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Factors in the suboptimum performance of rural water supply systems in the Ethiopian highlands

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Abstract: Access to safe drinking water services in the Ethiopian Highlands is one of lowest worldwide due to failure of water supply services shortly after construction. Over hundred water supply systems were surveyed to find the underlying causes of failure and poor performance throughout the Amhara Regional State. The results show generally that systems with decision-making power at the community level during design and construction remained working longer than when the decisions were made by a central authority. In addition, the sustainability was better for water systems that were farther away from alternative water resources and contributed more cash and labour. The results of this study of the importance of decision-making at the local level in contrast to the central authority is directly applicable to the introduction of rain water management systems as shown by earlier efforts of installing rain water harvesting systems in the Ethiopian highlands.

Media grab: Hundred surveyed water supply systems provided evidence for the importance of full community involvement both to lighten the burden of the overworked *woreda* staff, achieving greater quality of construction and sustained operation. Great poverty prevented payment and caused failure.

Introduction

Ethiopia has adopted the millennium development declaration and is devoted to the achievement of the millennium development goal (MDGs). Among the MDGs the most important development objectives are reducing poverty by enhancing economic growth, increasing agricultural production and improving rural water supplies.

Rural water-supply schemes in Ethiopia are partially or fully funded from governmental and nongovernmental resources. Many governmental organizations (GOs), non-governmental organizations (NGOs), donors and international non-governmental organizations (INGOs) through bilateral or multilateral projects and programs have been working for two decades in Ethiopia to increase coverage and to provide safe water supplies and sanitation to underserved populations in poor and remote rural areas in the highland.

In Africa and other developing countries, sustainability of rural water supply is quite low with 30 to 60% of the schemes becoming non-functional within 5 years after implementation. Failure of water supply systems in sub-Saharan Africa includes lack of community participation, lack of recovery of operation and maintenance costs, poor training, disinterested users committees (Carter et al. 1999; Mengesha et al. 2003; Carter 2009), weak administrative support (Bhandari and Grant 2007), non-suitability of the technology for its intended use (e.g. hand pumps cannot provide sufficient water for cattle in Mali, Gleitsmann et al. 2007) and finally limited sustainability of imposed community management structures (Harvey and Reed 2006: Deneke et al. 2011).

Despite the many efforts in Ethiopia, the failure of both constructed water supply points and rain water management structures have common key factors in sustainability. The factors for either system poor sustainability in the Ethiopian highlands are not very well known and no information is available how these factors vary spatially. Since rainwater management structure have only recently been implemented we made an in-depth analysis on how the sustainability of developed rural water supplies is affected by available alternative water resources, operation and maintenance practices, Water Use Committees (WUCs), community participation and project cost. Detailed surveys were carried out in five *wordeas* and a more general survey in the remaining part of Amhara. In this paper, an overview is given of the survey results of the performance of the more than 100 water point. More information can be found by searching http://soilandwater.bee.cornell.edu/research/international/eth_pubs.htm and includes the full report to WaterAid-Ethiopia, briefing notes and theses.

Material and methods

Several studies on rural water supply systems are combined in this overview. They can be divided in two studies (A and B). Study A was carried out by five master's students in the Cornell/BDU program on Integrated Water Management. In-depth surveys, consisting of formal interview, focal group discussion and field observation were conducted of 80 water supply systems in five districts (*woredas*): Achefer, Mecha, Libokemekem, Quarit and Semada (Figure 1). In order to understand better why systems failed water system selection was changed slightly during the study. In the initial survey the selection of water supply systems was random in the Achefer, Libokemekem and Semada *woredas*. In the follow-up survey in Mecha and Quarit *woredas*, water supply points were selected randomly with the restriction that half of the water points were functional and the other half were non-functional. From 12–20, water supply systems per *woreda* were investigated (Table 1). In all *woredas*, households were randomly selected with 160 households (HHs) in all districts except in Libokemekem (200 HHs) and Quarit (180HHs) (Table 1). Study B was intended to obtain a broad overview of all water supply systems in the Amhara region in the Ethiopia highlands and consisted of a survey of 32 water supply schemes located in 29 different *woredas* (Figure 1). The survey was done by faculty members of School of Civil and Water Resources Engineering at Bahir Dar University and was funded by WaterAid Ethiopia.

