WATER COMMITTEE ACTIVITIES AND CHARACTERISTICS AFFECTING WATER SYSTEM MANAGEMENT IN NORTHERN GHANA

Allison N. Fechter

A thesis submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Master of Science in the Department of Environmental Sciences and Engineering in the Gillings School of Global Public Health.

Chapel Hill
2017

Approved by:

Pete Kolsky

Jamie Bartram

Jordan Smoke

ABSTRACT

Allison N. Fechter: Water Committee Activities and Characteristics Affecting Water System Management in Northern Ghana
(Under the direction of Pete Kolsky)

Water committees are believed to play an important role in managing community water systems in rural Africa. While past research suggests a relationship between water committee effectiveness and long-term sustainability of water systems, the relationship between committee activities and improved management outcomes is unclear. This study examines survey data from 124 communities in Northern Ghana. Two statistical models were developed to analyze the effect of water system management on water point functionality and user satisfaction with water service. Holding community meetings, practicing non-monetary resource mobilization, and preparing maintenance schedules were indicators of better management. Although existing research mostly focuses on pre-construction participation, these results highlight the role that water committees can play in engaging community members after construction is complete. Additionally, the supporting environmental factors of (a) access to tools and spare parts, (b) access to outside support, and (c) training were associated with improved outcomes.

ACKNOWLEDGEMENTS

This research would not have been possible without the support of many people. I would first like to thank Dr. Pete Kolsky for his endless support and invaluable feedback throughout all stages of this research. I would like to thank my committee members, Dr. Jamie Bartram and Jordan Smoke for their support and input. I would also like to thank Dr. Michael Fisher who provided invaluable guidance and assistance throughout.

In the early stages of this research, I received essential guidance from Kaida Liang, Kate Shields Dr. Ryan Cronk, and Tori Klug. I am grateful to Teresa Edwards, a survey methodology expert at the Odum Institute, for reviewing survey questions. I'd also like to thank Dr. Ted Mouw for providing crucial feedback on statistical methods. Additionally, I'd also like to thank the people who took time to review the report and provide comments: Dr. Jacky MacDonald Gibson, Dr. Jill Stewart, Lauren Joca, Lisa Fleming, and Ben Gregory.

This research would not have been possible without the World Vision Ghana data collection staff. I would especially like to thank Zakaria Seidu for his leadership, support, and insight.

Funding for this research was provided by World Vision and the following awards from the University of North Carolina at Chapel Hill: Danial A. Okun Scholarship, Alan and Linda Rimer Scholarship, and the SPH Annual Fund.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CQI	Continuous Quality Improvement
IRB	Institutional Review Board
M&E	Monitoring and evaluation
MDG	Millennium Development Goal
NGO	Non-governmental organizations
PCS	Post-construction support
SDG	Sustainable Development Goal
UNC	University of North Carolina at Chapel Hill
WaSH	Water, sanitation, and hygiene

CHAPTER 1: INTRODUCTION

Background

The United Nations Sustainable Development Goal (SDG) 6 is to "ensure availability and sustainable management of water and sanitation for all" by 2030 (United Nations, n.d.-a). This goal comprises several targets, including Target 6.B: to "Support and strengthen the participation of local communities in improving water and sanitation management" (United Nations, n.d.-a). The Millennium Development Goals (MDGs), which set the 2000 to 2015 agenda for sustainable development, had focused on increasing access to sources classified as "improved"[1] (United Nations, n.d.-b).The SDGs build on the MDGs by requiring that water sources be not only "improved," but also "safely managed[2]." In response to SDG 6, governments, non-governmental organizations (NGOs), and other stakeholders involved in the international water, sanitation, and hygiene (WaSH) sector must now support and strengthen community management institutions, while also working to deliver a higher level of service than would be needed to meet the MDGs.

The community management model has dominated rural water sector policy and practice since the 1990s (Schouten & Moriarty, 2003). Inherent to the community management model are water committees, a group of elected or volunteer community members who oversee financial and technical management of local water systems (Chowns, 2015). It is believed that the presence of a management committee, combined with access to resources such as tools and post construction support, enhances functionality of water systems (Whittington et al., 2009). However, the success of community management varies. Target 6.B presents an opportunity for stakeholders to re-evaluate the assumptions surrounding the community management model, and implement approaches that support and strengthen

[1] "An 'improved' drinking-water source is one that, by the nature of its construction and when properly used, adequately protects the source from outside contamination, particularly fecal matter" (WHO/UNICEF, 2015)
[2] Safely managed is defined as "drinking water from an improved water source which is located on premises, available when needed and free from faecal and priority chemical contamination" (Joint Monitoring Programme, 2017).

water committees. To determine the best approach that stakeholders can take to support water committees, it is useful to better understand committee activities or characteristics are associated with better water system outcomes.

Past research suggests a relationship between water committee effectiveness and sustainability of water systems, and several studies have identified specific management activities and characteristics that are believed to promote water system sustainability (See Literature Review section). Frequently mentioned management activities include collecting revenue from users, holding regular committee meetings, and keeping financial and maintenance records. The most frequently mentioned characteristics involve gender balance: committees that have female members or female members holding key positions. To date, no studies have explored the association between management and water system outcomes by considering an extensive list of management activities and characteristics in unison. This research, which focuses on water committees in Northern Ghana, seeks to fill this gap by examining the association between a comprehensive list of activities and characteristics and two outcomes of interest: water source functionality and user satisfaction.

Research Objectives:

1) Conduct a literature review to identify management characteristics to include in the study and develop survey tools to measure these characteristics in Northern Ghana
2) Evaluate the relationship between management activities and characteristics and two outcomes of interest: water source functionality and user satisfaction

Literature Review

This literature review seeks to answer the following research question: Which water committee management activities and characteristics (including those that relate to external support) are associated with improved water system outcomes? Studies were identified from peer review literature using the Web of Science online database. Bibliographies of included studies were searched to identify additional relevant literature that was not found during the database search. Studies were included in the review if

the author analyzed a dataset and identified specific management activities or characteristics related to water system outcomes such as functionality. Both quantitative and qualitative studies were included in the review. Eligibility was limited to studies of rural areas, but not otherwise restricted geographically. Management activities and characteristics were extracted from each study. Following data extraction, four distinct categories of activities and characteristics were identified: a) financial management, b) activity level and accountability, c) community engagement, and d) knowledge, skills, and supporting environment.

Financial Management

Collecting revenue from water users is often referenced as an important measure in ensuring the sustainability of community managed water sources. Three studies included in this review cited revenue collection as a management characteristic (Adank et al., 2014; Fisher et al., 2015; Foster, 2013). In a study of 25,000 handpumps across Liberia, Sierra Leone, and Uganda, Foster (2013) found that the odds of a handpump being functional was higher when fee collection was practiced. Fisher et al. (2015), running a somewhat similar multivariate logistic regression model for handpumps in Ghana, found the same relationship between functionality and fee collection. Also focusing on handpumps in Ghana, Adank at al. (2014) found a strong positive correlation between fee collection and service level (a categorical variable encompassing functionality and service standards).

Expanding beyond the binary measure of whether fee collection is practiced and looking to the quantity of fees collected, two studies found relationships between fee quantity and functionality. Adank et al. (2014) found a correlation between functionality and revenue collection levels that exceeded annual expenditures, and Alexander et al. (2015) found that higher monthly fees were associated with higher functionality for water systems in Ethiopia. Four other studies referenced the water committee's ability to collect sufficient funds to cover operation and maintenance (O&M) and/or minor or major repairs as possible measures of financial management. However, none of these studies draw a statistical relationship between funds collected and improved water system outcomes (Chowns, 2015; Madrigal, Alpízar, & Schlüter, 2011; Marks, Komives, & Davis, 2014; Whittington et al., 2009). Schweitzer and

Mihelcic (2012) developed a sustainability assessment tool for community managed water systems in the Dominican Republic and cited both sufficient revenue to cover O&M and "significant" savings as indicators of financial durability.

Some studies asked, "who is paying?" and "when?" Three studies considered the proportion of debtors in a community as a financial management characteristic (Madrigal et al., 2011; Schweitzer & Mihelcic, 2012; van den Broek & Brown, 2015). In a study on the functionality of handpumps in Uganda, van den Broek and Brown (2015) highlight the importance of considering percent debtors since some communities may not require all users to pay for water. Foster (2013) considered the effectiveness of proactive versus reactive payments and found mixed results: proactive payments were related to higher levels of handpump functionality in Sierra Leone but lower levels in Liberia.

Most of the research surrounding financial management of community water systems concerns monetary fee collection. However, for many communities, this may be only one part of overall resource mobilization efforts. Through exploration of resource management practices among water committees in rural Ghana, Kenya, and Zambia, Behnke (2017) found that many of the study communities were practicing non-monetary resource mobilization. They found that non-monetary resource mobilization is more inclusive and allows more community members to contribute to the water system, particularly within non-cash economies or if a portion of the community is poor. Financial management activities and characteristics are summarized in Table 1.

Table 1: Financial management activities and characteristics

Characteristics/Activities	Source
Revenue collection from users	(Foster, 2013) (Fisher et al., 2015) (Adank et al., 2014)
Proportion debtors or proportion who don't pay	(Madrigal et al., 2011) (Schweitzer & Mihelcic, 2012) (van den Broek & Brown, 2015)
Funds collected adequate to cover O&M	(Whittington et al., 2009) (Chowns, 2015) (Marks et al., 2014) (Adank et al., 2014) (Madrigal et al., 2011)
Funds collected exceed cost of O&M and "significant savings" observed	(Schweitzer & Mihelcic, 2012)
Funds collected adequate to cover capital cost or proportion of capital cost	(Madrigal et al., 2011) (Marks et al., 2014)
Higher monthly fees	(Alexander, Tesfaye, Dreibelbis, Abaire, & Freeman, 2015)
Collecting money from users in advance of breakdown	(Foster, 2013)
Non-monetary resource mobilization	(Behnke et al., 2017)

Activity Level

Water committees are usually expected to hold regular committee meetings and keep records of meetings and/or finances. Three studies found positive relationships between committees that had at least one of these characteristics and improved outcomes. Foster (2013) found that holding regular committee meetings and having six or more committee members were both related to improved functionality in Uganda. Alexander et al. (2015) found that holding committee meetings at least every three months and keeping good records was positively associated with functionality in Ethiopia. In Ghana, Adank (2014) found that having up-to-date records was correlated with level of service.

Three studies mentioned the role of accountability, rules, and decision-making processes (Madrigal et al., 2011; Schweitzer & Mihelcic, 2012; Whittington et al., 2009). Madrigal et al. (2011) examined the determinants of performance for water committees in Costa Rica and found that having a set of working rules and local accountability were related to higher performance scores. Schweitzer and Mihelcic (2012) found a relationship between improved decision-making processes and attendance at water committee meetings in Costa Rica, linking two different management characteristics each of which is related to activity level.

Two studies mention the importance of accountability in relation to water system maintenance activities. Using multivariate logistic regression, Foster (2013) found that the odds of a handpump being functional in Uganda were higher when maintenance activities were performed. Similarly, Schweitzer and Mihelcic (2012) found that more hours per month of system maintenance was correlated with better functionality.

Female representation is often considered an important characteristic for sustainable management, and four studies examined the role of women on committees. Exploring the relationship between female participation on committees and level of project effectiveness using regression analysis, Prokopy (2004) found that having women on the committee did not lead to improved project outcomes in India. This is inconsistent with the finding from Foster (2013) that handpumps were more likely to be functional in Uganda with women on the committee. Madrigal et al. (2011) found that committees in Costa Rica performed better with female members. In a qualitative study that examined the role of women in water management in Kenya, Yerian et al. (2014) found that gender dynamics prevented women from feeling comfortable participating in meetings, revealing an important cultural dynamic that will likely vary by context. Activity level activities and characteristics are summarized in Table 2.

Table 2: Activity level management activities and characteristics

Characteristics/Activities	Source(s)
Presence of rules and decision-making process followed by committee	(Madrigal et al., 2011) (Chowns, 2015) (Schweitzer & Mihelcic, 2012) (Whittington et al., 2009)
Committee has active members	(Schweitzer & Mihelcic, 2012) (Foster, 2013) (Fisher et al., 2015)
Committee meets regularly	(Foster, 2013) (Whittington et al., 2009) (Alexander et al., 2015)
Women are active on the committee and hold key positions	(Foster, 2013) (Prokopy, 2004) (Whittington et al., 2009) (Madrigal et al., 2011)
Records are kept and up to date	(Marks et al., 2014) (Alexander et al., 2015) (Adank et al., 2014)
Compensation for water system caretaker	(Alexander et al., 2015)
Identifiable management structure	(Fisher et al., 2015)
Committee conducts regular service and maintenance activities	(Schweitzer & Mihelcic, 2012) (Foster, 2013)

Community Engagement

Two aspects of community engagement, community meetings and participation in water system decision making, are addressed in four of the studies included in this review (Marks et al., 2014; Prokopy, 2004; Schweitzer & Mihelcic, 2012; Walters & Chinowsky, 2016). Marks et al. (2014) found that project outcomes in Ghana were better when a larger proportion of households reported participating in water system decisions. Although Prokopy (2004) did not find a link between female participation and project improvements in India, she did find a relationship between overall participation and improvements. Walters and Chinowsky (2016) found that organizing and holding community meetings was a key activity related to water system functionality for communities in Nicaragua. Schweitzer and Mihelcic (2012) included percent attendance at community meetings in their water system sustainability assessment scoring tool.

Schweitzer and Mihelcic (2012) identified committee transparency, through accounting ledger and report frequency, as a component of their water system sustainability assessment scoring tool in the

Dominican Republic. They found that these measures of transparency were positively correlated with higher payments of water user fees.

It is possible that sense of ownership also relates to community engagement activities. Marks, Onda, and Davis (2013) found that community members' sense of ownership was associated with user confidence in water system and sustainable water system management in Kenya. Community engagement management activities and characteristics are summarized in Table 3.

Table 3: Community engagement management activities and characteristics

Characteristics/Activities	Source(s)
Community members' sense of ownership for community water supply system	(Marks, Onda, & Davis, 2013) (Madrigal et al., 2011)
Committee transparency	(Schweitzer & Mihelcic, 2012)
Committee holds community meetings/community members have opportunity to participate in decision making	(Marks et al., 2014) (Schweitzer & Mihelcic, 2012) (Walters & Chinowsky, 2016) (Prokopy, 2004)
Facilitate training sessions within the community	(Marks et al., 2014)

Knowledge, Skills, and Supporting Environment

Seven studies mentioned the importance of being able to access technical support from outside the community when needed, with the type of technical support varying by study. Foster (2013) found that committees in Sierra Leone that did not have access to a mechanic experienced a higher rate of non-functionality. Kayser et al. (2014) found that communities in El Salvador with access to circuit rider post-construction support (ongoing technical, financial, and operational assistance) experienced better water quality and had better overall community management practices. Davis et al. (2008) examined the relationship between PCS and sustainability in Bolivia, and found that communities that received management-oriented PCS visits had better performing systems. Whittington et al. (2009) found a positive relationship between household satisfaction and PCS visits (that provided financial or managerial assistance) in Bolivia. Fisher et al. (2015) and Schweitzer and Mihelcic (2012) both looked more at the number of days a community must wait once it requests the service of a mechanic. Fisher et al. (2015) found that functionality correlates inversely with the waiting period in days for water systems' repair in Ghana.

Availability of tools and spare parts are supporting environment characteristics, particularly for minor repairs that do not warrant a PCS visit. Foster (2013) found that handpumps were more likely to be functional in Sierra Leone when spare parts were located within 20 miles. Bayesian network analysis revealed that access to spare parts and tools increased the likelihood of a source being functional in Ghana (Fisher et al., 2015). Using qualitative methods, Chowns (2015) found that willingness to pay for replacement parts was slowing down repair time for water systems in Malawi.

Although PCS visits may be required for major repairs in most settings, it is beneficial for committees to at least have the skills related to minor repairs (Alexander et al., 2015; Marks et al., 2014). These skills are often obtained through training. In Ghana and Bolivia, Whittington et al. (2009) found a positive association between technical training of system operators or caretakers and both system performance and user satisfaction. In Bolivia, water committees with a system caretaker that attended training workshops had better performing systems, and those that received administrative support were more likely to have a higher proportion of taps functional (Davis et al., 2008). Similarly, Foster (2013) found that a greater proportion of handpumps were functioning when water committees had been trained in Uganda. Knowledge, skills, and supporting environment activities and characteristics are summarized in Table 4.

Table 4: Knowledge, skills, and supporting environment activities and characteristics

Characteristics/Activities	Source(s)
Ability to access support from outside the community ("post construction support" or area mechanics) when needed	(Marks et al., 2014) (Whittington et al., 2009) (Foster, 2013) (Kayser, Moomaw, Miguel, Portillo, & Grif, 2014) (Davis et al., 2008)
Number of days required to obtain the services of a mechanic/downtime	(Fisher et al., 2015) (Schweitzer & Mihelcic, 2012)
Availability of spare parts	(Foster, 2013) (Chowns, 2015) (Fisher et al., 2015)
Willingness to pay for replacement parts	(Chowns, 2015)
Availability of tools	(Fisher et al., 2015)
Committee can identify someone who is responsible for repairs	(Chowns, 2015)
Committee has capacity to make minor repairs	(Alexander et al., 2015) (Marks et al., 2014)
Capacity building training related to administrative and financial function	(Davis et al., 2008)
Operator and/or committee training	(Whittington et al., 2009) (Davis et al., 2008) (Foster, 2013)
Ability to apply skills learned in training	(Chowns, 2015)
External agency audits records periodically	(Alexander et al., 2015)

Summary

This review compiled a comprehensive list of water committee activities and characteristics that appear in the literature on community managed rural water systems. However, the list of characteristics for which one or more studies examine a statistical relationship between management activities and characteristics and improved water system outcomes (e.g. functionality, user satisfaction) is much shorter. This shorter list includes collecting fees, collecting higher monthly fees, holding regular meetings, keeping records, having committee members, holding meetings with community members/water system users. Key supporting environment variables include access to spare parts and tools, access to outside support or PCS, and committee training.

CHAPTER 2: METHODS

Background

This research was conducted as part of an ongoing monitoring and evaluation (M&E) partnership between the NGO World Vision and the Water Institute at the University of North Carolina at Chapel Hill (UNC). The ongoing partnership uses data collected through household, community, and water point survey instruments to evaluate the impact of World Vision's WaSH programs across four districts in Northern Ghana: Savelugu, Tolon, Gushiegu and Karaga. Since 1990, World Vision has implemented a number of WaSH programs in these districts, including water source installation (primarily boreholes with handpumps), water committee training, and hygiene and/or sanitation program implementation.

