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# Consequences of low sustainability in the effectiveness of national strategies to increase water access in the rural areas: evidence from three central regions of Tanzania.

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**Abstract**

Tanzania, as many other countries, has designed an ambitious Rural Water Supply and Sanitation Plan (RWSSP) to improve increase access to rural water: from 53% in 2005, up to 74% in 2015 and 90% in 2025. Emphasis is placed on the production of new schemes and only 6% of investment is foreseen for rehabilitation. This paper presents an analysis of the current functionality-time relationship for water points found in en extensive water point mapping study made in three regions of Tanzania, covering 15% of the total rural population of the country. Results show very low performance over time, since only between 35% and 47% of water points are working 15 years after installation. Consequences for the accomplishment of the RWSSP are discussed and some measures proposed.

**Keywords**: Access; sustainability; planning; rural water supply; Tanzania

## Introduction

Sustainability of rural water supply programmes in developing countries is a key concern for the sector. Current estimations for Sub-Saharan Africa are that only two out of three water points in rural areas on the continent are functional at any given time (RWSN,2009), recognizing at the same time the absence of wide data sets to backup this estimation. Other sources situate the functionality for handpumps from 40 to 50% (Harvey et al, 2004), based on diverse studies in many countries. For the case of Tanzania, 30% of systems were estimated as not functional (GoT, 2002). Despite this data, emphasis is frequently placed on the fast production of new schemes, while many of them become out of service in a very short period of time. The Government of Tanzania, as many others, has undertaken an ambitious plan to improve increase access to water: The Water Sector Development Programme (WSDP). It includes three sub-sector programmes: Water Resources Management and Development; Rural Water Supply and Sanitation (RWSSP); and Urban Water Supply and Sewerage. Currently, Tanzania has an estimated rural population of 25.9 million and the current coverage reported in the rural area was 53%.The RWSSP establish targets on the percentage of population in rural areas with sustainable and equitable access to safe water: 1) It will be 65% by 2010 (goal set by the National Strategy for Growth and Reduction of Poverty –MKUKUTA-); 2) At least 74% by mid 2015 (MDGs); and 3) 90% by 2025. The fulfilment of these targets will require extending water supply coverage to an additional 34.5 million people during the period 2005-2025.

On the other hand, the absence of adequate information systems hinders the possibilities of making an extensive analysis on the real sustainability of the rural services. To fight this situation of absence of information, a Water Point Mapping (WPM) approach has been specifically designed as a procedure to measure access indicators. It has been applied extensively by Water Aid and other NGDO in some African countries for a number of years. Water point mapping (WPM) can be defined

as an “exercise whereby the geographical positions of all improved water points in an area are gathered in addition to management, technical and demographical information. This information is collected using GPS and a questionnaire located at each water point. The data is entered into a geographical information system and then correlated with available demographic, administrative, and physical data. The information is displayed using digital maps.” (WaterAid, ODI, 2005). WPM’s main function is to simply and objectively demonstrate how water points are distributed within a territory; thus it serves as a valuable analysis and planning tool for governments. Moreover, it helps to define reliable indicators of access constructed from the lowest geographical level with the data available (Stoupy & Sudgen 2003; Jiménez & Pérez-Foguet, 2007; Jiménez & Pérez-Foguet 2008). Table 1 shows the difference of coverage found through a WPM study carried out in the period 2005-2006 in three regions of central Tanzania- Dodoma, Tabora and Singida. It includes the analysis and mapping of 6814 Water Points (WP) in 15 districts, in an area with a rural population of 3.95 million people.

Sustainability of the approach of the RWSSP has been recently assessed, as regards its overall design and policy (Giné & Perez-Foguet, 2008). As a complement to it, this paper assesses the influence of the existent low sustainability rates of rural water supplies in the effectiveness of the RWSSP. Evidence of sustainability rates is taken from the WPM study abovementioned. The aim of the study is to highlight the risk of underestimating the huge rates of non functionality currently observed in the development plans for the sector. It also underlines the importance of tackling sustainability issues in the rural water supplies.

