Boreholes as a solution to water problems in Central Tanzania

WEDC 11th Conference: Water and sanitation in Africa: Dar es Salaam 1985

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ABSTRACT
This paper first establishes the potential for groundwater in Central Tanzania based on climate and geology. It then identifies the water problems in these areas. A mention is made of other possible solutions to water problems mainly dams and shallow wells. These being unsuccessful, an emphasis is placed on boreholes as the only viable and logical solution to water problems in Central Tanzania.

INTRODUCTION

Central Tanzania which covers Dodoma, Singida and parts of Tabora and Shinyanga regions is prone to water problems mainly due to low rainfall. The low runoff produces sandy ephemeral streams. The geology is made up mainly of syn-orogenio and migmatitic granites. The weathered and fractured zones of these rocks are potential for groundwater.

Water problems are well known and different solutions namely dams and shallow wells have been tried. These have not been successful. With growing population, emphasis on irrigation and industrial expansion, the demand for water keeps on increasing. The viable and logical solution to water problems in Central Tanzania is boreholes.

The initial costs which include drilling and submersible pump installation are very high. However, the maintenance costs especially where the energy source is cheap are low compared to other means. Looking at the experience and success of China where boreholes are a common site in rural areas, Central Tanzania can be made very productive if boreholes are given the emphasis and importance that they deserve.

GENERAL

Location

Central Tanzania is located between latitudes 4° S and 7° S and longitudes 32° E and 36° E (Fig. 1). It is an old plateau standing at an elevation varying between 2000 and 4000 ft above mean sea level (1).

Population

Central Tanzania has a total population of 5 m.people (2). Together with Mwanza region, this area has the highest concentration of livestock in the country; approximately 10 million. Most of the area can be transformed into very productive land if water for irrigation is made available and about 40 m. acres can be developed. With no policy on land, water and vegetation conservation coupled with the explosive population growth, Central Tanzania is slowly becoming wasteland.

Climate

Central Tanzania is semi-arid. The average annual rainfall is about 30 in. ranging between 20 and 40 in. (2). Within this range, the rainfall is very variable. The average temperature is over 70° F giving a potential evapotranspiration value of about 59 in. per year for Dodoma region (3).

Geology

Central Tanzania is part of the African shield made up of some of the oldest basement rocks which are up to 2.7 billion years (4). The Dodoman system found in the area is made up of schists, gneisses, quartzites, amphibolite and hornblende gneisses, acid gneisses and migmatites (Fig. 1).

Igneous rocks occupying most of the area are synorogenic granites of varying compositions and ages but mainly Archaean. Intrusive rocks are dolerite and pegmatite dikes and quartz veins.

Due to the semi-arid nature of the area, extremes of temperature, exceeding 30° F daily, produce a mechanism by which the granites undergo a very characteristic kind of weathering through jointing (1). This kind of weathering is partly responsible for the groundwater potential in the area.

Potential for Groundwater

Many boreholes have been drilled in Tanzania and the total figure is about 3700 boreholes. About half this number, 46% was drilled in the semi-arid areas alone (Table 1). This is because of the absence of permanent rivers as a result of little rainfall producing very low runoff; less than 10% of the rainfall for Dodoma (3). Most of Central Tanzania is covered with sandy soils whose infiltration capacities are high. This and the fact that most of the streams have beds of coarse sand, recharge to the groundwater reservoir is quite substantial. For Dodoma region, recharge occurs whenever the annual rainfall exceeds 16 inches (3).

