

## Research Paper

# What determines the operational sustainability of rural drinking water points in Ethiopia? The case of Woliso woreda

Birki Gurmessa and Abate Mekuriaw

### ABSTRACT

Water is a fundamental element essential for life and health. However, more than 33.3% of rural water services in Ethiopia are not functioning and hence sustainability of rural drinking water points in the country is under question. With this in mind, this study was undertaken to investigate the factors that affect the operational sustainability of rural drinking water points in Woliso woreda, Ethiopia.

A semi-structured questionnaire was administered to a randomly selected 211 households from six rural Kebeles, which were selected using stratified sampling technique. Focus group discussions and key interviews were also held along with observation. The quantitative data were analysed through descriptive statistics and binary logistic regression. The qualitative data were used to augment the results from the regression analysis. The results revealed that water service fee, willingness to pay, occurrence of conflict in the water points, monitoring by water user committees, willingness to sustain service, users' participation in the water point construction, satisfaction with the water point service, perception on the possibility of contamination, and training on maintenance are found to be significant factors that affect the operational sustainability of rural drinking water points. Therefore, these significant factors should be sufficiently addressed when planning water supply projects.

**Key words** | operational sustainability, rural drinking water points, water user committee, willingness to pay

**Birki Gurmessa** (corresponding author)  
College of Agriculture and Veterinary Medicine,  
Jimma University,  
Jimma,  
Ethiopia  
E-mail: [birkigurmessa@gmail.com](mailto:birkigurmessa@gmail.com)

**Abate Mekuriaw**  
College of Development Studies,  
Addis Ababa University,  
Addis Ababa,  
Ethiopia

### INTRODUCTION

Water is an essential element for life and health. It also shapes economic and livelihood activities. Food security and income options generated in crop production, industry, domestic processing, aquaculture, livestock, recreation, navigation and transport, and electricity supply are obtained from water. Access to sufficient quality water is also fundamental for all human, animal and plant life. Thus, the provision of safe and adequate water supply has far-reaching

effects on health, productivity, quality of life and to ensure sustainable socioeconomic development. To improve access to safe water supply and sanitation demand, water has to be supplied where and when it is needed. However, lack of water supply and sanitation services are substantial globally.

At a global level, the availability of safe water is low. According to a joint report by [UNICEF and World Health Organisation \(WHO\) \(2019\)](#), 844 million people around the world lack basic drinking water services, and 2.3 billion people lack basic sanitation services in 2015. The majority of the world's population without access to improved water

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supply or sanitation services lives in Africa and Asia. One reason might be non-functionality of improved drinking rural water supply systems and the higher number of hand pumps in Africa not working at any given time. Nearly a third of all rural water supply schemes across sub-Saharan Africa is considered non-functional at any given time (Foster 2013). Thus, poor sustainability of water supply is a key barrier to accessing safe drinking water.

Failure to ensure access and safety of drinking water may expose the community to multidimensional risks related to health and socioeconomic activities (Foxwood 2005). For instance, a joint report by WHO and UNICEF (2017) indicates that nearly 850,000 people die every year from lack of access to safe water, sanitation and hygiene. As well, more than 360,000 children under the age of five die from diarrhoeal diseases. Waterborne diseases caused due to lack of adequate sanitation also force rural communities to spend a significant proportion of their meagre income on treatment and medication. The burden of this problem is also high on women's health and children's education. Women and girls spend large amounts of time carrying heavy vessels while walking long distances. The physical strain of these activities impacts their health, and if pregnant, the health of their unborn children. Girls spend an average of 200 hours each year collecting water and those who walk long distances to get water in the early morning fail to go to school or end up as drop-outs (WHO and UNICEF 2017).