**Table 1.** Comparison between the access to water obtained from WPM and the official figures.

| DODOMA | | | |
|---|---|---|---|
| District | Rural Population | Coverage through WPM | Official Data |
| Kongwa | 248.656 | 29% | 74,40% |
| Mpwapwa | 253.602 | 29% | 65% |
| Dodoma Urban | 242.771 | 25% | 38,20%[1] |
| Dodoma Rural | 438.866 | 23% | 51,20% |
| Kondoa | 428.090 | 23% | 38% |
| **Dodoma Region** | **1.363.329** | **25%** | **61%** |
| TABORA | | | |
| District | Rural Population | Coverage through WPM | Official Data |
| Nzega | 415.203 | 12% | 25,10% |
| Tabora Urban | 91.261 | 10% | 10,90%[1] |
| Uyui | 281.101 | 7% | 10,70% |
| Urambo | 369.329 | 6% | 14,40% |
| Igunga | 324.094 | 5% | 9,00% |
| Sikonge | 132.733 | 3% | 4,60% |
| **Tabora** | **1.613.721** | **8%** | **14%** |
| SINGIDA | | | |
| District | Rural Population | Coverage through WPM | Official Data |
| Singida Town Council | 56.949 | 66% | 32,00%[1] |
| Singida Rural | 400.377 | 21% | 39,40% |
| Iramba | 367.036 | 17% | 30,00% |
| Manyoni | 204.482 | 17% | 36,40% |
| **Singida Region** | **971.895** | **21%** | **37%** |

Note 1: The coverage data for Urban Districts is given for the rural part of it, in order to make figures directly comparable.

## Methodology

First, influence of technology in the rate of functionality is estimated from observed data. Water Points (WP) were grouped in four main categories: All type of Handpumps, Motorized systems, Gravity fed systems and Others-WP. Afterwards, the relationship between functionality rate, years after construction and category is defined. Management related questions of the study have been assessed, in comparison to functionality and category of WP. Finally, an estimation on the future access (in 2015) in the three regions is made. This is done applying the functionality rate obtained previously to the new investments planned by the government in the Rural Water Supply and Sanitation Program for the districts and the period mentioned.

## Technology of Water Points

The different types of water points were grouped in four categories, as shown in table 2. The reasons for establishing these groups are the following. Each category has very different management problems from others and similar among the category itself. Handpumps, regardless the depth and the type of well, confront similar management problems: relatively small groups of users and the difficult access to spare parts as the main challenge for the rural population. Gravity systems usually serve a larger number of people through a network. Small running costs lead to poor maintenance and low financial contribution, and usually face problems related to catchment management (bad quality and seasonality of water service). Motorized systems serving a network face the challenge of high running costs and technology dependency, which requires a high community involvement in management since the first moment. Others include a quite heterogeneous number of water points. They were not further split as all together they represent only 2,6% of the water points mapped. The sample is still two small to make conclusions on this category. Moreover, the categories chosen are the same as recognized by the Ministry of Water to assign the allocation of recurrent costs at District Level (GoT, 2006).

**Table 2**: Water points analyzed grouped by category.

| | | CENTRAL REGIONS | |
|---|---|---|---|
| CATEGORY | DEFINITION | Number of WP | % of sample |
| All handpumps | All water points providing water through a handpump, regardless its brand and the type of well/borehole. | 2326 | 39,3% |
| Motorized pumping systems | All water points fed by a pumping device operated through any kind of non-manual extraction system, excluding windmills. | 2180 | 36,8% |
| Gravity Fed | All water points fed by gravity systems, regardless the type of source. | 1263 | 21,3% |
| Others | Protected springs and rainwater-harvesting not feeding networks; water points fed by windmills. | 152 | 2,6% |

These categories help to group in a meaningful and understandable way all the possible combinations of water types, type of sources and extraction systems, facilitating the analysis of data. Apart from the abovementioned, there were 511 cattle troughs mapped, and 382 points could not be put in any category because of contradictions or absence of answers in the questionnaires. It is important to notice that only 49 of them were functional water points. Hence, the sample that was used is of 5,921 water points.

## Results

This section provides the results for the 15 districts studied. First, the functionality by category of WP is assessed in every District. Afterwards the relationship between the functionality and the years passed after construction of the WP is analyzed. Finally, we look at the relationship of the functionality of WP and the management related questions included in the study.