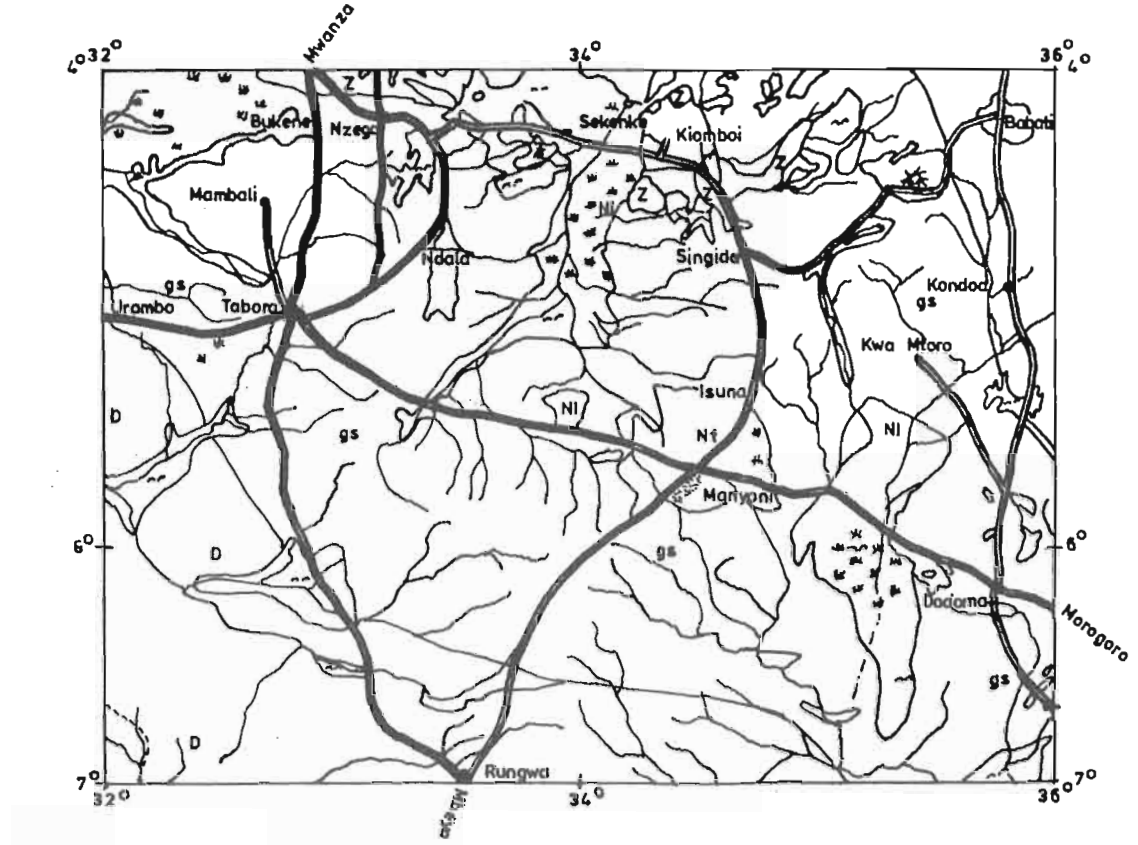

Fig. 1. Geological Map of Central Tanzania

Three zones are very potential for groundwater in granitic areas. These are (i) Old river channel, (ii) weathered zones and (iii) fractured zones produced due to expansion and contraction of rocks creating cracks and fissures which later expand and open up to large fractures (5). Others are produced due to faulting or other tectonic movements. Most boreholes yield their water from fractures as observed on borehole 119/75 in Dodoma (Table 1). Water derived from fractures is of very good quality.

The contacts between dolerite and pegmatite dikes and quartz veins with the country rock are other areas potential for groundwater.

WATER PROBLEMS

The problems to water are related to its use. Problems due to domestic use stem from the increasing human and livestock population.

The current annual population growth rate in Tanzania is about 3%. Therefore, there is a growing demand for drinking water all over the country.

Industries for food processing and building materials are mushrooming in Central Tanzania. Since these require much water, they put an extra stress on an already overstrained supply system.

The demand for water for irrigation purposes is to increase as a result of the new impetus now being placed on growing food crops. The drought that has adversely affected the production of food in these areas, has prompted new ways and means of agriculture to be sought.

