water Borne Diseases: - Water borne diseases has been identified due to inadequate access to potable water supply. Good quality of water is also not access to the households. Water gets polluted in transportation and lack of adequate hygienic practices in household, which are quite evident at household level.

Table:6- Prevalence of water borne and related diseases in Gondar city.

| Diseases | No. Of cases | % |
|-----------------------------|---------------------|----------|
| Malaria | 42170 | 62.62 |
| Helmenthiasis | 5720 | 8.50 |
| Diarrhea | 5676 | 8.43 |
| Intestinal Parasites | 4524 | 6.72 |
| Skin Diseases | 3571 | 5.30 |
| Eye Infection | 3247 | 4.82 |
| Amoebiasis | 1213 | 1.80 |
| Ascariasis | 1126 | 1.67 |
| Schistosomiasis | 154 | 0.08 |
| Ancylostomiasis | 41 | 0.06 |
| Total | 67342 | 100 |

Source Gondar city Administration- Nov 2004

The major water borne diseases are prevalent in the two woredas (district) include malaria, helmenthiasis, diarrhea, intestinal parasites skin and eye diseases amoebiasis, ascariasis and typhoid. In general the water borne and related diseases are accountable for 83 percent of the first ten prevalent diseases and more than 80 percent of the total infections moreover, the proportion of diseases directly associated with lack of clean and adequate potable water supply is about 29 percent of the total type of diseases and 64 percent of the water borne and water related diseases.

In addition, the assessments show that the environmental and sanitation condition of the city is growing worse. This condition is further aggravated by lack of proper functioning waste disposal system. This also has been identified as potential breeding site of disease vectors.

Moreover, the assessment indicated that no major threat of malaria has been observed within the watershed. Besides, known hosts like Schistosomiasis have never been observed in the project site.

Down Stream Effects: The farmers in “ Addisge Got” found immediate down stream of the dam used to access water from the Angereb River for different purpose (traditional` irrigation, bathing, washing clothes and livestock watering) . Currently these farmers are not getting this benefit because the dam abstracted the whole flow of the river.

Other Negative Impacts Observed in the Watershed

Clay soil mining: The clay extraction site which is located at kerebereg Madhanalem (at the left side of Korebereg River) Exposed the soil to both water and wind erosion. This may aggravate sediment flow to the dam. This deteriorates water quality and threatens the life of the dam. Moreover, the mining site also exposes residents to high risk of drowning.

Pollution/Contamination: One of the factors favoring the contamination of the reservoir site is related to the deterioration of hygienic practices of the residents of the watershed. Major causes of contamination on water sources are human and animal community dumps in the flow of the river, bathing, washing and cleaning on tributaries of Agngereb River.

The people are accustomed with open field defecation. Some of population directly defecate, bath and wash their clothes nearby and along courses. The observation made during the field work revealed that from the city and villages all sort of domestic garbage like plant fragments, animal bones, all sort of plastic bags, syringes, bottles and other refuse materials of both organic and inorganic origin have been easily washed and deposited in the reservoir.

Animal wastes, if not properly controlled, sometimes pose a serious public health threat. Over hundred types of animas disease can be transmitted to man via anima wasters. Studies indicate that also one cow produce pollution equivalent to that of 117 human’s hence, the current population of livestock with in the watershed poses potential risk of pollution.

Culture and Water:

Cleaning is not in culture. Urban people take shower weekly and rural people monthly. People from rural area buy cloth and use without cleaning till life of cloth. People do not drink water regularly. They drink soft drink, beer, wine or Tala (house hold prepared wine).

Conclusion: The number of population in the town is increasing due to both natural increase and rural urban migration. However, the amount of water supply does not commensurate with this increment in population. Having this deficit in supply, another tragedy is water wastage.

The most recent and the largest water supply in the town which is 4,836,060 liters in 2004 is almost half of the amount of water required for home consumption (8078360 liters) by the town population as set by WHO.

As it was indicated in the presentation and data analysis, if the produced amount was used properly with no wastage, 1,832,187.6m³ water could have been saved. This intern means the amount of water (5,019,692.05 liters per day) that one more year would have been supplied. This amount has a significant daily supply difference of 183,632.05 liters which is still highest compared with the highest daily supply of 4,836,060 liters in the year 2004.

As table three showed vividly, the income level of most of the house holds in the town is low and are not in a position to get connected with potable water supply. This is so because their income is not more than their subsistence life (daily bread and fees for other services) and the charge to get connected is about 700 (seven hundred) Ethiopian birr which is not affordable by the largest majority of the house holds in such low economic status.

Since the water source for the city is Angereb Dam, there is a considerable water supply variation from one season to another. During rainy season (June, July, and August) the water supply is better than the dry season (December, January and February) when there is a significant reduction in water discharge to the dam.

On average people clean their body and cloth weekly in the city but monthly in the rural areas due to the scarcity of water. The life expectancy is 47 years in Ethiopia.

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One birr : 8.65 USD

EC: Ethiopian Calendar (Seven year behind the International Calendar)