The ongoing partnership includes a Continuous Quality Improvement (CQI) process to identify potential interventions. Following baseline data collection in 2014, three interventions were identified: WaSH committee training and capacity building, distribution of tools for water point maintenance, and provision of safe water storage containers to households. Half of the study communities were randomly selected to receive the interventions. Standardized water committee training was conducted in all intervention communities. In addition, intervention committees received tools for water point maintenance. Specifically, World Vision distributes a standard tool kit for water point repair in the communities where they work. Over time, these tools can break or go missing. In the intervention communities, any tools that were missing from the standard toolkit were replaced. Six households were chosen at random in each intervention community to receive safe water storage containers. Data for this research were collected in two districts in Northern Ghana during follow-up data collection after the intervention (in both control and intervention communities).

Survey Development and Piloting

Survey Development

I reviewed literature concerning community managed water systems and compiled a list of water committee management activities and characteristics that are associated with increased functionality and service reliability (see Literature Review section). Four categories of activities and characteristics were identified based on the results of the literature review:

a) Financial management (e.g. collecting water user fees, saving money)

b) Activity level (e.g. holding meetings, having a gender balanced committee)

c) Community engagement (e.g. holding community meetings, transparency with the community)

d) Knowledge, skills, and supporting environment (e.g. access to outside support, access to spare parts)

Survey questions were developed to collect data on management activities and characteristics associated with each category. Questions developed specifically for this technical report were included in the community and household surveys.

Piloting

The survey questions were piloted in 29 communities in Northern Ghana in November 2016. Pilot data were reviewed to evaluate the effectiveness of the questions and data collectors gave feedback on their experience administering the surveys. After piloting, some survey questions were re-written for clarity and others were eliminated.

Ethical Approval

The University of North Carolina Institutional Review Board (IRB) approved this study (Approval number 14-0386). The Navrongo Health Research Centre in the Upper East Region of Ghana also gave approval for this study.

Data Collection

Sampling Methods

The ongoing M&E partnership, which predates this study, collects data on WaSH services in Northern Ghana using a cluster-randomized trial approach with repeat measures. The ongoing study includes a total of 224 communities across four districts in Northern Ghana: Savelugu, Tolon, Gushiegu, and Karaga. World Vision had previously installed water points in every study community. These 224 communities were randomized to two equal study arms: an intervention and a control arms. During the initial data collection in 2014, 926 waterpoints and 527 households were visited. For the purposes of the study described in this technical report, data collected during a monitoring cycle in 2017 from only two of the four districts was analyzed (Savelugu and Tolon), for a total of 124 study communities (Figure 1). Samples used for each of the statistical analysis (functionality and user satisfaction) are described in the following sections.

In addition to previously installing water points in every study community, World Vision had implemented water committee training and hygiene and/or sanitation programs in these districts. However, the extent of World Vision WaSH programming and additional technical support that might coincide with the programming, is not known for individual study communities. As such, this is a potential confounder that cannot be controlled for. Northern Ghana is an area of high activity by NGOs. Some of the study communities had water points installed by other NGOs (e.g. Water Aid, UNICEF), and it is possible that these NGOs implemented additional WaSH programming in the past. However, we are not aware of any NGOs, aside from World Vision, that were implementing WaSH interventions in the study communities at the time of this work. Two samples were identified, one for each outcome of interest (functionality and user satisfaction), as described below.

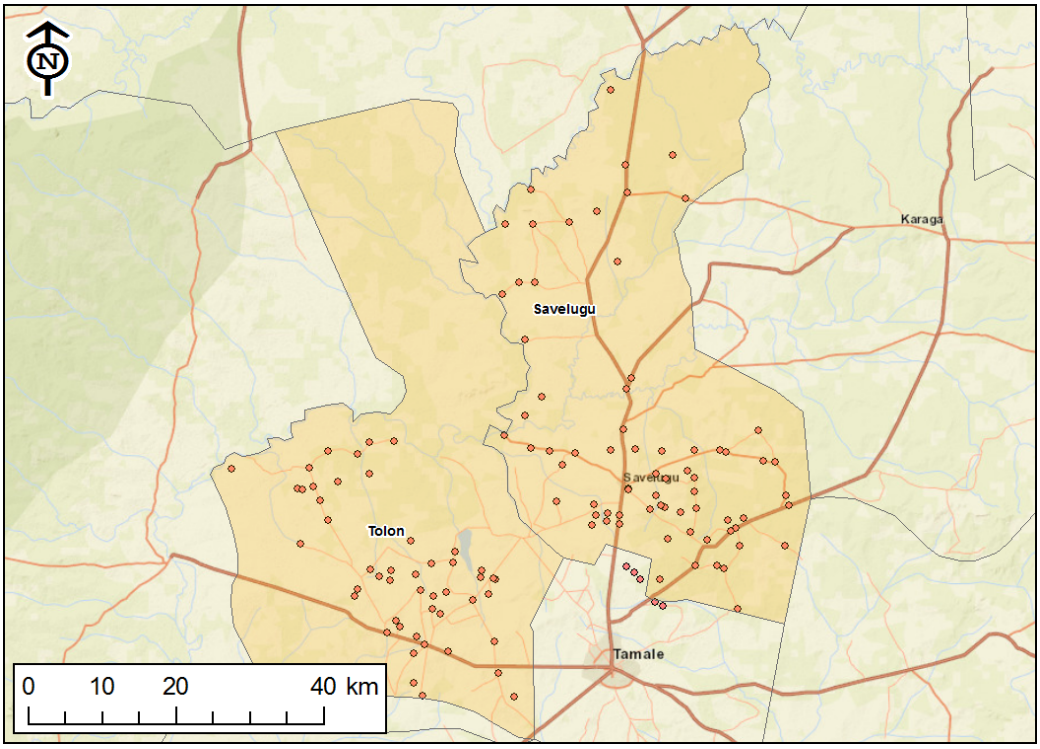


Figure 1: Map of 124 study communities showing district boundaries for Savelugu and Tolon

Functionality Sampling Methods

An analysis of water point functionality across the study communities was conducted using a sample of 440 water points. The initial data set consisted of 720 water points, and included all water points used for drinking within each study community. However, only source types that require a similar level of management were included in the sample: a) borehole with manual pump, b) protected dug well with handpump and c) public taps/standpipe. The initial sample also included three mechanized boreholes, but these were omitted from the analysis because all three were dysfunctional. Source types that do not require a similar level of management because they are not susceptible to mechanistic failure, such as surface water, were excluded from the analysis. The sample was further restricted to water points managed by a water committee, thereby excluding water points managed by schools or private operators.

User Satisfaction Sampling Methods

User satisfaction was analyzed using a sample of 200 households. These households were in a subset of 48 study communities where household survey data was collected. Initially, six households per

community were chosen for inclusion in the ongoing study using random sampling methods. Due to loss to follow-up, the total number of households per community in this sample ranges from two to six.

Data Collection Methods

Data were collected between December 2016 and March 2017 by World Vision Ghana data collectors. Two data collectors visited each community in the study and conducted mixed methods surveys of the community, water points, and households.

One community survey was completed for each community. This survey captures information on WaSH services available to the community and water committee activities and characteristics. The respondent for the community survey was water committee members (each sample community had one water committee), or a community leader when the committee was not available.

The household survey captured information on WaSH related behaviors and services and user satisfaction with water service, in addition to basic demographic and socioeconomic information. Surveys were conducted after informed consent was obtained and respondents could end the survey at any time. Surveys were conducted in the local language and data collectors were instructed to interview the female head of household whenever possible. If a female head of household was not available, data collectors interviewed a female household member over the age of sixteen. Households did not receive compensation for their participation.

Data collectors conducted a separate water point survey at each water source included in the study. The water point survey captures information on source type, functionality, and age of water point (where applicable). The respondent for the water point survey was either a water committee member, water point operator, or an otherwise knowledgeable community member. Although the water point data and community data were collected using separate survey instruments, data from both surveys were linked during analysis using unique community ID codes.

Statistical Analysis

Data were cleaned and analyzed using Stata 14 (Statacorp., College Station, TX). Two multivariable models were designed to examine the relationship between management characteristics (i.e. the key input variables) and improved outcomes (i.e. higher levels of functionality and user satisfaction). A conceptual diagram guided the development of both models (Figure 2).

Summary statistics were tabulated and a univariate regression was performed to identify which management characteristics identified in the literature review had the greatest association with water system functionality and user satisfaction (Table 5). The results of the univariate regression analysis helped the author identify key management characteristics to include as variables in the final models.

In addition to the key management characteristics, supporting environment variables which may enable water committees to achieve better outcomes, such as access to tools and availability of spare parts, were included in each model. The models also controlled for other factors believed to influence functionality (e.g. age of water point, population of community) and user satisfaction (e.g. source type, functionality of source in the past year).

Functionality Model

The functionality model analysis was conducted at the water point level, based on data collected on 440 water points. Functionality is a dichotomous outcome variable at the waterpoint level defined by the direct observation of whether water could be obtained from the water point at the time of the visit. Water points categorized as not functional included those that were out of service due to mechanical failures and those that were experiencing seasonal water shortages (note: protected dug wells with handpumps were categorized as not functional if the handpump was not working, regardless of whether water could be drawn from the well).

The multivariate analysis was conducted using multilevel logistic regression. This type of regression was chosen over a simpler single level logistic regression analysis because the number of water points per community (and therefore, the number of water points managed by each committee) vary from 1 to 16 water points. The multilevel analysis allows us to predict community level effect while

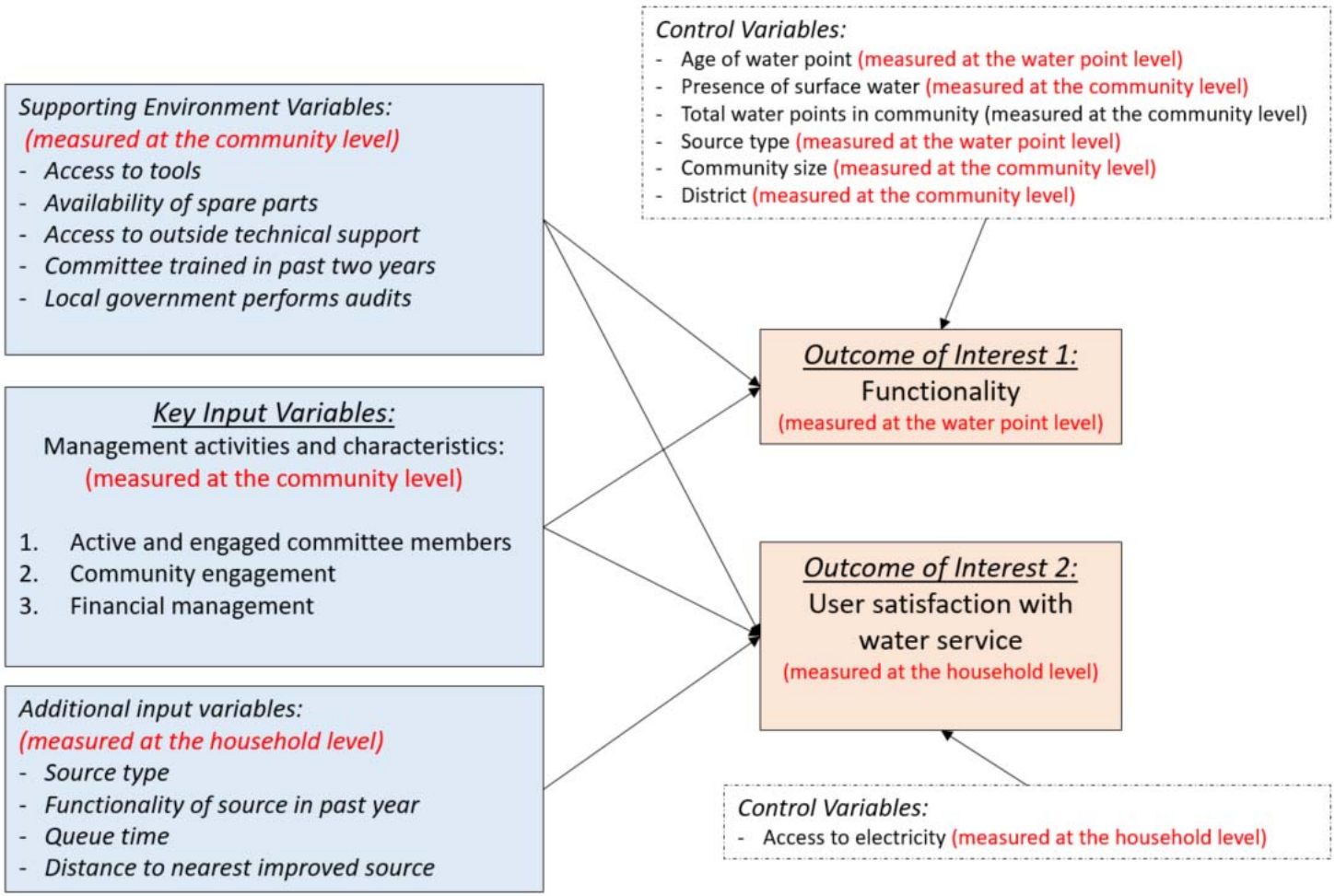
considering the varying number of water points per community. Imagine conducting this analysis using single level logistic regression: each water point would be considered a completely independent data point regardless of the total number of water points per community. The theory surrounding community managed water systems leads us to believe that functionality of a single community water point may be correlated with the functionality of other water points in the community. Therefore, a single level model is insufficient and a multilevel model is needed. Multilevel models are adept at handling this type of problem: they allow us to conduct a functionality analysis at the water point level, while still considering the effect of community on the functionality of individual water points.

User Satisfaction Model

User satisfaction was based on responses to the following household survey question: "How satisfied or dissatisfied are you with your water service?" Two hundred respondents answered this question on a three-point Likert scale of: "very satisfied," "somewhat satisfied," and "dissatisfied."

I assessed the relationship between independent variables and user satisfaction using ordered logistic regression analysis. This model was chosen because the dependent variable (user satisfaction) is based on ordinal data: three ordered categories increasing in value from "dissatisfied" to "very satisfied."

It is important to note that the functionality model and user satisfaction model comprise two separate analysis using two separate datasets. The functionality analysis was conducted at the water point level and the user satisfaction model was conducted at the household level. However, the data were collected in some of the same communities (functionality data was collected in 124 communities and user satisfaction data was also collected in 48 of those communities), and the datasets were linked via unique community IDs.



Note: One water committee was responsible for managing water point(s) per community

Figure 2: Conceptual model linking management, supporting environment, additional input, and control variables to outcomes of interest

CHAPTER 3: RESULTS

The following section presents results from the analysis. First, community and management committee summary statistics are presented. All committee activities and characteristics are summarized based on the four categories specified previously: a) financial management, b) activity level, c) community engagement, and d) knowledge, skills, and supporting environment. Next, results from the functionality analysis are presented. This is broken into two sub-sections: first summary statistics are presented for all water point characteristics, followed by results from the multivariable functionality model. Finally, results from the user satisfaction analysis are presented. This includes summary statistics for household and water service variables, and results from the multivariable user satisfaction model.

Community and Management Committee Characteristics

Data were collected in 124 communities. There was a large variance in population per community, ranging from 50 to 21,000 residents with a mean of 2,000 (median of 675) (Figure 3). The total population for all study communities was approximately 157,000 (excluding 8 communities for which the population was unknown). Each community had at least one community-managed water point (per the exclusion criteria), and each committee was responsible for managing an average of five sources (ranging from 1 to 15). Approximately 25% of water committees were managing 2 or fewer water points and approximately 75% of water committees were managing 6 or fewer water points. The most common type of community-managed source was a borehole with a manual pump. Most communities (92%) had at least one borehole. The second most common type of community-managed source was a public tap/standpipe. Water committees were responsible for a variety of management functions, as summarized in Table 5.

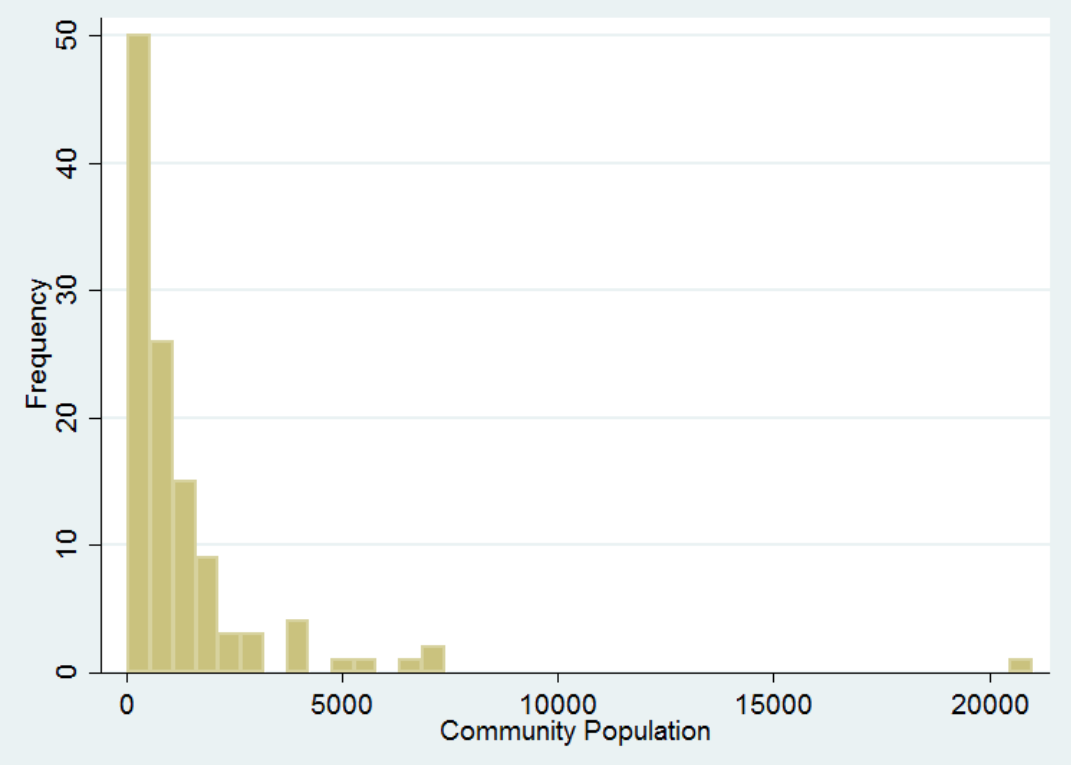


Figure 3: Frequency of populations for all 124 sample communities

Table 5: Management activities and characteristics considered in analysis

Management Variables	N (%) n=124*
Activity Level	
Committee prepares maintenance schedules	20 (16%)
Committee keeps financial records	53 (43%)
Committee meets regularly and had 100% of committee members attended the last meeting	70 (56%)
Committee held a meeting in the last month	41 (33%)
Mean percent of committee that is female	(39%)
Committee meets regularly and have women on the committee that attend as often, or more often, than men on the committee	95 (77%)
Committee has a female in a key financial position (financial clerk, revenue collector, treasurer, or vendor)	59 (48%)
Committee has a female chair or vice chair	16 (13%)
Government checked financial records in the past year	11 (9%)
Community Engagement	
Committee held a community meeting in the past 6 months	83 (67%)
Financial Management	
Community members pay for water	75 (60%)
Committee practiced non-monetary resource mobilization (community labor and/or donations)	66 (53%)
Committee collected additional money from users in response to the last breakdown	44 (35%)
Committee has more than 500 Ghana Cedis in savings	20 (16%)
Committee has an administrative or financial clerk	91 (73%)
Committee has a vendor at every water point	27 (22%)
Knowledge, Skills, and Supporting Environment	
Repair person received training in past two years	38 (31%)
Repair person has access to tools and spare parts	67 (54%)
Committee has access to outside technical support when needed	106 (85%)
Committee received training related to financial management	28 (23%)

*Data incomplete for some variables

Activity Level

Water committees ranged in size from one to fifty members with an average committee size of nine. Nearly all water committees included at least one female member (97%) and an average committee was 39% female. Most committees (89%) met regularly, and 33% reported meeting in the past month. Seventy-seven percent of committees reported that women on the committee attend meetings as often as or more often than men on the committee, and close to half of all committees (48%) had female members holding key financial management positions (financial clerk, revenue collector, treasurer, and vendor). About half of all committees reported keeping records: 43% reported keeping financial records

and 16% reported preparing maintenance schedules but only a small proportion showed the records to data collectors (13% and 3% respectively).