*Functionality by category of WP*

Results show a very different functionality rate by category of water point in each of the districts studied, as show in figure 1 (Districts are named by numbers in the graphic). If there are less than 10 water points from one category in a District, this has not been represented in order not to extract conclusions on extremely low samples. As it can be seen, with this criterion not all categories are present in each district. It is remarkable how different sustainability rates can be found for the same type of WP in neighbour areas, and no standard tendency can be found for any technology. Instead, the age of the WP, years after construction, plays a significant role in the rate of functionality by category, as it is explained afterwards.

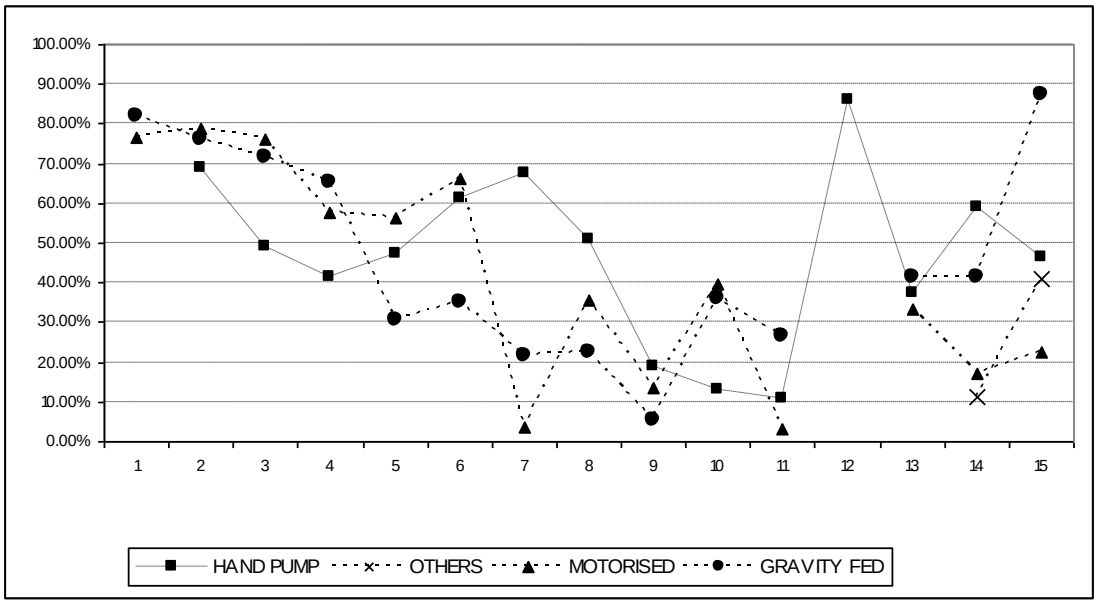


**Figure 1**: Rate of functionality by category of water point and District.

*Functionality by category over time*

In order to analyze the relationship between the category and the time after installation of the water point, the following methodology has been used. The water points have been grouped by age (in 5-year steps) regardless its location. Average functionality for every group has been represented in the Figure 2. Tendency curve has been drawn for every category (represented in the same figure).

Handpumps and motorized water points show a very regular functionality-time descending curve, being $R^2$ equal to 0,99 and 0,92 respectively. Gravity fed water points show a more irregular tendency. Functionality of water points constructed in the early nineties is very low (below 40%) while WP from the period 1985-1990 were performing much better (almost 60%), and the ones constructed in the 1980-1985 were mainly not functional (slightly over 20% of functionality). Despite this irregular trend, the tendency curve ($R^2$ =0,71) shows a similar descending slope as the rest. For the “others” category, the oldest water points (more than 25 years old) are functional only in 18% of the cases, with 60% in the previous 5-year period. The

tendency curve has similar slope as the others, with $R^2$ =0,76. The points of Gravity and Others category have been linked for better understanding of the figure.

