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Predicting Sustainability of Rural Hand Pumps in Northern Mozambique

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Predicting Sustainability of Rural Hand Pumps in Northern Mozambique

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2005

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An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Global Environmental Health
2014

Abstract

Predicting Sustainability of Rural Hand Pumps in Northern Mozambique
By Andrea L. Martinsen

Introduction: Sub-Saharan Africa lags behind the rest of the world in expanding coverage to improved water sources, and high rates of failing hand pumps in the region are another major impediment of equitable access to a sustainable water supply. Previous studies have found that governance, the decision-making process through which water, sanitation, and hygiene committees (WASHCos) identify and resolve their own problems, is associated with hand pump functionality.

Methods: We conducted a cross-sectional study in two different districts in northern Mozambique using a mixed-methods approach to assess the association between governance, women's experience, and sustainability of rural hand pumps. Regression analyses were conducted to identify potential predictors of hand pump sustainability, as well as the categories of governance most strongly associated with sustainability. Governance was divided up into four main categories, which included responsiveness, finances, management, and accountability.

Results: Of the 143 total hand pumps assessed, 90 (63%) of them were functioning on the day of the survey. The different models measuring the association between past and current functionality with individual components of governance identified varying predictors of functionality. Overlapping components included perceived water quality ($p=0.003$) and WASHCo rules and regulations ($p=0.04$). Finances and responsiveness were found to be most strongly associated with current functionality ($p=0.001$); however, when controlling for all other covariates, only responsiveness was significant. Those communities with at least one functioning water point had a higher mean score (79.9) for positive women's experience score than those no functioning water points (62.7) ($p=0008$).

Discussion: As our models produced varying results, it is difficult to conclusively identify any specific components of governance associated with sustainability. This differed from previous CARE studies that did not control for external factors such as community location or type of pump.

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Acknowledgements

Thank you first and foremost to the staff of CARE Mozambique, without whom this study would not have been possible. They include Nic Dexter, Sharmila Moiane, Castro de Costa Pereira, Cassamo Ismael Ibraimo, and Octavio Gildo João.
Their knowledge and expertise helped me immensely to gain a better understanding of hand pump technology, as well as cultural heritage and political history of the area of Northern Mozambique. I would also like to extend a special thanks to my fellow researcher, John Kaufman, who made the countless hours in the back of a pick-up on bumpy back roads in Mozambique much more enjoyable. The data collection and preliminary data analysis were truly a team effort.

Additionally, I would like to thank Dr. Matthew Freeman, for his support and guidance throughout the process, from the start of the summer practicum to the completion of this thesis. His feedback and constructive comments (which even came when I missed my original deadlines) have been essential to the development of this project. The staff of CARE USA and CARE Water has also been essential to this project, in laying the groundwork for this study, developing the survey tools, and providing logistic and financial support. Thanks go to Helen Pankhurst and Stephanie Ogden.

Finally, thanks to my friends and family who have provided additional support during the past two years at Rollins. Each and every one of you has helped in your own special way.

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Chapter 1: Literature Review

Introduction

An estimated 768 million people worldwide lack access to an improved drinking water source according to most recent reports by the Joint Monitoring Programme (JMP) [1]. Since the establishment of the MDGs, over two billion people have gained access to improved sources, and in 2012, the JMP announced that the MDG target 7c, to halve the proportion of the world's population without sustainable access to a source of safe drinking water, had been met ahead of its 2015 goal [2].

Despite significant progress over the past twenty years, much of sub-Saharan Africa is still lagging behind, however. Approximately one third of the population in the region do not have access to an improved source of drinking water, and there remain notable disparities between rural and urban coverage [1]. These numbers are useful in showing trends and estimating coverage; however, there are limitations in the data presenting an accurate measure of the actual service delivery. Not addressed are issues of water quality, quantity, or equitable access amongst the population [3].

Another major issue that is not adequately addressed is that of intermittent service and failing infrastructure [1]. Although MDG 7c calls for sustainable access to safe drinking water, it is not clearly stated what is meant by the term sustainable, nor are there clear metrics defined by the JMP [3]. The sustainability of water infrastructure is a major challenge that has received considerable attention, but continued low levels of sustainability in sub-Saharan Africa impede progress toward meeting the MDG target. It is estimated that one in three hand pumps in the region are not functioning at any given

time [4]. This may result in an overestimation of actual coverage, as non-functioning water points, intermittent service and poor service delivery affect those whom are deemed to already have gained access but whose water supply is irregular and unsustainable [4].

According to the most recent JMP report, national coverage for improved drinking water in Mozambique is 47%, much less than the regional average for sub-Saharan Africa. Only 33% of rural households have access compared with 78% of urban households [1]. Many countries in Sub-Saharan Africa, such as Mozambique, face the double burden of continuing to expand coverage in rural areas to the millions that have never had access to improved drinking water while also sustaining the existing infrastructure. It is necessary for both of these competing priorities to be addressed to see long-term improvements in development and health [5].

Global Burden of Water-Related Disease

The lack of safe drinking water is a major threat to public health, especially in developing countries. Approximately 10% of the total global burden of disease can be attributed to unsafe water, inadequate sanitation, and poor hygiene. The global burden consists mostly of diarrheal disease but also includes malnutrition, intestinal nematode infections, lymphatic filariasis, trachoma, and schistosomiasis [6]. Diarrheal disease is one of the leading causes of childhood mortality [7]. Insufficient water, sanitation, and hygiene (WASH) results in an estimated 1.5 million deaths annually due to diarrhea [6], and approximately 800,000 children die each year from diarrheal disease, of which a large percentage could be prevented through cost effective WASH interventions [8]. There are economic returns from investment in water supply and improved sanitation due

to decreased burden of disease. For every one USD invested, a two-fold return is expected for water supply and 5.5 for sanitation [9].

Low levels of sustainability of improved water supplies can also have a large effect on morbidity and mortality due to diarrheal disease. A recent study in sub-Saharan Africa showed that poor reliability and interruptions in water supply may diminish almost all health benefits that come from an improved drinking water source. Young children may be particularly at risk for infection when reverting to drinking raw water [10].

On top of the adverse health effects from consuming nonpotable water are the negative effects that come from carrying water from faraway sources. Women and girls bear the responsibility for collecting water in most households in sub-Saharan Africa [11]. There is scarce research addressing the specific health impacts that come from this; however, the literature mentions back injuries, as well as micronutrient deficiencies that can result from high caloric expenditures during times of scarce resources [12].

Hand Pumps

Hand pumps have been promoted in many countries as an improved source of drinking water that has a low initial investment and is easy to maintain. The term hand pump is used to describe any device that lifts groundwater from a hand dug well or borehole operated by human power [5]. They have become the most common water supply intervention in rural areas of sub-Saharan Africa, with over 60,000 hand pumps installed annually [4]. Groundwater from wells or boreholes is one of most viable options for rural water supplies [5]. Although the general quality of groundwater sources varies due to depth, land use, and flow characteristics, it is often more potable than surface water and requires less treatment prior to distribution [5, 13].

Common Types of Hand Pumps

One of the most common types of hand pumps in sub-Saharan Africa is the Afridev pump, which was developed in Malawi and Kenya in the 1980s. The Afridev pump was designed to be easily maintained, and all parts can be removed and replaced by community workers without removing the pump main [14]. These pumps require regular replacement of low-cost spare parts and will require that higher cost spare parts be replaced every few years when regularly used [15]. It is now a public domain pump, and the design can be purchased and manufactured around the world [14]. Although many hand pumps are limited in the depth of groundwater that they can pump, some versions of the Afridev pump can lift from up to eighty meters, making it particularly suitable for deep boreholes [5].

Another common type of hand pump that has more recently been implemented in parts of sub-Saharan Africa is the rope pump. It is estimated that rope pumps cost 75 to 80% less than traditional pumps because they can be easily manufactured using locally available materials [5, 16]. The average lifespan is largely dependent on proper operation and maintenance, as parts, such as the rope itself, will need regular replacement [16]. It is better suited for shallow hand dug wells because it has a limited capacity for lifting water from large depths [5].

The nira pump is not in the public domain but has been installed across many countries in sub-Saharan Africa, including Mozambique. Its advantages include that it is easy to install and simple for communities to maintain. Similar to the rope pump, it is more suitable for shallow wells of twelve meters or less [17]. Figure 1 below shows diagrams of these three examples of hand pumps.