In order to improve this situation, construction of potable water projects in rural areas is one of the major steps that enhances a community's access to safe water and the health of its members. However, this alone cannot guarantee sustainability of rural drinking water points. For example, more than 33.3% of rural water services in Ethiopia are not functioning due to lack of funds for operation and maintenance, and inadequate community participation and commitment (ADF 2005; Water Aid 2011; Foster 2013). As a result, there is wide agreement that non-functionality of rural water services threatens the sustainability of rural drinking water points in Ethiopia. Basically, the sustainability of rural drinking water points is about whether or not water points continue to be functional and deliver benefits over time. No time limit is set on those continued services. In other words, the sustainability of water points is about permanent beneficial use in the water service (Water Aid 2011).

Access to safe drinking water supplies and sanitation services in Ethiopia are among the lowest in sub-Saharan Africa. In 2005, the government of Ethiopia approved the Universal Access Program with the objective of providing safe water to all citizens of the nation. Subsequently, the government, along with its development partners, has exerted a great deal of effort and substantial progress has been made. At the end of the first phase of the Growth and Transformation Programme (GTP I), access to potable water for urban areas was 91% and access in rural Ethiopia was about 82% by the standards of GTP I (NPC 2016). Water supply coverage for rural areas by the standards of GTP I was 15 litre consumption per day per person (l/c/d) within 1.5 km radius, and 20 l/c/d in urban within 0.5 km radius. However, these figures go down considerably when lensed through GTP II standards (25 l/c/d within 1 km radius for rural areas and 40–100 l/c/d for urban areas); where rural, urban and national water supply coverage stood at 59%, 51% and 58%, respectively (NPC 2016). Cognizant of this low coverage, due emphasis was given under GTP II to the expansion of potable water supply with a target to achieve 85%, 75% and 83% potable water coverage, respectively in rural areas, urban areas and the country as a whole by the end of GTP II (2019/20). Towards achieving the plan in rural areas, a great deal of investment was put into the construction of potable water points. The mid-term review of GTP II shows that potable water coverage has increased to 68.5% in rural areas, 54.7% in urban areas and overall coverage of 65.7% (NPC 2018).

Despite this progress, little information is known about the operational sustainability of potable drinking water points. This paper, thus, investigates the determinants of operational sustainability of rural drinking water points/schemes (RDWPs) in Ethiopia by taking Woliso woreda, Oromia Regional State, as a case. Like other woredas of the region in particular, and the country in general, the woreda is not unique when it comes to the provision of rural drinking water point schemes by the government. From this perspective, the woreda could provide a good deal of evidence to reflect the problem as a rough representative of the country. As well as this, since one of the researchers has good knowledge of the woreda and had observed a considerable number of potable water projects failing to function after some time of operation, it made the woreda a good choice for the study.