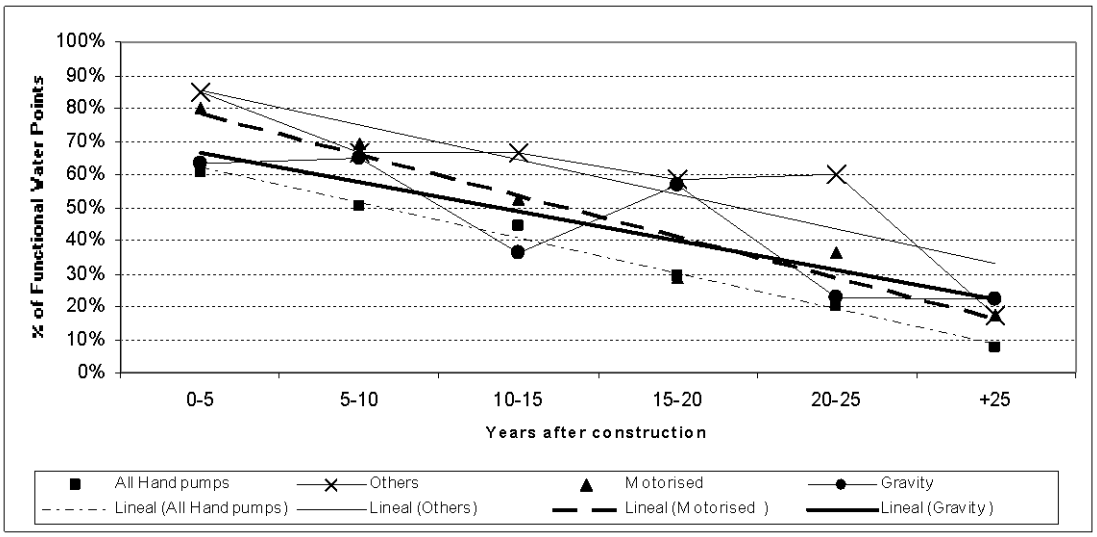


**Figure 2:** Rate of functionality by category of water point over time**.**

If we analyze the tendencies showed by the lineal regression we find interesting results. Surprisingly, handpumps show the less favourable functionality-time function, starting from 61% in first five years to 8% in 30 year period. Motorised systems start from 79% to 17% in the same period, and gravity fed systems, from 67% to 19%, working better in the long run that any other category of water point. In all cases, only between 35% and 47% of water points are working 15 years after installation. Others-WP show a better score, but the total number of this kind of WP is very low (only 152 out of 6814), and as it has been explained before, it is the sole category that groups very different water points. RWSSP predictions estimate that the largest proportion of people (48%) will be served by handpumps, 25% by motorized systems and 21% by gravity flow networks (GoT, 2006b). Thus, the sustainability by type of WP is of critical importance, as it will be discussed hereinafter.

*Relationship between functionality of WP and management related questions*

The analysis of the questions dealing with management at community level does not show any conclusive relationship with the functionality of the WP studied. As we can see in table 3, the celebration of meetings was very similar regardless functionality. Surprisingly, income was reported slightly above 50% for functional water points but 43% for not functional. As regards to expenditure reported, only 36,4% of functional water points declared money expenditure in the year before the survey, which could indicate a poor preventive maintenance of the systems. In all cases, respondents declared not to know about the fact in less than 10% of the cases. Less than 3% of respondents declared that the system had expenditure and no income, which could indicate a contradiction between answers. 63,7% of functional water points that declared to have income had also expenditure, which seems reasonable for a functional service.

**Table 3:** Answers to management related questions for the 15 Districts, regardless category of WP.

| | Last year meetings declared | Last year income declared | Last year expenditure declared |
|---|---|---|---|
| **% of Functional WP that** | 79,5% | 54,8% | 36,4% |
| **% of Not Functional WP that** | 68,7% | 43,5% | 17,5% |

Interesting results are found when disaggregating these questions by category (figure 3 and 4). Motorised systems in functional water points had the highest rates of income and expenditure (66% and 54%); however, it is not understandable how 46% of motorised functional water points could run without it. Gravity systems score low both in income (44%) and expenditure (35%). Functional handpumps declare expenditure in only 19% of the cases. If we look at non-functional water points, also a lot appears to be happening at village level. Meetings took place in a similar rate, regardless the category of WP. Income is collected in 40% of the cases. Unfortunately the data do not allow knowing if this money was to be used for reconstruction, initial contribution for another water point or others. Expenditure was significantly lower in all categories, but no further analysis is possible. At any case, more research would be needed in order to find and formulate the right questions in the right way to obtain additional management-related information.

