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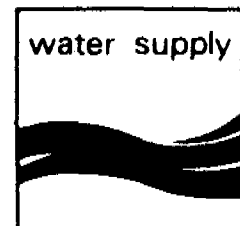
NATIONAL SHALLOW WELLS PROGRAMME

CHAPTER TWO

POSSIBILITIES FOR SHALLOW WELLS IN TANZANIA

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2. POSSIBILITIES FOR SHALLOW WELLS IN TANZANIA

2.1. Introduction

This chapter seeks to give an impression of the numbers of shallow wells that can be constructed in Tanzania. The information on which the estimates are based was obtained from three types of sources:

- a. from on-going shallow wells (implementation) projects
- b. from water master plans
- c. from personal communication with people that are active in the water supply field in the various regions

Needless to say, the first type of sources is generally the most reliable, since the information given is based on actual field experience, obtained during a project that focuses on the construction of wells.

The second group sometimes yields less reliable results. Two main reasons for this can be identified:

- the option of having (shallow) wells as a rural water supply source may have been given little attention or may not have been considered at all during the preparation of the master plan
- even if (shallow) well construction has been part of the master plan studies, results may turn out to be less representative because:
 - a. The survey methods used render it impossible to detect shallow aquifers. This has happened where Schramm rigs were used for exploratory drilling: the temporary casing used in the upper part of the borehole effectively closed off any shallow aquifer
 - b. Shallow groundwater may occur (and it often does) in a patchy pattern. Without specialized, experienced hydrogeological staff, and with the constraints in terms of available time and money as experienced with hydrogeological investigations during a water master plan phase, it may be difficult to obtain a representative impression of the shallow groundwater potential during such a phase. Experience of the shallow wells (implementation) projects appears to indicate that in practice the possibility of constructing shallow wells is better than assumed in the master plans.

Personal communication, finally, may yield additional information, but its effectivity in cases where neither shallow wells projects nor water master plan studies are carried out will, of course, be limited.

In the next paragraphs summaries will be given of the shallow wells potential per Region, in alphabetical order. Information given, was obtained in the period mid-1980 to mid-1981. Partly because of this extended period of information gathering, but also because not all master plan reports proved to be accessible, the information given sometimes is of a tentative nature, and adjustments may prove to be necessary.

2.2. Arusha Region

There is no water master plan for Arusha, nor is it being prepared. USAID is assisting in carrying out the "Arusha Planning and Village Development Project", which has a rural water supply component, and covers 3 of Arusha's 6 Districts, with approx. 70% of the total population. Two survey and two construction teams were reported to have become operational at the end of 1980.

Partly because of the large number of existing piped supplies, the population that can (still) be served by shallow wells was estimated at 15% of the total rural population only.

2.3. Coast Region

and

2.4. Dar-es-Salaam (rural) Region

Conflicting information is available on the shallow groundwater potential in these two regions.

The Investigation Report by CBA Engineering Ltd. (Vancouver), of February 1978 states that "one zone, comprising the river deposits of the Wami, Ruvu and Rufiji rivers has a good potential for groundwater", whereas "in the rest of the project area the shallow groundwater has a low yield which may become negligible in the dry season".

The actual master plan report, of February 1979, however, states that from the 355 settlements in the project area:

74% use groundwater from shallow pits/shallow wells

24% use surface water

2% use boreholes

It continues "the most appropriate method of using groundwater sources in the Project Area is by constructing shallow, large-diameter wells in recent alluvial deposits associated with the major rivers and intermittent streams. Shallow wells located in the smaller alluvial deposits associated with ephemeral streams could be used for village water supplies, but the occurrence of drought periods makes the reliability of these shallow groundwater sources uncertain".