## RESEARCH METHODS

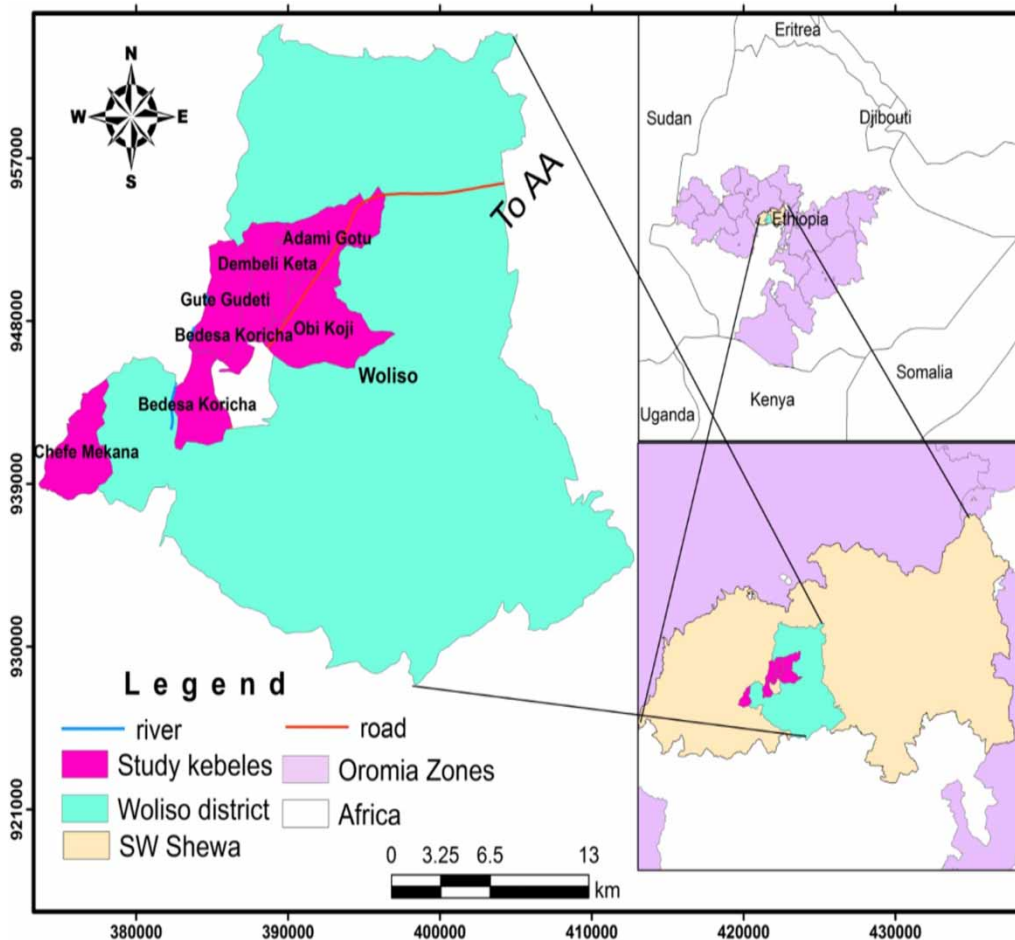
### Description of the study area

As shown in [Figure 1](#), Woliso woreda (district) is located in the central part of the country under South West Shoa Zone of Oromia National Regional State. It is divided into 37 Kebeles (the lowest administrative unit in Ethiopia composed of one or more villages) and one town, Woliso, the capital of the woreda. The town is located 114 km west of the capital city of the country, Addis Ababa. The woreda is the second largest woreda in the zone with a land area of 702.38 km<sup>2</sup> and it is located between geographic coordinates of 8°16'N–9°2'N and 37°31'E–38°46'E. The highest and the lowest elevations of the woreda are 2,800 and 1,500 m above sea level, respectively.

According to the water sector office of the woreda (2015), the total population of the woreda is 179,532 and about 154,501 people have access to potable water supplies. This shows that the coverage of water points is 86%. This has to be understood solely in terms of percentage coverage, but not in terms of the operational sustainability of the scheme (water points).

### Sample size and sampling technique

A multi-stage sampling design was employed to select Kebeles and users (represented by household heads). First, six rural Kebeles with a relatively higher number of drinking water points, medium and lower number of drinking water points were selected after stratifying all the 37 rural Kebeles of the study area into three strata (Kebeles having higher,



**Figure 1** | Map of the study area (source: Oromia Bureau of Finance and Economic Development, 2016).

medium and lower number of drinking water points). Second, the users of drinking water points were picked proportionally from each of the Kebeles through simple random sampling technique.

The sample size of the study was decided following Godden's (2004) determination formula which is given below:

$$n = \frac{Z^2 pq}{d^2}$$

where,  $n$  is the desired sample size;  $Z$  stands for standard score at 95% confidence level which is 1.96;  $p$  is estimated target population proportion;  $q$  is  $1 - p$ ; and  $d$  is confidence interval, expressed as a decimal, in this case 0.05. Substituting the value into the formula provided a sample size of 196. By assuming 7.5% for contingency, 211 users were selected for the survey.

In addition, two experts from the water sector office of the woreda were purposively selected for key interview, and three focus group discussions (FGD) comprising six household heads from each Kebele were organized. The participants for the key interview and focus group discussion were selected purposively based on their knowledge and experience (participation in construction and subsequent management) on potable water points.