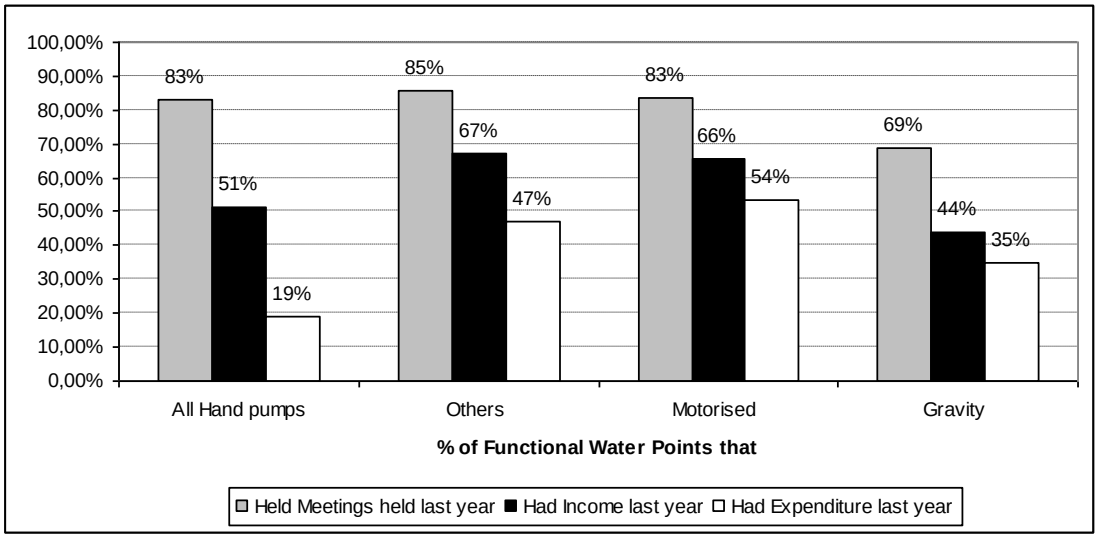


**Figure 3:** Answers to management related questions for functional water points, grouped by category of water points**.**

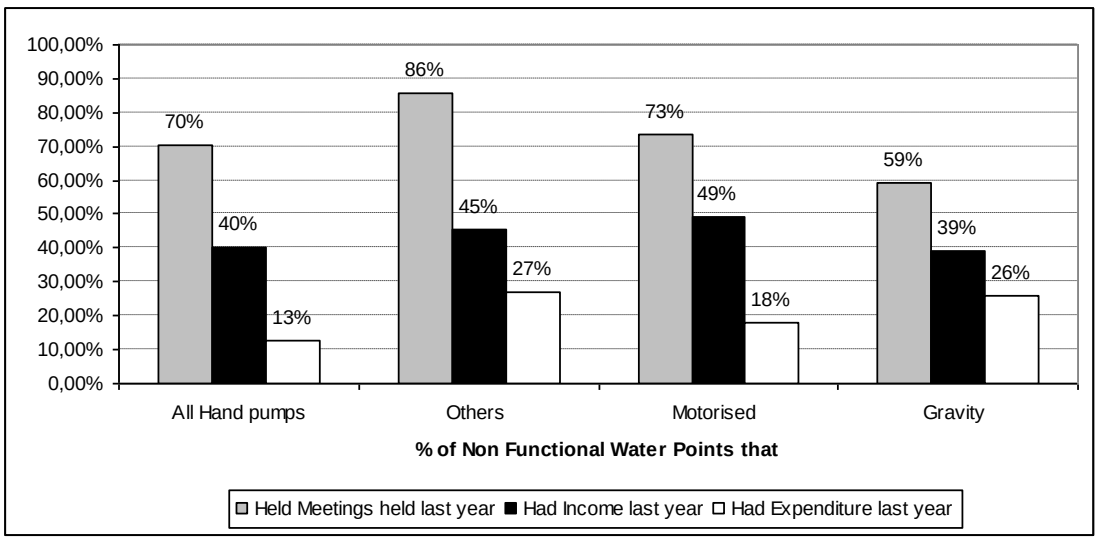


**Figure 4:** Answers to management related questions for non-functional water points, grouped by category of water points.