Community Engagement

Most communities (81%) reported that the water committee had held a community meeting at some point, and 67% reported that a community meeting had taken place in the last six months. Thirty-six percent of household survey respondents had attended a community meeting led by the water committee. However, only 15% of household respondents reported involvement in a decision about the water system.

Financial Management

The water committee reported that users paid for water in 60% of communities (most of which reported that 100% of users paid for water). Most of these committees (80%) practiced regular fee collection (yearly, quarterly, monthly, weekly, or every time they fetch water), while 20% of committees collected money following breakdown. Some communities practiced non-monetary resource mobilization (53%), through either a) communal labor (e.g. communal farming), b) donating goods or livestock (e.g. shea nuts, maize, bowl of rice), c) other fundraising activities, or a combination of the three mechanisms. Communal labor was the most common response. In particular, communities in this region are known to organize communal farming activities where community members will collectively farm a piece of land to raise money for the water system. About half of all committees (55%) had money saved for repairing water points when needed, and 16% had more than 500 Ghana Cedis (approximately 100 USD). Financial positions were common: 73% of committees had an administrative or financial clerk, and 22% had vendors.

Knowledge, Skills and Supporting Environment

In most communities (87%), the water committee was responsible for repairs, but only 31% of committees had received training in maintenance and repair in the past two years. A smaller proportion (23%) reported receiving training related to financial management. About half (54%) of the committees reported having access to the tools and spare parts needed to keep the water points running. Most

committees (85%) had a repairperson or team outside of the community who they could contact for advanced technical support when needed. "Area mechanic" and "private maintenance person" were the two most-commonly cited forms of outside support. All committees that had called for outside support in the past year reported that the support person, or team, came when they were called and 71% reported that the person/team came within one day.

Functionality

The following sub-sections present results from the functionality analysis. First water point summary statistics are presented, followed by results from the multivariable functionality model.

Water Point Characteristics

A total of 440 water points was included in the descriptive analysis, but because of missing data, a subset of 311 water points was included in the final multivariate regression. The most common source of missing data was water point age, although data was missing for some of the other variables as well. It is possible that missing data introduces bias, but some percentage of missing data is generally unavoidable in these types of studies. The water points included three different source types: boreholes with manual pumps (66%), protected dug wells with handpumps (10%), and public taps/standpipe (24%) (Table 6). Fifty-nine percent of the water points were functional, or had water available on the day of the visit. Boreholes with manual pumps were the most functional source type with 65.9% functional, followed by public tap/standpipe (50.9% functional) and protected dug well with handpump (31.8% functional). The water points ranged in age from one to fifty-seven years with an average age of 10 years (Figure 4).

Table 6: Facility characteristics

	N (%) n=440*
Source type:	
Borehole with manual pump	290 (66%)
Protected dug well with handpump	44 (10%)
Public tap/standpipe	106 (24%)
Total water points (per community):	
1-4	95 (22%)
5-7	143 (32%)
8-10	72 (16%)
11-16	130 (30%)
Water point age:	
1-5	71 (20%)
6-9	77 (22%)
10-14	139 (40%)
15-57	65 (18%)

*Data incomplete for some variables

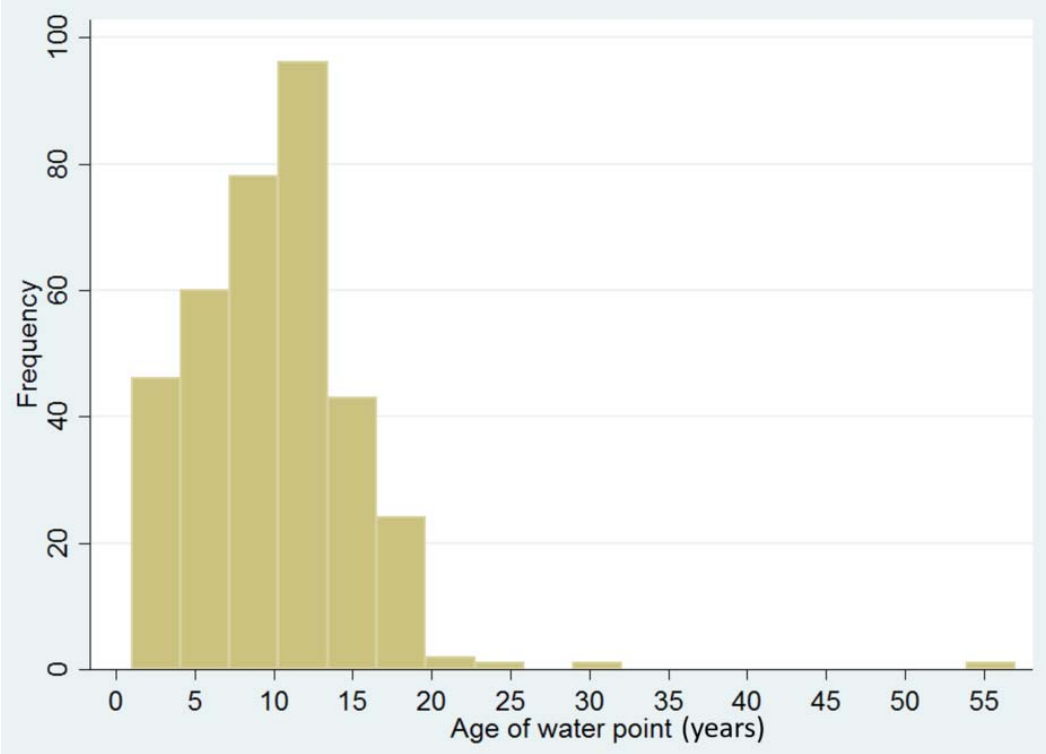


Figure 4: Frequency of water point ages for 440 water points included in the sample

Functionality Model Results

Results from the multilevel logistic regression analysis of variables associated with water point functionality are listed in Table 7. Most variables are categorical, but two variables are continuous: a)

population and b) proportion of committee that is female. Each categorical variable has a reference category. For example, the reference variable for source type is borehole with manual pump. The two other source type categories, protected dug well with handpump and public tap/standpipe, should each be interpreted in respect to the reference category. The first line, "Source type: Protected dug well with handpump vs. borehole with manual pump," should be interpreted as follows: protected dug wells with handpumps are 89% less likely to be functional than boreholes with manual pumps. Interpreting a continuous variable, such as population, can be less intuitive. Population can be interpreted as follows: for each one person increase in population the odds of functionality increase by less than 0.001. The effect of population increase on functionality is very small, however, the effect is significant to the $p<.05$ level. It is important to look at both the odds ratio and p-value when interpreting the variables: although population was a significant variable in the multivariable regression, the effect (odds ratio) was practically negligible.

Table 7: Multilevel logistic regression analysis of variables associated with water point functionality

	OR (95% CI)	P-value
Community Characteristics (control variables)		
Population	1.000 (1.000 - 1.000)	0.011
Presence of surface water in community: yes vs. no	0.190 (0.0662 - 0.544)	0.002
District: Savelugu vs. Tolon	0.596 (0.263 - 1.350)	0.215
Facility Characteristics (control variables)		
Source type:		
Source type: Protected dug well with handpump vs. borehole with manual pump	0.113 (0.0338 - 0.377)	0.000
Source type: Public tap/standpipe vs. borehole with manual pump	0.480 (0.202 - 1.142)	0.097
Total water points:		
Total water points: 5-7 vs. 1-4	0.194 (0.0688 - 0.549)	0.002
Total water points: 8-10 vs. 1-4	1.274(0.385 - 4.213)	0.691
Total water points: 11-16 vs. 1-4	0.459(0.122 - 1.724)	0.249
Water point age:		
Age: 6-9 vs. 1-5	0.154 (0.0571 - 0.417)	0.000
Age: 10-14 vs. 1-5	0.816(0.321 - 2.076)	0.669
Age: 15-57 vs. 1-5	0.432(0.145 - 1.289)	0.132
Key Supporting Environment Variables		
Repair person has access to tools and parts: yes vs. no	2.504 (1.053 - 5.953)	0.038
Access to outside technical support:		
Access to outside support but never called or "N/A" vs. no access to outside support	4.788 (1.135 - 20.20)	0.033
Received outside support vs. no access to outside support	2.885 (0.938 - 8.871)	0.065
Key Management Variables		
Committees that have held a community meeting in last 6 months: yes vs. no	2.348 (1.045 - 5.277)	0.039
Savings:		
Savings: 1-500 Cedis vs. no savings	0.201 (0.0690 - 0.588)	0.003
Savings: 501-8,000 Cedis vs. no savings	0.277 (0.0949 - 0.811)	0.019
Resource mobilization type (monetary or non-monetary)		
Only monetary resource mobilization vs. no resource mobilization	2.048 (0.666 - 6.302)	0.211
Combination monetary and non-monetary resource mobilization vs. no resource mobilization	2.351 (0.753 - 7.343)	0.141
Only non-monetary resource mobilization vs. no resource mobilization	6.787 (1.609 - 28.63)	0.009
Proportion of committee that is female	7.484(0.281 - 199.6)	0.230
Committee meets regularly and had 100% of committee members attended the last meeting: yes vs. no	0.949(0.437 - 2.058)	0.894
Constant	4.209(0.401 - 44.21)	0.231
Observations, Number of groups		333, 103
Log likelihood		-162.27

Key supporting environment variables

The model suggested a statistically significant association between functionality and two supporting environment variables: access to tools and spare parts and access to outside technical support. Both variables were measured at the community level. Water points managed by committees that had access to tools and spare parts were over two times more likely to be functional compared to water points managed by committees that did not have access to these resources (p=0.04). Outside support was categorized as a) committee does not have someone outside of the community who they could call if the water point breaks down, b) committee does have someone outside of the community who they could call but they never have, and c) committee has received outside support following a breakdown. Water points managed by committees that had received outside support were almost three times more likely to be functional than water points managed by committees that did not have access to outside support (p=.07). Water points managed by committees that had access but had not called were almost five times as likely to be functional as water points managed by committees who did not have access to outside support (p=.03).

Key management variables

Two financial management variables were included in the multivariate model based on the results of the preliminary analysis: resource mobilization and savings. The model explored the relationship between functionality and two types of resource mobilization: monetary fee collection and non-monetary fee collection activities such as communal farming or donation of goods/livestock. The resource mobilization variable is comprised of four categories: No resource mobilization, only monetary, only non-monetary, or a combination of monetary and non-monetary resource mobilization. One form of resource mobilization was statistically significant: water points located in communities where only non-monetary resource mobilization was practiced were almost seven times as likely to be functional as water points located in communities with no resource mobilization (p=.009). Water points managed by committees that had money saved for repairs were significantly less likely to be functional than water points managed by committees that did not have money saved. This was true for savings that are both 100 USD (500

Ghana Cedis) or less (80% less likely to be functional) and savings that were greater than 100 USD (72% less likely to be functional).

The model results revealed a statistically significant relationship between the community engagement variable and functionality. Water points managed by committees that had held a community meeting in the past 6 months had over two times greater odds of being functional as compared to water points located in communities where a water committee had not held a meeting in the past six months (p=.04).

The model did not suggest an association between activity level variables (proportion of females on the committee and regular meetings with 100% committee attendance at the last meeting) and functionality. Increased proportion of females on the committee had an odds ratio greater than one but the variable was not significant. Regular meetings and 100% committee attendance had an odds ratio less than one but also was not significant.

Community and facility characteristics

Population of community, presence of surface water in the community, and district all served as community-level control variables. Population had a statistically significant but practically negligible effect on functionality with an odds ratio of one. Water points located in communities with a surface water source were 80% less likely to be functional compared to communities that did not have a surface water source (p=0.002). The effect of district (Savelugu district vs. Tolon district) was not significant in the multivariate model.

Water points that were six to nine years old were less likely to be functional than water points that were one to five years old (p<0.001). No statistically significant relationship existed for older water points. The source type was also significant: the handpumps installed in protected dug wells and public taps/standpipe were much less likely to be functional than boreholes with manual pumps[3] (p<0.001 and p=0.1). Total number of water points was also significant: water points located in communities with five

[3] As noted earlier, no data were collected on whether water could still be drawn from the protected well by hand when the handpump was broken.

to seven water points were 80% less likely to be functional than water points located in communities with one to four water points (p=0.00).

User Satisfaction with Water Service

The following sub-sections present results from the user satisfaction analysis. First household and water service delivery characteristics are summarized for the study sample, followed by results from the multivariable user satisfaction model.

Household and Water Service Delivery Characteristics

Two hundred respondents across the 48 communities where household surveys were conducted answered the question "how satisfied or dissatisfied are you with your water service" (See Sampling Methods section for a description of household sampling methods). Respondents ranged in age from 20 to 80 (mean of 37) and were almost entirely female (99%). The average household size was six people (range 2 to 13). Of the 200 households interviewed, 38% were dissatisfied with their water service, 33% were somewhat satisfied, and 29% were very satisfied. The majority of respondents identified an improved source as their main household water source in both the wet and dry season (68%) (Table 8). Most households were within 500 m of an improved source, with a mean distance of 370 m (median 155 m). The median reported queue time was 20 minutes, with a much higher mean of 55 minutes due to some very high reported queue times (seven respondents reported five to six hours in queue). Seventy-two percent of households reported that their most recent water source had broken down for one day or more in the past year.

Many households reported that they do not pay for water (44%) (only referring to monetary payments because non-monetary fee collection data was not available at the household level). Thirty-six percent of respondents reported attending a community meeting about the water system in the past year, and 15% of respondents had been involved in a decision about the water system.

Table 8: Household and water service delivery characteristics

Variable	N (%) n=200*
Household Characteristics Variables	
Household has electricity	115 (58%)
Pay frequency:	
Don't pay	88 (44%)
Every time they fetch water	50 (25%)
Monthly	27 (14%)
When the system breaks	35 (18%)
Water committee holds community meeting and respondent attendance	
Committee hasn't held a community meeting	82 (41%)
Committee held a community meeting but respondent didn't attend	46 (23%)
Respondent attended community meeting	72 (36%)
Respondent has been involved in a decision about the water system	30 (15%)
Key Water Service Delivery Variables	
Source type:	
Main wet and dry season sources are a mix of improved and unimproved	44 (22%)
Main wet and dry season sources unimproved	40 (20%)
Main wet and dry season sources improved	115 (68%)
Most recent source broke down for more than 1 day in past year	141 (72%)
Variable	**Mean (median)**
Queue time (minutes)	55 (20)
Distance to nearest improved source (m)	370 (155)

*Data incomplete for some variables

User Satisfaction with Water Service Model Results

Results from the multilevel logistic regression analysis of variables associated with user satisfaction with water service are listed in Table 9. Like the functionality multivariable regression analysis output table (Table 7), Table 9 also displays odds ratios, confidence intervals, and p-values for each independent variable included in the user satisfaction with water service multivariable regression analysis. The odds ratios presented in this table can be interpreted as "odds of a user being very satisfied with his/her water service." For example, the odds of a user being very satisfied (as opposed to somewhat satisfied or dissatisfied) are 3.8 times higher if his/her household's main wet and dry season sources are improved as opposed to those households that use a mix of improved and unimproved sources.

Table 9: Ordered logit regression analysis of variables associated with user satisfaction with water service

	OR (95% CI)	P-value
Key Water Service Delivery Variables		
Source type:		
Main wet and dry season sources unimproved vs. mix of improved and unimproved	0.281(0.0909 - 0.868)	0.027
Main wet and dry season sources improved vs. mix of improved and unimproved	3.806(1.614 - 8.976)	0.002
Most recent source broke down for more than 1 day in past year: yes vs. no	0.410(0.200 - 0.840)	0.015
Queue time	0.996(0.992 - 1.000)	0.062
Distance to nearest improved source	1.000(1.000 - 1.001)	0.406
Household Characteristics Variable		
Household has electricity: yes vs. no	0.849(0.438 - 1.644)	0.627
Key Supporting Environment Variables		
Repair person who has received training in past two years: yes vs. no	2.047(1.027 - 4.081)	0.042
Committee received training related to financial management	2.653(1.313 - 5.364)	0.007
Key Management Variables		
Pay frequency:		
Pay frequency: every time they fetch vs. don't pay	1.537(0.630 - 3.747)	0.345
Pay frequency: monthly vs. don't pay	1.167(0.398 - 3.420)	0.778
Pay frequency: when the system breaks vs. don't pay	0.598(0.243 - 1.474)	0.264
Water committee holds community meeting and respondent attendance		
Committee held a community meeting but respondent didn't attend vs. no meeting	1.487(0.616 - 3.592)	0.378
Respondent attended community meeting vs. no meeting	2.113(0.962 - 4.637)	0.062
Respondent has been involved in a decision about the water system: yes vs. no	0.565(0.225 - 1.417)	0.223
Committee prepares maintenance schedules: yes vs. no	3.448(1.191 - 9.983)	0.022
Committee has met in the past month: yes vs. no	0.574(0.264 - 1.249)	0.162
Observations	182	
Pseudo R^2	0.196	

Key supporting environment variables

Both supporting environment variables (repair person who has received training in the past two years and committee that had received training related to financial management) were associated with increased user satisfaction. The odds of households being very satisfied (as opposed to somewhat satisfied or dissatisfied) with their water service are two times higher in communities where the water committee had received training in the past two years compared to communities where the water committee had not received training in the past two years ($p=0.04$). Similarly, the odds of households being very satisfied were almost three times higher in communities where water committees had been trained and reported that training had improved their financial management skills ($p=0.007$).

