Original article

Sustainability of Drinking Water Supply Projects in Rural of North Gondar, Ethiopia

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Abstract

Background: Safe water supply coverage in the rural areas of Ethiopia is very marginal. The coverage still remains very low because of limited progress in water supply activities in these areas. Factors affecting the continued use of the outcome of water supply projects in the background of limited resources are not well studied.

Objectives: To assess the utilization, functionality, community participation and sustainability of water projects.

Methods: A cross-sectional descriptive study was conducted in 11 randomly selected Peasant Associations located in North Gondar using a pre-tested structured questionnaire in a total of 768 house holds in the months of December 2001 to January 2002. Six focus group discussions and 114 physical site observations were conducted to check the interaction and linkages within the hierarchies of project management and of water supply projects.

Results: Four hundred forty two (57.6%) households were using protected water sources. The average frequency of water collection was 2.04 times per day with the mean per capita water consumption of 6.68 liters per day. The duration of waiting time needed to collect water at the water points was positively associated with the respondents complains about the non-functionality of water points. Community participation as defined in terms of some kind of contribution to small-scale drinking water development was more associated with spring protections than hand dug well protection. Results from observational checklists showed that 77% of the protected springs and 52% of the hand-dug wells used to be none-functional at least once from the time when their service was commissioned. Only 30.0% of the visited small-scale water projects had guards, some form of fences, cloth washing stands, and animal water troughs that are positive efforts to the advantages of maximizing community services. While the existence of Water Committee and labor contribution were identified as strengths, lack of built in trust and poor coordination were cited as weakness in the focus group discussions.

Conclusion and Recommendation: Available water projects were not effectively used because of the existing user high demand in one hand, and frequent non- functioning schemes and poor project coordination on the other hand. Enhancing community participation in sustaining the functions of water supply projects and strengthening the technical and resource capacity of Woreda Water Desks are strongly recommended to sustain the community water services. [*Ethiop.J.Health Dev.* 2003;(3):221-229]

Introduction

Water supply projects have impacts on people's lives, which extend far beyond the expected improvements to health and reduction in time spent collecting water. Involving community members in evaluation of their own projects brings new insights into both the wider impacts of interventions and the factors contributing to the long-term sustainability of water supply system (1). Sustainable development requires that people have access to safe drinking water supply services. At the beginning of 2000, 1.1 billion

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(17%) people of the world's population were without access to improved water. The majority of these people live in Asia & Africa (2). Ethiopia is considered to have one of the poorest drinking water supply indicators. National drinking water supply coverage is estimated at 33.2%. For urban areas the coverage for safe water is 83.5%, where as for rural areas this is 24.7% (3).

The administrative structures to rural areas are often limited to address the environmental health needs. Sustainability is expected to be achieved by building a partnership with communities that should lead towards improving the beneficiary's problem- solving capacities (4).

Some reports from Ethiopia as well other as developing countries showed that insufficient and inappropriate technology account for the failure of some of the projects (5). Insufficient water facilities, poor physical structures, low reliability of the services and facility designs, distance and the time needed to collect water, and low awareness about their uses are some factors affecting the continued functioning and utilization of water supply schemes (6,7). Although several water supply projects were constructed in Gondar area, the majority of them are reported to be non-functional at present affecting a significant proportion of users. However, studies on factors affecting the sustainability of water supply schemes through the WHO recommended indicators were not studied in the area (6). The present study was, therefore, initiated to assess the factors affecting drinking water supply utilization, type and degree of community participation and functioning of water supply projects on the background of limited resources for developing such community services.

Methods

A descriptive community based cross sectional study design complemented by focus group discussion and field observation in the rural setting of North Gondar was conducted in the months of December 2001 to January 2002. The study area has a population of 2, 391, 545 with male to female ratio of 1:0.97. Urban and rural population accounted 270,937 (11.3%), 2,120,608 (88.7%), respectively. North Gondar has varied landscapes predominately covered with rugged hills and plateau formation determining the presence of different ecological settings characterized by different climatic conditions (8).