## Discussion

*The allocation of resources and the calculation of costs in the RWSSP*

As it has been said, the Government of Tanzania has ambitious targets under the RWSSP for increasing the access to water in the whole country. This will require the provision of new water supply services and the promotion of sanitation to an estimated 34.5 million residents. The foreseen allocation of resources is based on two general principles (GoT, 2006b):

- Districts with less coverage will receive more funds in order to increase their level of service closer to the national level. As an example, in 2005 the reported coverage by District vary from 6,4% to 91,8%. In 2025, the RWSSP targets that all districts will fit in the range 80-95%.
- Technology mix (and costs) proposed are based on the current presence of technologies in the districts, combined with a demand assessment study and the opinion of experts.

Equity is a valuable goal in itself. Nevertheless it cannot be ignored that districts having less coverage are also likely to have more difficulties in keeping the new WP functional. As we can see in figure 5, there is a fairly good relationship between the coverage found in 14 Districts[1], and the rate of functionality of WP found in the same district.. Thus, adequate capacity building both at community and LGA level should be performed in parallel with the big investments in infrastructures.

As regards the technological choice, it seems reasonable to promote the same technologies that are already present in one District, since we can presume that the choice in the past was reasonable, as well as they might benefit from economies of scale at district level. As we can see in figure 6, the most predominant category performs better compared to the average of functionality of the other categories present in the District (if number of WP below 10, the category has not been considered). In average, the rate of functionality of the predominant category is 1,18 times higher than the average of relevant categories in the District. Only in one case (District number 15), the general sustainability was significantly higher (more than 10%) than the one of the predominant category.

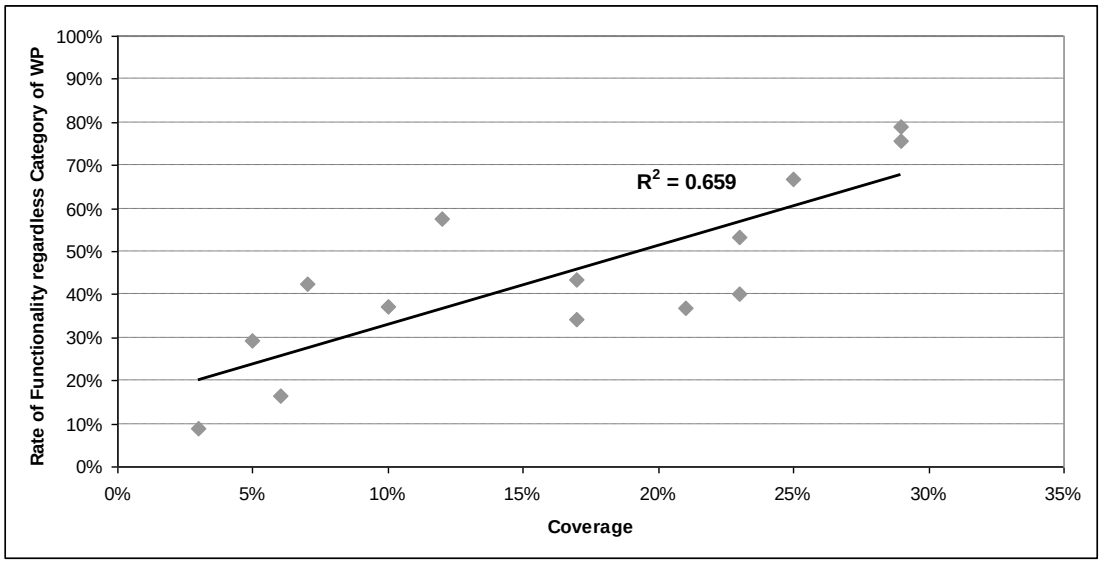


**Figure 5:** Relationship between the coverage of WP and the functionality observed in 14 districts studied.

1. Singida Town was excluded because of its very high coverage compared to others, as well as for being rural part of a Town

