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SANITATION AND WATER FOR ALL

Groundwater for rural water supply in the Rift Valley

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GROUNDWATER POTENTIAL IN Ethiopia is estimated at approximately 1.6 million cubic meters. Quite a small portion of this resource is presently developed in the rural areas, the limitation being prohibitively high initial development cost. Already developed groundwater sources are used primarily for drinking water supply. It offers access to safe water for approximately 40-80 per cent of the water supply provided to the urban population, and it is the largest fresh water source in the country. Despite the high initial cost, groundwater is increasingly becoming an important source of drinking water supply in Ethiopia.

The drought in 1984/85 in Ethiopia inflicted heavy losses both in human and livestock population. In response to this drought, Catholic Relief Services (CRS) and Lay Voluntary International Association (LVIA) jointly drilled and equipped a total of 50 wells between 1986 and 1997 in the rift valley areas. This paper presents a preliminary assessment of the hydrology, water quality and the usefulness of these wells.

The study area.

The Rift Valley Area in Ethiopia is a long and narrow strip of low lying plainland[1] in between the highlands. It stretches from the north eastern part of the country to the southern border with Kenya, and divides the highland masses into two, the Central and Eastern Highlands of Ethiopia. It is part of the great rift valley of East Africa. In the north eastern part, there is Dallol Depression, an area with altitude below sea level, and it is one of the hottest places in the world. The altitude of the central and southern rift valley areas range between 1550 and 1750 m.a.s.l, and supports active pastoral and settled agricultural systems.

Geography and climate

The study area is located between Meki and Shashemene, approximately 135km and 250kms south of Addis Ababa, respectively, and within a distance of 10 and 15kms along both sides of the main road. It lies between Latitude 7° 30 and 8° 15 N, and at approximately 38° and 39° E Longitude. The total area is estimated approximately 700 to 900 km^2. The altitude of the area ranges between 1650 and 1700m.

The area has a flat topography gently sloping towards the south. The climate is semi arid with annual rainfall between 600 and 800mm. The annual maximum and minimum temperatures range between 30° and 10°C, respectively. The annual potential evapotranspiration for Zewai and Langano were reported as 2170 and 2175 mm, respectively (Tesfaye, 1982).

The area is frequently affected by cyclic droughts of different nature and intensity. The droughts are of three types; (i) Meteorological drought, a situation when the actual rainfall is significantly less than the climatologically expected rainfall; (ii) hydrological drought, associated with the depletion of surface water, consequently reduces the level of surface water sources; lakes, rivers and reservoirs/ ponds, drop in groundwater level, etc. The hydrological drought results when meteorological drought is sufficiently prolonged; and (iii) agricultural drought occur when soil moisture is inadequate to support a healthy growth of crops to maturity. The three types of droughts are common not only in the rift valley areas but in many parts of Ethiopia.

Socio economic profile

The total population of the study area is estimated at about 73,786 (15 per cent of the total population) distributed in three districts, Meki (49 per cent), Zewai (39 per cent) and Shashemene. The people of the area are predominantly Oromo, other minority groups such as Gurages, Amharas, etc. are also living in the area. Agricultural activities, mainly crop and livestock production, are the mainstay of the household economy and a primary source of income although the people are largely subsistence farmers.

With the rapidly increasing population, one natural resource base of the area declines sharply and it is becoming increasingly marginalized. Paradoxically it is also carrying a large livestock population which is also a prime source of cash income and a vital economic asset to the people.

The per capita income is expected to be not more than the national average, US $ 110 (World Bank, 1995). The people are severely affected by extreme poverty. The major sources of water are ponds (which are close to villages), rivers and lakes.

Access to potable water in the rural areas is expected to be one of the lowest in the country, the national average being 19 per cent (FDRE, 1995). Health indicators in the study area show that infant mortality in the area is 131/ 1000, one of the highest in the world, life expectancy is around 46 years, and an estimated 40 per cent of the children suffer from malnutrition (CRS, 1990).

Hydrogeology of the area

Many of the wells investigated in this study lack detailed hydrogeological information prior to their drilling since they were drilled as an emergency response to the 1984/85 drought. However, the description of the log samples taken during the drilling operations showed that the surface profile consists of fine clay to fine sand for a depth of approximately 20 metres followed by alternate clay, sand and a mixture of gravel formations as the depth increases downward up to 115 metres. The colour varies widely from red and dark brown at the surface to light brown and grey at lower depths. Most of the wells are deep wells. The wells with shallow depths are variable in yield generally believed to be of low to high potential.

According to Tesfaye (1982), the geology of the large part of the rift valley areas is characterized by Lacustrine Sediments and Volcano-Sedimentary Rocks. Locustrine Sediments are the most common one within the rift valley. They form the second largest next to ignimbrites. The geological formation in the upper soil profile has good primary and secondary porosity and permeability characteristics which enable continuous recharge to the groundwater.