All villages having a total of 228 water supply schemes represented the sampling frame for this study. The villages were stratified by two broad types of implementing organizations: non-governmental (UN Capital Development Fund, Ethiopian Orthodox Church, Ethiopian Red Cross Society & UNICEF/"Wereda" Integrated Basic Services) and governmental (Ministry of Health, Ministry of Water Resources, and Gondar College of Medical Sciences). One from each stratum with the highest number of out puts was identified in order to randomly select a total of 11 villages possessing some kind of water supply schemes.

The required sample size was obtained using a conservative estimate of 50% of community participation level, 5% of margin of error, and 95% confidence of certainty. Assuming a design effect of 2 the minimum sample size required for the study was 768 households that were selected using a systematic random sampling method from the selected villages.

A pre-tested structured questionnaire was used for the quantitative survey. The questionnaire included information on demographic and socio economical characteristics of the respondents and functioning, utilization, and participation in water supply facilities. Field observations using structured checklists were administered in 114 (50%) of projects. Data for the observation included mainly distance, service duration, and protection mechanism. A total of 6 focus group discussions (FGDs) were managed to collect qualitative data using a semi structured questionnaire guide, note taking and record taping. Four FGDs were arranged at grass root

level for males and females separately, and 2 FGDs at project management level. Each FGD consisted of 6-8 participants with the same socio-economic background. The principal investigator in quite and private locations moderated FGDs. Summaries of FGDs were transcribed. The container used for water collection and the time needed to collect water was standardized through calibration of known volume and walking distances, respectively. A stopwatch was used to measure the time spent to wait and collect water during site observation. Each of the data collectors had fixed their average time by watching at least one woman while collecting water from their respected areas of houses to water source and back to their house. Ten 12th grade trained female enumerators supervised by two sanitarians collected the data. The field data quality was checked through intensive supervision, daily meetings and discussions to ensure the completeness and consistency of the collected data.

Proxies for the measurement of functioning, utilization, and participation were used to assess factors affecting sustainability (6, 9). **Functioning** is referred to the proper physical state of water supply projects in relation to their present working conditions at the time of survey. It also included the benefits in reference to the physical structures as measured in terms of distance, type of technology, and sanitary protection systems. **Utilization** is referred to the extent of social and health benefits as measured mainly by the proportion of users and per capita consumption. **Sustainability** is the continued service of water supply projects over time to serve their own purposes. Proxies of sustainability are those factors affecting functioning, utilization, and community participation.

Data were entered, cleaned and analyzed using EPI-INFO version 6 & SPSS version 10 statistical packages. Odds ratio with 95% CI & multi variate logistic regression analysis were employed to assess the significance and associations between variables.

Results

A total of 768 female house hold respondents were interviewed. The distribution of socio-demographic, socio- economic and some selected characteristics of respondents are shown in Table 1. The mean (SD) age of respondents was 37.09 (13.52). Six hundred ninety eight (90.9%) respondents were illiterate. Most, 632 (82.3%), were married.

Table 1: **Distribution of respondents by socio-demographic variables in North Gondar, January 2002 (n=768)**

Variables	No.	%
Age (years)		
15 – 19	23	3.0
20 –24	106	13.8
25 –29	113	14.7
30 – 34	112	14.6
35 –39	90	11.7
40 – 44	96	12.5
45 –49	55	7.2
50 +	173	22.5
Mean ± SD	**37.09 ±**	**13.52**
Religion		
Christian	760	99.0
Muslim	8	1.0
Ethnicity		
Amhara	729	94.9
Kemant	39	5.1
Education		
Illiterate	698	90.8
Only read Or/and write	15	2.0
Grade 6 and below	40	5.2
Above grade 6	15	2.0
Marital status		
Married	632	82.3
Unmarried	7	0.9
Divorced	49	6.4
Widowed	80	10.4
Occupational status		
Farmer	150	19.5
House wife	618	80.5
Husband's educational status *		
Illiterate	365	57.8
Grade 6 and below	53	40.0
Above grade 6	14	2.2

* (n=632)

Use of protected water sources was accounted to 442 (57.6%) households. Mean family size's was 5.3 ranged from 1 to 12 persons with an estimated mean family income of 60.72 Birr per month (Table 2). The study showed that water per capita utilization had a significant association with the family size (OR=8.56, 95% CI (1.56, 77.91)).