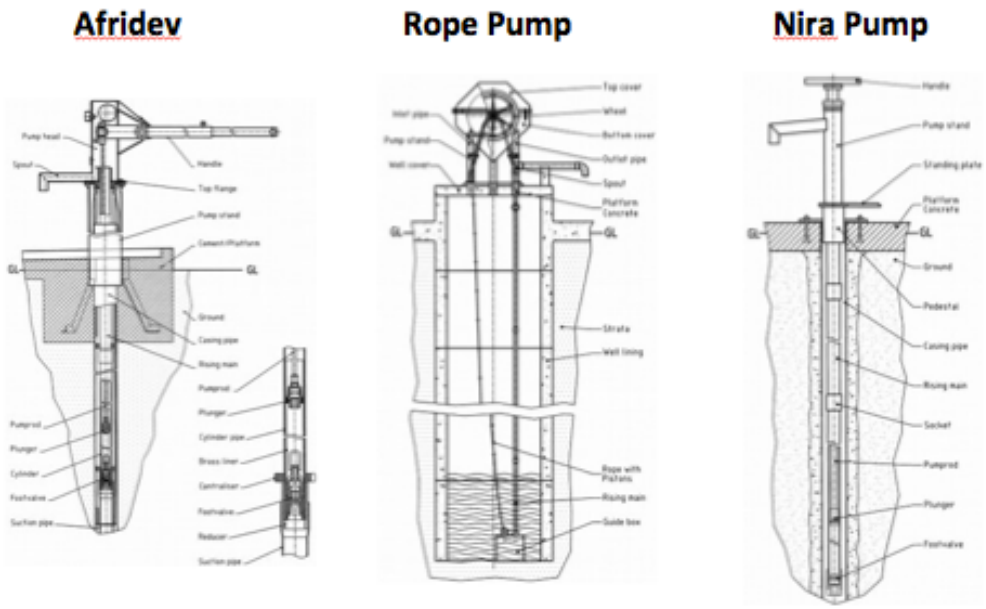

Figure 1.1: Sketches of three common types of hand pumps found in northern Mozambique and other parts of sub-Saharan Africa [17]

Failure Rates of Hand Pumps in sub-Saharan Africa

Although these hand pumps have gained popularity because of their easy to install and maintain designs, multiple reports show high rates of non-functioning pumps in the field. One report from twenty countries showed that 36% of hand pumps across sub-Saharan Africa were no longer functioning. Some countries had a relatively high functionality rate, such as Madagascar, where only 10% of water points were not functioning. In other countries that have faced years of civil war, such as the Democratic Republic of the Congo, two thirds of the water points were not functioning [18]. Another study from eleven countries in sub-Saharan Africa produced a similar range, with functionality rates from 35-80% [19]. The Mozambican government last performed an inventory in 2002-2003 of existing water points, and they found that approximately 30% of water points were not functioning [20]. Similar inventories done in other countries

estimated that as many as 70% of boreholes in the Eastern Cape of South Africa and 55% of boreholes in Tanzania were no longer functioning [21, 22].

Other reports estimate the resulting loss in investment from failing infrastructure. In a recent survey of water points throughout sub-Saharan Africa, researchers found approximately 50,000 broken systems, representing roughly $215-360 million USD in failed investments [23]. Another report by the International Water and Sanitation Centre puts the situation much more bleakly. Of the 600,000 to 800,00 hand pumps installed across sub-Saharan Africa in the past twenty years, approximately 30% are known to fail soon after installation, accounting for between $1.2 to $1.5 billion USD wasted on failed water points [24].

There is debate within the WASH sector over where to target future investments. While it is important to target rural areas that have never had access and are often the most disadvantaged in services, it is also imperative to maintain existing infrastructure. Focusing entirely on expansion can jeopardize investments made to date [25]. However, it is estimated that the necessary investments to maintain existing infrastructure is three times what is needed to expand coverage [26].

Community Management of Water Supply

Starting in the 1980s, there was a shift from "supply-driven" WASH interventions toward "demand-led" approaches [27]. Rapid construction of water points without community involvement was considered to be at fault for the premature failure of infrastructure during the Drinking Water Supply and Sanitation Decade (1981-1990), and multiple studies hence have shown that the demand-driven approach has led to increased

levels of sustainability of water supply [28]. This led to the paradigm shift to community management of rural water supply.

The goals of community managed WASH include increased participation in the decision-making process, an expanded ownership over the system, and improved sustainability [27, 29]. This is sometimes referred to as the village level operation and management of maintenance (VLOM) concept [15].

Typically, this approach involves forming a new water, sanitation, and hygiene committee (WASHCo), as the governing body responsible for the community water supply. Implementing agencies have important roles to form and train WASHCos to ensure sustainability of the water supply after they have left the community. Training empowers WASHCos on such tasks as establishing and collecting tariffs for water, operating and maintaining the system, and creating system regulations [29].

As governmental institutions often have limited capacity or commitment to maintain rural water systems, the VLOM model shifted the responsibility onto communities. However, there remain limitations to this approach. Harvey and Reed (2007) detail six main reasons for why community management systems begin to breakdown within the first one to three years after an intervention. They include the following: (1) participation in WASHCos is most often voluntary, and members do not feel incentivized to contribute in the long-term, (2) members die or leave the community, and it is difficult to replace them and train new members, (3) the community loses trust in the WASHCo if there is a lack of transparency and accountability, (4) members abandon the WASHCo due to lack of contribution from water point users, (5) there is a loss of contact with implementing agencies or governmental institutions, and finally (6)

communities cannot pay for major repairs and disband when the system cannot be repaired. In conclusion, community management can be a fragile system that relies heavily on the commitment of individuals to maintain their own infrastructure, if not supported by external agencies.

Water Point Sustainability

In 1992, the United Nations (UN) made its first formal commitment to sustainability in international development. The UN Agenda 21 declared that 'sustainability is the integration of environmental and development concerns for the fulfillment of basic needs and improved living standards for all [30].' Simply put, sustainability may be defined as something that continues to function for the time in which it was designed. In terms of water supply, this means that water remains available at the same quantity and quality over time [31]. This definition, however, assumes static conditions that will stay the same without any further inputs. A more comprehensive definition of sustainability, which takes into consideration that service will degrade over time if nothing is done, is 'constancy in water supply and sanitation services – which may be achieved through evolving and adaptive delivery mechanisms [32].'

Multiple conceptual frameworks have been developed to better understand the underlining factors that lead to long-term sustainability of water supply. One such framework is the sustainability chain, which illustrates the four essential links that are required for sustainability. It begins with motivation, or community demand, for the new improved source of drinking water. After this is met, ongoing maintenance of the infrastructure and cost recovery for repairs or replacement are necessary. Finally, the

continuing support of external agencies, such as NGOs or the government, is required [32]. Figure 2 below depicts this framework.

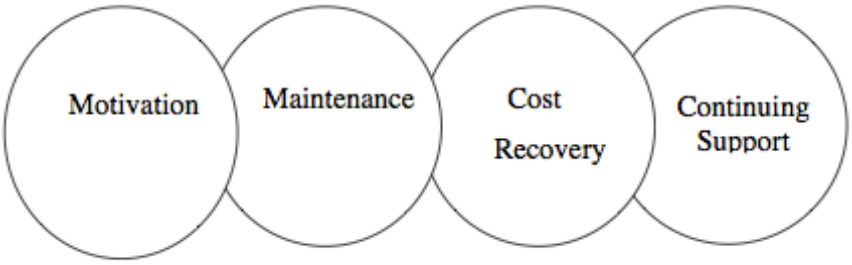

Figure 1.2: The sustainability Chain [32].

Another framework is that of WaterAid, which combines the concepts of motivation and continuing support of the sustainability chain and adds the importance of good community management by a water committee. They are responsible for revenue collection and ongoing operation and maintenance [33].

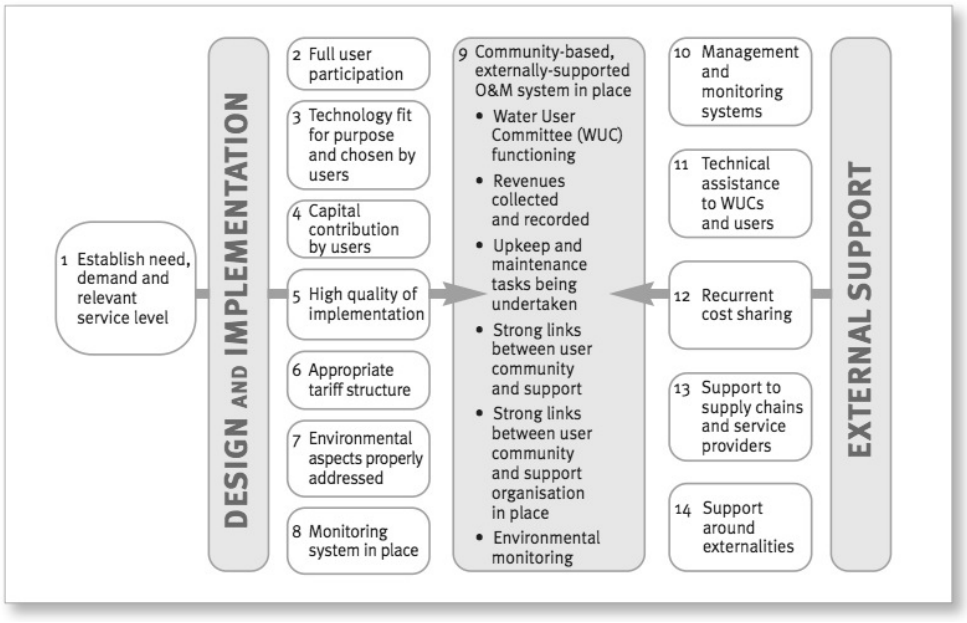

Figure 1.3: WaterAid Conceptual Framework for externally supported community-based management of rural water supply [33].