Nevertheless in its breakdown of water sources to be used in the future, the same report gives the following summary:

- a. Ruvu pipelines : 21% of design population (62 settlements)
- b. Groundwater sources : 25% of design population
8 settlements to be supplied by boreholes
100 settlements to be supplied by large-diameter wells
- c. Surface water sources : 49% of design population
(127 settlements)
- d. Rainwater catchment tanks: 2% of design population

For the 100 settlements to be supplied by large-diameter wells the present population (1978) was quoted as 128,556 people. (The 74% of the population that appear to actually use shallow groundwater at present amount to 452,160 people < 1978 >).

2.5. Dodoma Region

No water master plan reports on Dodoma Region are available. In personal communication with representatives of the Regional Water Engineer it was mentioned that an estimated 25-50% of the rural population could be supplied with shallow wells. During the actual water master plan study investigations had never centered on shallow wells, however, and this option was given consideration only later. RWE staff has received a training in shallow well survey and construction in Morogoro, and shallow wells are being constructed in the Region.

2.6. Iringa Region

A water master plan is presently under preparation. So far the hydrogeological findings appear to indicate that relatively few areas in Iringa Region are suitable for shallow wells. Nevertheless it is the stated policy of the Danida Steering Unit for Water Project to have shallow wells constructed wherever possible. Construction units for shallow wells will be formed in the 3 Regions covered by this donor organization: Iringa, Mbeya and Ruvuma Regions. Construction targets for the financial year 1981/82 are 50 wells per Region.

2.7. Kigoma Region

There is no water master plan for the Region, nor is there any information on the feasibility of shallow wells.

2.8. Kilimanjaro Region

The final report on the water master plan for Kilimanjaro Region is dated December 1977.

Since the option of constructing shallow wells is hardly mentioned in the report, it is not clear whether there are hardly any possibilities for shallow wells or that the option simply has not been investigated by itself and that all attention has been focused on the supply of surface water, as the predominant water source.

The impression is given that the latter is indeed the case and that the availability of groundwater has been investigated only in those cases where no suitable surface water is available. Furthermore, boreholes appear to have been considered as the principal means of groundwater abstraction.

In only one case shallow wells are mentioned: "There are only limited numbers of shallow wells in the region. A few shallow wells are found in the Kahe Basin and Sanya Juu areas.

In the Kaha Basin it is possible to make use of shallow wells; however, protection of water from contamination is necessary. The main reasons for shallow well contamination are collapse of the earthen wall and inflow of wasted water. But both of them can be prevented by making use of concrete rings.

In this area, it is recommended to use shallow wells for domestic supply where the size of the population is small (less than 1,000 persons) and there are no boreholes for irrigation. In this case protection of wells against flood is necessary.

In Sanya Juu, shallow groundwater is available in a patchy area; however, fluctuation of the water level is great so that the yield of the shallow wells is not so reliable as that of the Kahe Basin. Water quality has to be carefully examined in this area since fluoride contamination is found in many cases".

A more quantitative indication of the possibilities for shallow wells is not given, however.

2.9. Lindi Region

A "Rural Water Supply Construction Project in Mtwara and Lindi Regions" is carried out by Finnwater. In its phase I (January 1978-March 1980) a total of 556 shallow wells have been constructed, 40% of which are located in Lindi Region. Three types of shallow wells have been made: ring wells (476), machine auger wells (50) and hand-dug wells (39). For phase II, which is currently under way, a total production rate of 300 shallow wells per year is foreseen. It is expected that at least 50 percent of the rural population of Lindi Region can be supplied through shallow wells.

2.10. Mara Region

A "Water Master Plan for the Mara, Mwanza and West Lake Regions" has been prepared by Brokonsult. It reports that 337 villages were surveyed in Mara Region, most of which use some kind of surface water, with slightly more than 10% using wells as water source.

A study of the shallow well potential in the 3 Regions resulted in maps, indicating the number of shallow wells that can be put down in every 2 x 2 kilometer block and which can produce during 19 out of every 20 dry seasons (95% reliability).

For Mara Region a mean of 9.95 wells per 4 km² was found, with a standard deviation of 33.1.

Taking the mean value of 9.95 on face value and relating it to the total land surface of Mara Region (approx. 21,750 km²) would result in a total of more than 54,000 wells in this Region alone, which would be sufficient for 16.2 million people, theoretically.