Table 2: Distribution of respondents by family size, family income and type of projects in North Gondar, January 2002, (n=768)

Variables	**Number**	**Percent**
Family size (number)		
1-4	289	37.6
5-8	430	56.0
9 and above	49	6.4
	Mean ± SD	**5.31 ± 2.06**
Family income (Birr per month)		
49 and below	382	49.7
50 – 99	292	38.0
100 and above	94	12.3
	Mean ± SD	**60.72 ± 55.29**
Protected water sources		
Yes	442	57.6
No	326	42.4

The majority, 359 (81.2%), took more than 15 minutes for a round trip to collect drinking water. Two hundred seventy three (61%) respondents collected water two times per day. The mean (SD) water per capita consumption was 6.68 (4.36) liters per day. Three hundred fifty seven (80.8%) of the respondents used about 8 liters and less water per capita per day and only 10 (2.3%) were found to collect more than 20 liters per capita per day (Table 3). Complaints of respondents about projects functionality had significant association with time taken to fetch water at the water source point (OR=0.18, 95% CI (0.08, 0.39) (Table 4)).

Table 3: **Characteristics of water utilization in North Gondar, January 2002. (n=442)**

Variables	**Number**	**Percent**	**Mean ± SD**
Time for collecting water (minutes)			
15 and less	83	18.8	
16 – 30	287	64.9	
30 and above	72	16.3	20.51 ± **7.89**
Water collection frequency per day			
Once	83	18.8	
Twice	273	61.8	
3 times and above	86	19.4	2.04 ± **0.69**
Per capita consumption (liters)			
8 and less	357	80.8	
9 –19	75	16.9	
20 and above	10	2.3	6.68 ± **4.36**

Table 4: **Respondents complaint about functionality condition of water supply projects associated with time waiting at the water source point, duration of service and financial contribution in North Gondar, January 2002. (n=442)**

Variables	Conditions of functioning		OR (95% CI)
	Functioning (n=390)	**Not Functioning (n=52)**	
Time waiting at the water Source to collect water (minutes)			
≤ 5	180	43	0.18(0.08,0.39)
≥ 6	210	9	1.00
Cash contribution for water use (n=339)			
Yes	280	43	2.96(0.76,9.76)
No	11	5	1.00
Service duration of The projects (in years) (n=768)			
< 5	387	53	1.46(0.03,13.40)
≥ 5	5	1	1.00

* Those who contributed money were only 339

Three hundred thirty nine (76.7%) respondents out of all users of protected water sources have made contributions either in cash or in kind needed for water developments. The distribution of participation in contribution by development stage is: 273(80.5%), 41(12.1%), 11(3.24%), 8(2.4%), and 6(1.8%) in construction only, construction and coordination, construction and planning, planning only, and maintenance, respectively. The types of contributions are indicated in Fig 1. After controlling possible confounding variables, contribution made by respondents had significant association with the waiting time duration needed to collect water at the water source points (OR=0.39, 95%CI(0.31,0.96)) (Table 5). The majority of none contributors 50(48%) claimed that participation was not the work of females, assuming the task of working with small-scale water supply systems is the job of males. More community participation was observed for spring protection than hand dug wells development ($p<0.05$).