As depicted in the conceptual frameworks, the sustainability of water points depends on a combination of many factors [34]. From the literature emerges a number

of different themes that impact sustainability. Harvey and Reed identify eight specific 'building blocks' that together contributed to a sustainable water supply. These include policy context, institutional arrangements, financial and economic issues, community and social aspects, technology and the natural environment, spare parts supply, maintenance systems, and monitoring [5]. A study conducted in sub-Saharan Africa by the United Nations Development Programme (UNDP) and the World Bank emphasized the importance of operation and maintenance to rural water point sustainability, particularly of spare parts supply and trained mechanics [35]. Montgomery et. al. identify three main components that are necessary for sustainability. They consist of community demand, local financing, and dynamic operation and maintenance [36].

Indicators for Sustainability

Sustainability, which is the long-term provision of service, can be difficult to define and measure; however, various indicators can be used as proxy measures for sustainability [33, 34]. Though new technologies such as Akvo FLOW have developed simple tools to prospectively monitor sustainability, most studies assess sustainability retrospectively. In those cases, functionality – current availability of water – is often used as a proxy indicator for sustainability [37]. The most common indicator is "current functionality," whether or not the water point is functioning and providing water at the time of visit or "past functionality," the proportion of time that it has been providing water since implementation [34].

It is acknowledged in the literature that these measures are imperfect proxy indicators for sustainability, as they do not take into account service delivery, equity of access, and realization of intended benefits [4]. Furthermore, current functionality is only

a snapshot of a point in time and therefore, past functionality may be a better representation of sustainability as a whole.

Governance and Sustainability

Water point governance is defined as the "the range of political, social, economic, and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society [38]." It is important to distinguish the term "governance" from both "government" and "governing." The latter terms refer to a centralized body of authority and the act of managing society, while governance is 'the process of decision-making by which society defines and handles its problems [39].'

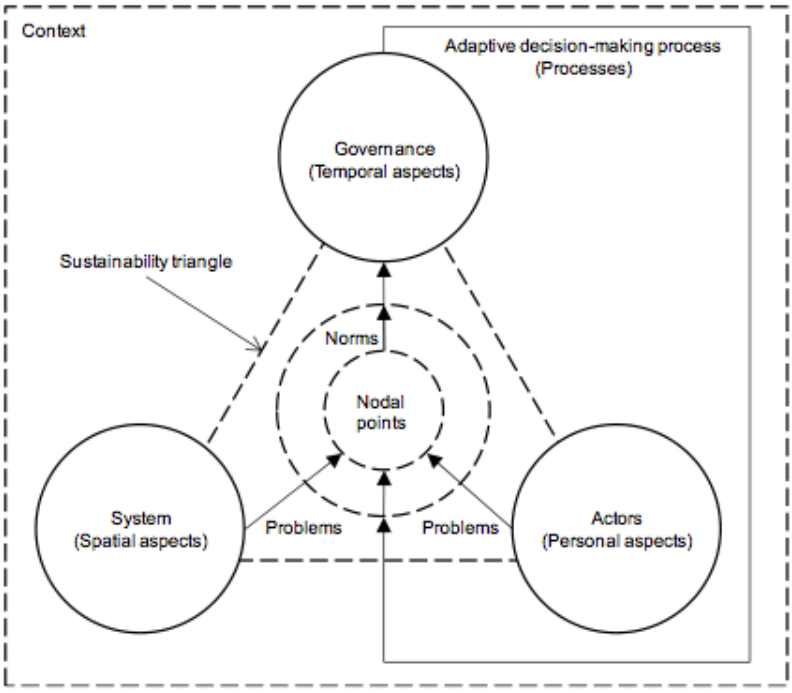

Figure 1.4: Conceptual framework showing sustainability triangle where the system, actors, and governance converge [39].

Iribarnegaray and Seghezzeo depict the relationship between sustainability and governance in a conceptual framework found in Figure 3. Problems originate with the

system or the system actors and then converge with the temporal aspects of governance in the sustainability triangle. Through an adaptive decision-making process, actors handle issues within the system under their own norms of governance [39].

For many rural water systems in sub-Saharan Africa, the responsibility of water point governance falls on the WASHCo, which is established often at the time of the intervention to take care of a variety of different tasks for the water system.

Robust local governance is strongly associated with current level of functioning of hand pumps in sub-Saharan Africa [40-42]. In previous studies, CARE used four main domains of governance, which included accountability, inclusivity, participation, and transparency [40, 42-44]. Accountability is the level of responsibility that the existing WASHCo has over the water point and its operation. Inclusivity is the level of involvement of all members of the community in the WASHCo, including women and all ages and ethnicities. Participation is the level of involvement of the community in the initial decision making, labor contribution, and ongoing maintenance of the water point. Finally, transparency includes record-keeping, the rules and regulations governing the WASHCo, and reporting back to the community [42].

All studies conducted by CARE used a governance snapshot survey to identify key components of governance that are associated with water point functionality. In the first study performed in the Cabo Delgado Province by two Emory researchers and CARE Mozambique staff, 59 (68.6%) of water points were functioning well, 11 (12.8%) were functioning with some difficulty, and 16 (18.6%) were no longer functioning. Those communities with a ‘high’ level of governance, according to the scoring system devised by the researchers, had a 68% increased odds of having a well functioning water

point than those with a 'low' level of governance (p=0.004). Accountability and inclusivity also showed to be associated with functionality (p=0.027 and p=0.025) [43]. The specific components of governance that were found to be associated with functionality included (1) the existence of water committees, (2) regular meetings of WASHCos, (3) diversity in WASHCos, (4) empowering women with roles in the committee, and (5) participation in maintenance training [40]. Table 1 shows results from this study for each individual governance domain.

Table 1.1. The association between governance domain and functionality in the Montepuez and Balama districts of Cabo Delgado, Mozambique, 2011. Prevalence ratios compare functionality between communities with 'high' governance and those with 'low' governance [43]

Governance Domain	Crude Prevalence Ratio ≤2 years (95% CI) *n=32*	Crude Prevalence Ratio ≥3 years (95% CI) *n=52*	**Adjusted Prevalence Ratio^**	**95% Confidence Interval**	P-value†
Accountability	1.21 (0.69, 2.13)	1.56 (1.12, 2.17)	**1.46***	1.10, 1.94	0.027
Inclusivity	0.94 (0.52, 1.68)	1.86 (1.23, 2.81)	**1.48***	1.06, 2.07	0.025
Participation	1.49 (0.60, 3.69)	1.48 (0.87,2.50)	**1.48**	0.94, 2.34	0.085
Transparency	1.02 (0.55, 1.88)	1.41 (1.04, 1.90)	**1.32**	1.01, 1.73	0.182
Total Governance	1.33 (.72, 2.547)	1.985 (1.17, 3.38)	**1.68***	1.12, 2.51	0.004

*Significant at the 95% confidence level. ^Adjusted prevalence ratios are adjusted for age (water points being ≤2 years or ≥3 years).
† P-values are two-sided and based on the Fischer Exact test. A p-value <0.05 is considered significant at the 95% confidence level. *[43]*

The following year in 2012, CARE Mozambique staff conducted a follow-up study in the Nampula province using a similar governance snapshot tool. Current functionality was reported to be 81%, with 77% of water points reporting that they were functioning without difficulties [45] A predictive model was constructed controlling for all governance covariates. Significant predictors were found to be committee meetings (OR 2.8, 95% CI 1.1, 6.9); retaining women on committee (OR 2.4, 95% CI 1.1, 5.2), and district level support of water point maintenance (OR 3.9, 95% CI 1.9, 8.3) [46].

Besides assessing components of governance, the objective of CARE's research was to construct a predictive tool of sustainability building off of each iteration of the

governance snapshot survey [44]. One of the major weaknesses identified in previous tools was the lack of attention given to the area of finance and how that relates to functionality [45]. Other components that were identified as potentially significant and in need of further examination included the following: committee elections, community awareness of committee roles and responsibilities, existence of bylaws, mechanic training, length of time to fix a problem, preventative maintenance, how funds are raised and kept, record keeping, community knowledge of finances of scheme, audits, and planning ahead for breakdowns of the system [44].