The high standard deviation, however, indicates that there are very great variations in the shallow well potential within the Region.

Nevertheless, it may be assumed that a major part of the rural population, possibly as large as 75-80%, could be supplied through shallow wells.

2.11. Mbeya Region

A water master plan is presently under preparation by the same consultant (CCKK) as for Iringa and Ruvuma Regions. Again preliminary hydrogeological investigations appear to indicate that relatively few areas in this Region are suitable for shallow wells.

Nevertheless, in line with the stated Danida policy, shallow wells will be constructed wherever possible, construction units for shallow wells will be formed and 50 wells are planned to be constructed during the financial year 1981/82.

2.12. Morogoro Region

A shallow wells implementation project (the "Morogoro Wells Construction Project") is being executed by DHV/ONV, since mid-1978. The project, which is carried out in the northern half of the Region only, has constructed a total of 550 shallow wells in the period between July 1978 and July 1981. Based on the experience gained so far, the total number of shallow wells that can be constructed in, or close to, the villages in this part of the Region is estimated at 974, thus catering for about 292,200 people (or: 52% of the rural population in the northern half of the Region).

Hydrogeological conditions in the southern half of the Region are being investigated by the "Water Supply Survey Southern Morogoro Region" project. It is expected that up to 80% of the rural population in this part of the Region could be supplied through shallow wells, or: approximately 305,750 people (1978 situation).

2.13. Mtwara Region

As mentioned before (paragraph 2.9) Finnwater is carrying out a rural water supply project in the Mtwara and Lindi Regions. In the first phase of that project (January 1978-March 1980) a total of 336 shallow wells (60% of the total shallow wells production) were constructed in Mtwara Region.

Phase II, which will last until 1982, is expected to produce a total of 300 shallow wells per year, in both regions together. It is expected that 30% of the rural population of Mtwara Region can be supplied through shallow wells.

2.14. Mwanza Region

The "Water Master Plan for the Mara, Mwanza and West Lake Regions" referred to in paragraph 2.10, indicates a mean of 6.72 wells per 4 km² (producing not less than 6 m³/day each, for at least 19 out of every 20 dry seasons) for Mwanza Region. Again combining the information with the total land surface of the Region (19,700 km²), a total of 33,100 wells would be possible in theory, sufficient for 9.9 million people. Also in this case the standard deviation is relatively high (13.2), indicating that there are great variations in the shallow well potential within the Region.

Nevertheless, it is again assumed that a major part of the rural population, possibly as large as 75-80%, can be supplied through shallow wells.

The World Bank, in its appraisal report No. 1867a TA, mentions a target of 540 wells to be constructed over 5 years. A World Bank-sponsored wells construction project was thus set up in Mwanza Region, with an estimated production of 150 wells over the financial year 1980/81.

2.15. Rukwa Region

According to information received from Norad officers it is intended to construct approximately 800 wells. Not clear is whether these wells would be constructed in Rukwa Region alone, or in both Norad-sponsored regions: Rukwa and Kigoma, together.

In the first case the total number of people to be supplied through shallow wells (240,000), would amount to 61% of the rural population, in the latter case it would mean 24% of the combined rural population (based on 1978 census figures).

2.16. Ruvuma Region

This is the third region for which a water master plan is being prepared by CCKK (see also parts 2.6 and 2.11). The hydrogeological findings indicate better possibilities for shallow wells in Ruvuma Region than in Iringa and Mbeya Regions, and especially in Tunduru District.

As has been mentioned before, it is Danida's stated intention to have shallow wells constructed wherever possible, to form construction units for this purpose and to aim at the construction of 50 wells in this Region during the financial year 1981/82.

2.17. Shinyanga Region

The water master plan, prepared by Nedeco, and submitted in October 1974, estimated that a total of 2,200 shallow wells would be required (and could be found) in the Region.