Table 5: **Contribution of respondents to the water supply projects associated with selected variables in North Gondar, January 2002 (n=442)**

Back ground Characteristics	**Presence of Any contribution**		**Crude OR (95% CL)**	**ADJ. OR (95% CL)**
	Yes n=339	**No** n=103		
Time for collecting water in minutes				
≤15	65	18	1.12(0.61,2.09)	0.87(0.49,2.26)
≥16	274	85	1.00	1.00
Time waiting at the water point in minutes				
≤ 5	155	63	1.00	1.00
≥ 6	184	40	**0.53(0.33,0.86)**	**0.39(0.31,0.96)**
Water frequency (per day)				
Once	61	21	1.00	1.00
Twice	278	82	0.86(0.48,1.55)	0.66(0.64,2.02)
Service duration of the project (in years)				
<5	1	5	0.06 (0,0.67)	0.49 (0,0.15)
≥5	340	100	1.00	1.00
Water per capita (in liters/day)				
≥ 20	6	4	0.45(0.10,2.20)	0.15 (0.70,9.46)
<20	333	99	1.00	1.00

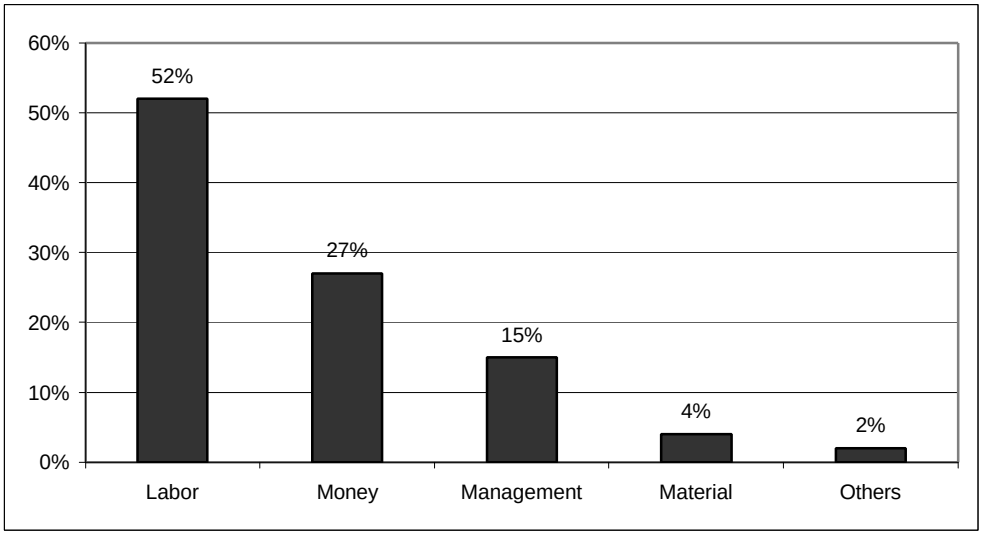

Figure 1: **Distribution of respondents by their types of contribution of the development of the water projects in the rural setting of North Gondar, January 2002 (n=442)**

Among the none users of the protected water sources, 326(42.5%), reasons for not using the schemes were identified as: complaints on system breakage, long distance, inability to pay service fee, lengthy waiting time for water collection by 48.2%, 22.1%, 10.4%, and 7.1%, respectively. Others complained about the quality of water and guards.

As a solution for the continued use of protected water sources, respondents suggested: regular maintenance, increasing the number of protected water sources, improving user's participation by 33%, 29%, and 10% of the households, respectively. Others suggested the need to have guards and trained personnel to undertake maintenance works, increasing the capacity of water sources through spring collection boxes and faucets.

The findings from focus group discussions were organized by analyzing strengths, weaknesses opportunities and threats (SWOT). Water Committee formation, active participation and capacity building were identified as strengths. Insufficient community partnership with the management, lack of adequate skills of financial management for water sources, and the absence of gender sensitivity were discussed as weaknesses. Some of the opportunities were accessing to safe water for better health, bringing community awareness on hygiene through latrine demonstration, understanding the need of water source attendants and fencing, and reducing the problem of water leeches. Insufficient water during dry season from developed water sources, poor coordination between stakeholders and local government, and the growth of eucalyptus trees around water sources were identified as the threats.

Discussion

The very low coverage of drinking water supply in rural areas of Ethiopia has existed for decades (10). Many other developing nations around the globe share this experience (11) Ignorance, poverty coupled with lack of strong community commitment still continues to degrade the immediate environment contributing decisively to the sustained transmission of communicable diseases.