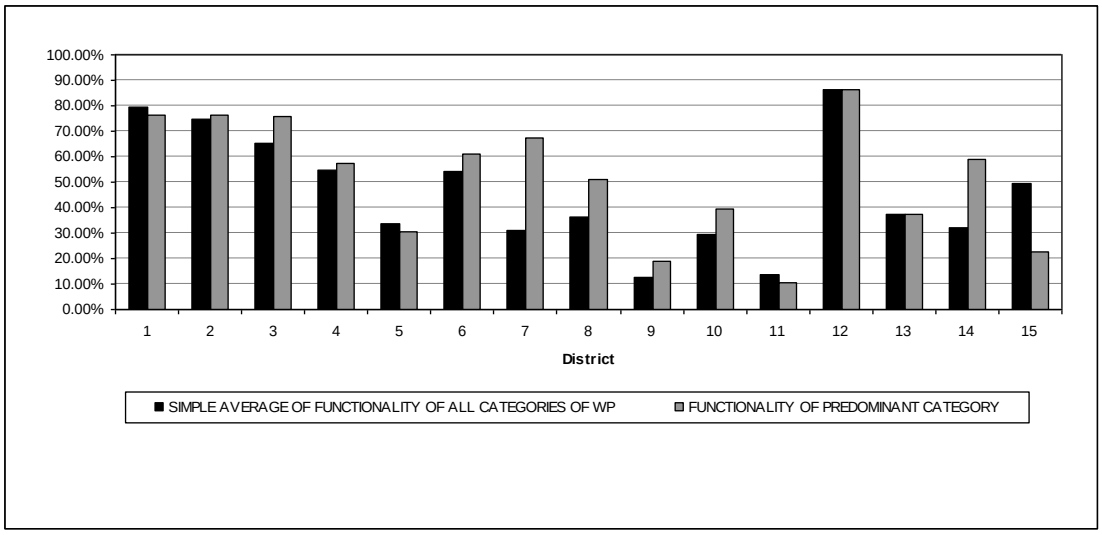


**Figure 6:** Rate of functionality of the predominant category of WP compared to the simple average of functionality of all categories in 15 Districts studied.

*The effect of current sustainability rates on national targets*

Government investment predictions for the period 2005-2025 assume that only 25% of all existing systems in 2004 will require major investment in rehabilitation during the period. Capital investment in major system rehabilitation is assumed to represent 66% of the cost of new water supply services. As a result of both assumptions, 1105 MUSD is foreseen as investment in new services in the period 2005-2015 but just 70MUSD in rehabilitation (GoT, 2006b). Detailed predictions for the regions concerned can be summarized in table 4: 10,300 WP should be newly constructed and 1,088 repaired during the 2005-2015 period, according to national plans.

In this study, the functionality-time functions found for these three regions (Figure 2) have been used to asses the number of Water points that would become not functional over time. For that purpose the mean value of the functionality rate for each 5-year period has been applied to each group of water points, depending on their age. 2015 is taken at the starting year to count. Water Points older than 30 years have been estimated a constant rate of functioning, as shown in Table 5.

**Table 4**: Water Points planned by category until 2015 in Dodoma, Tabora and Singida. Source: Government of Tanzania, as explained in main text.

| CATEGORY OF WATER POINT | NEW SERVICES | | REHABILITADED | |
|---|---|---|---|---|
| | 05-10 | 11-15 | 05-10 | 11-15 |
| All Hand pumps | 2781 | 2516 | 240 | 211 |
| Others(windmill, rainwater, springs) | 559 | 493 | 76 | 66 |
| Motorised pumped systems | 1886 | 1701 | 216 | 190 |
| Gravity | 196 | 168 | 48 | 41 |

**Table 5**: Functionality rates applied to each category of WP depending on their age.

| Category of Water Point | More than 25years | 20 to 25 years | 15 to 20 years | 10 to 15 years | 5 to 10 years | Below 5 years |
|---|---|---|---|---|---|---|
| All Hand pumps | 9% | 19% | 30% | 41% | 51% | 62% |
| Others | 33% | 43% | 54% | 64% | 75% | 85% |
| Motorised | 16% | 29% | 41% | 53% | 66% | 78% |
| Gravity | 22% | 31% | 40% | 49% | 58% | 67% |

Applying the estimated population growth rates, the results of the simulation made gives the following results. Out of 17,240 water points ever installed in the three

regions, only 9,009 will be operational in 2015. The RWSSP estimates to rehabilitate 1,088 water points in the period, while as a reference, if current sustainability rates are maintained, 4,059 of the newly installed WP from 2005 onwards would have become not functional by 2015. That means that more than 742,750 people would be affected only by the low sustainability of actions implemented in 2005-2015.