REGION	Total No. of Bhs.	GRANITES Ave. Yield x 1000 gph	GRANITES Ave. Quality TDS, ppm	GNEISSES Ave. Yield x 1000 gph	GNEISSES Ave. Quality TDS, ppm	SCHISTS & PHYLLITES Ave. Yield x 1000 gph	SCHISTS & PHYLLITES Ave. Quality TDS, ppm	QUARTZITES Ave. Yield x 1000 gph	QUARTZITES Ave. Quality TDS, ppm	DOLERITE DIKES Ave. Yield x 1000 gph	DOLERITE DIKES Ave. Quality TDS, ppm
Arusha	191	4.3	-	1.4	1637	-	-	-	-	-	-
Coast	173	-	-	-	-	-	-	-	-	-	-
Dsm	90	-	-	-	-	-	-	-	-	-	-
Dodoma	742	3.3	978	2.5	648.8	-	-	1.8	916	1.2	850.9
Iringa	84	2.0	ND	ND	ND	-	-	-	-	-	-
Kagera	125	1.0	585	-	-	1.2	204.75	1.5	202	-	-
Kigoma	67	3.7	165	0.1	ND	-	-	0.5	ND	-	-
K'njaro	129	2.9	ND	1.5	769	-	-	-	-	-	-
Lindi	166	1.5	ND	1.0	ND	-	-	-	-	-	-
Mara	121	1.0	552.5	-	-	-	-	3.4	288.35	1.7	807.5
Morogoro	160	0.9	ND	1.1	1365	-	-	-	-	-	-
Mtwara	149	1.0	-	1.0	ND	-	-	-	-	-	-
Mwanza	179	1.3	490.9	-	-	-	-	-	-	1.4	ND
Rukwa	102	0.8	ND	0.7	ND	-	-	-	-	-	-
Ruvuma	27	-	-	0.9	518.3	-	-	-	-	-	-
Shinyanga	110	0.8	804	-	-	-	-	0.2	-	-	-
Singida	480	1.5	727	-	-	1.1	920	-	734	-	661
Mbeya	89	1.5	ND	0.6	ND	0.6	220	-	-	-	-
Tabora	192	0.9	898.52	-	-	0.5	618	1.5	655	-	-
Tanga	271	1.0	355.2	2.3	1831	-	-	-	-	-	-

ND = No Data TDS = Total dissolved solids ppm = Parts per million

Data on Bh 119/75 - Dodoma

Depth (ft)	SWL (ft)	Water strike (ft)	Yield (gph)	Drawdown (ft)	Aquifer	Quality TDS (ppm)
398.7	94	125	80,000	13	Weathered and fractured granite	1015

SOLUTION

The problems of water in Central Tanzania have been known for a long time and different solutions tried. Many dams have been built in the area to store water during the rainy season to be used during the dry season. Dams have not been very successful because of problems of siltation, low runoff resulting in empty or partially filled structures, high evaporation losses, and leakages due to loose foundations. Surface water requires complex treatment procedures before the water can be used for drinking.

Another very recent solution has been shallow wells. These have been tried in Shinyanga region with little success and there are ongoing extensive programmes in Mwanza, Morogoro, Mtwara and Lindi regions. Shallow wells are unsuitable in arid areas because of the great depths to the water table except in a few river alluvials where the depth might be shallow. Even then, the supply is unreliable, scanty and very localized. Shallow wells cannot serve large populations or irrigate large areas.

The only viable and logical solution therefore is boreholes. As mentioned above, Central Tanzania has potential for groundwater and already there exists an extensive network of boreholes from which a hydrogeological map can be prepared. This, together with other methods currently in use, can be used to locate other potential sites suitable for borehole drilling.

The best way to utilize the boreholes is by use of electric motor submersible pumps especially if cheap electricity is available. The Tanzania Electric Supply Company (TANESCO) can solve the energy problem by providing hydroelectric power through their expanding grid. Besides the TANESCO grid, small scale hydroelectric power stations could be set up on dams built across some of the rivers like the Bubu in Dodoma region to cater for small communities or small to medium scale farms. The Chinese have been very successful in this. The resilience of the submersible pumps far surpasses that of diesel, wind or solar pumps. Submersible pumps do not need regular maintenance like the other pumps. Although they cost more T Shs.150,000 (£7143 at T Shs. 21 to £1), after installation they are almost maintenance free.

Borehole water if not saline is usually of very good quality requiring no treatment at all. Aquifers being extensive formations assure a reliable, safe and sustained water supply for a long time unlike surface water which is adversely affected by drought and surface pollution.

CONCLUSION

Three things have to be done before the borehole solution can show any positive results in Central Tanzania. First, water has to be accorded highest priority in National Planning. Adequate funds have to be made available for the high surveys and drilling costs.

Second, a campaign has to be launched to educate the people on the value and importance of the expensive service being extended to them by the Government. Bylaws where necessary should be instituted to discourage vandalism and other kinds of irresponsibilities.

The third which goes with the second is the setting up of a National Policy on water, land and vegetation conservation. Once established, people have to be made to understand its objectives and a monitoring system worked out.

Once such a basis has been established, there is no reason why the borehole solution should not work in Central Tanzania or any other similar place.

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