One of the follow-ups of the water master plan was the "Shinyanga Shallow Wells Project" carried out by DHV/Ilaco/ONV in the period 1974-1978. Extensive groundwater survey work was carried out in this period, and at the time the project was handed over entirely to the Tanzanian authorities (July, 1978) a total of 752 shallow wells had been constructed, with an estimated remaining potential of 2,573 wells: 1,523 with a maximum depth of 7 m, and 1,050 deeper wells.

The total of 3,325 wells would be able to cater for some 997,500 people (or: approx. 80% of the rural population).

At the time of the Morogoro Conference on Wells (August, 1980) some 994 shallow wells had been finished, serving 298,500 people in 297 villages (or: approx. 300 people per well).

2.18. Singida Region

The "Tanzania/Australia Water Development Project Singida Region", which effectively started in 1975, undertook a survey of the Region's Water resources late in 1977, with the following findings:

- shallow wells (unlined)	are used by	39% of the population
- wells in rivers	are used by	17% of the population
- lined wells	are used by	7% of the population
- boreholes	are used by	23% of the population
- springs	are used by	8% of the population
- flowing rivers	are used by	1% of the population
- dams	are used by	5% of the population

With wells, in one form or another, accounting for 63% of the total water supply, a separate shallow wells project was started in 1979. At the time of the Morogoro Conference on Wells (August 1980) a total of 32 ring wells and 7 tubewells had been constructed.

It is estimated that for the majority of remote villages properly constructed shallow wells form the optimal solution. The existing situation shows in any case that at least 63% of the rural population could be supplied with water from shallow wells.

2.19. Tabora Region

The "Tabora Region Water Master Plan" by Brokonsult states that the result of a survey of 162 shallow wells "suggests that it should prove feasible to locate reliable shallow wells in most places in the Region". It also says "Reliability of wells dug to proper depths and properly sited can be considered very good indeed. In Tabora there is no real difficulty with siting reliable shallow wells".

In most parts of the Region the supply of water by shallow wells is the only water source available and in many cases the wells give acceptable and sufficient water for the daily demands of the villages.

It is, therefore, assumed that at least 75% of the rural population could be supplied through shallow wells.

According to the RWE records there are 1570 existing shallow wells (situation 1979), 95% of which are unlined. With financial help from TRIDEP a shallow well program is being executed. Per mid-1980 approx. 30 wells had been completed. The initial goal was to construct 137 wells in the Region during the financial year 1979/80, with a final target of constructing 500 wells per year when the project is fully developed. Due to various difficulties the entire project suffered a delay of approximately one year, however.

2.20. Tanga Region

The Tanga Water Master Plan by AHT (1976) mentions that in 8% of the total area of the Region there are good prospects for shallow wells and deep wells; in 1% of the total area there are good prospects for deep wells only.

In 4% of the total area there are no prospects for shallow wells and only locally for deep wells; in 62% of the total area shallow nor deep wells are generally feasible and in 25% they are not feasible at all (outcrops, etc.).

According to the master plan new rural water supply works are required for 1.27 million people, at an estimated total cost of TAS 385 million. Shallow wells are planned for only 26,000 people, or: 3% of the 1978 population.

Within the framework of the TIRDEP programme a shallow wells construction project is being carried out. During the financial year 1979/80 a total of 10 wells were constructed, with a construction target of 38 wells (+ rehabilitation of 9 existing wells) for the financial year 1980/81.

2.21. West Lake Region

In the "Water Master Plan for the Mara, Mwanza and West Lake Regions" by Brokonsult, mentioned in para's 2.10 and 2.14, for West Lake Region a mean of 15.9 shallow wells per 4 km² is indicated (producing not less than 6 m³/day each, for at least 19 out of every 20 dry seasons). With a total land surface of 28,750 km² for the Region, a total of 114,990 wells would be possible, in theory, catering for some 34.5 million people.

The large standard deviation (28.5) already indicates that it is a theoretical value, and that great variations in the shallow well potential within the Region must be expected.