### Data source and collection instruments

Both primary and secondary sources of data were used. A semi-structured questionnaire was used to collect quantitative data. This tool was used in particular to collect socioeconomic and water point-related data (on the variables indicated in Table 1) from users. The questionnaire was translated into the local language (Oromo language). The qualitative data were also collected from key informant interviews, focus group discussion and observation of the water points. Observation was employed to assess the functionality of sample rural drinking water points. The data collection was carried out with full consent of the respondents. Upon making the purpose of the data collection (research purpose) clear, data were collected from the respondents with their full knowledge and agreement.

### Method of data analysis

The descriptive statistics (frequency and percentage) and regression analysis were employed to analyse the data. Since the dependent variable is a dichotomy (operational sustainability/functional and non-sustainability/not functional), binary models (logit or probit) are used. For simplicity and easy interpretation, the researchers preferred binary logistic regression model to predict the effects of independent variables on the dependent variable.

### Specification of the model

The dependent variable (functionality, i.e., operational sustainability of the rural drinking water point/sustainability of RDWP) is dichotomous with two values, 1 if the water point is functioning and 0 otherwise. Based on Gujarati (2004), the model is specified as follows:

$$p_i = E(Y = 1/X_i) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_i)}} \quad (1)$$

In the logistic distribution equation,  $P_i$  is the probability of rural drinking water point's sustainability;  $X_i$  is a set of explanatory variables of the  $i^{\text{th}}$  user;  $\beta_0$  and  $\beta_1$  are the parameters to be estimated.

When  $\beta_0 + \beta_1 X_i$  in Equation (1) is replaced by  $Z_i$ , Equation (2) (the probability of sustainability of the water point) is obtained:

$$P_i = \frac{1}{1 + e^{-Z_i}} = \frac{e^{Z_i}}{1 + e^{Z_i}} \quad (2)$$

The possibility of non-functionality ( $1 - P_i$ ) can be depicted in Equation (3) as follows:

$$1 - P_i = \frac{1}{1 + e^{Z_i}} \quad (3)$$

From the above two equations, the odds ratio in favour of sustainable of RDWP could thus be:

$$\frac{P_i}{1 - P_i} = \frac{1 + e^{Z_i}}{1 + e^{-Z_i}} = e^{Z_i} \quad (4)$$

The logit model uses logarithmic transformation to assume linearity of the outcome variable on the explanatory

variables. The logit model could thus be expressed as:

$$L_i = \ln\left(\frac{P_i}{1 - P_i}\right) = Z_i = \beta_0 + \beta_1 X_i \tag{5}$$

If the disturbance term  $u_i$  is considered in the general logit model with a set of variables, the equation becomes:

$$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + u_i \tag{6}$$

$X_1, X_2, \dots, X_n$  are independent (explanatory) variables affecting operational sustainability of RDWPs. The explanatory variables are listed in Table 1.

The variables were selected based on previous empirical studies in the field. In this regard, other variables such as queuing time at the water point, type of management model and type of technology (pump) were considered. However, queuing time at the water point was found to correlate with users' satisfaction on the water point service. In addition, it was noticed in the FGD that conflict between users usually arises in water schemes where there are long queues and the water flow (amount) is low; if not, these are the only reasons. On top of this, the researchers observed that occurrence of conflict as an explanatory variable is rarely considered in similar studies. Conversely, the occurrence of conflict in the water points of the study area was