Based on past research done by CARE, the snapshot tool was altered 'to identify areas that most threaten sustainability [47].' The new tool, the Governance into Functionality Tool (GiFT), was developed to encompass four different domains of governance, which include responsiveness, finances, management, and accountability. Further questions about functionality were also included to get a more comprehensive picture of service delivery. Figure 4 below depicts the conceptual framework for this research, and questions from the GiFT for each category are detailed below in Table 2.

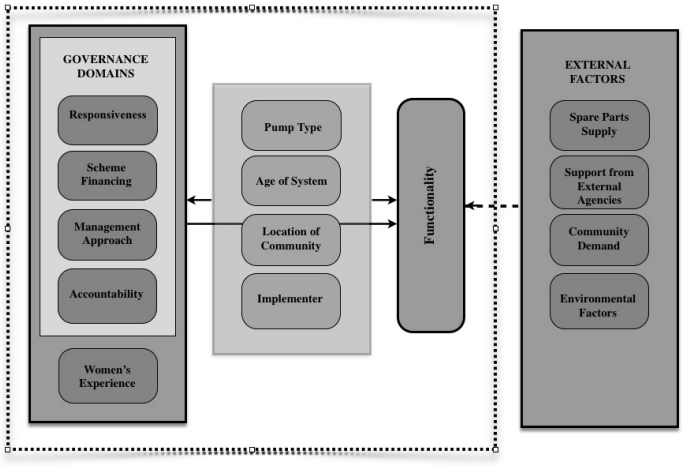

Figure 1.5: Conceptual Framework of CARE research using GiFT tool, which includes four main domains of governance: responsiveness, financing, management, and accountability, as well as women's experience.

Table 1.2: Questions from GiFT for functionality and domains of Governance

Governance into Functionality Tool (GiFT)	
Functionality	1. Is the hand pump working and providing water today? 2. If no, how long has it not been working? 3. How many times has the scheme broken down since establishment? 4. If the scheme has broken since establishment, for how long was it broken? 5. How would you rate the quality of water provided for human consumption?
Governance Category	
Responsiveness	• Has the hand pump been broken down for more than 6 months? • Who fixed the problem? Did committee mechanic fix it? NGO technician? Government technician? Local business? • How was the repair paid for? Was it paid for with saved available funds? Did the committee ask for funds from the community? Government? NGO? • Have there been any problems/breakdowns that were beyond the community's ability to repair?
Finances	• Does the community raise funds to maintain the hand pump? • If so, how are funds raised? Pay per use? Pay at regular interval? • Do all households pay the same rate? • If the hand pump needed a small repair, does the committee have funds to cover this cost? • If the hand pump had a major breakdown, does the committee have funds to cover this cost? • Is there a rotating savings and loan scheme linked to the water supply scheme?
Management	• Does the WASHCo exist? • Have WASHCo members been trained? • Does the WASHCo hold meetings with members? • Is there a designated person who controls who collects water? • Is there a mechanic within the community undertakes repairs? • Has there been preventative maintenance carried out in the last year? • What is the role of women within the WASHCo regarding decision making?
Accountability	• Have WASHCo elections been held openly and transparently? • After the first WASHCo elections, have there been re-elections? • Does the WASHCo have clear rules and procedures that are known and updated? • Does the WASHCo hold meetings with the community? • Are written financial records kept up-to-date? • Does the committee report back to users about the financial status of the water point? • Are there audits and/or other financial checks carried out every year?

Responsiveness

Responsiveness refers to the way in which a WASHCo responds to a water point failure, for example, who makes the repair, who pays for the repair, and how long it takes to make the repair. The literature concludes that even with the VLOM model, some degree of ongoing support from external agencies is necessary to maintain community-managed water supplies [4]. However, while a strong support network is positively associated with functionality, it was found to be negatively associated with the financial sustainability of the WASHCos in a recent study of hand pumps in Ghana. One explanation was that those WASHCos who could rely on outside support were less inclined to raise the necessary revenue to fix their own systems [28]. Less explored is the link between self-sufficiency of WASHCos and functionality.

Finances

With the VLOM model, much of the burden of recurrent costs of the water system often falls entirely on the community. Recurrent costs may include spare parts, tools, repair labor, transport, or replacement units, so it is the responsibility of the WASHCo to administer the level of tariffs, the mode of payment (per volume or flat rate per month or year), and whether subsidies will be given to any households. Because many communities are moving from an unimproved 'free' source of water to an improved source of drinking water with some system of tariffs, the motivation of the community to contribute may be a significant obstacle to financially sustaining the system [32].

In a 2006 study done in Tanzania assessing rural water supply sustainability, correlations were found water point functionality with both revenue collection and a bank savings account for WASHCo funds [22, 36]. Many WASHCos resorted to saving the

money within the community, either with individuals or in a general village account. The lack of formal banking services can lead to less transparency in the financial management of the system [22]. According to this study, the method of revenue collection also had an impact on the outcome of functionality. It was stated that tariffs per unit volume of water was better than a monthly tariff, as the latter method was more difficult to keep track of who had paid [22]; however, this method may preclude some households from getting water, as many subsistence farmers only receive an income during harvest times [32]. Other factors that were found to be associated with functionality were wages of caretakers who collected revenues and treasurers, as well as capital contributions required to implementing agencies or governmental institutions [22].

In a multi-country assessment of different factors of sustainability, Foster (2013) also found that there was a significant association between revenue collection and functionality of hand pumps in Liberia and Sierra Leone. Researchers also compared functionality rates where tariffs were collected in advance of any breakdown and those where tariffs were collected following a breakdown. Contrary to what was expected, there was no improvement in those systems that had advance revenue collection. A possible explanation for these counterintuitive results was that tariffs are rarely set according to actual repair costs and therefore WASHCos often do not have the necessary available funds for repairs even when they do collect funds in advance [4].

Management

A multi-country study conducted in Uganda, Sierra Leone and Liberia assessed multiple factors of WASHCo management. The adjusted odds of having a functional hand pump increased significantly for WASHCos that had regular committee meetings,

had women in key committee positions, when they conducted preventative maintenance, and when there was a mechanic available. Not found to be significant, though, in any of the countries was that the WASHCo was trained. This was contrary to expected results, as training is thought to be necessary precursor for other components of governance, but it may be some indication of varying levels of quality in the training that WASHCos receive. Furthermore, it may also reflect the need for more ongoing support rather than a one-time training when the hand pump is installed [4].

Accountability

Although CARE identified several components of accountability as important determinants of sustainability, no literature was found linking the accountability with water point sustainability.

Women's Experience and Sustainability

Past studies have established the link between women's involvement in the decision-making process and the sustainability of water systems [48]. For this reason, many African countries have implemented water policies that require an equal proportion of men and women on rural WASHCos. Despite these changes to the law, meeting the quota for women on the WASHCo often fails to produce meaningful equal participation among the sexes [48].

There is scarce literature that evaluates the connection between women's experience following a WASH intervention and the sustainability. A recent report by CARE found that WASH interventions had a positive effect on most women's lives, both directly and indirectly. Direct effects include the time to collect water, amount of water collected, and health of themselves and family members. Indirect impacts are economic

and educational opportunities, dignity and respect, and leisure time. Despite most women reporting that their lives were benefited, women's experience following an intervention was not homogenous [49].

As women or girls bear the responsibility for collecting water in most households in Sub-Saharan Africa [11], it is unexplored as to whether a more positive women's experience results in greater demand for a water point and thus, increased sustainability.

Other factors that affect Sustainability

Findings from these studies reflect the importance of using multiple indicators in the analysis of water point sustainability, as it is dependent on many different factors. Several factors that were outside of the scope of this study have been found in other studies to be important indicators of sustainability. In a recent study in Ghana, researchers found that external support of WASHCos post-construction is strongly associated with sustainability of hand pumps. This includes both institutional support and management-oriented support [28, 50]. Also significant in the Ghana study was the availability of secondary sources, which was found to decrease the odds of functionality [28].

Technical problems can arise with the AFRIDEV pump due to design flaws, manufacturing defects, or installation errors. Furthermore, in many parts of Sub-Saharan Africa, it is difficult to obtain quality replacement parts when needed, making it even more difficult for the systems to be sustained in rural communities [14]. The availability of supply networks is very important, as fifty percent or more of the nonfunctional hand pumps in sub-Saharan Africa are not working due to the lack of spare parts [51].

Finally, one other factor that was not explored in this study was that of community ownership. Although previous studies have assessed the relationship between community participation and sense of ownership of the hand pump, less explored is the how sense of ownership affects sustainability outcomes [52].

Justification for Research

The purpose of this study was to inform and improve the sustainability of CARE's WASH interventions using the refined tools. The literature offers several preconditions for water supply sustainability; however, besides the recent CARE studies, there is a lack of empirical evidence linking governance and women's experience with sustainability. Furthermore, while the association between community participation, in general, and sustainability is well documented, there is comparatively little research identifying which factors of community participation matter most to sustainability[28]. By identifying potential impediments to sustainability of water points, CARE and other implementing agencies can prioritize these in terms of relative importance to improve training and programming, both at the start of a program and throughout its lifespan. Furthermore, this research has the potential to improve monitoring efforts by identifying key indicators to predict sustainability.