Key management variables

One financial management variable, whether households pay for water, was included in the multivariable model but was not significantly associated with user satisfaction. Two activity level variables were included in the model: whether or not the water committee had met in the past month and whether or not the committee keeps maintenance schedules. The odds of households being very satisfied with their water service were lower if their community's water committee had met in the past month, but this relationship was not significant. Keeping maintenance schedules was significant: households were three and a half times as likely to be very satisfied in communities where committees prepared maintenance schedules ($p=0.02$).

The model revealed a marginally significant association between community engagement activities and user satisfaction, particularly attending community meetings about the water point. Households that attended community meetings about their water points in the past year were twice as likely to be very satisfied with their water service as those living in communities where the water committee had not held a meeting in the past year ($p=0.06$). Fifteen percent of respondents reported having been involved in a decision about the water supply, but this variable was not significant in the multivariate model.

Water service delivery and household characteristics variables

Access to improved sources was related to water user satisfaction in this model. Households that used an unimproved source in both the wet and dry season were significantly less likely to be very satisfied than households that used a mix of improved and unimproved sources (p=0.03). Households that used an improved source in both the wet and dry seasons were almost four times as likely to be very satisfied as households that used a mix of improved and unimproved sources (p=0.002). Functionality was also related to water user satisfaction: users were 0.41 times less likely to be very satisfied if their most recent source had broken down for more than one day in the past year (p=0.02). Distance from the nearest improved water source was not significant in the multivariate model, but amount of time spent queueing for water was marginally significant. The odds that a user was very satisfied with his/her water service decreased slightly for each additional minute spent queueing for water (p=0.06). For example, there is a 24% decrease in the odds of a user being very satisfied for each additional hour spent queueing. Access to electricity was included as a household characteristic variable, but was not significant in the model.

CHAPTER 4: DISCUSSION

The results reveal an association between key management activities and improved water system outcomes in Northern Ghana. Holding community meetings and practicing non-monetary resource mobilization were associated with higher odds of functionality. Attending community meetings and living in a community where the water committee prepared maintenance schedules were associated with higher odds of users being very satisfied. While it is certainly plausible that these activities could directly contribute to better functionality and greater user satisfaction, it may also be that they are by-products of other practices which produce these desirable outcomes; given the limitations of a study designed to make the most of available data, we cannot attribute causality to these practices. Whether or not they may be viewed as direct "causes", however, these activities can be considered useful indicators of effective management leading to better outcomes for water committees in Northern Ghana. Furthermore, the results show that the right supporting environment factors also promote improved water system outcomes: access to tools and spare parts, access to outside support, and training.

Community Engagement

The results from both the functionality and user satisfaction models indicate an association between committee efforts to engage the community in water system decision making and improved water system outcomes. Water points managed by committees that held a community meeting in the last six months to discuss the water system were more likely to be functional, and community members who attended these meetings were more likely to be satisfied with their water service. It is possible that community members who are more engaged in water system management feel a greater sense of responsibility for their water point and may be more motivated to make contributions that help keep it functional. The association between meeting attendance and user satisfaction further emphasizes the value of these meetings. It is possible that engaged community members are more likely to be satisfied with their water service, although unraveling the relationship between meeting attendance, user

satisfaction, and community engagement would be beyond the scope of this research. Results from qualitative research that examined the relationship between social capital and sense of ownership and improved outcomes for community managed water systems in Ghana, Kenya, and Zambia (Kelly et al., n.d.) provide additional insight: successful water committees use inclusive decision making as a tool to foster a sense of ownership among community members, which can lead to greater participation in the decision making process or resource mobilization activities.

This finding is supported by Walters and Chinowky (2016), who used graphical modeling and factor networks to examine factors related to functionality of community managed water points in Nicaragua. They found that organizing and holding community meetings was a key factor related to water system functionality.

Other studies that have examined the relationship between community meetings and improved outcomes focus on participation during the project planning phase. Prokopy (2004) and Marks et al. (2014) found that household participation during the project planning phase was linked to improved project outcomes in India and Ghana, respectively. Although our findings on the benefits of community engagement are similar, it is difficult to compare the effect of water committee efforts to engage a community after construction to efforts made during the planning phase. The former relates to management effectiveness while the latter could be the result of short-term efforts made by an NGO to engage the community during project implementation. It is plausible that post-construction community engagement initiated by the water committee has a more meaningful association with project success in the long term. However, this type of community engagement is seldom mentioned in the literature, and the results of this study suggest that it should be considered for future research.

It is also important to consider the methodological challenges of comparing concepts such as participation and engagement across different contexts and studies. The timing of participation (during project planning and implementation vs. after construction) is not the only factor that varies across studies. Each author is likely adopting a different definition of participation and employing different measurement methods.

Financial Management

Much of the research surrounding financial management concerns fee collection or payments in the form of money. This research looked at an expanded concept of resource mobilization by considering not only whether users pay for water, but also whether users engage in other forms of non-monetary resource mobilization (defined as either communal labor (e.g. communal farming), contribution of goods or livestock (e.g. shea nuts, maize, bowl of rice), fundraising activities, or a combination of the three mechanisms):

> *"In some communities, water users will make non-monetary contributions to help keep water facilities running. Do you know of one or more community members who have contributed the following: [Read answer choices and choose all that apply]?*
>
> *a) Community labor (e.g. communal farming)*
> *b) Non-monetary contributions (e.g. shea nuts, maize, bowl of rice)*
> *c) Fundraising activities*
> *d) Other, please specify*
> *e) Don't know*
> *f) Not applicable"*

Communal labor was the most common response (46% of communities reported practicing) and contribution of goods or livestock was the second most common (15%). In particular, communities in this region are known to practice community labor by organizing communal farming activities in which community members collectively farm a piece of land to raise money for the water system.

Although the intention of asking water committees about communal labor practices was to discern whether communities were coming together in a collective effort to raise money for the water system, it is certainly possible that this response could have been selected in communities where water users volunteer their time to fix the water system. However, this question was not intended to capture community labor in the form of repairs. The term "community labor" was derived by the data collectors who had extensive experience working in this region, and the intention of this term was emphasized through training.

There was an association between practicing only non-monetary resource mobilization and functionality. Of all the management variables in the model, this one had the strongest association with

functionality. The two other resource mobilization categories, only monetary and combination of monetary and non-monetary, were not significant. It is unclear why practicing only non-monetary resource mobilization would have a significant association with functionality but practicing both monetary and non-monetary resource mobilization would not. One possible explanation is that non-monetary resource mobilization has an element of community engagement. Communities where some users pay money and others contribute non-monetary resources may not fully benefit from this community engagement component. This is consistent with findings from qualitative research on resource mobilization in Ghana, Kenya, and Zambia (Behnke et al., 2017) which suggested that non-monetary resource mobilization might contribute to inclusivity and greater community participation in water point management.

Two studies using multivariate regression showed that monetary water user payments were associated with higher odds of borehole functionality in specific countries within Sub-Saharan Africa ((Fisher et al., 2015), (Foster & Hope, 2016)). Our preliminary analysis also indicated that water user payments were associated with functionality. However, once we accounted for non-monetary resource mobilization, monetary fee collection was no longer significantly associated with functionality.

Surprisingly, water points that were managed by committees that had money saved for repairs had significantly lower odds of functionality. This was true for both savings categories: those with 500 Ghana Cedis (approximately 100 USD) or less and those with more than 500 Ghana Cedis. It is possible that some water committees save money because they are managing water systems that break down more frequently, or alternatively, water committees with no savings may have higher odds of functionality because they are spending income regularly on maintenance or repairs to keep the system running. Given the cross-sectional study design, it is not possible to determine which came first: savings or breakdowns.

In contrast to our findings, other authors report a relationship between savings and improved functionality of water systems. Van den Broek (2015) found that non-functionality of handpumps in Uganda was related to a shortage of maintenance funds. Similarly, Schweitzer and Mihelcic (2012)

identified "significant" savings as an indicator of financial durability for community managed water systems in the Dominican Republic. The culture surrounding savings likely vary by context. Although having money on hand to pay for repairs may be beneficial in some contexts, excess cash may be a burden or liability in others (Whittington et al., 2009). This could be true for our study, especially considering the success of non-monetary resource mobilization, which is likely to reduce the amount of excess funds that committees have on-hand. Regardless, our findings show that quantity of money in savings is not an indicator of effective management for the communities included in this study.

Activity Level

Preparation of maintenance schedules by committees was significantly associated with user satisfaction. Two past studies considered the role of maintenance activities in improving water system outcomes, but both studies examined the effect of maintenance on functionality. Foster (2013) and Schweitzer and Mihelcic (2012) found an association between maintenance activities and functionality in Uganda and the Dominican Republic respectively.

Two activity-level variables, 1) proportion of committee that is female, and 2) committees meet regularly with 100% attendance at the last meeting, were included in the functionality model and neither was found to be significantly associated with functionality. This is surprising because preliminary analysis revealed that both variables were significantly associated with functionality in univariate regression. However, in a multivariable model that controlled for community and facility characteristics along with other management variables, these variables were no longer significant contributors to functionality outcomes.

It is not entirely surprising that proportion of committee that is female was not significant in the multivariable model. Several variables relating to the role of women on committees (females in key positions, female attendance at meetings, etc.) were considered for inclusion in the final multivariable model, but none had a significant effect on functionality once other management variables and controls were included. The role of women on committees varies, and past studies have found varying results in different settings. Prokopy (2004) found that having women on committees did not lead to improved

project outcomes, while Foster (2013) found that handpumps were more likely to be functional with women on the committee, and Madrigal et al. (2011) found that committees performed better with female members.

Knowledge, Skills, and Supporting Environment

The results from both models indicated an association between supporting environment variables and improved water system outcomes. Users were two times more likely to be satisfied with their water service when their water committee had received training in the past two years and almost three times more likely to be satisfied if that committee reported that the training had improved their financial management skills. Preliminary analysis revealed that training was not associated with functionality in this dataset, so training was not included as a variable in the functionality model. However, access to tools and spare parts and access to outside support were both associated with higher odds of functionality.

Our findings linking committee training to higher user satisfaction are consistent with Whittington et al. (2009), who found that committee training was associated with user satisfaction in rural communities in Ghana and Bolivia. This study also found that committee training was associated with system performance. Whittington et al. (2009) is one of a few studies that draw an association between committee or operator training and functionality or other measures of system performance (Foster 2013, Davis et al. 2008). We did not find an association between committee training and functionality, and thus, did not include it in the final multivariate functionality model. Although this discrepancy may seem surprising, 96% percent of water committees included in our study had received training at some point. Therefore, we looked specifically at committees that had received training in the past two years. It is possible that committees with recent training did not have an advantage over committees that had received training more than two years ago. However, there are a number of other reasons why this study may not have found a relationship between training and functionality, such as quality of training or water committee turnover since the last training.

The results showed that access to outside technical support was associated with higher odds of functionality, even when those water committees had never requested the assistance of an outside

repair-person or team. This variable likely serves as a measure of competence, even when the committee has not actually benefitted from the services of a repair-person. Committees that know who to call for outside support may be better organized and better equipped to deal with management issues, regardless of whether they have ever called for help. It's also possible that this variable is an indicator of other advantages. Committees with access to outside support may be located closer to cities or roads and have greater access to additional resources.

To our knowledge, this is the first study to differentiate between communities who have called for outside support, have never called but have access to outside support, and have no outside support. However, several studies have linked access to outside support or PCS with water system functionality. Water committees in Sierra Leone that did not have access to a mechanic experienced higher rates of non-functionality (Foster, 2013). Davis et al. (2008) found that communities that received management oriented PCS visits had better performing systems in Bolivia. Fisher et al. (2015) found in Ghana that functionality correlates inversely with the number of days that a community must wait for an outside mechanic to arrive. Our findings linking availability of tools and spare parts with increased odds of functionality are also consistent with findings from Foster (2013) and Fisher et al. (2015).

Limitations

There are several limitations to this work. Foremost, the study is limited by its cross-sectional design that examines the relationship between management characteristics and two outcome variables that are measured at one point in time: functionality and user satisfaction. Because this is a cross-sectional study, it is not possible to demonstrate a causal relationship between the independent variables and the two outcome variables. As such, this study seeks to shed light on the relationship between management and water system sustainability by identifying associations between activities and characteristics and two outcomes of interest.

There are a variety of reasons that a water point might break down (e.g. technical failure, seasonality, and vandalism). Some, such as seasonality, are less related to management practices.

Despite this, functionality was still considered to be a rigorous dependent variable because it is a straight-forward and easy to measure outcome.

Much data about water committee characteristics are based on direct response questions that are susceptible to recall bias and other forms of response bias. This analysis was based on data from 124 communities. For future analysis, a larger dataset would be beneficial. Although some of our key management variables could be considered for inclusion in studies outside of Northern Ghana, the results from this work are specific to two regions in Northern Ghana and cannot be generalized to other contexts.

CHAPTER 5: CONCLUSION

This study examined the relationship between committee activities and characteristics and two improved water system outcomes in Northern Ghana: water point functionality and water user satisfaction. Most notably, holding community meetings, practicing non-monetary resource mobilization, and preparing maintenance schedules were associated with improved outcomes. Supporting environment factor (access to tools and spare parts, access to outside support, and training) were also associated with improved outcomes. Given the limitations of cross-sectional studies, we cannot contribute causality to these practices, but we can think of these activities and characteristics as indicators of effective management for water committees in Northern Ghana. This study examined outcomes at both the water point and individual household level by modeling both functionality and user satisfaction. Considering both levels allowed for examination of interconnections between specific committee tasks, community engagement, the supporting environment, and improved outcomes. In addition to identifying three possible indicators for water committee effectiveness in Northern Ghana, this study provides insight on the role of water committee activities related to community engagement and financial management that has not been addressed by past studies.

Past research on community engagement has focuses on participation before or during construction and financial involvement through fee payments. The results of this study show that efforts made by the water committee to engage the community after construction is complete are associated with improved water system outcomes. Odds of a water point being functional were higher when they were managed by water committees that engaged the community through meetings and non-monetary resource mobilization activities. Additionally, individuals who participated in community meetings were more satisfied with their water service. The success of non-monetary resource mobilization activities in these communities (i.e. communal labor (e.g. communal farming) and donation of goods and/or livestock) show that financial management activities are not only a means to an end, but also a valuable

opportunity to increase community engagement. Future research should focus on better understanding the mechanisms associated with water committee led community engagement activities and identifying meaningful mechanisms for engaging community members, and should be performed over a period of time to reduce some of the uncertainty of the directionality of relationships.

Even though the literature surrounding community management often points to saving money as an important aspect of management, the existence of water committee savings was not a robust indicator of good management in our study communities. In fact, savings were associated with water point non-functionality. This finding, coupled with the apparent benefits of non-monetary resource mobilization, indicates that it may be necessary to begin a broader conversation that considers resources other than fee collection and savings since these activities do not appear to be the best indicators of management effectiveness. Future research should seek to explore the relationship between revised financial management indicators and improved water system outcomes. The revised indicators should be based upon an expanded definition of resource mobilization.

In the coming years, NGOs and governments will strive to achieve Target 6.B of the SDGs by working to support and strengthen community management institutions. The results indicate that empowering water committees with the skills needed to engage their communities could be a meaningful way to achieve this objective. Additionally, NGOs and governments can assist water committees by enhancing access to outside support and increasing access to tools and spare parts where possible.

APPENDIX: SURVEY INSTRUMENTS

The following surveys were developed by researchers at the Water Institute at the University of North Carolina at Chapel Hill, based on survey instruments used in previous studies (Evans et al., 2013), published core questions for water and sanitation monitoring (WHO/UNICEF, 2006), published monitoring manuals (Howard, 2002), and questions from nationally representative surveys (e.g. DHS, MICS, etc.), as well as questions developed by Water Institute Researchers with input from questionnaire development experts at UNC's Carolina Survey Research Laboratory.

Community Survey

Question	Response
1. Date	_____
2. Time: Enter hour	_____
3. Time: Enter minutes	_____
4. GPS Coordinates	_____
5. Country	Burkina Faso_____ Ethiopia_____ Ghana_____ India_____ Mali_____ Mexico_____ Niger_____
6. Region	_____
7. District ID	_____
8. Organization	CARE_____ CRS_____ One Drop_____ UNC_____ UNICEF_____ WaterAid_____ World Vision_____ WSA_____
9. Your name	_____
10. Name of community	_____
11. Community ID	_____
Community Characteristics	
12. How many people live in this community?	_____
13. How many water points does this community have? Please include both waterpoints that are working and those that are not currently working.	_____
14. How many of these water points are currently functioning?	_____
15. How many boreholes does this community have? Please include both boreholes that are working and those that are not currently working.	_____
16. How many of these boreholes are currently functioning?	_____
Sanitation and Hygiene Practices	
17. Has a CLTS triggering meeting been held in this community?	Yes_____ No_____ Not applicable_____ Don't know_____ Decline to state_____
Only answer if you responded Yes to Q17	
18. How long ago was the triggering meeting held?	_____
Only answer if you responded Yes to Q17	
19. Days, Weeks, Months, or Years	Day(s)_____ Week(s)_____ Month(s)_____ Year(s)_____
Only answer if you responded Yes to Q17	
20. Have any new household toilets/latrines been constructed in this community since the CLTS triggering meeting was held?	Yes_____ No_____ Not applicable_____ Don't know_____ Decline to state_____
Only answer if you responded Yes to Q20	
21. How many new household toilets/latrines have been constructed in this community since the CLTS triggering meeting was held?	_____
22. Has this community been certified as ODF (open defecation-free)?	Yes_____ No_____ Not applicable_____ Don't know_____ Decline to state_____
Only answer if you responded Yes to Q22	
23. Does the community have a sign or document showing its ODF status?	Yes_____ No_____ Not Applicable_____ Don't Know_____ Decline to State_____
Only answer if you responded Yes to Q23	
24. [Photo] Take a photo of the ODF sign or other ODF documentation	_____
Only answer if you responded Yes to Q22	
25. [Direct Observation] Year community certified ODF [If observation not possible ask] When year this community certified as ODF?	_____
26. How many toilet facilities/latrines are there in this community? Please include both those that are used and those that are not in use.	_____
27. Does anyone in your community sell latrine construction materials?	Yes_____

No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded No to Q27

28. Where is the nearest seller of latrine construction materials? (miles) _____

29. How are children's feces disposed of in this community?

Child used toilet/latrine_____
Put/rinsed into toilet or latrine_____
Put/rinsed into drain or ditch_____
Thrown into garbage bin or pile_____
Buried_____
Left in the open_____
Not applicable_____
Don't know_____
Decline to state._____

30. [Direct Observation] Are visible human excreta present in the community?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

31. Is there anyone in this community who is responsible for promoting hygiene?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q31

32. Have any hygiene promotion activities been conducted in this community?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q32