The time taken to fetch water from protected sources greater than 15 minutes in this study was higher than that of the findings in Lesotho, in Zambia, and else where in Ethiopia (12). It exceeded the guide line value recommended time by WHO (13), which is set at 15 minutes of walking distance, equivalent to a distance of about one kilometer. Thus children and mothers, who are the common water attendants, spend much time on water collection in the rural settings of Ethiopia. This is believed to affect spare times required for other household affairs that may impact the health of the family as a whole (7)

The amount of water per capita consumption, about 8 liters and less used by the majority, was significantly different from WHO guide line value set at least 20 liters per capita per day (9). This study revealed that consumption is inversely related to the duration of time to collect water, distance to the water points, increased family size, and the ability to pay service fees. Inadequate drinking water adversely affects personal hygiene, clean food preparation, and housing sanitation, hence favoring the transmission of water borne and water washed communicable diseases.

Community's better participation in protected spring development than in hand dug wells can be possibly explained by the difference in approaches used by stakeholders for community mobilization. The high volume and type of work for spring protection which is more labor intensive in the study area is more likely to require more participation. However, it is not possible to rule out if the weakness came from the stakeholders' participatory approach related to wells, which is also as important as the other water point. The frequent hand dug well service interruption due to pump failure might also discourage the community to consider the partnership.
Community participation in its various forms consisting mainly of labor, cash, service, kind, and advice contributions is critical and decisive for developing and using water supply projects (14). The high rate of participation in the study area, about 77%, is very encouraging entry point to sustain the community service. The result revealed that community members understand reasons for their participation aimed at efficiency, building a sense of ownership and capacity building for purpose of sustainability (12). The local government inputs geared towards sustaining the effort is another management dimension that requires supports for improving its documentation and maintenance capacity in terms of spare parts and tools from respective stakeholders.

The extent of community involvement can be indirectly assessed through identifying negative factors involved in initiating the motives to participate. The fact that frequent brakeage of water systems, hard to reach to water points, inadequateness of water sources, and much time required to collect water discourages the use of protected water requires close attention to address the issue of sustainability for developmental works to ensure "whether or not something continues to work over time" (15).

The issue of Sustainability without addressing this concern will lead to poor community participation, and often forcefully breaking the system in order to access the water for their intended use. Spring protections with adequate yield and continued run offs during the night time and day time when not used by humans, creates extra opportunity to serve this purpose. This study indicated, although not significant proportion, that 19.2% of the observed water points had animal troughs and washing stands.

Field observations had given a chance to observe both the negative and positive factors related to water use and physical features of the water schemes. The presence of fences and guards in 29.8% of water points is a positive participatory response from the beneficiaries reflecting their desire to sustain the technology. Negative attitudes are related to the mishandling of water sources like poor site clearing and not replacing or maintaining damaged water faucets.

In the focus group discussions, issues were raised by the governmental and non-governmental organization was the issue of the completed projects handover. It was also very recently that the Water and Mining Energy Offices (WMEO) took the responsibility of to be handed over water supply projects. Unfortunately the water desk agents at the "Wereda" level representing WMEO were not yet skillful and resourceful to manage and maintain the existing projects. Lack of tools and spare parts are some of the observed problems. "Wereda" management also lacked the effort to maintain Water Committee capacity to reproduce and manage the local financial sources required to ensure the continued service of water points.

In conclusion, various factors are interacting to maintain the intended objectives of any water supply projects. The utilization of water sources mainly depended on their functionality; this in turn depends on the magnitude and type of community participation, the whole purpose focused to sustain the continued use of water supply projects. Considering the modest water service fee, distance from water points, involving community at all stages of water development, and building adequate skill and capacity to maintain water sources are essential factors to sustain the water system. Strengthening the technical and management capacity of "Wereda" Water Desks, improving the coordination at all levels of management, and maintaining community participation are recommended for future action.

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