**Table 1** | Independent variables affecting sustainability of rural drinking water points (SRDWP)

Variable	Variable type	Variable descriptions and unit of measurement	Expected sign with SRDWP
Dependent variable (SRDWP)	Dummy	'1' if the system is functioning, otherwise '0'	
Independent variables			
Social and institutional factors			
Participation	Dummy	Participation of the household (user) during project implementation/RDWP construction: '1' if yes, '0' if no	-
Distance	Continuous	Household's distance from the nearest city, measured by minutes by foot	+
Satisfaction	Dummy	User's satisfaction on the services they get from the water points: '1' if satisfied, '0' if not satisfied	+
Willingness2 sustain	Dummy	User's willingness to sustain/protect service of RDWP: '1' if yes, '0' if no (a proxy measurement to which a user is determined to protect or keep the water points functioning by exerting time and labour, and holding other responsibilities associated with the scheme)	+
Conflict	Dummy	Occurrence of conflict in RDWP: '1' if a user has encountered or observed conflict in the water points, otherwise '0'	-
Fence	Dummy	Availability of fences (surrounding the water points): '1' if yes, '0' if no	+
Training	Dummy	User's training opportunity on maintenance: '1' if yes, '0' if no	+
Monitoring	Dummy	Water user committee monitoring the water points: '1' if yes, '0' if no	+
Alternative	Dummy	Alternative source of water other than the water points: '1' if yes, '0' if no	-
Technical factors			
Age	Continuous	Age of the water system	-
Economic and financial factors			
Fee	Continuous	User's monthly payment for water service (Ethiopian Birr, ETB)	+
Willingness2pay	Continuous	How much a user could possibly pay for maintenance of the water points per month in ETB	+
Environmental and water attribute factors			
Amount	Continuous	Availability (amount) of water at the point per hour/day	-
Contamination	Dummy	User's perception on the possibility of contamination: '1' if yes, '0' if no	-

reported. Taking these points into consideration, queuing time was dropped from the model while retaining users' satisfaction and the probability of conflict occurrence. Similar is the case where types of technologies were highly correlated to each other, and thus dropped from the model. Type of management model was also excluded since there was no variation in the management type of the water schemes.

## RESULTS AND DISCUSSION

### Characteristics of respondents

From the total 211 respondents, about 71% were males, while 29% of them were females. The mean age was 43, while the maximum and minimum ages were 85 and 23, respectively. Most respondents (47%) were in between 39 and 54 years of age. Sixty-five per cent had received formal education, whereas 29% were illiterate and 6% were exposed to some form of non-formal education. The average household size was five, with maximum and minimum sizes of ten and one, respectively.

### Water points' status in the woreda

As per the recordings of woreda office of water, there are 393 drinking water points throughout the rural Kebeles of the

woreda. These water points are composed of five types, namely, shallow well (174 in number), motorized spring (2), spring on spot (51), hand dug well (122) and spring distribution (44). Among these drinking water points, the office assumes that 85% of the water points in the woreda are operationally sustainable. This study crosschecked the recordings of the woreda by actually asking the users. The operational functionality of the water points were recorded as reported by users and, as depicted in Figure 2, some of the water points were observed physically by the researcher as well. From the total users surveyed, 62% of the users indicated that the water points that they use are functioning, whereas 38% of them reported that the water points they are using were not functioning at the time of data collection. This result significantly differs from the expectation of the woreda office of water services (assuming that 85% of the water points are functioning and 86% of the population has access). This is mainly because of the low level of monitoring activities by the woreda office and lack of budget for the operation and maintenance of the water points.

### Factors affecting the operational sustainability of rural drinking water points

As shown in Table 2, the overall model with chi-square value of 131.61 and a probability of  $p < 0.000$  indicates



**Figure 2** | Functional RDWP (left) and non-functional RDWP (right). *Source:* Researcher's own photograph from the field work.

that the set of explanatory variables has a significant effect on operational sustainability of RDWPs. With this result, the null hypothesis (all of the regression coefficients in the model are equal to zero) is rejected. As shown in Table 2, the coefficient of several variables is different from zero at 1%, 5% and 10% level of significance. The variables in the model explained 46.83% (pseudo R<sup>2</sup>) of the variation in sustainability of RDWPs. Hosmer and Lemeshow's goodness-of-fit statistics, chi<sup>2</sup>, is 8.83 with a *p* value of 0.3573 (insignificant) and this shows that the model fits the data well.

Although the woreda office of water services puts the figure of functioning RDWPs higher, the empirical result here shows that there are actually fewer sustainable water points. A number of social, economic, institutional and technical factors contribute to unsustainability of the water points. The regression result shows that out of 14 factors considered in the regression, nine factors significantly determine the operational sustainability of rural drinking water points in the study area. These significant variables are presented in Table 2. In order to see the relative importance of these variables, a dominance analysis was carried out

following the procedure provided by Azen & Traxel (2009). Accordingly, water fee is found to be the most important factor followed by willingness to pay for the maintenance of water points, while participation in training is the least important among the significant explanatory variables. The details are presented in Table 2.