33. How recently have hygiene promotion activities been conducted? _____

Only answer if you responded Yes to Q32

34. Days, Weeks, Months, or Years

Day(s)_____
Week(s)_____
Month(s)_____
Year(s)_____

WaSH Committee

35. Is there a WaSH/Watsan committee in this community that manages drinking water facilities?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q35

36. How many members does the WaSH/Watsan committee have? _____

Only answer if you responded Yes to Q35

37. How many female members does the WaSH/Watsan committee have? _____

Only answer if you responded Yes to Q35

38. What is the name of the WaSH committee chairperson or most senior WaSH committee member? _____

Only answer if you responded Yes to Q35

39. List the name of one WaSH committee member with a mobile phone who can act as a contact _____

Only answer if you responded Yes to Q35

40. Please provide the full mobile number of this committee member _____

Only answer if you responded Yes to Q35

41. List the name of another WaSH committee member with a mobile phone who can act as a contact _____

Only answer if you responded Yes to Q35

42. Please provide the full mobile number of this committee member _____

Only answer if you responded Yes to Q35

43. Does the WaSH committee manage any piped water systems?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Yes to Q43

44. Does the WaSH committee have a system manager?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to state_____

Only answer if you responded Yes to Q43

45. Does the WaSH committee have a system operator?

Yes_____
No_____

Not Applicable_____
Don't Know_____
Decline to state_____

Only answer if you responded Yes to Q45

46. Has the system operator received technical training?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Yes to Q35

47. Does the WaSH committee have an administrative or financial clerk?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to state_____

Only answer if you responded Yes to Q35

48. Does the WaSH committee have a revenue collector?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to state_____

49. Does each water point have a vendor?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to state_____

Only answer if you responded Yes to Q35

50. What position(s) do women hold on the water committee? (select all that apply)

Chair_____
Vice Chair_____
Secretary_____
Treasurer_____
Kiosk Attendant_____
System Manager_____
System Operator_____
Administrative Clerk_____
Financial Clerk_____
Vendor_____
Revenue Collector_____
Other, specify_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q35

51. Does the WaSH/Watsan committee meet regularly and manage the facilities?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q35

52. When was the last time that the WaSH/Watsan committee met to discuss the WaSH facilities in this community?

_____

Only answer if you responded Yes to Q35

53. Days, weeks, months or years?

Day(s)_____
Week(s)_____
Month(s)_____
Year(s)_____

Only answer if you responded Yes to Q51

54. How many of the WaSH/Watsan committee members attended the last committee meeting?

_____

Only answer if you responded Yes to Q51

55. How often would you say women on the committee attend meetings in comparison to men on the committee?

Do not attend at all_____
Attend less often_____
Attend more often_____
Don't know_____
Not applicable_____
Decline to state_____

Only answer if you responded Yes to Q35

56. Are meeting records available? (check)

Yes (records observed)_____
Yes (records not observed)_____
No (records not observed)_____
Not Applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Yes (records observed) to Q56

57. [Direct Observation] Take a photo of most recent meeting records, if possible _____

Only answer if you responded Yes to Q35

58. Are maintenance records available? (check)

Yes (records observed)_____
Yes (records not observed)_____
No (records not observed)_____
Not Applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Yes (records observed) to Q58

59. [Direct Observation] Take a photo of most recent maintenance records, if possible _____

Only answer if you responded Yes to Q35

60. Does the WaSH committee prepare maintenance schedules?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Yes to Q60

61. Does the WaSH committee undertake routine maintenance according to the maintenance schedule?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Yes to Q35

62. For how many water points is the WaSH committee responsible? _____

Only answer if you responded Yes to Q35

63. Does the water committee ever hold meetings with the community?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q63

64. When was the last time that the water committee held a community meeting? _____

Only answer if you responded Yes to Q63

65. Days, weeks, months or years?

Day(s)_____
Week(s)_____
Month(s)_____
Year(s)_____

Only answer if you responded Yes to Q63

66. About how many community members attended the last meeting? _____

Maintenance

67. Is there anyone in the community who is responsible for repairing the community's water facilities when they break down or have a problem?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Yes to Q67

68. Who in the community is responsible for repairing the facility when it breaks or has a problem?

WaSH Committee_____
Community leader_____
Private maintenance person_____
No one_____
Not applicable_____
Don't Know_____
Decline to state_____

Only answer if you responded WaSH Committee|Community leader|Private maintenance person|District/Local government to Q68

69. Has the person/persons who maintains the facility received training in this type of maintenance?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q69

70. How long ago did the maintenance person/team in this community receive training in pump maintenance and repair? _____

Only answer if you responded Yes to Q69

71. Days, weeks, months or years?

Day(s)_____
Week(s)_____
Month(s)_____
Year(s)_____

Only answer if you responded Yes to Q69

72. What other topics were covered in this training? (select all that apply)

System management_____
Financial management_____
Administrative tasks_____
Community engagement_____
System maintenance_____

System repair_____
Other, specify_____
None_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q69

73. Has the water facility needed any repairs since the last training? [If the facility has needed repairs more than once since the last training, ask the respondent about the last time]

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q73

74. Did the maintenance person/team attempt to make any repairs?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q74

75. In attempting to make repairs, did the maintenance person/team use any skills taught in the training?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q74

76. Did the maintenance person/team successfully fix the water facility when they attempted to make the repairs?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q69

77. What other activities has the training helped you to do better? _____

Only answer if you responded Yes to Q69

78. How many people are there living in this community who have been trained to repair this water point? _____

Only answer if you responded WaSH Committee|Community leader|Private maintenance person|District/Local government to Q68

79. Is this community able to get the spare parts and materials needed to keep this water point functioning?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded No to Q79

80. Why not?

No supplier_____
Part was not in stock_____
Lack of funds_____
No one available to go get part_____
Did not know which part to buy_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded WaSH Committee|Community leader|Private maintenance person|District/Local government to Q68

81. Does the person/persons who maintains the facility possess all the necessary tools?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

82. Which tools does this community have for repairing water points?

17/19-mm Combination flat spanner_____
19-mm Combination spanner_____
Rod lifter_____
Rod Clamp_____
Pipe Wrench_____
Pipe lifter (Pair of two)_____
Pipe clamp_____
Grip pliers_____
Crank spanner_____
22/24-mm Ring spanner_____
Axle punch_____
Chain fork_____
Chain Support_____
Bearing Presser_____
Afridev Socket Spanner_____
Afridev Fishing tool_____
Nira Allen Key (10mm)_____

Nira F- Key_____

Only answer if you responded WaSH Committee|Community leader|Private maintenance person|District/Local government to Q68

83. Did the maintenance person/team come the last time they were called?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded WaSH Committee|Community leader|Private maintenance person|District/Local government to Q68

84. The last time the facility needed repairs, how long did you have to wait between when the problem was first discovered and the time that the facility was repaired? _____

Only answer if you responded WaSH Committee|Community leader|Private maintenance person|District/Local government to Q68

85. Days, weeks, months or years?

Day(s)_____
Week(s)_____
Month(s)_____
Year(s)_____

86. Is there someone outside the community that you can call if a water facility is broken down or has a problem?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Yes to Q86

87. Who can the community call if they are unable to repair a water facility?

Area mechanic_____
Private maintenance person_____
District/Local government_____
NGO or development organization_____
No one_____
Not applicable_____
Don't Know_____
Decline to state_____

Only answer if you responded Yes to Q86

88. Do you have a phone number for this outside support person or team?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Yes to Q88

89. Could you please provide this phone number? _____

Only answer if you responded Yes to Q86

90. Have you ever called this outside support person/team to come repair a water facility?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Yes to Q90

91. When was the last time the community called this outside support person/team? _____

Only answer if you responded Yes to Q90

92. Days, weeks, months or years?

Day(s)_____
Week(s)_____
Month(s)_____
Year(s)_____

Only answer if you responded Yes to Q90

93. Did the support person/team come the last time they were called?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q93

94. How long did it take them to come the last time they were called? _____

Only answer if you responded Yes to Q93

95. Days, weeks, months or years?

Day(s)_____
Week(s)_____
Month(s)_____
Year(s)_____

Financial

96. Do people pay to fetch water in this community?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q96

97. How often do people pay for water in this community? Does each person pay as they fetch, or do people pay at certain times every month or year?

Every time they fetch_____
daily_____
weekly_____
monthly_____

yearly_____
when the system breaks_____
no fixed schedule (when they have money)_____
Not applicable_____
Don't Know_____
Decline to state_____

Only answer if you responded Every time they fetch to Q97

98. How much do people pay to fill a 20-L container once? _____

Only answer if you responded daily to Q97

99. How much do people pay each day? _____

Only answer if you responded weekly to Q97

100. How much do people pay each week? _____

Only answer if you responded monthly to Q97

101. How much do people pay each month? _____

Only answer if you responded yearly to Q97

102. How much do people pay each year? _____

Only answer if you responded Every time they fetch|daily|weekly|monthly|yearly to Q97

103. Cedis or Pesewas?

Cedis_____
Pesewas_____

Only answer if you responded Every time they fetch|daily|weekly|monthly|yearly|when the system breaks|no fixed schedule (when they have money) to Q97

104. What percentage of people pay something for water? _____

105. The last time that water facility broke down, did the water committee collect additional money from community members to cover the cost of repairs?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

106. Does the WaSH committee/community have money saved for repairing/replacing the facility when needed?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

107. In some communities, water users will make non-monetary contributions to help keep water facilities running. Do you know of one or more community members who have contributed the following: [Read answer choices and choose all that apply]

Community labor (e.g. communal farming)_____
Non-monetary contributions (e.g. shea nuts, maize, bowl of rice)_____
Fundraising activities_____
Other, please specify_____
Don't know_____
Not applicable_____

Only answer if you responded Yes to Q106

108. What is the balance that the WaSH committee/community has available for repairing/replacing the facility? _____

Only answer if you responded Yes to Q106

109. Cedis or Pesewas?

Cedis_____
Pesewas_____

110. What is the amount of funds that the WaSH committee/community collected in the last year for repairing/replacing the facility? _____

111. Cedis or Pesewas?

Cedis_____
Pesewas_____

112. What is the amount of funds that the WaSH committee/community spent in the last year on repairing/replacing the facility? _____

113. Cedis or Pesewas?

Cedis_____
Pesewas_____

Only answer if you responded Yes to Q106

114. Where are these funds kept?

Bank account_____
Cash box_____
With a committee member but not in a cash box_____
Not applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Yes to Q106

115. Is the WaSH committee able to access these funds when needed?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded No to Q115

116. Why not?

Account holder died or moved away_____
Key to cash box lost_____
Bank refuses to allow committee to access funds_____
Not Applicable_____
Don't Know_____
Declines to State_____

Only answer if you responded Yes to Q35

117. Does the WaSH committee have a cash book or other financial records? (check)

Yes (records observed)_____
Yes (records not observed)_____

No (records not observed)_____
Not Applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Yes (records observed) to Q117

118. Were monthly revenue records kept last year?

Yes (records observed)_____
No (records not observed)_____
Not Applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Yes (records observed) to Q117

119. Are financial records up-to-date, and are all expenses and income accounted for?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes (records observed)|Yes (records not observed) to Q117

120. In the last year, has any government person come to check the financial records?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to State_____

121. [Photo] Take a photo of the financial records _____
122. Thank the respondent for their time. [Record your notes here] _____
123. In the last year, has any government person come to monitor the operation and maintenance of the waterpoints in this community?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Yes to Q123

124. How long ago did they last come to monitor? _____

Only answer if you responded Yes to Q123

125. Days, weeks, months, or years

Day(s)_____
Week(s)_____
Month(s)_____
Year(s)_____

126. End time: hour _____
127. End time: minute _____

Waterpoint Survey

Question	Response
1. Date	_____
2. Time: Enter hour	_____
3. Time: Enter minutes	_____
4. GPS Coordinates	_____
5. Country	Burkina Faso_____ Ethiopia_____ Ghana_____ India_____ Mali_____ Mexico_____ Niger_____
6. Region	_____
7. District ID	_____
8. Organization	CARE_____ CRS_____ One Drop_____ UNC_____ UNICEF_____ WaterAid_____ World Vision_____ WSA_____
9. Your name	_____
10. Community ID	_____
11. Name of community	_____
Facility Functionality	
12. [Direct Observation] Source type	Piped water into dwelling_____ Piped water to yard/plot_____ Public tap/standpipe_____ Mechanized borehole_____ Borehole with manual pump_____ Protected dug well with handpump_____ Protected dug well without pump_____ Unprotected dug well_____ Protected spring_____ Unprotected spring_____ Rainwater collection_____ Pay another person to fetch/ buy filled containers from a vendor_____ Bottled water- sachet water- or "pure water (sachet water)"_____ Cart with small tank/drum_____ Tanker-truck_____ Surface water (river- dam- lake- pond- stream- canal- irrigation channels)_____
13. [Direct Observation] Is water available from this source?	Yes_____ No_____ Not applicable_____ Don't know_____ Decline to state_____
Only answer if you responded No to Q13	
14. Has water been available from this source on any day in the past year?	Yes_____ No_____ Not applicable_____ Don't know_____ Decline to state_____
Only answer if you responded Borehole with manual pump|Protected dug well with handpump to Q12	
15. [Direct Observation] If the water point is functional, how many pump strokes are needed before water begins to flow?	_____
Only answer if you responded Yes to Q13	
16. [Direct Observation] Use the timer to record the time required to fill the 20 liter container: minutes	_____
Only answer if you responded Yes to Q13	
17. [Direct Observation] Use the timer to record the time required to fill the 20 liter container: seconds	_____
18. [Photo] Take a photograph of the waterpoint	_____
Only answer if you responded No to Q13	
19. Why is water not available from this source?	Water Source Inadequate_____ motorized pumps inadequate_____ Treatment plants inadequate_____ Main storage inadequate_____ Rising main inadequate_____

Distribution storage inadequate_____
Water points (taps) inadequate_____
Utilization exceeds theoretical demand_____
Pipes broken_____
Tap broken_____
Animals contaminated water_____
Broken/missing pump handle_____
Broken/missing chain_____
Broken/missing pump cylinder_____
Broken/missing valve_____
Broken/missing rod_____
Broken/missing gasket_____
Broken Handpump (other above ground failure)_____
Broken handpump (below-ground failure)_____
Lack of electricity or fuel_____
Water Vendor Did not come_____
Facility locked_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded No to Q13

20. Why has the system not yet been repaired?

Don't know whom to call_____
Repair person did not come_____
Parts not available_____
Repair person unable to fix system_____
Lack of funds to repair or pay fuel/electricity _____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Piped water into dwelling|Piped water to yard/plot|Public tap/standpipe|Mechanized borehole|Borehole with

21. In the past year, has the water system been broken down for more than one day (apart from seasonality problems)? If the water system is currently broken down, mark yes.

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q21

22. When did this water system last break down? _____

Only answer if you responded Yes to Q21

23. Days, weeks, months or years?

Day(s)_____
Week(s)_____
Month(s)_____
Year(s)_____

Only answer if you responded Yes to Q21

24. For how long was water not available from this source the last time it broke down? [If system is still broken, record time since the system broke.]

_____

Only answer if you responded Yes to Q21

25. Days, weeks, months or years?

Day(s)_____
Week(s)_____
Month(s)_____
Year(s)_____

Only answer if you responded Borehole with manual pump to Q12

26. What was done to repair the water source the last time it broke?

Nothing_____
replace chain_____
replace gasket/rubber ring_____
replace valve_____
replace leather cap_____
replace Cylinder_____
replace rod_____
Replace hand pump_____
Retrieve fallen cylinder_____
Rehabilitate borehole_____
Don't Know_____
Not Applicable_____
Decline to State_____

Only answer if you responded Piped water into dwelling|Piped water to yard/plot|Public tap/standpipe|Mechanized borehole to Q12

27. What was done to repair the water source the last time it broke?

Nothing_____
Replace pipe_____
Replace valve_____
Replace pump_____

Replace switch_____
Repair pipe _____

Only answer if you responded Yes to Q13

28. Scan the barcode of the watersample _____

Only answer if you responded Yes to Q13

29. Water sample ID _____

Only answer if you responded Yes to Q13

30. Are you taking a duplicate sample at this water point?

Yes_____
No_____

Only answer if you responded Yes to Q30

31. Scan the barcode of the duplicate watersample _____

Only answer if you responded Yes to Q30

32. Water sample ID for duplicate _____

Only answer if you responded Yes to Q13

33. Are you taking a field blank sample at this water point?

Yes_____
No_____

Only answer if you responded Yes to Q33

34. Scan the barcode of the field blank _____

Only answer if you responded Yes to Q33

35. Water sample ID for field blank _____

Only answer if you responded Yes to Q13

36. Are you taking a CDC sample at this water point?

Yes_____
No_____

Only answer if you responded Yes to Q36

37. Scan the barcode of the CDC sample _____

Only answer if you responded Yes to Q36

38. Water sample ID for CDC sample _____

Only answer if you responded Yes to Q30

39. Are you taking a CDC duplicate sample at this water point?

Yes_____
No_____

Only answer if you responded Yes to Q39

40. Scan the barcode of the CDC duplicate water sample _____

Only answer if you responded Yes to Q39

41. Water sample ID for CDC duplicate water sample _____

Only answer if you responded Yes to Q33

42. Are you taking a CDC field blank at this water point?

Yes_____
No_____

Only answer if you responded Yes to Q42

43. Scan the barcode of the CDC field blank _____

Only answer if you responded Yes to Q42

44. Water sample ID for CDC field blank _____

Facility Characteristics - questions

45. Who is the facility administrator you are interviewing?

WaSH committee member_____
Community leader_____
School or institution administrator_____
Private individual_____
Head of household_____

46. [Direct Observation] Year the water point was constructed, if visible _____

47. What year was this water point constructed? _____

48. [Direct Observation] Organization that constructed the water point, if visible

World Vision_____
UNICEF_____
WaterAid_____
CARE_____
other NGO_____
Local Government_____
Community_____
Not applicable_____
Don't know_____
Decline to state_____

49. Which organization constructed this water point?

World Vision_____
UNICEF_____
WaterAid_____
CARE_____
other NGO_____
Local Government_____
Community_____
Not applicable_____
Don't know_____
Decline to state_____

50. Does more than one family use this facility?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

51. How many households use this facility? _____
52. How many people use this facility? _____

Only answer if you responded No to Q13

53. How many people were using this facility the last time it was working? _____
54. Does anyone use this water source for drinking?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded No to Q13

55. Did anyone use this water source for drinking the last time water was available from this source?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

56. Who in this community manages this water point?

WaSH Committee_____
Community Leader_____
Private person_____
District/local government_____
Church_____
School_____
Vendor_____
No one_____
Not applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Piped water into dwelling|Piped water to yard/plot|Public tap/standpipe|Mechanized borehole to Q12

57. Has this community experienced any pipe breaks in the last week?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Reliability

58. Is water available from this source at all times?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

59. In the past two weeks, have there been any times when water was not available for a full day or more?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q59

60. For how many days in the last two weeks was water not available? _____

Only answer if you responded Yes to Q59

61. Are you able to predict which days water will be available from this source?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

62. Is water available from this source at all hours of the day?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded No to Q62

63. For how many hours was water not available yesterday? _____

Only answer if you responded No to Q62

64. Are you able to predict which hours water will be available from this source?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

65. Are there months during the year that water is not available from this source?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q65

66. During which months of the year is water not available from this source?

January_____
February_____
March_____
April_____
May_____
June_____
July_____
August_____
September_____
October_____
November_____
December_____
Not applicable_____
Don't know_____
Decline to state_____

Facility Characteristics - observations

67. [Direct Observation] Unique water point ID (Barcode) _____
68. [Direct Observation] Unique water point ID (Confirm) _____
69. [Direct Observation] Implementer's source ID, if different _____
70. [Direct Observation] Type of water point

School WASH point_____
Community WASH point_____
Health Center_____
Private WASH point_____

Only answer if you responded Borehole with manual pump|Protected dug well with handpump to Q12

71. [Direct Observation] What is the pump type?