Chapter 2: Manuscript

A. Introduction

In 2012, the Joint Monitoring Programme (JMP) announced that the Millennium Development Goal (MDG) target 7c, to halve the proportion of the world's population without sustainable access to a source of safe drinking water, had been met ahead of its 2015 goal. Since the establishment of the MDGs, over two billion people have gained access to improved sources [2], but despite significant progress over the past twenty years, much of sub-Saharan Africa is still lagging behind. Approximately one third of the population in the region remain without access, and there exist significant disparities between rural and urban coverage [1]. The burden of poor and inequitable water supply falls heavily on rural and low-income populations [53].

Another concern is the sustainability of the existing water supply in sub-Saharan Africa. Failing infrastructure and intermittent service delivery are major impediments toward meeting the MDG target in the region, as it is estimated that one in three hand pumps in the region are not functioning at any given time [4]. Moreover, poor sustainability may result in an overestimation of actual coverage, as non-functioning water points and intermittent service affect those whom are already counted to have access to an improved source of drinking water [4, 54].

Water Supply in Mozambique

National coverage for improved drinking water in Mozambique, at 47%, is lower than the regional average. Only 33% of rural households have access compared with 78% of urban households [1]. Low levels of sustainability are also a major problem in

Mozambique. In a recent inventory of existing water points, the Mozambican government found that approximately 30% of water points were no longer functioning [20].

Many countries in sub-Saharan Africa, such as Mozambique, face the double burden of expanding coverage in rural areas to the millions who have never had access to improved drinking water while also sustaining the existing infrastructure. It is necessary for both of these competing priorities to be addressed to see long-term improvements in development and health [5].

Water Point Sustainability

Sustainability may be defined as something that continues to function for the time in which it was designed [31]. In terms of water supply, this means that quantity and quality remain constant through adapting mechanisms of delivery [31, 32]. The sustainability of water points depends on a combination of many factors, including technical, environmental, cultural, financial, and institutional issues [34].

Due to high rates of failure, the focus of monitoring has shifted from measuring increased coverage of improved sources to measuring quality of service delivery over time [54]; however, the long-term provision of water supply and quality of service delivery can be difficult to define and monitor. Though new technologies such as Akvo FLOW have been developed as simple tools to prospectively monitor sustainability, most studies assess sustainability retrospectively [37]. In those cases, functionality – the availability of water – is often used as a proxy indicator for sustainability [37]. The most common indicator is "current functionality," whether or not the water point is functioning

and providing water at the time of visit or "past functionality," the proportion of time that it has been providing water since implementation [34].

Governance and Sustainability

Water governance is defined as the "the range of political, social, economic, and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society [38]." In other words, governance is the decision-making process through which these administrative systems identify and resolve their own problems [39].

These systems may involve external agencies, such as non-governmental organizations (NGOs) or governmental institutions, which are largely responsible for the implementation of water systems. In the case of many rural water systems in sub-Saharan Africa, water, sanitation and hygiene committees (WASHCos) are established at the time of the intervention to take responsibility of local water point governance post-construction. Their responsibilities include operating and maintaining the system, establishing a system of revenue collection, and creating system regulations [29].

Robust local governance is strongly associated with current level of functioning of hand pumps in sub-Saharan Africa [40-42]. CARE conducted previous studies in northern Mozambique in 2011 and 2012. In the first study performed in the Cabo Delgado province, 59 (68.6%) of water points were functioning well, 11 (12.8%) were functioning with some difficulty, and 16 (18.6%) were no longer functioning. Those communities with 'good' governance had a 68% increased odds of having a well functioning water point than those with low scores of governance ($p=0.004$) [43]. The specific components of governance that were found to be associated with functionality

included (1) the existence of water committee, (2) regular meetings of WASHCos, (3) diversity in WASHCos, (4) empowering women in the WASHCo, and (5) mechanic training [40].

The following year in 2012, current functionality was reported to be 81%, with 77% of water points reporting that they were functioning without difficulties [45]. A predictive model was constructed controlling for all governance covariates, and significant predictors were found to be committee meetings (OR 2.8, 95% CI 1.1, 6.9), retaining women on committee (OR 2.4, 95% CI 1.1, 5.2), and district level support of water point maintenance (OR 3.9, 95% CI 1.9, 8.3) [46].

Women's Experience and Sustainability

The term "women's experience" refers to the perceived effects, both direct and indirect, that a WASH intervention has on the women of the community. A recent report by CARE found that WASH interventions positively impacted most women's lives, both directly and indirectly. Direct effects include the time to collect water, amount of water collected, and health of themselves and family members. Indirect impacts may include economic and educational opportunities, dignity and respect, and leisure time [49]. Women's involvement in the decision-making process can improve sustainability outcomes of water systems. For this reason, many implementing agencies have promoted an equal proportion of men and women on rural WASHCos [48]. However, it is less understood the impact of women's experience on the sustainability of water points.

Research Objectives

The purpose of this study was to inform and improve the sustainability of CARE's WASH interventions using a refined governance survey tool. The literature

offers several preconditions for water supply sustainability; however, besides the recent CARE studies, there is less evidence identifying and prioritizing specific determinants of hand pump sustainability [4]. By identifying potential impediments to sustainability of water points, CARE and other implementing agencies can prioritize these in terms of relative importance to improve training and programming, both at the start of a program and throughout its lifespan.

As previous studies have suggested a relationship between robust governance and functionality, we sought to quantify these associations and to better understand factors that influence sustainability. The primary research question was:

1. Is there an association between governance and water point functionality?
    a) Which categories of governance (finances, management, accountability, and responsiveness) are most strongly associated with functionality?
    b) Which individual components of governance within each category are associated with functionality?
    c) What is the role of governmental institutions and regional maintenance groups in the provision and upkeep of sustainable water points?

The second research question and sub-questions are the following:

2. Is there an association between women's experience following a WASH intervention and water point functionality?
    a. Is there an association between direct effects on women's lives and water point functionality?
    b. Is there an association between indirect effects on women's lives and water point functionality?

B. Methods

A cross-sectional study of 103 individual water, sanitation, and hygiene committees (WASHCos) from 73 different communities in the Cabo Delgado province of northern Mozambique was conducted in June and July of 2013 by researchers from Emory University and staff from CARE Mozambique, a nongovernmental organization. CARE Water adapted two semi-structured cross-sectional surveys that had been previously implemented in Mozambique and other countries in sub-Saharan Africa. These surveys gathered information about water point functionality, water committee governance, and women's experience following an intervention. Further information was gathered about the water points and local institutions using water point observations and interviews.

Research Questions and Hypothesis

This study assessed the associations between governance and women's experience with sustainability of rural water points in northern Mozambique, particularly of the Afridev hand pump most commonly installed by CARE Mozambique. This study focused primarily on the governance of community managed hand pumps and WASHCos, as the prominent managing bodies of rural water points in sub-Saharan Africa [29]. In conjunction with WASHCos, we also sought information about the governance of district level government agencies and regional maintenance groups.

Study Setting and Background

This study was commissioned by CARE USA to assess the performance of CARE Mozambique's HAUPA (Portuguese acronym for Environmental Hygiene and Productive

Use of Water) project. CARE Mozambique administered the HAUPA project in the Cabo Delgado and Nampula provinces and installed or rehabilitated 600 rural community hand pumps between the years of 2004 and 2011 [40]. Besides assessing components of governance, CARE's research objective was to construct a predictive tool of sustainability building off of previous studies using a governance snapshot survey [44]. For this study, the snapshot tool was altered to identify areas of weakness in previous iterations that most threaten sustainability [47]. The CARE studies conducted in the Cabo Delgado and Nampula provinces in 2011 and 2012 found that there was a significant difference between total functionality scores for functioning hand pumps and non functioning hand pumps [40, 43]. This study was performed as a follow-up in the Namuno and Montepuez districts of Cabo Delgado, using adapted survey tools that targeted problem areas.

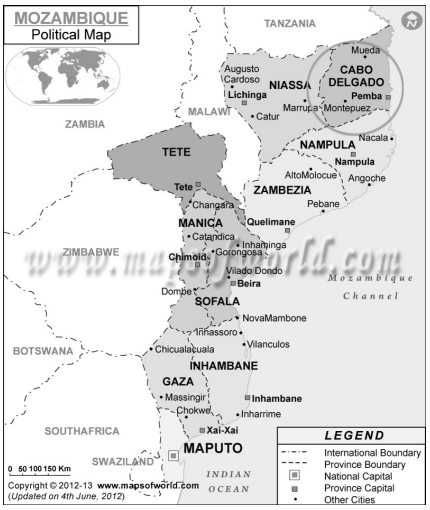

Figure 2.1. Political Map of Mozambique [55]. This study took place in two districts of the Cabo Delgado province in northeastern Mozambique.