As depicted in Table 2, water service fee, willingness to pay, occurrence of conflict in the water points, monitoring by water user committees, willingness to sustain service, users' participation in the water point construction, satisfaction with the water point service, perception on the possibility of contamination, and training on maintenance significantly affect the operational sustainability of RDWPs.

### Water fee

Water users in the study area pay on average 4.48 Ethiopian Birr (ETB) per month for the water services. The average water charge of users for the functional water points is 4.78 ETB/month and this figure is significantly higher than the average water charge of users for non-functional rural drinking water points (3.99 ETB/month), i.e., users at the

**Table 2** | Logistic regression estimation result for SRDWPs

Variable name	Odds ratio	<i>P</i> >  z	Marginal effect (dy/dx)	Standardized dominance statistics	Ranking (relative importance)
Fee (Monthly payment for water service)	5.011405***	0.000	0.3563499	0.2883	1
Willingness2Pay (User's willingness to pay for the maintenance of water points)	1.379844***	0.001	0.0711876	0.1552	2
Conflict (Occurrence of conflict in RDWP)	0.2128107***	0.003	-0.3628033	0.0894	3
Monitoring (Water user committee monitoring the water points)	3.633398***	0.008	0.2802063	0.0699	4
Willingness2Sustain (User's willingness to sustain/protect service of RDWP)	5.202686*	0.070	0.3903961	0.0687	5
Participation (Participation of the user during project implementation)	3.105278*	0.052	0.2210257	0.0532	6
Satisfaction (User's satisfaction on the RDWPs)	2.894183**	0.024	0.2237879	0.0501	7
Contamination (User's perception on the possibility of contamination)	0.4699142*	0.091	-0.1611238	0.0393	8
Training (User's training opportunity on maintenance)	6.142544**	0.040	0.4249129	0.0387	9

Logistic regression statistics number of obs = 211.

LR chi<sup>2</sup>(14) = 131.61 Prob > chi<sup>2</sup> = 0.0000.

Log likelihood = -74.708068 Pseudo R<sup>2</sup> = 0.4683.

Hosmer-Lemeshow chi<sup>2</sup> = 8.83 Prob > chi<sup>2</sup> = 0.3573.

Note: \*\*\*, \* and \*\* indicate the level of significance at 1%, 5% and 10% respectively.

Source: Own survey data.

functional water points pay more than the users that used to pay under the now non-functional water points. This clearly shows that water points that charged relatively more have higher operational sustainability. Similarly, the regression analysis shows that the probability of sustainability increases by 35.6% ( $p < 0.01$ ) with 1 ETB per month increment in the price of rural water service. This finding coincides with the study by Welle & Williams (2014). They found that sustainability of rural drinking water points is highly dependent on water fee. This is a plausible result in the sense that fees cover operational and maintenance costs of the water points.

### Willingness to pay

The socioeconomic status of the users in the study area is different, and the same applies to the willingness to pay for the operation and maintenance of water points. Users were asked how much they are willing to pay per month to keep the functionality of their respective water points. The users indicated they would pay an average of 6.24 ETB/month, with a maximum of 15 ETB per month. There were also a few users who stated they would pay nothing at all. The average willingness to pay among users that have access to functional water points is 7.11 ETB/month, and this figure is significantly higher than the average willingness to pay (4.85 ETB/month) among users residing around non-functional water points. This is an indication that water points' sustainability is better among users who are willing to pay more as their payment could help to cover the operational and maintenance costs associated with the water points. The regression result also implies the same. User's willingness to pay for the water service is found to be a positive and statistically significant ( $p < 0.001$ ) factor that determines operational sustainability of the water points. The probability of sustainability increases by 7.12% when users are willing to increase the payment by 1 ETB per month. This result corresponds those of Welle & Williams (2014) and Sutton *et al.* (2012), who found the probability of sustainability of rural drinking water schemes increasing as willingness to pay increases. It is clear that whenever users pay for the services, the collected payment can help to cover maintenance costs of the schemes. In particular, willingness to pay has to be encouraged in developing

countries, where once the water points or schemes are installed, local governments are less likely to invest in running the service due to lack of budget and competing budget needs. Because of this, rural drinking water schemes usually fail with a short service life.