India Mk II_____
Afridev_____
Vergnet_____
Nira_____
Water4_____

Only answer if you responded Piped water to yard/plot|Public tap/standpipe|Mechanized borehole|Borehole with manual pump|Protected dug

72. [Direct Observation] Is there a latrine within 10 meters of the water point?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Piped water to yard/plot|Public tap/standpipe|Mechanized borehole|Borehole with manual pump|Protected dug

73. [Direct Observation] Is the nearest latrine on higher ground than the water point?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Piped water to yard/plot|Public tap/standpipe|Mechanized borehole|Borehole with manual pump|Protected dug

74. [Direct Observation] Is there human excreta on the ground within 10 meters of the water point?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Piped water to yard/plot|Public tap/standpipe|Mechanized borehole|Borehole with manual pump|Protected dug

75. [Direct Observation] Is there a sewer or gutter receiving sewage within 10 meters of the water point?

Yes_____
No_____
Not applicable_____
Don't know_____

Decline to state_____

Only answer if you responded Piped water to yard/plot|Public tap/standpipe|Mechanized borehole|Borehole with manual pump|Protected dug

76. [Direct Observation] Is there animal excreta on the ground within 10 meters of the water point?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Piped water to yard/plot|Public tap/standpipe|Mechanized borehole|Borehole with manual pump|Protected dug

77. [Direct Observation] Is there any other obvious source of pollution within 10 meters of the water point (e.g. rubbish dump, etc.)?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Piped water to yard/plot|Public tap/standpipe|Mechanized borehole|Borehole with manual pump|Protected dug

78. [Direct Observation] Does the water point have a cement floor?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q78

79. [Direct Observation] Is there any ponding of stagnant water within 2 meters of the cement floor of the water point?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q78

80. Does the water point have a full cement apron?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Yes to Q78

81. [Direct Observation] Does the water point have a drainage channel?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q81

82. [Direct Observation] Is the water point's drainage channel broken, cracked, in need of cleaning?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q81

83. [Direct Observation] Is the drainage channel filled with stagnant water?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

84. [Direct Observation] Is there fencing around the installation adequate to keep animals out?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q78

85. [Direct Observation] Are there visible cracks on the cement floor around the water point?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Piped water into dwelling|Piped water to yard/plot|Public tap/standpipe to Q12

86. [Direct Observation] Are there signs of leaks in the mains pipes feeding this system?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Piped water into dwelling|Piped water to yard/plot|Public tap/standpipe to Q12

87. [Direct Observation] Are pipes exposed within 10 m of this waterpoint?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q78

88. Does the water point have cement walls?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Yes to Q88

89. [Direct Observation] Are there any cracks in the walls of the water point?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q88

90. [Direct Observation] Do the walls of the water point's concrete pad extend below the surface of the ground at all points?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Mechanized borehole|Borehole with manual pump to Q12

91. [Direct Observation] Are the above-ground parts of the water point hardware loose at the point of attachment to base (which could permit water to enter the casing)?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Mechanized borehole|Borehole with manual pump to Q12

92. [Direct Observation] Is the base of the water point adequately sealed to the concrete pad, so that water cannot enter into the borehole?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Water Safety

Only answer if you responded Yes to Q13

93. [Measure] Concentration of arsenic (ppb) _____

Only answer if you responded Yes to Q13

94. [Measure] Concentration of flouride (ppm) _____

Only answer if you responded Yes to Q13

95. [Measure] Turbidity of water (NTU) _____

Only answer if you responded Yes to Q13

96. [Measure] Conductivity of water (µS) _____

Only answer if you responded Yes to Q13

97. [Measure] pH of water _____

Water Safety - Duplicate Sample

Only answer if you responded Yes to Q30

98. [Measure] Concentration of arsenic (ppb) _____

Only answer if you responded Yes to Q30

99. [Measure] Concentration of flouride (ppm) _____

Only answer if you responded Yes to Q30

100. [Measure] Turbidity of water (NTU) _____

Only answer if you responded Yes to Q30

101. [Measure] Conductivity of water (µS) _____

Only answer if you responded Yes to Q30

102. [Measure] pH of water _____

Water Safety - Field blank

Only answer if you responded Yes to Q33

103. [Measure] Concentration of arsenic (ppb) _____

Only answer if you responded Yes to Q33

104. [Measure] Concentration of flouride (ppm) _____

Only answer if you responded Yes to Q33

105. [Measure] Turbidity of water (NTU) _____

Only answer if you responded Yes to Q33

106. [Measure] Conductivity of water (µS) _____

Only answer if you responded Yes to Q33

107. [Measure] pH of water _____

Metadata II

108. End time: hour _____
109. End time: minute _____
110. Write any of your notes here _____

Household Survey

Question	Response
1. Date	_____
2. Time: hours	_____
3. Time: minutes	_____
4. GPS coordinates	_____
5. Country	Burkina Faso_____ Ethiopia_____ Ghana_____ India_____ Mali_____ Mexico_____ Niger_____
6. Region	_____
7. District ID	_____
8. Your name	_____
9. Organization	CARE_____ CRS_____ One Drop_____ UNC_____ UNICEF_____ WaterAid_____ World Vision_____ WSA_____
10. Community name	_____
11. Unique community ID	_____
12. Household ID. If no ID flag is present, ask the respondent's permission to place an ID flag on the house so you can find it again later.	_____
13. Full name of respondent	_____
14. Has informed consent been obtained?	Yes_____ No_____
Household characteristics - I	
15. How many people live in your household? Household means the number of people living under this roof, including	_____
16. [Direct Observation] Does the respondent live in a multi-household compound?	Yes_____ No_____ Not applicable_____ Don't know_____ Decline to state_____
Only answer if you responded Yes to Q16	
17. What is the total number of people living in this compound including yourself?	_____
18. How many children under the age of 5 live in your household?	_____
19. Has one or more of these children under the age of 5 had diarrhea in the past two weeks? Diarrhea means having three or more loose or liquid stools within 24 hours.	Yes_____ No_____ Not applicable_____ Don't know_____ Decline to state_____
20. Are there any children in your house who are attending primary or secondary school?	Yes_____ No_____ Not applicable_____ Don't know_____ Decline to state_____
Only answer if you responded Yes to Q20	
21. Has one or more of these children who attend school missed one ore more days of school in the past two weeks due to illness?	Yes_____ No_____ Not applicable_____ Don't know_____ Decline to state_____
22. Has any child younger than 5 who lived in this household died in the last year?	Yes_____ No_____ Not applicable_____ Don't know_____ Decline to state_____
23. What is the highest level of school you have completed?	Never attended school_____ Some primary school (did not complete)_____ Primary (up to grade 6)_____ Secondary (up to grade 12)_____ University (above grade 12)_____ Technical Institute (above grade 12)_____ Non-formal education_____ Not applicable_____ Don't know_____ Decline to state_____
Participant	
24. [Direct Observation] Is the participant male or female?	Male _____ Female_____
25. How old are you?	_____
26. Did you go fetch water yesterday?	Yes_____ No_____ Not applicable_____

Don't know_____
Decline to state_____

Only answer if you responded Yes to Q26

27. How many times did you go to fetch water yesterday? _____

Only answer if you responded Yes to Q26

28. When you went to fetch water yesterday, which container did you use? [Estimate container size in Liters] _____

Only answer if you responded Yes to Q26

29. Each time you went to fetch water, how many containers like this did you carry and fill? _____

Person 1

30. Who else lives in this household? [Record first name only; ask respondent to begin with any other adults in the household, then list all children from oldest to youngest].

_____

31. Is [NAME] male or female?

Male_____
Female_____

32. How old is [NAME]? _____

33. Years, months, weeks, days?

Years_____
Months_____
Weeks_____
Days_____

34. Did [NAME] go to fetch water yesterday?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q34

35. How many times did [NAME] go to fetch water yesterday? _____

Only answer if you responded Yes to Q34

36. When [NAME] went to fetch water, which container did [NAME] use? [Estimate container size in Liters] _____

Only answer if you responded Yes to Q34

37. Each time [NAME] goes to fetch water, how many containers like this does [NAME] carry and fill? _____

38. Is there another person to add?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Person 2

Only answer if you responded Yes to Q38

39. Who else lives in this household? [Record first name only; ask respondent to begin with any other adults in the household, then list all children from oldest to youngest].

_____

Only answer if you responded Yes to Q38

40. Is [NAME] male or female?

Male_____
Female_____

Only answer if you responded Yes to Q38

41. How old is [NAME]? _____

Only answer if you responded Yes to Q38

42. Years, months, weeks, days?

Years_____
Months_____
Weeks_____
Days_____

Only answer if you responded Yes to Q38

43. Did [NAME] go to fetch water yesterday?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q43

44. How many times did [NAME] go to fetch water yesterday? _____

Only answer if you responded Yes to Q43

45. When [NAME] went to fetch water, which container did [NAME] use? [Estimate container size in Liters] _____

Only answer if you responded Yes to Q43

46. Each time [NAME] goes to fetch water, how many containers like this does [NAME] carry and fill? _____

Only answer if you responded Yes to Q38

47. Is there another person to add? [2]

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Person 3

Only answer if you responded Yes to Q47

48. Who else lives in this household? [Record first name only; ask respondent to begin with any other adults in the household, then list all children from oldest to youngest].

_____

Only answer if you responded Yes to Q47

49. Is [NAME] male or female?

Male_____
Female_____

Only answer if you responded Yes to Q47

50. How old is [NAME]? _____

Only answer if you responded Yes to Q47

51. Years, months, weeks, days?

Years_____
Months_____
Weeks_____
Days_____

Only answer if you responded Yes to Q47

52. Did [NAME] go to fetch water yesterday?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q52

53. How many times did [NAME] go to fetch water yesterday? _____

Only answer if you responded Yes to Q52

54. When [NAME] went to fetch water, which container did [NAME] use? [Estimate container size in Liters] _____

Only answer if you responded Yes to Q52

55. Each time [NAME] goes to fetch water, how many containers like this does [NAME] carry and fill? _____

Only answer if you responded Yes to Q47

56. Is there another person to add? [3]

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Person 4

Only answer if you responded Yes to Q56

57. Who else lives in this household? [Record first name only; ask respondent to begin with any other adults in the household, then list all children from oldest to youngest]. _____

Only answer if you responded Yes to Q56

58. Is [NAME] male or female?

Male_____
Female_____

Only answer if you responded Yes to Q56

59. How old is [NAME]? _____

Only answer if you responded Yes to Q56

60. Years, months, weeks, days?

Years_____
Months_____
Weeks_____
Days_____

Only answer if you responded Yes to Q56

61. Did [NAME] go to fetch water yesterday?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q61

62. How many times did [NAME] go to fetch water yesterday? _____

Only answer if you responded Yes to Q61

63. When [NAME] went to fetch water, which container did [NAME] use? [Estimate container size in Liters] _____

Only answer if you responded Yes to Q61

64. Each time [NAME] goes to fetch water, how many containers like this does [NAME] carry and fill? _____

Only answer if you responded Yes to Q56

65. Is there another person to add? [4]

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Person 5

Only answer if you responded Yes to Q65

66. Who else lives in this household? [Record first name only; ask respondent to begin with any other adults in the household, then list all children from oldest to youngest]. _____

Only answer if you responded Yes to Q65

67. Is [NAME] male or female?

Male_____
Female_____

Only answer if you responded Yes to Q65

68. How old is [NAME]? _____

Only answer if you responded Yes to Q65

69. Years, months, weeks, days?

Years_____
Months_____
Weeks_____
Days_____

Only answer if you responded Yes to Q65

70. Did [NAME] go to fetch water yesterday?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q70

71. How many times did [NAME] go to fetch water yesterday? _____

Only answer if you responded Yes to Q70

72. When [NAME] went to fetch water, which container did [NAME] use? [Estimate container size in Liters] _____

Only answer if you responded Yes to Q70

73. Each time [NAME] goes to fetch water, how many containers like this does [NAME] carry and fill? _____

Only answer if you responded Yes to Q65

74. Is there another person to add? [5]

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Person 6

Only answer if you responded Yes to Q74

75. Who else lives in this household? [Record first name only; ask respondent to begin with any other adults in the household, then list all children from oldest to youngest].

_____

Only answer if you responded Yes to Q74

76. Is [NAME] male or female?

Male_____
Female_____

Only answer if you responded Yes to Q74

77. How old is [NAME]?

_____

Only answer if you responded Yes to Q74

78. Years, months, weeks, days?

Years_____
Months_____
Weeks_____
Days_____

Only answer if you responded Yes to Q74

79. Did [NAME] go to fetch water yesterday?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q79

80. How many times did [NAME] go to fetch water yesterday?

_____

Only answer if you responded Yes to Q79

81. When [NAME] went to fetch water, which container did [NAME] use? [Estimate container size in Liters]

_____

Only answer if you responded Yes to Q79

82. Each time [NAME] goes to fetch water, how many containers like this does [NAME] carry and fill?

_____

Only answer if you responded Yes to Q74

83. Is there another person to add? [6]

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Person 7

Only answer if you responded Yes to Q83

84. Who else lives in this household? [Record first name only; ask respondent to begin with any other adults in the household, then list all children from oldest to youngest].

_____

Only answer if you responded Yes to Q83

85. Is [NAME] male or female?

Male_____
Female_____

Only answer if you responded Yes to Q83

86. How old is [NAME]?

_____

Only answer if you responded Yes to Q83

87. Years, months, weeks, days?

Years_____
Months_____
Weeks_____
Days_____

Only answer if you responded Yes to Q83

88. Did [NAME] go to fetch water yesterday?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q88

89. How many times did [NAME] go to fetch water yesterday?

_____

Only answer if you responded Yes to Q88

90. When [NAME] went to fetch water, which container did [NAME] use? [Estimate container size in Liters]

_____

Only answer if you responded Yes to Q88

91. Each time [NAME] goes to fetch water, how many containers like this does [NAME] carry and fill?

_____

Only answer if you responded Yes to Q83

92. Is there another person to add? [7]

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Person 8

Only answer if you responded Yes to Q92

93. Who else lives in this household? [Record first name only; ask respondent to begin with any other adults in the household, then list all children from oldest to youngest].

_____

Only answer if you responded Yes to Q92

94. Is [NAME] male or female?

Male_____
Female_____

Only answer if you responded Yes to Q92

95. How old is [NAME]?

_____

Only answer if you responded Yes to Q92

96. Years, months, weeks, days?

Years_____
Months_____
Weeks_____
Days_____

Only answer if you responded Yes to Q92

97. Did [NAME] go to fetch water yesterday?

Yes_____
No_____
Not applicable_____
Don't know_____

Decline to state_____

Only answer if you responded Yes to Q97

98. How many times did [NAME] go to fetch water yesterday? _____

Only answer if you responded Yes to Q97

99. When [NAME] went to fetch water, which container did [NAME] use? [Estimate container size in Liters] _____

Only answer if you responded Yes to Q97

100. Each time [NAME] goes to fetch water, how many containers like this does [NAME] carry and fill? _____

Only answer if you responded Yes to Q92

101. Is there another person to add? [8]

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Person 9

Only answer if you responded Yes to Q101

102. Who else lives in this household? [Record first name only; ask respondent to begin with any other adults in the household, then list all children from oldest to youngest]. _____

Only answer if you responded Yes to Q101

103. Is [NAME] male or female?

Male_____
Female_____

Only answer if you responded Yes to Q101

104. How old is [NAME]? _____

Only answer if you responded Yes to Q101

105. Years, months, weeks, days?

Years_____
Months_____
Weeks_____
Days_____

Only answer if you responded Yes to Q101

106. Did [NAME] go to fetch water yesterday?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q106

107. How many times did [NAME] go to fetch water yesterday? _____

Only answer if you responded Yes to Q106

108. When [NAME] went to fetch water, which container did [NAME] use? [Estimate container size in Liters] _____

Only answer if you responded Yes to Q106

109. Each time [NAME] goes to fetch water, how many containers like this does [NAME] carry and fill? _____

Only answer if you responded Yes to Q101

110. Is there another person to add? [9]

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Person 10

Only answer if you responded Yes to Q110

111. Who else lives in this household? [Record first name only; ask respondent to begin with any other adults in the household, then list all children from oldest to youngest]. _____

Only answer if you responded Yes to Q110

112. Is [NAME] male or female?

Male_____
Female_____

Only answer if you responded Yes to Q110

113. How old is [NAME]? _____

Only answer if you responded Yes to Q110

114. Years, months, weeks, days?

Years_____
Months_____
Weeks_____
Days_____

Only answer if you responded Yes to Q110

115. Did [NAME] go to fetch water yesterday?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q115

116. How many times did [NAME] go to fetch water yesterday? _____

Only answer if you responded Yes to Q115

117. When [NAME] went to fetch water, which container did [NAME] use? [Estimate container size in Liters] _____

Only answer if you responded Yes to Q115

118. Each time [NAME] goes to fetch water, how many containers like this does [NAME] carry and fill? _____

Only answer if you responded Yes to Q110

119. Is there another person to add? [10]

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Person 11

Only answer if you responded Yes to Q119

120. Who else lives in this household? [Record first name only; ask respondent to begin with any other adults in the household, then list all children from oldest to youngest]. _____

Only answer if you responded Yes to Q119

121. Is [NAME] male or female?

Male_____
Female_____

Only answer if you responded Yes to Q119

122. How old is [NAME]? _____

Only answer if you responded Yes to Q119

123. Years, months, weeks, days?

Years_____
Months_____
Weeks_____
Days_____

Only answer if you responded Yes to Q119

124. Did [NAME] go to fetch water yesterday?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q124

125. How many times did [NAME] go to fetch water yesterday? _____

Only answer if you responded Yes to Q124

126. When [NAME] went to fetch water, which container did [NAME] use? [Estimate container size in Liters] _____

Only answer if you responded Yes to Q124

127. Each time [NAME] goes to fetch water, how many containers like this does [NAME] carry and fill? _____

Only answer if you responded Yes to Q119

128. Is there another person to add? [11]

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Person 12

Only answer if you responded Yes to Q128

129. Who else lives in this household? [Record first name only; ask respondent to begin with any other adults in the household, then list all children from oldest to youngest]. _____

Only answer if you responded Yes to Q128

130. Is [NAME] male or female?

Male_____
Female_____

Only answer if you responded Yes to Q128

131. How old is [NAME]? _____

Only answer if you responded Yes to Q128

132. Years, months, weeks, days?

Years_____
Months_____
Weeks_____
Days_____

Only answer if you responded Yes to Q128

133. Did [NAME] go to fetch water yesterday?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q133

134. How many times did [NAME] go to fetch water yesterday? _____

Only answer if you responded Yes to Q133

135. When [NAME] went to fetch water, which container did [NAME] use? [Estimate container size in Liters] _____

Only answer if you responded Yes to Q133

136. Each time [NAME] goes to fetch water, how many containers like this does [NAME] carry and fill? _____

Only answer if you responded Yes to Q128

137. Are there any more people to add? How many? _____

Water Source

138. What is the main source of drinking-water for members of your household during the dry season?

Piped water into dwelling_____
Piped water to yard/plot_____
Public tap/standpipe_____
Mechanized borehole_____
Borehole with manual pump_____
Protected dug well with manual pump_____
Protected dug well without pump_____
Unprotected dug well_____
Protected spring_____
Unprotected spring_____
Rainwater collection_____
Pay another person to fetch/ buy filled containers from a vendor_____
Bottled water- sachet water- or "pure water (sachet water)"_____
Cart with small tank/drum_____
Tanker-truck_____
Surface water (river- dam- lake- pond- stream- canal- irrigation channels)_____
Not applicable_____
Don't know_____
Decline to state_____

139. For how many months each year do you use this source? _____

140. Are there ever times during the dry season when water is not available from [SOURCE]?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q140

141. When your main source is not available, what other source of drinking-water for members of your household do you use in the dry season?