Four main domains of governance were identified, which include responsiveness, finances, management, and accountability. Responsiveness refers to how the WASHCo

responds to a break in the pump – who fixed and paid for the break, how timely it was repaired, and if there is a problem that cannot be resolved by the WASHCo. The finances category refers to revenue collection, the availability of funds for a small or large repair, and preventative maintenance. Management assesses the operation and maintenance of the water point, how well caretakers and mechanics function, and the role of women on the WASHCo. Finally, accountability refers to how well the WASHCo reports back to the water point users about the financial situation and the rules and regulations.

Selection Criteria

One of CARE's objectives was to perform an inventory of functioning and non-functioning hand pumps of the HAUPA project, so we sought full coverage of communities in the two selected districts that had received an intervention. Due to the long distances between sites, the limited time available for study, and no comprehensive list of sites, we were unable to reach full coverage. A purposive sampling strategy was chosen for logistic reasons, and we visited 72 communities in total, half in each district.

The HAUPA interventions included both new hand pump installations, as well as rehabilitated hand pumps. We only selected communities in Namuno and Montepuez that had received at least one water point intervention through HAUPA. However, surveys were also conducted pertaining to water points constructed or rehabilitated by other organizations if they were found in those same communities that had received an intervention through HAUPA.

Research Tools

Semi-Structured Surveys

A cross-sectional survey was conducted using two tools developed by CARE and adapted in the field in a pilot study. Contracted translators in country translated all surveys from English to Portuguese at the beginning of the summer. Surveys were then translated simultaneously in the field from Portuguese to Macua, the local language of northern Mozambique, by either CARE staff or a contracted interpreter fluent in both languages. Following pilot testing, multiple questions were altered to make them more easily understood based on local context.

The first semi-structured survey was a "governance into functionality" tool (GiFT). This survey was based on a tool that has been utilized in Mozambique and other countries and was altered for this study to target components of governance that were previously found to be significant and to include those that had been overlooked. Previously, the GiFT tool divided governance into the domains of participation, inclusion, transparency, and accountability. To target previously identified areas of weakness, this study divided governance of the WASHCos into four main domains: (1) responsiveness, (2) finances, (3) management, and (4) accountability. The survey tool is found in Appendix 1.

The GiFT was administered for each operating WASHCo in a community. If a community had more than one water point and WASHCo, multiple surveys were administered in that community. In communities where there were WASHCos managing more than one water point, only one survey was conducted per WASHCo in this case.

For each GiFT, a total of five community members were selected to participate. CARE staff, in coordination with community leaders or chiefs, recruited survey participants. The participant group for the GiFT ideally included at least one member from the following groups: (1) a male WASHCo member, (2) a female WASHCo member, (3) a male non-WASHCo member, and (4) a female non-WASHCo member. A balanced and mixed interest group was desired to gain the perspective of a both sexes and both WASHCo members and non-WASHCo members; however, this was not possible in all cases due to lack of advanced warning to the communities. The answer to each question was deliberated amongst the group, and one final answer was decided upon. As the five community members discussed and deliberated on the survey, this information was also recorded by hand by enumerators or Emory students and then later typed into a narrative in Microsoft Word.

The Impact of WASH on Women Tool (IWWT) was used to quantify the women's experience, both direct and indirect, following a WASH intervention. In each community visited, one women's experience survey was conducted, regardless of how many water points or WASHCos existed in that community. The participant group was all female and ideally included both WASHCo members and non-WASHCo members that used any of the community water points being studied. Discussion was also recorded by hand by enumerators at the time of the survey and then typed up into a narrative. Appendix 1 shows the survey tool.

Water Point Observations

Each water point was visited to verify information collected during the surveys, including the current functionality, the type of hand pump, and the year that the water

point was either installed or had been rehabilitated. Information was recorded about current use of the water point, whether there was a caretaker at the site, and when possible, the type of mechanic failure that had occurred for non-functioning water points. Data was collected on spare parts that were necessary for repair. However, we were dependent on the availability of knowledgeable community members present at the time of the visit, so this information was not verified. Furthermore, there were many communities that did not have adequate operation and maintenance knowledge of the Afridev pumps to adequately diagnose their mechanic failures.

Interviews

Key-informant interviews were conducted with district-level government officials from the Ministry of Infrastructure, the body responsible for water and sanitation infrastructure in Mozambique. In addition, local artisans from both districts were interviewed, who had been trained during the CARE HAUPA project to make repairs on hand wells. The purpose of these interviews was to better understand the role that government officials and local artisans played in maintaining hand wells.

Data Management and Analysis

All data were collected on paper surveys between June and July by researchers from Emory University and CARE Mozambique staff and double entered by separate researchers using Microsoft Excel in Montepuez, Mozambique and Atlanta, Georgia.

Data from GiFT and IWWT were analyzed using SAS version 9.3, and all analyses of qualitative data were done in Microsoft Word.

Statistical Analysis

Definition of Analysis Variables

The outcome of interest for this study is the functionality of water points. Functionality was measured in two different ways using the GiFT: (1) a dichotomous outcome of yes/no, was the water point currently functioning and providing water on the day of the visit and (2) a continuous outcome of estimated proportion of time functional since establishment of water point. The first outcome was derived from self report and direct observation at the water point and the latter outcome was calculated using data collected from the GiFT on number of times the water point has broken down and approximate time dysfunctional before each individual repair.

The predictor variables for functionality in this study were components of water point governance. The GiFT divided individual components of governance into four broad domains: (1) responsiveness, (2) finances, (3) management, and (4) accountability. The responses were scored out of ten points for each domain, for a total of forty points altogether. The scoring system can be found in more detail in Appendix 2, Table A.1.

The IWWT divided the women's experience into direct, indirect, and overall impacts (Appendix 2, Table A.2). Respondents ranked their responses to each component measured in the IWWT from 1 (worse than before the intervention) to 4 (significantly better than before the intervention). A total of 92 points was possible for all questions. Because data was collected at the community level and many communities had more than one water point, the outcome of interest used to analyze this data was whether or not the community had at least one functioning water point.

Summary Statistics

We conducted a univariable analysis to find the central tendency, the spread, and the shape of the distribution of all continuous variables and to find the frequencies of categorical variables. Additionally, currently functioning water points were stratified by district, year of last intervention, type of hand pump, implementer (a CARE intervention or non-CARE intervention), and new vs. rehabilitated.

Governance and Functionality

We first tested the hypothesis that there was an association between rural WASHCo governance and water point functionality. We used a two-sample t-test to measure the difference in means for governance scores between functioning and non-functioning water points. This was done for each category of governance, as well as the total governance score. Stratified two sample t-tests were also used to evaluate for possible interaction. Possible interaction terms included district, pump type, implementer, and age of system. Terms with stratified differences in means greater than 10% from the unadjusted difference in means were included in the logistic regression model.

We used a Chi-square test for association to find the increased odds of functionality for each individual predictor within the broad categories. This was done by first recoding each governance factor as a dichotomous yes/no categorical variable.

To further assess the association between governance and water point functionality, a series of adjusted models were constructed that controlled for *a priori* specified covariates. Dichotomous individual components of governance, as well as the four categories of governance were used as explanatory variables for our outcomes of

interest, both current and past functionality. The first model was constructed using logistic regression to determine which categories of governance were most strongly associated with current functionality. Interaction terms were included in the model. Logistic regression was also used to identify the components of governance associated with current functionality. A full explanatory model was constructed rather than a backwards selection model. This was done because we wanted to determine which explanatory variables were significant and which were not, rather than to identify a 'best' model [56]. Using this method, we identified significant independent variables while controlling for all other governance covariates. All ORs were reported as crude and adjusted, controlling for age, pump type, implementer, and district. Multicollinearity was assessed for each model using variance inflation factors. Highly correlated variables with a variance inflation factor of greater than ten were removed from the model.

Multiple linear regression was used to assess the relationship between the individual governance variables and past functionality. In the case that the distribution of past functionality was not normal, we took the natural log to normalize the outcome variable. Predictors were selected using a backwards selection model at the significance level of $p<0.1$.

Qualitative data was assessed through thematic analysis using Microsoft Word, by recording key issues that reoccurred in the discussion narrative and key-informant interviews.

Women's Experience and Functionality

The two-sample t-test was also used to measure the difference in means for the indirect, direct, and total women's experience scores between communities with at least one functioning water point and those without any functioning water point.

Ethics

The survey protocol was deemed exempt by the Institutional Review Board (IRB) at Emory University. All participation was voluntary for the semi-structured surveys, as well as the interviews. Prior to beginning the survey, verbal consent was obtained from all participants.