In terms of coverage, it would increase in the three regions from 17,5% in 2005 to 39,7% for 2015, meaning that 2.248.229 people would be served. Government estimations at the time would be to have 3.558.955 people served with the same investment, meaning a coverage of 62,9%. Thus, the effect of low sustainability summed with the inaccurate initial data would result in an overestimation of service coverage to 1,306,652 people, e.g. 23% of total population in the area.

As an example, if sustainability rates would be increased by a 10% in all categories, additional 262.665 people (5% of total population) would maintain their access to water in the same period. If 15% would be increased only in handpumps, 175.828 people would maintain their access in the three regions.

## Conclusions

Tanzania, as many other countries, has designed an ambitious plan to improve increase access to rural water: from 53% in 2005, up to 74% in 2015 and 90% in 2025, aiming to give access to 34.5 million people during the period. Emphasis is placed on the fast production of new schemes: 1105 MUSD is foreseen as investment in new services in the period 2005-2015 and just 70MUSD in rehabilitation; the assumption adopted is that only 25% of the services in place in 2004 would need rehabilitation over the 20 year period of the programme.

The analysis of the functionality of water points over time found in three regions of Tanzania is dramatically low, for all categories of WP. The results show that some categories of water points prove to be rather sustainable in some areas, while in others fail completely. In aggregated terms, handpumps show the less favourable functionality-time function, starting from 61% in first five years to 8% in 30 year period. Motorised systems start from 79% to 17% in the same period, and gravity fed systems, from 67% to 19%, working better in the long run that any other category of water point. In all cases, only between 35% and 47% of water points are working 15 years after installation. RWSSP predictions estimate that the largest proportion of people (48%) will be served by handpumps, followed by 25% of motorized systems and 21% by gravity flow networks.

The analysis of the management related information provided in the Water Point Mapping did not show conclusive results between income, expenditure and functionality of Water Points. It is remarkable that motorised water systems have the best performance when reporting about income and expenditure, which is coherent with the high functionality rate found in the first 15 years of service. Handpumps score the worst as regards to those questions, which is also coherent with the low functionality-time function found.

The allocation of resources in the RWSSP is based on the promotion of equity between districts. This is a valuable goal, but the study shows (figure 5) that districts with current low coverage also have a worse functionality rate, e.g., they have more difficulties to maintain WP functional. Thus, massive investment alone is those places can be risky. Adequate capacity building both at community and LGA level should be performed in parallel with the big investments in infrastructures if results over time want to be sustained.

The determination of costs in the RWSSP is based on the technology mix found in each district, combined with a demand assessment carried out in 18 districts and the opinion of experts. Data from the three regions studied show that, in average,

functionality of the predominant category of WP in a District is 1.18 times better than the average for the same district. Thus, it seems a good strategy to promote, when conditions allow for that, the same category of WP already existing, since they might benefit from local economies of scale.
As regards to the achievement of the targets of the RWSSP, if current sustainability trends are maintained and the investment is distributed as it has been foreseen (94% to new services and 6% for rehabilitation), they will not be fulfilled. Coverage would be of 39.7% compared to the 62.9% expected in 2015. If this simulation would be up scaled, the national programme would probably fail on its main target of 74% coverage by mid-2015, and 90% coverage by 2025. As an example, if sustainability rates would be increased by a 10% in all categories, coverage in the three regions studied would increase in 5% in the first ten years of the programme.

The study shows that it is urgent to improve functionality of the services over time if RWSSP is to be achieved. It is crucial to invest more in building management capacities at community level and foster post-project support at district level. Additionally, resources allocation criteria would need to consider a more realistic amount for rehabilitations, combined with adequate efforts in capacity building for underserved districts. A special plan for support in the first years of running of the services would be reasonable, in order to ensure the investment made. A sound information system should be in place to monitor real progress and enhance the sharing of best practices. Finally, more research is needed to look for factors affecting sustainability in different places, to be able to promote the right type of service for every place.

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