There are several perennial streams originating from the highlands in both sides of the rift valley and inter the lakes (Langano, Zewai, Shalla) which occupy the low-lying middle areas of the rift valley. The depth to groundwater generally varies within the depth of less than 120 meters, and lesser elevation towards the lakes.

Assessment of the groundwater

A total of 50 boreholes were investigated for their hydrology, water quality and their services to the community. The following assumptions were considered in investigating the boreholes: (i) the aquifers are unconfined and are not fully penetrated; (ii) no drawdown interference; and (iii) the geologic formation is heterogeneous.

Hydrology

Available hydrological data of these wells includes depth of well, depth to static water level (SWL), water yield and chemical analysis of water samples. The depth of the wells ranges between 45 and 199 metres, and depth to the SWL vary significantly between 25 and 96 metres, and showed high coefficient of variation. While the wells yield ranged between 0.463 and 3.3 litres per second, again a very high variation except the yield of the 5 wells constructed between 1996 to 1998. While in the study of Tesfaye (1982), the estimated yield of boreholes drilled by the government in the same area were reported to range between 0.03 and 5.8 lt/sec. The reason for such high variation in the well yield could be attributed to the following:

- the variation in the geological formation; and
- poorly conducted pump tests.

Most of the well yield reported between 1989 and 1994 by LVIA were presumed to have been based on the discharge of the wind powered pumps which have variable discharges for different depths, and limited capacity for depths more than 80 meters. The pump tests for the last five wells were taken on the basis of readings at dynamic head, and the water yields were in the range between 1.5 and 3.3 lt/sec.

Table 1. Water quality of selected BHs

Groundwater quality

The quality of the groundwater generally depends on the chemical and biological content of the soluble substances as the water percolate though the vadose zone. As a result the content of chemicals and generally the quality of the groundwater varies quite significantly. Table 1 shows chemical analysis of well water samples taken from selected boreholes (BHs) in the study area. The total dissolved solids (TDS) ranged between 160 and 2170 ppm, and the fluoride content were in the range of 0.8 and 24.5 mg/lt. The recommended maximum values[2] are less than 500 and 1.7 ppm, respectively, and the mandatory limits for rejection was 1000 and 3.4 ppm, respectively. Two to three boreholes in ten (mostly deep ones) are with higher fluoride content. The temperature of the water for some boreholes at the time of drilling were reported warm to hot although this characteristic gradually disappears. Other chemicals such as Na, CO3 and Cl vary without any meaningful pattern and ranged between 14 and 450, 0 and 549, and 0.02 and 284, respectively. Some of the wells were rejected (unfit for human consumption) because of high chemical content and particularly for their high fluoride, although the water color and odour were at acceptable standard. Children using these water sources suffered teeth damage (Tesfaye, 1982).

Sustainability

Developing a well for drinking water supply is generally less expensive compared to other (surface) water sources. In Ethiopia, using CRS rigs and duty free imported casings, the cost of drilling water wells and capping only was estimated in the range between US $ 3140 and $ 4831 (the official rate between 1986 and 1990 was US $ 1 = Birr 2.07). Today the cost of drilling and casing a well by private drilling agencies is in the range between US $ 14,300 and

Figure 1. Location of the study area and distribution of BHs

$ 22,850. Most of these wells were equipped with wind powered lifting device (windmill), a ferrocement water storage facility and a distribution stand. Except the wind mill, other devices are simple and maintainable locally. The technology used is sturdy and simple to use once it is constructed and put in place. Local technicians are trained to provide maintenance services. The time recorded for a major break down by this device is in the range of 10 and 16 years, and the service cost is generally low and inexpensive.

The average users per well were estimated to vary between 200 and 250 households, and serves 3 to 5 villages. Communities are organized in village water committees, assigning water caretakers and fee collectors, and these members ensure that there is adequate service to the community.

Discussion and conclusion

Potable water supply is a high priority need, and groundwater is an appropriate source of drinking water supply (reliable, clean and safe) for rural areas not only in the rift valley areas but in many parts of Ethiopia. However, the geology and hydrology of groundwater in the rift valley is highly variable. Water table depths varies widely implying a highly variable geological formation; varying aquifer structure and geometry. The variation of the depth of the wells indicates the variation in the aquifer formation and depths, although most wells were not penetrating the full water bearing formations. It is, therefore, difficult to determine the potential of the aquifers.

The well yield was estimated based on the pumps used, but not based on properly conducted pump tests. That is why the low yields and high variation were reported. An average yield in the range between 1.5 and 3.3 litres per second is expected. The services obtained from these wells between 1986 and 1989 had been very impressive, saved the lives of many people, and effectively mitigated the effects of drought.

The problem with this source of water supply is the high initial cost which is at the moment beyond the reach of the rural community. The quality of the water is also another concern that requires special attention. High fluoride level is a common water-quality problem in the area. At times wells with high fluoride content are not even considered for irrigation purposes because of the fear of being used for drinking purposes. However, groundwater is an appropriate source of drinking water in most of the study area.

Reference

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1 Average width is 70-80 m (Tesfaye,1982)

2 US Public Health Service 1962 Drinking Water Standards

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