C. Results

A total of 72 communities in the Montepuez and Namuno districts were included in this study. The GiFT survey was administered to 103 different mixed groups, who collectively managed 143 individual hand pumps. The IWWT survey was administered to 72 different groups of women, one per community. The communities were evenly distributed between the two districts, with 36 communities in each. We assessed a total of 80 hand pumps (56%) in Montepuez and 63 (44%) in Namuno.

Governance and Sustainability

Of the 143 total hand pumps assessed in this study, 90 (63%) of them were functioning on the day of the visit. In Montepuez district, 60 (75%) hand pumps surveyed were functioning, while 30 (48%) hand pumps in Namuno district were functioning. The proportion of functioning hand pumps was higher for non-CARE implementing agencies. Overall, 27 (73%) hand pumps implemented by other agencies

were functioning, whereas 63 (59%) CARE hand pumps were functioning. Hand pumps that had never been rehabilitated also had a higher proportion functioning, with 74 (65%) currently functioning and 16 (55%) of rehabilitated water points functioning at the time of visit. Functionality also differed by type of hand pump. The most common type of water point surveyed was the borehole with an Afridev hand pump, which also had the highest proportion functioning. The number of boreholes with functioning hand pumps was 74 (67%), compared with 10 (59%) shallow wells, 0 (0%) rope pumps, and 3 (50%) nira pumps. Results of this descriptive analysis are found in Table 2.1.

Table 2.1: Prevalence and Percentage of Functioning Hand Pumps Stratified by System Age, Implementer, Type of Last Intervention, and Pump Type in Namuno and Montepuez Districts, Cabo Delgado, Mozambique, 2013.

Variable		Namuno District	Montepuez District	All Water Points
		# functioning/N (%)	# functioning/N (%)	# functioning/N (%)
Total # of Water Points		30 /63(47.6%)	60/80 (75.0%)	90/143(62.9)
System age (years)	*≤4.5**	19/30 (63.3%)	42/56 (75.0%)	61/86 (70.9%)
	>4.5	11/33 (33.3%)	18/24 (75.0%)	29/57 (50.9%)
Implementer	*CARE*	25/55 (45.5%)	38/51 (74.5%)	63/106 (59.4%)
	UNICEF	0	7/10 (70.0%)	7/10 (70.0%)
	RedCross	0	3/4 (75.0%)	3/4 (75.0%)
	ArcoIris	0	1/2 (50.0%)	1/2 (50.0%)
	EWB	0	10/12 (83.3%)	10/12 (83.3%)
	Government	4/7 (57.4%)	0	4/7 (57.4%)
	Total non-CARE	5/8 (62.5%)	22/29 (75.9%)	27/37 (73.0%)
Last Intervention	*Rehabilitated*	4/15 (26.7%)	12/14 (85.7%)	16/29 (55.2%)
	Newly Constructed	26/48 (54.2%)	48/66 (72.7%)	74/114 (64.9%)
Pump Type	*Borehole w/ Afridev*	22/41 (53.7%)	52/69 (75.4%)	74/110 (67.3%)
	Shallow well w/ Afridev	4/8 (50.0%)	6/9 (66.7%)	10/17 (58.8%)
	Rope Pump	0/6 (0.0%)	0	0/6 (0.0%)
	Nira Pump	3/6 (50.0%)	0	3/6 (50.0%)

*4.5 was found to be the median age of system. The number of functioning hand pumps was stratified by less than or greater than the median for use in further statistical analysis.

The date of last intervention, the year that the water point was either newly installed or rehabilitated by an implementing agency, ranged from 2001 to 2013. Figure 2.2 shows the current functionality stratified by year of last intervention. Past functionality ranged from 5.9% to 100% of the time since implementation that the hand pump was functioning. Of the currently functioning hand pumps, a large proportion of them had either never broken or had been functioning over 99% of the time since implementation; however, 15 (11%) had been functioning less than 50% of the time since implementation (Table 2.2). Table 2.3 shows descriptive statistics for system age, past functionality, amount of time broken since implementation, and number of times broken stratified by both district and current functionality.

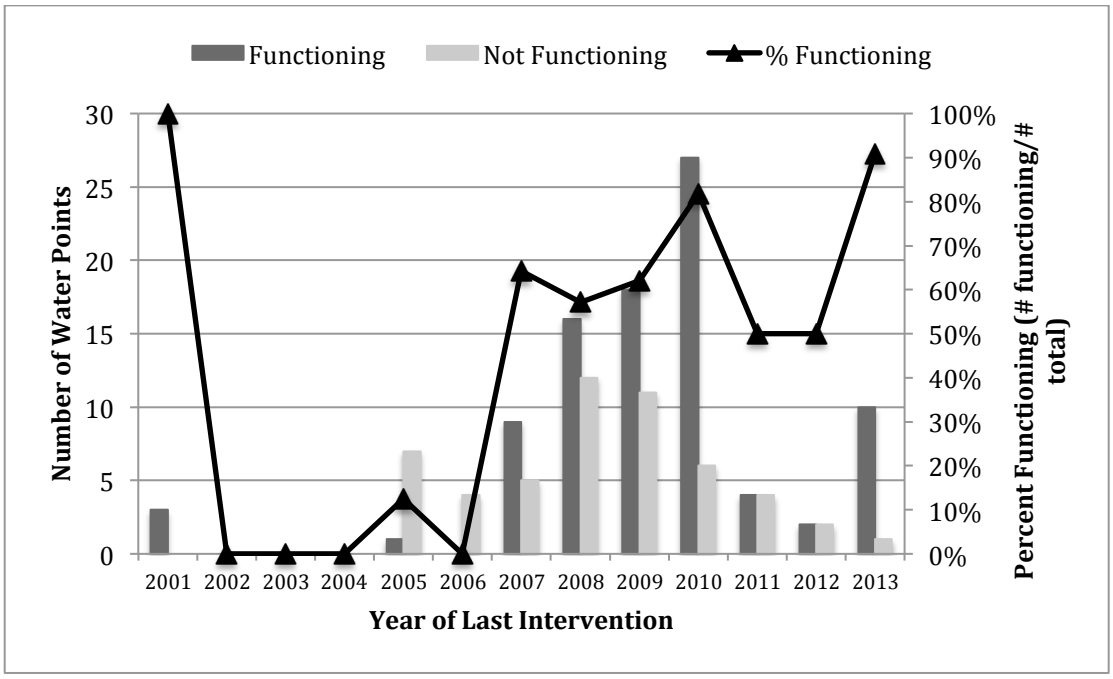

Figure 2.2: Current Water Point Functionality and Percent Functioning Stratified by Year of Last Intervention in Montepuez and Namuno Districts, Cabo Delgado, Mozambique, 2013 (n=142)

Table 2.2: Frequency and Percentage of Hand Pumps that fell into each category of past functionality, which is the percentage of time since last implementation that the hand pump has been functioning, in Namuno and Montepuez districts, Cabo Delgado, Mozambique, 2013.

Past Functionality	N (%)
100%	30 (21.6%)
99%-99.99%	29 (20.9%)
90%-99.99%	54 (38.8%)
80% - 89.99%	17 (12.2%)
70% - 79.99%	11 (7.9%)
60% - 69.99%	9 (6.5%)
50% - 59.99%	3 (2.2%)
< 50%	15 (10.8%)

Table 2.3: Characteristics of Functionality for Water Points stratified by district and current functionality in Namuno and Montepuez Districts, Cabo Delgado, Mozambique, 2013.

Characteristic of Functionality		N	Mean (SD)	Difference in Means*	p-value
System Age (years)		142	4.6 (2.3)		
	Namuno	62	5.7 (2.3)	**2.0**	**<0.0001**†
	Montepuez	80	3.8 (1.9)		
	Functioning	90	4.3 (2.3)	**0.9**	**0.02**†
	Non-functioning	52	5.2 (2.0)		
Past Functionality: Proportion of Time Since Implementation Water Point has functioned (%)		139	83.8% (24.8%)		
	Namuno	62	79.0% (28.3%)	**8.7%**	**0.05**§
	Montepuez	77	87.7% (21.0%)		
	Functioning	88	93.8% (16.0%)	**27.2%**	**<0.0001**†
	Non-functioning	51	66.6% (27.8%)		
Amount of Time Broken since Implementation (days)		143	294 (484)		
	Namuno	63	426 (593)	**236.5**	**0.006**§
	Montepuez	80	190 (346)		
	Functioning	90	82.7 (208.4)	**570.2**	**<0.0001**†
	Non-functioning	53	652.9 (597.3)		
# of times broken		139	1.5 (1.3)		
	Namuno	59	1.4 (1.1)	0.2	0.4§
	Montepuez	80	1.6 (1.5)		
	Functioning	86	1.3 (1.4)	**0.5**	**0.03**†
	Non-functioning	53	1.8 (1.1)		

*Difference in means calculated using a two-sample t-test. Significant differences at the 95% significance level in means in bold.