Nevertheless, it is again assumed that a major part of the rural population, say 75-80%, can be supplied through shallow wells.

2.22. Conclusions

Table 2.1. gives a summary of the rural population and the percentages (or numbers) that could be supplied through shallow wells according to the information contained in the previous paragraphs.

It has been mentioned before that part of that information is of a tentative nature, while no or hardly any information could be obtained about the feasibility of shallow wells in the Iringa, Kigoma, Kilimanjaro, Mbeya, Rukwa and Ruvuma Regions. When these regions are, therefore, not taken into account, table 2.1 shows that approximately 6 million of rural people out of a total of approximately 11 million (or: 55%) could be supplied through shallow wells. In the remaining regions the possibilities for shallow wells might be more restricted, but since no actual information is available so far, it is tentatively assumed that 50% of Tanzania's rural population could be supplied through shallow wells.

According to official statistics, in 1978 an average of 37% of Tanzania's rural population was served with water from an improved source. On the one hand this means that shallow wells most probably have been taken into account; on the other hand all completed (piped) water supply schemes must have been taken into account, whether in practice these are operating or not.

Table 2.1. - Population data, per Region

Region	Rural population (1978-census)	Rural population that can be supplied through shallow wells		Percentage of rural population supplied with water **)
		%	numbers	
1. Arusha	934,397	15	140,160	37
2. Coast	516,849	25	129,200	37
3. Dar-es-Salaam	94,176	25	23,540	70
4. Dodoma	813,344	25-50	203,340-406,670	62
5. Iringa	865,619	no data yet	no data yet	28
6. Kigoma	590,162	no data	no data	24
7. Kilimanjaro	832,930	no data	no data	54
8. Lindi	500,594	50	250,300	41
9. Mara	679,315	75-80	509,490-543,450	20
10. Mbeya	790,315	no data yet	no data yet	46
11. Morogoro-North	557,000*	52	292,000) 31
Morogoro-South	382,190*	80	305,750	
12. Mtwara	723,216	30	216,960	35
13. Mwanza	1,435,418	75-80	1,076,560-1,148,330	30
14. Rukwa	394,095	no data	no data	31
15. Ruvuma	514,810	no data yet	no data yet	33
16. Shinyanga	1,254,736	~ 80	997,500	71
17. Singida	558,138	≥ 63	351,630	52
18. Tabora	750,657	75	562,990	13
19. Tanga	892,043	~ 3	26,000	31
20. West Lake	932,357	75-80	699,270-745,890	12
Total	15,012,276		5,784,690-6,140,370	37

Notes *) estimated division
 **) situation 1978

Field information as quoted by various Regional Water Engineers shows that actually only one-third to one-quarter of the piped supply schemes may be operating satisfactorily, so that in practice the rural population served with water (approx. 5-6 million people according to the data of table 2.1) might be as low as 2-3 million people.

When we restrict ourselves to the period up to the CCM's target year, 1991 (which happens to coincide with the end of the International Water Supply and Sanitation Decade) it will be obvious that during those years a number of water supply facilities will cease to operate because they will have become obsolete. This will again reduce the percentage of rural population that, while being served with water in 1978, would still have a reliable water supply in 1991.

Taking these factors into account, we can make the following calculation:

- rural population in 1978: 15 million people (rounded figure)
- population increase in the period 1978-1991, based on an average population growth of 2 to 3 percent per annum: 6 million people
- population served (in 1991) by water supply facilities that exist at present: 3 million people (or: 60% of official figure; this may be an over-estimation)

Consequently, the number of rural population for which water supply facilities would have to be constructed before 1991, in order to have a water supply coverage of 100% by that year, amounts to: 15 million + 6 million - 3 million = 18 million people.

If we assume, as argued earlier, that 50% of these people could be supplied with water through shallow wells, this means a total of 9 million people for which shallow wells would have to be constructed up to the year 1991. It is obvious that this figure must be used as a rough estimate only, but the order of magnitude is expected to be reasonable. Therefore, in the following chapters this number will be used.

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