Table 1. Description of study areas (Source: PCC 2008 and WaterAid Ethiopia)

Study area Name	Area (km2)	Population size 2007 census	Zone	% of rural population	Site selections
Achefer	2500.00	173,211	West Gojam	93	Randomly 16 villages
Libo Kemekem	1706.20	198,374	South Gondar	89	Random 20 villages
Mecha	1612.50	292,250	West Gojam	92	8 villages functional 8 not functional
Semada	2281.72	228,271	South Gondar	96	Randomly 16 sites
Quarit	613.6	166,848	West Gojam	98	6 villages functional 6 not functional
Amhara Region	161,828	17,214,056	11 zones	89%	32 sites selected

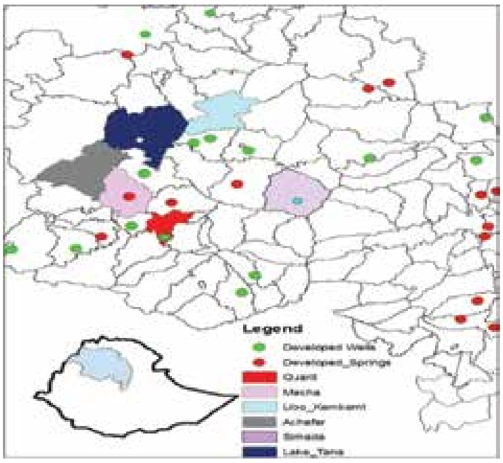

Figure 1 Map with locations of water supply points (red and green points) studied at regional level and Woredas (shaded area) where studies were conducted.

Data collection by formal surveys and focal group discussios was done in Study A from July to November in 2008 for Achefer and Libo-Kemekem districts and for the remaining districts, from September to December 2010. Surveys for Study B were conducted from October 2010 to March 2011.

Results and discussion

Functionality of schemes**:** In Study A (Table 1), water supply schemes consisted of hand dug wells, shallow wells and natural (or gravity) springs. The hand pump wells were less than 30 meter deep with the exceptions of the Semada district where the depth was 60 m. In study B in addition to the same types of water supply systems, 2 boreholes were surveyed.

In the Achefer, Libokemekem and Semada *woredas* (Figure 1), where water supply systems were selected at random (Tables 2 and 3), about two thirds were operational, one tenth completely not functioning and the remainder needed major repairs. The percentage of failed and broken water supply systems is nearly equal to that reported by African Development Fund in 2005.

Table 2. Functionality of schemes with technology type in the three districts where water points are selected randomly. HDW is hand dug wells

Study areas	Type of scheme	Number of water supply schemes	Functional	Non-functional	Functional with breakage
Libokemekem	HDW	16	13	3	0
Achefer	HDW	8	7	0	1
	Springs	8	2	0	6
Semada	HDW	6	5	0	1
	Springs	10	4	1	5
Amhara Region	HDW	15	6	3	6
	Shallow well	3	0	2	1
	Springs	12	6	1	5
	Borehole	2	2	0	0
Total		80	45	10	25

Table 3. Distribution of water point types where they are selected randomly for functional and non-functional categories

Study areas	Type of scheme	Number of water supply schemes	Functional	Non-functional	Functional with breakage
Mecha	HDW	14	8	0	6
	Springs	2	0	2	0
Quarit	HDW	8	5	3	0
	Springs	4	0	3	0

Amount of water use per day: The average water use from functional systems in study A was between 10 and 15 l/day per capita which was significantly less than the WHO guidelines of 20 l/day, (Minten et al. 2002; Mengesha et al. 2003; Collick 2008). In the Achefer and Semada *woredas,* we found that an increase of household by one person decreases significantly the per capita water consumption by 1.5 l/day. In addition in Achefer *woreda* increase in travel by 1 km to the water source decreased water use by 6.2 l/day per capita. Thus, both large family size and improved sources of water force households to use unimproved water sources when at closer distance than the improved source.

Alternative sources**:** Generally in most watersheds, several sources are available for obtaining drinking water. In the Amhara region (study B), we found that besides the improved sources, 65% of the villages had unprotected alternative source. In addition 24% of the village had choice between two improved sources. In Semada *woreda*, about 68% of the 160 respondents had more than one source. The availability of alternative unprotected spring water sources affects the sustainability of developed scheme. For example in the Mecha *woreda,* we found that approximately two thirds of the systems failed for households that used spring water before the new system was installed. In contrast, less than 20% was in need of repair for households that used traditional hand dugs in the back yard before the improved system was installed. These results are directly related to the belief of the rural population that the quality of water is good from spring and poor from hand dug wells. Thus for spring users there is no need to use water from a protective source and once the system is broken there is very little incentive to repair it. The opposite is true for communities that used water from the traditional hand dug wells and consequently more improved sources remain operating. Similarly to Semada *Woreda* in the Achefer villages the functionality was inversely related to the availability of alternative drinking water sources. It was found that in a village without alternative sources, none of the water system was completely broken.