Piped water into dwelling_____
Piped water to yard/plot_____
Public tap/standpipe_____
Mechanized borehole_____
Borehole with manual pump_____
Protected dug well with manual pump_____
Protected dug well without pump_____
Unprotected dug well_____
Protected spring_____
Unprotected spring_____
Rainwater collection_____
Pay another person to fetch/ buy filled containers from a vendor_____
Bottled water- sachet water- or "pure water (sachet water)"_____
Cart with small tank/drum_____
Tanker-truck_____
Surface water (river- dam- lake- pond- stream- canal- irrigation channels)_____
Not applicable_____
Don't know_____
Decline to state_____

142. [Direct Observation] Is the household's main dry season water source on-plot?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

143. What is the main source of drinking-water for members of your household during the wet season?

Piped water into dwelling_____
Piped water to yard/plot_____
Public tap/standpipe_____
Mechanized borehole_____
Borehole with manual pump_____
Protected dug well with manual pump_____
Protected dug well without pump_____
Unprotected dug well_____
Protected spring_____
Unprotected spring_____
Rainwater collection_____
Pay another person to fetch/ buy filled containers from a vendor_____
Bottled water- sachet water- or "pure water (sachet water)"_____
Cart with small tank/drum_____
Tanker-truck_____
Surface water (river- dam- lake- pond- stream- canal- irrigation channels)_____
Not applicable_____
Don't know_____
Decline to state_____

144. [Direct Observation] Is the household's main wet season water source on-plot?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

145. For how many months each year do you use this source?
_____

146. Are there ever times during the wet season when water is not available from [SOURCE]?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q146

147. When your main source is not available, what other source of drinking-water for members of your household do you use in the wet season?

Piped water into dwelling_____
Piped water to yard/plot_____
Public tap/standpipe_____
Mechanized borehole_____
Borehole with manual pump_____
Protected dug well with manual pump_____
Protected dug well without pump_____
Unprotected dug well_____
Protected spring_____
Unprotected spring_____
Rainwater collection_____
Pay another person to fetch/ buy filled containers from a vendor_____
Bottled water- sachet water- or "pure water (sachet water)"_____
Cart with small tank/drum_____
Tanker-truck_____
Surface water (river- dam- lake- pond- stream- canal- irrigation channels)_____
Not applicable_____
Don't know_____
Decline to state_____

Water reliability

148. What water source did you most recently fetch water from?

Piped water into dwelling_____
Piped water to yard/plot_____
Public tap/standpipe_____
Mechanized borehole_____
Borehole with handpump_____
Protected dug well_____
Unprotected dug well_____
Protected spring_____
Unprotected spring_____
Rainwater collection_____

Bottled water- sachet water- or "pure water (sachet water)"_____
Cart with small tank/drum_____
Tanker-truck_____
Surface water (river- dam- lake- pond- stream- canal- irrigation channels)_____
Not applicable_____
Don't know_____
Decline to state_____

149. Is water available from this source at all times?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded No to Q149

150. Has there been any time in the last two weeks that you could not get any water from [source] for a full day or more?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q150

151. For how many days in the last two weeks was water not available? _____

Only answer if you responded Yes to Q150

152. Are you able to predict which days water will be available from this source?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded No to Q149

153. Is water available from this source at all hours of the day?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded No to Q153

154. For how many hours was water not available yesterday? _____

Only answer if you responded No to Q153

155. Are you able to predict which hours water will be available from this source?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

156. Are there months during the year that water is not available from this source?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q156

157. Which months is water not available from this source?

January_____
February_____
March_____
April_____
May_____
June_____
July_____
August_____
September_____
October_____
November_____
December_____
Not applicable_____
Don't know_____
Decline to state_____

Water Functionality

158. Has there been any time in the last year that you could not get any water from [source] for a full day or more (including today)?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q158

159. For how long was water not available from your main source the last time it broke down? [If system is still broken, record time since the system broke.] _____

Only answer if you responded Yes to Q158

160. Days, weeks, months, years?

Day(s)_____
Week(s)_____
Month(s)_____
Year(s)_____

Only answer if you responded Yes to Q158

161. How many times has this water point broken down in the past year? _____

Water user satisfacation

162. How satisfied or dissatisfied are you with your water service?

Very satisfied_____
Somewhat satisfied_____
Dissatisfied_____
Don't know_____

Decline to state_____

163. How satisfied or dissatisfied are you with the committee that manages the water facilities in your community?

Very satisfied_____
Somewhat satisfied_____
Dissatisfied_____
Not applicable_____
Decline to state_____

164. Has the water committee held a community meeting in the past year?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q164

165. Did you attend any of the community meetings that the water committee held in the past year?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

166. Have you ever been actively involved in making a decisions about the water supply?

Yes_____
No_____
Don't know_____
Not applicable_____
Decline to state_____

Water Quantity

167. How long do you usually have to queue to fetch water from this source? _____
168. Minutes, hours?

Minute(s)_____
Hour(s)_____

169. Do you use water from your main water source for a farm or garden?

Farm_____
Garden_____
Both_____
None_____

170. Do you use your main water source for a business? [If yes, ask what type of business: mark all that apply]

no_____
restaurant_____
prepared food or drinks_____
washing cars_____
washing clothes for money_____
construction_____
fetching water for others for money_____

Water Accessibility

171. Can you take me to the water source that you most recently fetched water from?

Yes_____
No_____
Sends other person to show water source_____

Only answer if you responded Yes\|Sends other person to show water source to Q171

172. Record time you start water walk: hour _____

Only answer if you responded Yes\|Sends other person to show water source to Q171

173. Record time you leave for water walk: minute _____

Only answer if you responded Yes\|Sends other person to show water source to Q171

174. Record GPS coordinates of water point _____

Only answer if you responded Yes\|Sends other person to show water source to Q171

175. [After taking GPS coordinates, return to the house] Record time of return: hour _____

Only answer if you responded Yes\|Sends other person to show water source to Q171

176. Record time of return: minute _____

Household water

177. Do you treat your water to make it safer for drinking?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q177

178. What do you usually do to the water to make it safer to drink? Anything else? [Do not read choices, record all items mentioned]

boil_____
Add bleach/chlorine_____
Strain it through a cloth_____
Use a water filter (ceramic- sand- composite- etc.)_____
Solar disinfection_____
Let it stand and settle_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q177

179. In the last two weeks, have you treated your water:

Everyday_____
Most of the days_____
Half of the days_____
Less than half of the days_____
Not at all_____
Not applicable_____
Don't know_____
Decline to state_____

180. Scan the barcode of the household water sample _____
181. Water sample ID _____
182. Can you serve me some water the way you normally take it? [Direct Observation] Does/is the drinking-water storage container: (mark all that apply)

Have a lid that is completely covering it?_____

Have a narrow opening_____
Have a tap or spigot_____
Beyond reach of animals (1 meter or more from the ground)?_____
Clean (free of dirt- debris- garbage- faecal matter- etc.)?_____
Not applicable_____
Don't know_____
Decline to state_____

183. [Direct Observation] Take a picture of the respondent taking water from the drinking-water storage container the way they normally take it

_____

184. [Direct Observation] How was the water served from the storage container?

Poured_____
Dispensed through a spigot or spout_____
Dipped/scooped_____

185. [Direct Observation] What was used to dip or scoop the water?

Dipper or ladle_____
Bucket_____
Hands_____
Cup- bowl- jar- or can_____

186. [Direct Observation] What is the main material of the floors inside all the rooms of the house?

Earth / Sand_____
Dung_____
Wood planks_____
Palm / Bamboo_____
Parquet or polished wood_____
Vinyl or asphalt strips_____
Ceramic tiles_____
Cement_____
Carpet_____
Not applicable_____
Don't know_____
Decline to state_____

187. What is the source of this [the water that is sampled] water (mark all that apply)? Probe to ask "are any other sources mixed in?"

Piped water into dwelling_____
Piped water to yard/plot_____
Public tap/standpipe_____
Mechanized borehole_____
Borehole with handpump_____
Protected dug well_____
Unprotected dug well_____
Protected spring_____
Unprotected spring_____
Rainwater collection_____
Bottled water- sachet water- or "pure water (sachet water)"_____
Cart with small tank/drum_____
Tanker-truck_____
Surface water (river- dam- lake- pond- stream- canal- irrigation channels)_____
Not applicable_____
Don't know_____
Decline to state_____

188. [Direct Observation] What is the main material of the dwelling walls?

No walls_____
Dirt/earth_____
Cement_____
Dung_____
Cane/Palm/Tree trunks_____
Bamboo with mud_____
Stone with mud_____
Uncovered adobe_____
Plywood_____
Cardboard_____
Reused wood_____
Stone with lime/cement_____
Bricks_____
Cement blocks_____
Covered adobe_____
Wood planks/shingles_____
Not applicable_____
Don't know_____
Decline to state_____

189. [Direct Observation] What is the main material of the dwelling roof?

No Roof_____
Thatch/straw/Palm leaf_____
Metal_____
Wood planks_____
Sod/grass and earth_____
Rustic mat/woven plant material_____
Palm / Bamboo_____
Cardboard_____
Finished Wood boards_____
Calamine / Cement fibre_____
Ceramic tiles_____
Cement slab_____
Roofing shingles_____
Plastic_____
Not applicable_____
Don't know_____
Decline to state_____

Sanitation Facility characteristics

190. [Do not read answers out loud] Some people prefer to defecate in the bush or the open, some prefer to defecate in a latrine, and some prefer other places. What are the places that adult men and women in this household defecate? (mark all that apply) Probe to ask "Is there any other place?" until they finish

[Latrine]_____
[Bush- field- no sanitation facilities]_____
[In water body- river or lake]_____

191. [Do not read answers out loud] Some people prefer to defecate in the bush or the open, some prefer to defecate in a latrine, and some prefer other places. Where are the places that boys and girls over the age of 3 in this household go to defecate (mark all that apply) Probe to ask "Is there any other place?" until they finish

[Latrine]_____
[Bush- field- no sanitation facilities]_____
[In water body- river or lake]_____

192. [Direct Observation] According to the answers of the two previous questions, does anyone in this household defecate in a latrine?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q192

193. Can you show me the toilet facility that you use?

Yes_____
No_____
Sends other person to show sanitation facility_____

Only answer if you responded Yes to Q193

194. Record time you leave for toilet facility: hour _____

Only answer if you responded Yes to Q193

195. Record time you leave for toilet facility: minute _____
196. Sanitation facility ID _____

Only answer if you responded Yes to Q193

197. [Direct Observation] GPS coordinates of primary sanitation facility _____

Only answer if you responded Yes\|Sends other person to show sanitation facility to Q193

198. [Direct Observation] Is the sanitation-facility on-plot?

Yes - in own dwelling_____
Yes - in own yard/plot_____
No - facility is off-plot_____
Not observed_____

Only answer if you responded Yes - in own dwelling\|Yes - in own yard/plot to Q198

199. [Direct Observation] What type of toilet facility is it? [If “flush” or “pour-flush” and you cannot tell where the waste goes, probe] Where does it flush to?*

Flush/pour flush to piped sewer system_____
Flush/pour flush to piped septic tank_____
Flush/pour flush to pit latrine_____
Flush/pour flush to elsewhere_____
Flush/pour flush to unknown place/not sure/don't know_____
Ventilated improved pit latrine (VIP)_____
Pit latrine with slab_____
Pit latrine without slab/open pit_____
Composting toilet_____
Hanging toilet/hanging latrine_____

Only answer if you responded No - facility is off-plot\|Not observed to Q198

200. [Direct Observation] What type of toilet facility is it? [If “flush” or “pour-flush” and you cannot tell where the waste goes, probe] Where does it flush to?

Flush/pour flush to piped sewer system_____
Flush/pour flush to piped septic tank_____
Flush/pour flush to pit latrine_____
Flush/pour flush to elsewhere_____
Flush/pour flush to unknown place/not sure/don't know_____
Ventilated improved pit latrine (VIP)_____
Pit latrine with slab_____
Pit latrine without slab/open pit_____
Composting toilet_____
Hanging toilet/hanging latrine_____

Only answer if you responded Yes\|Sends other person to show sanitation facility to Q193

201. [Direct Observation] Does the facility shows signs of recent use?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes - in own dwelling\|Yes - in own yard/plot to Q198

202. [Direct Observation] Is this facility accessible to disabled people?

Yes_____
No_____

Only answer if you responded Yes\|Sends other person to show sanitation facility to Q193

203. [Photo] Take a photo of the sanitation facility _____

Only answer if you responded Yes - in own dwelling\|Yes - in own yard/plot to Q198

204. [Direct Observation] Is the sanitation facility in working order?

In working order_____
Not in working order_____

Only answer if you responded Not in working order to Q204

205. [Direct Observation] Why is the sanitation facility not functioning as intended?

Facilities unreliable_____
Facilities unhygienic_____
Facilities poorly constructed_____
Facilities unsafe due to large cracks in the slab or other defects_____
Pit full_____
Facilities flooded_____
No water_____
Locked_____

Only answer if you responded Yes - in own dwelling\|Yes - in own yard/plot to Q198

206. [Direct Observation] Is the inside of the sanitation facility soiled with feces?

Yes_____
No_____

Only answer if you responded Yes - in own dwelling\|Yes - in own yard/plot to Q198

207. [Direct Observation] Is there evidence of feces on the ground within 10 meters of the sanitation facility?

Yes_____
No_____

Only answer if you responded Yes - in own dwelling\|Yes - in own yard/plot to Q198

208. [Direct Observation] Is there an unpleasant or offensive smell within the sanitation facility which could discourage use of the facility.

Yes_____
No_____

sewer system|Flush/pour flush to piped septic tank|Flush/pour flush to pit latrine|Flush/pour flush to elsewhere|Flush/pour flush to unknown place/not sure/don't know|Ventilated improved pit la

209. [Direct Observation] Is there evidence of cracking or damage to the toilet pedestal or squat-slab?

Yes_____
No_____

responded Flush/pour flush to piped sewer system|Flush/pour flush to piped septic tank|Flush/pour flush to pit latrine|Flush/pour flush to elsewhere|Flush/pour flush to unknown place/not sure/

210. [Direct Observation] Is there any damage to the pipes or plumbing?

Yes_____
No_____

Only answer if you responded Flush/pour flush to pit latrine|Ventilated improved pit latrine (VIP)|Pit latrine with slab|Pit latrine without slab/open pit|Composting toilet to Q199

211. [Direct Observation] Is the pit uncovered?

Yes_____
No_____

Only answer if you responded No to Q211

212. [Direct Observation] Is the cover slab incompletely sealed?

Cover slab incompletely sealed_____
Cover slab properly sealed_____

Flush/pour flush to piped sewer system|Flush/pour flush to piped septic tank|Flush/pour flush to pit latrine|Ventilated improved pit latrine (VIP)|Pit latrine with slab|Pit latrine without slab/open p

213. [Direct Observation] Is there evidence that the pit or septic tank is full, overflowing or allowing wastes to leak onto the ground?

Yes_____
No_____

Only answer if you responded Yes|Sends other person to show sanitation facility to Q193

214. How often do adult men in your household use this latrine when they are home (never, sometimes, or always)?

Never_____
Sometimes_____
Always_____
Uses a separate latrine_____
Don't know_____
Not applicable_____
Decline to state_____

Only answer if you responded Yes|Sends other person to show sanitation facility to Q193

215. How often do adult women in your household use this latrine when they are home (never, sometimes, or always)?

Never_____
Sometimes_____
Always_____
Uses separate latrine_____
Don't know_____
Not applicable_____
Decline to state_____

Only answer if you responded Yes|Sends other person to show sanitation facility to Q193

216. How often do boys older than 3 in your household use this latrine when they are home (never, sometimes, or always)?

Never_____
Sometimes_____
Always_____
Uses a separate latrine_____
Don't know_____
Not applicable_____
Decline to state_____

Only answer if you responded Yes|Sends other person to show sanitation facility to Q193

217. How often do girls older than 3 in your household use this latrine when they are home (never, sometimes, or always)?