### Occurrence of conflict at the water points

This factor is found to be a statistically significant ( $p < 0.01$ ) factor that affects the operational sustainability of RDWPs negatively. The likelihood of sustainability with the occurrence of conflict in the water points is 0.213 lower than those with water points with no incidence of conflict. The marginal effect of this variable is  $-0.363$ , implying that the probability of operational sustainability of water points decreases by 36.3% with the prevalence of conflict in the service points. It was also revealed in FGD that conflicts usually occur during queuing time (line ups of jerry cans as seen in Figure 3) at the water points, particularly in the water points where the number of households using drinking water from the same water points is high. Whenever



**Figure 3** | Queue at the water point. Source: Researcher's own photograph from field work.



conflict occurs there is a probability of breaking the mechanical system (pumping) of the water points. Similarly, water points that provide service to a larger number of users tend to wear out due to pressure on the mechanical system of the water points. Unless addressed on time, these reasons deter the sustainability of the water schemes.

### Monitoring by water user committee

Monitoring of the DWPs by water user committees is found to increase the probability of operational sustainability of the water points significantly ( $p < 0.01$ ) with odds ratio of 3.63. The marginal effect of this variable is 0.28, implying that the probability of sustainability increases by 28% when the scheme is monitored by water user committees. Monitoring by water user committee essentially plays an important role by allowing the members to detect problems and defects in the water points so that decisions can be taken on time. They may also hold regular meetings and discussion about the quality, service and maintenance of the points, and report the status to users or the community. Such discussions essentially contribute to the sustenance of the water points by allowing the committee and the community to respond to problems observed at the water points.

### Willingness to sustain/protect service

Willingness to sustain service is another important factor found to affect operational sustainability of RDWPs. This factor measures users' willingness to protect the service so as to keep it functional. Since households do have access to other alternative sources of water (well, streams and rivers), there might be the possibility among users not to provide the required level of protection for the potable water schemes, in as far as the alternative sources provide them with the required amount and quality of water. In addition, if they usually encounter long waiting times at the potable water schemes, they might not be interested in exerting their time and effort, and allocate meagre resources towards the protection of the water schemes in as far as they do have other dependable sources of water. In such cases, some users might not care whether the water point is functional or not. Lack of care for the water points, in turn, affects the users' sense of willingness to protect the service. The

result in this study also shows that the probability of sustainability increases by 39% ( $p < 0.1$ ) when users are willing to protect the service as compared to users who are not willing to do so. Welle & Williams (2014) also found a similar result when sustainability of drinking water point is dependent on a community's willingness to sustain/protect the service. It appears that the more users are willing to protect the service, the more they will engage in the protection and management of the schemes which, in turn, keeps the service running.

### Participation in the construction of water points

The marginal effect of this variable is 0.221, which implies that the probability of operational sustainability increases by 22.1% when users participate in the construction of the water scheme project than if they do not. Participation during project implementation (DWP construction) is found to be a statistically significant ( $p < 0.1$ ) factor that affects the operational sustainability of RDWPs positively. This result is similar to previous studies by Marks *et al.* (2014), Aliy (2013), Abebe *et al.* (2013), and Marks & Davis (2012). These studies reported a positive relationship between community project sustainability and stakeholders' participation. This clearly indicates that participation during project implementation increases the sense of ownership for the participants so that they manage, monitor and maintain the rural drinking water points, thus enhancing their operational sustainability.