Operation and maintenance**:** Surveys in Libokemekem, Semada, Quarit and Mecha *woredas* were directed towards understanding the various aspects of willingness to pay for operation and maintenance (O&M) of water facilities. The percentage of payers was in the order of 30% except in the Quarit district in which the functional system had great number of users contributing. In almost all cases, the amount collected did not cover the cost of maintenance. An interesting fact and often overlooked in reasons for failure of water systems is that the cash for obtaining water was just too costly for the poor families and therefore obtained lower quality water from traditional sources to save money.

WUCs: Water Use Committees (WUCs) were instituted in many villages for governing water systems (for example 90% in Semada, 100% Achefer and 62% Mecha of the villages had WUC's). The idea of water point management through WUC is reasonable taking into account both the scattered rural settlement pattern and the small number of *woreda* level experts relative to the number of water supply systems. In the Quarit *Woreda*, for example, only five experts (1 office head, 1 planning and documentation expert, 1 operation and maintenance expert, 1 pump attendant and 1 water quality expert) for the total of more than 200 water supply points. In many cases the WUCS were ineffective, had unclear responsibilities and authority in part due to outsider initiated institutional structure dominated by local administrators from government rather than local indigenous institutions as described in Deneke et al. (2011). This is demonstrated in Semada *woreda* where 47% of the respondents did not know the existence and/or the role of water user committee. Well-functioning WUCs are important because for instance in Achefer *Woreda*, there was a direct and statistically significant ($p<10\%$) relationship between trust of WUCs and the amount of cash contributed.

Community participation: In Ethiopia, just like other African countries, the degree of community participation is extremely important This is well demonstrated in the surveys in the study of the Quarit and Mecha *woredas* (Figure 2).

The functionality of the system was much greater when either the community of a local leader had the responsibility for selecting the water points rather than the implementer. This is also the reason that the number of operational systems was much greater in the Mecha compared to Quarit system because local communities and leaders were more involved in the selection process.

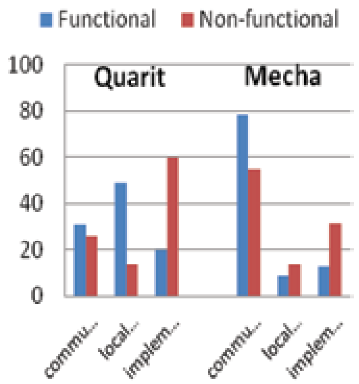

Figure 2 Community, local leader and implementer's share of responsibility in site selection in Quarit and Mecha Woredas

Project cost: Participation of households during water source installation is an important indicator for future project sustainability. This was well demonstrated in the Achefer *Woreda* where there was no complete failure and where for over 75% of the systems labour was provided for site clearing and construction and material were given such as wood. In addition 10 to 12%, the project cost was covered by the community. There was a similar situation in Mecha district in which nearly half of the community contributed cash, labour and local materials in case of the functional water points. In non-functional water point, majority of the community participate by providing only food and local beer for labourers.

Conclusions and recommendations

Despite many years of development efforts, both access to safe water supplies and well-maintained rainwater management systems in the Ethiopia highlands continues to be challenging. There are many parallels between the implementations of rural water systems and rainwater management systems. Success of either system depends largely on effective community participation in assuring that the systems function to the satisfaction of the users.

In case of water supply systems, 10 and 20% have failed completely. This will in near future be increased by 35% unless immediate solutions are devised by understanding the factors for unsustainability.

The availability of alternative water sources was an important factor in the failure of the system. Labour shortages often forced the family members to obtain water from a water point that was closest to the home. It is important for the sustainability of the system to consider providing sufficient water at a fair distance from their house by improving unprotected alternative sources near the houses.

The members of the community have often insufficient cash resources for payments. Therefore most cash collected for O&M should be spent on maintenance rather than operation such as payment for guard. Operation payments could be in kind by through participation of all households.

For the sustainability of the water points, the degree of participation of community or local leaders should be high. Although in all cases the communities requested for the water supply system and provided some level of services, only in the currently operational systems local traditionally community leadership participated in the selection of site, project scheduling and important decisions during construction.

The final important factor in success of the water systems was the functioning of the Water User Committees (WUCs). In most cases in failed systems, WUCs was found to be selected for formality to fulfil the requirement of implementers. They weren't fully recognized by the community and the communities did not trust them. It might be preferable to use local indigenous institutions as described in Deneke et al. (2011) or local traditional leaders to assure WUCs that are trusted by the communities, so that payments will make for repair and systems can be repaired when broken.

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