Never_____
Sometimes_____
Always_____
Uses a separate latrine_____
Don't know_____
Not applicable_____
Decline to state_____

Only answer if you responded Yes to Q193

218. When was this toilet facility constructed?

_____

Only answer if you responded Yes to Q193

219. Did your household build this latrine?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q219

220. How much did it cost to build this latrine? (answer in Ghana Cedis)

_____

Only answer if you responded Yes to Q219

221. Where did you get the materials to build this latrine? (choose all that apply)

Market_____
Store or other commercial supplier_____
Given by government_____
Given by NGO_____
Don't know_____
Not applicable_____
Decline to state_____

Only answer if you responded Market|Store or other commercial supplier to Q221

222. Where did you get the money to build this latrine? (choose all that apply)

Savings_____
Microfinance loan_____
Borrowed money from a friend or family member_____
government_____
NGO_____
Don't know_____
Not applicable_____
Decline to state_____

Only answer if you responded Yes to Q219

223. [Do not read answers out loud] Why did you build this latrine? (check all that apply)

Program was offering subsidy_____
Someone told me I had to_____
Had enough money to build it_____
For sick/old relatives_____
Construction of new house_____
Neighbour got one_____
For events (wedding/funeral/etc.)_____
For visitors_____
For relatives coming to visit_____
Requested by children_____
For health or hygiene reasons_____
For safety reasons_____
Because of CLTS_____
Other, specify_____
Don't know_____
Not applicable_____
Decline to state_____

to piped septic tank|Flush/pour flush to pit latrine|Flush/pour flush to elsewhere|Flush/pour flush to unknown place/not sure/don't know|Ventilated improved pit latrine (VIP)|Pit latrine with slab|F

224. Has this toilet facility ever completely filled with excreta so that it was unusable or overflowing?

Yes_____
No_____
Not Applicable_____
Don't Know_____
Decline to State_____

Only answer if you responded Yes to Q224

225. What was done when this happened?

Abandon it_____
Abandon it and construct a new sanitation facility_____
Switch to second pit/tank/vault onsite (within 5 m)_____
Respondent/Relative/Friend Emptied the pit/septic tank_____
Hired someone else to empty the pit/septic tank_____
Nothing/no action taken_____

Only answer if you responded Abandon it|Abandon it and construct a new sanitation facility|Nothing/no action taken to Q225

226. [Direct observation] Has the pit/vault/tank been buried or covered in any way?

Yes_____
No_____

Only answer if you responded Respondent/Relative/Friend Emptied the pit/septic tank|Hired someone else to empty the pit/septic tank to Q225

227. What method was used to empty the pit/septic tank?

Manually with buckets, spades, shovels_____
Manually by digging a hole next to the pit and breaking the pit open_____
Manually with a piston pump and flywheel mounted on a cart (MAPET)_____
Manually using a hand pump and hose (Gulper)_____
Using a vacuum tanker truck_____
Using a minivacuum tanker (Vacutug, size of small cart)_____

ally with buckets, spades, shovels|Manually by digging a hole next to the pit and breaking the pit open|Manually with a piston pump and flywheel mounted on a cart (MAPET)|Manually using a ha

228. Where was the emptied fecal sludge disposed of?

Dug a hole and buried it_____
Discarded to ground, or bush_____
Discarded to rubbish pile/trash dump_____
Used in farming or gardening_____
Discharged to river, stream or canal_____
Discharged to lake, pond, or dam_____
Discharged to ocean_____
Discharged to storm drain/sewer drain or gutter_____
Not Applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Using a vacuum tanker truck|Using a minivacuum tanker (Vacutug, size of small cart) to Q227

229. Where was the pumped out fecal sludge disposed of?

Discharged it to dumpsite/landfill_____
Discharged it to river, stream or canal_____
Discharged to lake, pond or dam_____
Discharged to ocean_____
Discharged to storm drain/sewer drain or gutter_____
Land applied not for agriculture within community_____
Land applied not for agriculture outside the community_____
Land applied for agriculture within community_____
Land applied for agriculture outside the community_____
Discharged at treatment facility_____
Not Applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Flush/pour flush to elsewhere|Flush/pour flush to unknown place/not sure/don't know to Q199

230. [Direct Observation] Are excreta discharged directly to the ground or to an open sewer or gutter

Directly to the ground_____
To an open sewer or gutter_____

Only answer if you responded No to Q193

231. What type of toilet facility do you use? [If "flush" or "pour-flush" probe] Where does it flush to?

Flush/pour flush to piped sewer system_____
Flush/pour flush to piped septic tank_____
Flush/pour flush to pit latrine_____
Ventilated improved pit latrine (VIP)_____
pit latrine with slab_____
Pit latrine without slab/open pit_____
composting toilet_____
bucket_____
hanging toilet/hanging latrine_____
No facilities or bush or field_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q192

232. Is this facility shared with other families who are not relatives?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q192

233. How many households (including your own) use this facility? _____

Only answer if you responded Yes to Q192

234. Is the sanitation facility for your household functional?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q193

235. Record time you return from sanitation walk: minute _____

Only answer if you responded Yes to Q192

236. Is your household using this sanitation facility?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q193

237. Record time you return from sanitation walk: hour _____

No Latrine Households

Only answer if you responded No to Q192

238. [Do not read the answer choices out loud] What are the reasons why you don't have a latrine? (choose all that apply)

No money/cost is too high_____
No materials to build latrine_____
Latrine not important_____
Open defecation tradition_____
Habit of open defecation_____
Vast/available area for open defecation_____
Prefer the field/bush/open_____
No external support/assistance to build_____
Never received information on the importance of using latrine_____
No one to build latrine_____
No space in or near house_____
A pit toilet smells too much_____
We do not own the house/land_____
Don't want to spend time on cleaning_____
Haven't thought about it; we are fine the way we do it now_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded No to Q192

239. Do you wish that you owned a latrine?

Yes_____
No_____
Don't know_____
Not applicable_____
Decline to state_____

Only answer if you responded Yes to Q239

240. [Do not read the answer choices out loud] Why do you wish that you owned a latrine? (choose all that apply)

For safety reasons_____
For status within the community_____
Because my neighbors have one_____
For health or hygiene reasons_____
For visitors_____
Convenience/saves time_____
Good for the environment_____
Not smelling_____
Don't know_____
Not appliacble_____
Decline to state_____

Only answer if you responded No to Q192

241. What would be the most important characteristics of a latrine if you built or bought a one?

Latrine that looks nice_____
Easy to operatre and maintain_____
Easy to build and cheap_____
Strong and durable/can last long_____
Can provide privacy_____
Clean and no bad smell_____
Flush latrine_____
Comfort_____
Privacy_____
I am not interested in building or buying a latrine_____
Don't know_____
Not applicable_____
Decline to state_____

Sanitation reliability

242. Are you able to use this facility at all times?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded No to Q242

243. At what times can you use this sanitation facility? [Calculate the number of hours per day that the facility is available--may need to ask follow-up questions] _____

244. In the past year, has the sanitation facility been not available or out of service for more than one day?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q244

245. How long was the sanitation facility out of service the last time it broke down? [If system is still broken, record time since the system broke.]

_____

Only answer if you responded Yes to Q244

246. Why was the facility nonfunctional?

Pit became full_____
Pit collapsed_____
Structure collapsed_____
Pit became flooded_____
Pipe became blocked_____
Facility too dirty_____
Smell too unpleasant_____
Fear of animals or snakes_____
Facility too hot to use_____
No water_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q244

247. Days, weeks, months, years?

Day(s)_____
Week(s)_____
Month(s)_____
Year(s)_____

Sanitation excreta disposal

248. Does any child younger than 3 years old live in this household?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

249. New question - please change name

_____

Only answer if you responded Yes to Q248

250. [Do not read answer choices] The last time the youngest child (less than 3 years) passed feces, what was done to dispose of the feces?

[Child used toilet/latrine]_____
[Put/rinsed into toilet or latrine]_____
[Put/rinsed into drain or ditch]_____
[Thrown into garbage bin or pile]_____
[Buried]_____
[Threw feces away in the open/threw in bush]_____
[Left in the open]_____
Not applicable_____
Don't know_____
Decline to state._____

251. [Direct Observation] Are excreta present in the house or yard?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

252. Has any member of your household seen a person openly defecate in this community in the past two weeks?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Hygiene

253. [Direct Obervation] Are soap (or its equivalent) and water present in the household?

Present (observed)_____
Present (not observed)_____
Not present (observed)_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Present (observed) to Q253

254. [Direct Observation] What type of detergent or cleanser is used? Mark all that apply.

Soap_____
Ash_____
Mud or sand (specifically for hand hygiene)_____
None_____
Not applicable_____
Don't know_____
Decline to show_____

255. Can you show me how you wash your hands? [Direct Observation] How does the respondent wash their hands? Mark all that apply

Use of water_____
Use of soap_____
Use of ash or other cleanser_____
Rubbing motion_____
Not shown_____

256. [Direct Observation] Is there a fixed location for handwashing?

Yes_____
No_____
Not observed_____

Only answer if you responded Yes to Q256

257. [Direct Observation] GPS coordinates of hygiene location

_____

258. Does the handwashing facility have access to enough water always, sometimes, or never?

Always_____
Sometimes_____
Never_____
Not applicable_____
Don't know_____
Decline to state_____

259. [Do not read the options] When do you wash your hands? [Mark all that apply]

[After defecation]_____
[After cleaning or changing a baby]_____
[Before food preparation]_____
[Before eating]_____
[Before feeding a child]_____
Not applicable_____
Don't know_____
Decline to state_____

260. [Do not read the options] Are there any other times that you wash your hands? [Mark all that apply]

[After defecation]_____
[After cleaning or changing a baby]_____
[Before food preparation]_____
[Before eating]_____
[Before feeding a child]_____
Not applicable_____
Don't know_____
Decline to state_____

Household characteristics - II

261. Is there one or more able-bodied adults in the household capable of performing physical labor?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

262. What is the primary occupation of the highest-earning member of your household (including yourself)?

No occupation_____
farming_____
raising livestock to sell_____
labor or construction_____
selling agricultural products_____
selling other goods_____
teaching_____
office worker_____
secretary_____
government employee/civil servant_____
driver_____
craftsman (carpenter- metal worker- electrician- etc.)_____
Banking- finance_____
owns a food stall or restaurant_____
selling food_____
Owns a business that is not a farm or restaurant_____
Pastor or other religious position _____
Not applicable_____
Don't know_____
Decline to state_____

263. Does any member of this household have a bank account?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

264. Do you or someone living in this household own this dwelling? If “no”, then ask: do you rent this dwelling from someone not living in this household?

Own_____
Rent_____
Neither own nor rent_____
Not applicable_____
Don't know_____
Decline to state_____

265. Does this household own any livestock, herds, other farm animals, or poultry?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q265

266. Which animals do you own?

Cows_____
goats_____
Sheep_____
Chickens/Guinea Fowl/poultry_____
Other_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Other to Q266

267. What other animals do you own? (list all) _____

268. Does any member of this household own any land that can be used for agriculture?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q268

269. How much land does this household own? _____

Only answer if you responded Yes to Q268

270. Acres or hectares?

Acre(s)_____
Hectare(s)_____

271. Does this house have electricity?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

272. Does any member of this household pay to fetch water?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q272

273. How often do members of this household pay for water? Do you pay as you fetch, or do you pay at certain times every month or year?

Every time they fetch_____
daily_____
weekly_____
monthly_____
yearly_____
when the system breaks_____
no fixed schedule (when they have money)_____
Not applicable_____
Don't Know_____
Decline to state_____

Only answer if you responded Every time they fetch to Q273

274. How much do you pay each time to fill the container you showed me earlier? _____

Only answer if you responded daily to Q273

275. How much do you pay each day? _____

Only answer if you responded weekly to Q273

276. How much do you pay each week? _____

Only answer if you responded monthly to Q273

277. How much do you pay each month? _____

Only answer if you responded yearly to Q273

278. How much do you pay each year? _____

Only answer if you responded Every time they fetch|daily|weekly|monthly|yearly to Q273

279. Cedis or Pesewas?

Cedis_____
Pesewas_____

280. What type of fuel does your household mainly use for cooking?

Charcoal_____
Wood_____
Straw/Shrubs/Grass_____
Electricity (electric stove)_____
Liquefied Petroleum Gas (LPG)_____
Natural gas_____
Biogas_____
Kerosene_____
Coal / Lignite_____
Animal dung_____
Agricultural crop residue_____
No food cooked in household_____
Not applicable_____
Don't know_____
Decline to state_____

Only answer if you responded Yes to Q272

281. How satisfied or dissatisfied are you with the way that the water committee uses the collected funds?

Very satisfied_____
Somewhat satisfied_____
Dissatisfied_____
Not applicable_____
Don't know_____
Decline to state_____

282. Does any member of your household own: A working bicycle?

Yes _____
No_____
Not applicable_____
Don't know_____
Decline to state_____

283. Does any member of your household own: A working motorbike?

Yes _____
No_____
Not applicable_____
Don't know_____
Decline to state_____

284. Does your household have: A Working Car?

Yes_____
No_____
Not applicable_____
Don't know_____
Decline to state_____

285. Does any member of your household own: A working Mobile Telephone?

Yes _____
No_____
Not applicable_____
Don't know_____
Decline to state_____

286. Does your household have: A working radio?

Yes _____

No_____
Not applicable_____
Don't know_____
Decline to state_____

287. Does your household have: A Working Television?

Yes _____
No_____
Not applicable_____
Don't know_____
Decline to state_____

288. Does your household have: A working refrigerator?

Yes _____
No_____
Not applicable_____
Don't know_____
Decline to state_____

289. Thank the respondent for their time [Record your notes here] _____
290. End time: hour _____
291. End time: minute _____

REFERENCES

Adank, M., Kumasi, T. C., Chimbar, T. L., Atengdem, J., Agbemor, B. D., Dickinson, N., & Abbey, E. (2014). The State of Handpump Water Services in Ghana: Findings from Three Districts. *Sustainable Water and Sanitation Services for All in a Fast Changing World*, 1–7.

Alexander, K. T., Tesfaye, Y., Dreibelbis, R., Abaire, B., & Freeman, M. C. (2015). Governance and functionality of community water schemes in rural Ethiopia. *International Journal of Public Health*, (2009). https://doi.org/10.1007/s00038-015-0675-x

Behnke, N. L., Klug, T., Cronk, R., Shields, K. F., Lee, K., Kelly, E. R., … Bartram, J. (2017). Resource mobilization for community-managed rural water systems: Evidence from Ghana, Kenya, and Zambia. *Journal of Cleaner Production*, *156*(April), 437–444. https://doi.org/10.1016/j.jclepro.2017.04.016

Chowns, E. (2015). Is Community Management an Efficient and Effective Model of Public Service Delivery? Lessons from the Rural Water Supply Sector in Malawi. *Public Administration and Development*, 1–10. https://doi.org/10.1002/pad

Davis, J., Lukacs, H., Jeuland, M., Alvestegui, A., Soto, B., Lizarraga, G., … Wakeman, W. (2008). Sustaining the benefits of rural water supply investments: Experience from Cochabamba and Chuquisaca, Bolivia. *Water Resources Research*, *44*(12), 1–14. https://doi.org/10.1029/2007WR006550

Evans, B., Bartram, J. K., Hunter, P., Williams, A. R., Geere, J., Majuru, B., … Schmidt, W. (2013). Public Health and Social Benefits of at-house Water Supplies: Final Report. *University of Leeds: Leeds, UK*, 53. Retrieved from http://r4d.dfid.gov.uk/Output/193336/

Fisher, M. B., Shields, K. F., Chan, T. U., Christenson, E., Cronk, R. D., Leker, H., … Bartram, J. (2015). Understanding handpump sustainability: Determinants of rural water source functionality in the Greater Afram Plains region of Ghana. *Water Resources Research*. https://doi.org/10.1002/2014WR016770

Foster, T. (2013). Predictors of Sustainability for Community-Managed Handpumps in Sub-Saharan Africa: Evidence from Liberia, Sierra Leone, and Uganda. *Environmental Science & Technology*, *47*(21), 12037–12046. https://doi.org/10.1021/es402086n

Foster, T., & Hope, R. (2016). A multi-decadal and social-ecological systems analysis of community waterpoint payment behaviours in rural Kenya. *Journal of Rural Studies*, *47*, 85–96. https://doi.org/10.1016/j.jrurstud.2016.07.026

Howard, G. (2002). *Water supply surveillance: a reference manual*. WEDC, Loughborough University.

Joint Monitoring Programme. (2017). Safely managed drinking water, 56. Retrieved from https://www.wssinfo.org/fileadmin/user_upload/resources/JMP-SMDW-TR-1-March-2017.pdf

Kayser, G. L., Moomaw, W., Miguel, J., Portillo, O., & Grif, J. K. (2014). Circuit Rider post-construction support: improvements in domestic water quality and system sustainability in El Salvador. *Journal of Water, Sanitation and Hygiene for Development*, *in press*, 1–11. https://doi.org/10.2166/washdev.2014.136

Kelly, E., Lee, K., Shields, K. F., Cronk, R., Behnke, N., Klug, T., & Bartram, J. (n.d.). The role of social capital and sense of ownership in rural community-managed water systems: qualitative evidence from Ghana, Kenya, and Zambia.

Madrigal, R., Alpízar, F., & Schlüter, A. (2011). Determinants of Performance of Community-Based Drinking Water Organizations. *World Development*, *39*(9), 1663–1675. https://doi.org/10.1016/j.worlddev.2011.02.011

Marks, S. J., Komives, K., & Davis, J. (2014). Community participation and water supply sustainability: evidence from handpump projects in rural Ghana. *Journal of Planning Education and Research*, 1–11. https://doi.org/10.1177/0739456X14527620

Marks, S. J., Onda, K., & Davis, J. (2013). Does sense of ownership matter for rural water system sustainability? Evidence from Kenya. *Journal of Water, Sanitation and Hygiene for Development*, *3*(2), 122. https://doi.org/10.2166/washdev.2013.098

Prokopy, L. S. (2004). Women's participation in rural water supply projects in India: is it moving beyond tokenism and does it matter?, *6*.

Schouten, T., & Moriarty, P. (2003). Community water, community management : from system to service in rural areas, 192.

Schweitzer, R. W., & Mihelcic, J. R. (2012). Assessing sustainability of community management of rural water systems in the developing world. *Journal of Water, Sanitation and Hygiene for Development*, *2*(1), 20. https://doi.org/10.2166/washdev.2012.056

United Nations. (n.d.-a). Goal 6 .:. Sustainable Development Knowledge Platform. Retrieved July 10, 2017, from https://sustainabledevelopment.un.org/sdg6

United Nations. (n.d.-b). United Nations Millennium Development Goals. Retrieved from http://www.un.org/millenniumgoals/environ.shtml

van den Broek, M., & Brown, J. (2015). Blueprint for breakdown? Community Based Management of rural groundwater in Uganda. *Geoforum*, *67*, 51–63. https://doi.org/10.1016/j.geoforum.2015.10.009

Walters, J. P., & Chinowsky, P. S. (2016). Planning rural water services in Nicaragua: A systems-based analysis of impact factors using graphical modeling. *Environmental Science & Policy*, *57*, 93–100. https://doi.org/10.1016/j.envsci.2015.12.006

Whittington, D., Davis, J., Prokopy, L., Komives, K., Thorsten, R., Lukacs, H., … Wakeman, W. (2009). How well is the demand-driven, community management model for rural water supply systems doing? Evidence from Bolivia, Peru and Ghana. *Water Policy*, *11*(6), 696–718. https://doi.org/10.2166/wp.2009.310

WHO/UNICEF. (2006). Core questions on drinking water and sanitation for household surveys, 80.

WHO/UNICEF. (2015). 2015 Update and MDG Assessment. *World Health Organization*, 90. https://doi.org/10.1007/s13398-014-0173-7.2