### Satisfaction with the water point service

Satisfaction is also found to be a statistically significant ( $p < 0.05$ ) factor that influences operational sustainability of RDWPs positively. The probability of sustainability of RDWPs increases as users are satisfied with the water point's service with odds ratio of 2.89. The marginal effect of this variable is 0.224, implying that the probability of operational sustainability increases by 22.4% when users are satisfied with the service. Similar results have also been reported by Welle & Williams (2014) and Sutton *et al.* (2012). They reported sustainability of a service to depend largely on the degree to which users are sufficiently satisfied. When users are satisfied with the schemes, it is

highly likely that they will be willing to cover the costs of running the schemes and to serve on water users' committees. When water schemes are installed in the vicinities of users, it reduces the time spent fetching water from streams and rivers. In addition, water points provide safe water as compared to the water from streams and rivers. Water points provide clean water throughout the year while streams and rivers are flooded in the rainy season, making them dirty. This makes water points viable sources of clean water even in the rainy season. Due to these reasons, there is a very high likelihood of satisfaction among users on the services of water points (as far as the points continue to function and satisfy users' water demand).

### Perception on the possibility of contamination

Perception on the possibility of contamination is another factor found to be statistically significant ( $p < 0.1$ ) but negatively affecting the operational sustainability of the water points with odds ratio of 0.47. The marginal effect of the variable is negative with a magnitude of 0.161, implying decrement of the probability of sustainability by 16.1% when users perceive the possibility of contamination at the water points. In rural water schemes, besides household usage, animals drink water at the water points, as can be seen in Figure 4. The discussion with FGD revealed that there is minimum follow up and support points from the woreda water experts in cleaning the water point on time. Key informants also stated that in such cases households develop the sense of the possibility of contamination in the water points so that they might pay little attention to its sustainability. The researcher also observed cattle drinking water at the water points and contamination of some of the water points with animal faeces.

### Training on maintenance

As expected, training on maintenance is found to be a statistically significant ( $p < 0.05$ ) factor that affects operational sustainability of RDWPs positively with odds ratio of 6.143. The odds ratio result indicates that the likelihood of sustainability increases by 6.143 when users are trained on maintenance of the water points. In terms of percentage, the probability of sustainability increases by 42.5% when



**Figure 4** | A cow drinking water around the water point. Source: Researcher's own photograph from field work.

users are trained on maintenance of the water points as compared to non-trained users. This finding is in accordance with previous studies conducted by Welle & Williams (2014) and Katz & Sara (2005), who found that training to users and water committees played an important role in ensuring the sustainability of rural drinking water points. Training provides users with the knowledge and skill that helps them manage, monitor and maintain the water points. It is particularly important since plumbers who repair water points are almost absent in rural areas of Ethiopia. Thus, training helps users to take responsibility for servicing the schemes on time and before the schemes are damaged badly and go beyond maintenance. In addition, training helps to raise the awareness of users as regards to safe and clean water. For the sake of safe water, users can work towards maintaining the functionality of the water schemes.

## CONCLUSION

Although the government of Ethiopia has done a great deal and invested in rural water schemes, more than 33.3% of the water points are not functioning at any one time. With this observation, this study investigated factors affecting the sustainability of rural drinking water points in rural Kebeles of Woliso woreda. It is found that 62% of rural drinking

water points are functional and 38% of them are non-functional. It is also found that water service fee, willingness to pay, occurrence of conflict in the water points, monitoring by water user committees, willingness to sustain service, users' participation in the water point construction, satisfaction with the water point service, perception on the possibility of contamination, and training on maintenance are the major factors that affect the operational sustainability of rural drinking water schemes. It is therefore very important to consider users' participation in constructing water schemes so as to develop a sense of ownership among users, which in turn, increases the operational sustainability of the water points. In addition, introducing some affordable level of service fee is essential to sustain the water points. These practices should also be supported by the provision of functional training to users and water user committees on the management and maintenance of the water schemes. Equipping the community with knowledge and skill enables the community to properly monitor and manage the schemes, and solve problems and conflicts that arise in the water points. Doing so enhances the operational sustainability of rural drinking water points which are constructed with large amounts of finance that come from competing investment sectors and the meagre income of developing countries like Ethiopia.

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