† p-value calculated using Pooled method

§ p-value calculated using Satterthwaite method

The score for each separate governance domain ranges from 0 to 10 and the total governance score from 0 to 40. Functioning water points had a higher average scores for

all categories of governance compared to non-functioning. The mean total governance score among functioning water points (23.1) was higher than non-functioning (15.1) water points ($p<0.0001$) We also assessed the difference in mean scores for hand pumps older and newer than the median age. The score for finances was higher for newer systems (4.0) than for older systems (2.7), with a difference in mean scores of 1.3 ($p=0.009$) (Table 2.4).

Table 2.4: Characteristics of Governance Categories stratified by functionality and system age (newer vs. older systems) in Namuno and Montepuez Districts, Cabo Delgado, Mozambique, 2013. (n=143)

Governance Domain		**Mean (SD)**	**Difference in Means***	**p-value**
Total Governance Score		20.1 (9.4)		
	Functioning	23.1 (8.8)	**8.0**	**<0.0001**
	Non-functioning	15.1 (8.0)		
	≤4.5† ages	21.3 (9.5)	2.8	0.08
	>4.5 ages	18.4 (9.0)		
Responsiveness		5.4 (3.1)		
	Functioning	6.7 (2.3)	**3.7**	**<0.0001**
	Non-functioning	3.1 (2.8)		
	≤4.5 age	5.7 (2.8)	0.9	0.09
	>4.5 age	4.8 (3.3)		
Finances		3.5 (2.9)		
	Functioning	4.2 (3.0)	**2.1**	**<0.0001**
	Non-functioning	2.2 (2.2)		
	≤4.5 age	4.0 (3.3)	**1.3**	**0.009**
	>4.5 age	2.7 (2.0)		
Management		6.7 (2.7)		
	Functioning	7.1 (2.6)	**1.0**	**0.03**
	Non-functioning	6.1 (2.6)		
	≤4.5 age	6.7 (2.8)	0.1	0.8
	>4.5 age	6.6 (2.5)		
Accountability		4.6 (2.5)		
	Functioning	5.1 (2.5)	**1.3**	**0.003**
	Non-functioning	3.8 (2.3)		
	≤4.5 age	4.8 (2.6)	0.5	0.2
	>4.5 age	4.3 (2.4)		

* Difference in means calculated using a two-sample t-test, and all p-values calculated using pooled method. Significant differences at the 95% significance level in means in bold.

† 4.5 was found to be the median age of system. The number of functioning hand pumps was stratified by less than or greater than the median for use in further statistical analysis.

When conducting bivariate analyses for individual components of governance, the following were found to have a significant association with current functionality: (1) water quality, (2) revenue collection, (3) the availability of saved funds for a small repair, (4) the existence of a WASHCo, (5) regular meetings of the WASHCo members and with community members, and (6) WASHCo rules and regulations (Table 2.5)

Table 2.5: Results of Bivariate Analysis for each individual factor of governance with current functionality in Namuno and Montepuez Districts, Cabo Delgado, Montepuez, 2013.

Explanatory Variable	**OR (95% CI)***	**p-value**
Perceived water quality	**0.35 (0.15-0.84)**	**0.016**
Responsiveness		
Fixed by community mechanic	1.85 (0.91-3.77)	0.087
Saved funds to make repair	1.77 (0.87-3.61)	0.11
Unresolved problem (missing=4)	**2.15 (1.58-2.94)**	**<.0001**
Finances		
Revenue collection	**2.96 (1.47-5.99)**	0.0021
Funds for small repair?	**4.68 (2.17-10.1)**	**<0.0001**
Funds for large repair?		
ROSCA	1.79 (0.18-17.)	0.612
Management		
Existing WASHCo	**2.60 (1.05-6.44)**	**0.035**
Trained WASHCo	1.40 (0.62-3.16)	0.424
Regular WASHCo meetings	**3.02 (1.47-6.21)**	**0.0022**
Caretaker	1.12 (0.48-2.63)	0.786
Functional Mechanic	1.19 (0.59-2.39)	0.627
Preventative maintenance	1.96 (0.98-3.89)	0.054
Women as important decision makers	2.45 (0.7-7.82)	0.121
Accountability		
Open elections	1.38 (0.67-2.83)	0.387
Multiple elections	1.48 (0.49-4.45)	0.487
Rules	**3.02 (1.47-6.21)**	**0.0022**
Community Meetings	**3.13 (1.45-6.72)**	**0.0028**
Financial reporting	2.00 (0.79-5.09)	0.141
Financial records	1.98 (0.99-3.95)	0.0523

* Chi-square test for association was used to obtain OR for each dichotomous explanatory variable. All significant results at the 95% significance in bold.

The different models measuring the association between the two different outcomes of past and current functionality with individual components of governance

identified varying predictors of functionality. The variables found to be associated with past functionality included a WASHCo that fixed their own water point, a WASHCo that had funds saved to pay for a break, the perceived water quality, and whether or not the WASHCo was trained (Table 2.6), while those associated with current functionality were perceived water quality, whether or not the WASHCo had funds to make a routine small repair, whether or not the WASHCo had a problem they could not resolve themselves, whether or not the WASHCo had a caretaker, and finally WASHCo rules that are established and followed. WASHCos who had established rules and regulations had a 3.85 times greater odds of a currently functioning water point ($p=0.04$) than those who did not. Those that had fund saved for a small repair had a 5.86 times greater odds of having a functioning water point ($p=0.04$) than those who did not, and finally WASHCos who reported never having a problem they couldn't resolve had a 20.2 times greater odds of a functioning water point ($p<0.001$) than those that did not. A perception of good water quality and the presence of a caretaker were negatively associated with functionality (Table 2.7).

Table 2.6: Results from Linear Regression Using Backwards Selection Model Controlling for district, system age, pump type, and implementing agency in Namuno and Montepuez districts, Cabo Delgado, Mozambique, 2013.

Explanatory Variable	Parameter Estimate	p-value
Intercept	0.7	<.0001
District	0.1	0.01
System Age	0.04	0.4
Pump Type	0.03	0.6
Fixed their own water point	0.1	0.03
Paid for repair themselves using saved funds	-0.1	0.01
Water quality	-0.1	0.02
Trained WASHCo	0.1	0.02

Table 2.7: Results of Logistic Regression Model for individual components of governance in Namuno and Montepuez districts, Cabo Delgado, Mozambique, 2013.

Explanatory Variable	Unadjusted		Multivariable Adjusted*	
	OR (95% CI)	**p-value**	**OR (95% CI)**	**p-value**
Responsiveness				
Fixed by community mechanic	0.6 (0.1-2.5)	0.5	0.8 (0.2-3.5)	0.7
Saved funds to make repair	0.5 (0.1-2.4)	0.4	0.5 (0.09-2.5)	0.4
Unresolved problem (missing=4)	**13.3 (3.7-47.8)** †	**<.0001**	**20.2 (4.6-88.8)**	**<.0001**
Finances				
Revenue collection	3.0 (0.6-16.4)	0.2	2.1 (0.3-14.2)	0.4
Funds for small repair?	3.4 (0.9-13.7)	0.08	**5.86 (1.11-31.0)**	**0.04**
Funds for large repair?		0.95		0.95
ROSCA	1.2 (0.04-35.1)	0.9	1.2 (0.02-78.3)	0.9
Management				
Existing WASHCo?	0.4 (0.08-2.1)	0.3	0.7 (0.1-4.3)	0.7
Trained WASHCo	1.3 (0.3-5.7)	0.7	3.3 (0.6-19.0)	0.2
Regular WASHCo meetings	1.7 (0.4-8.4)	0.5	1.23 (0.23-6.46)	0.8
Caretaker	**0.2 (0.04-0.9)**	**0.03**	**0.2 (0.03-0.9)**	**0.04**
Functional Mechanic	**0.2 (0.05-0.8)**	**0.02**	0.3 (0.06-1.5)	0.1
Preventative maintenance	2.2 (0.6-8.8)	0.3	2.2 (0.5-9.8)	0.3
Women as important decision	0.9 (0.1-7.8)	0.9	0.5 (0.04-5.4)	0.5
Accountability				
Open elections	0.6 (0.2-1.9)	0.3	0.4 (0.09-1.6)	0.2
Multiple elections	4.4 (0.8-22.4)	0.08	1.6 (0.2-10.9)	0.6
Rules	**4.6 (1.4-15.5)**	**0.01**	**3.9 (1.1-14.0)**	**0.04**
Community Meetings	2.3 (0.5-10.1)	0.3	2.3 (0.5-10.9)	0.3
Financial reporting	1.0 (0.1-8.7)	1.0	1.2 (0.1-13.1)	0.9
Financial records	0.5 (0.1-3.0)	0.5	0.2 (0.03-1.6)	0.1
District				
Montepuez			1	
Namuno			**12.4 (2.1-74.5)**	**0.006**
System Age (years)				
<4.5 years			1	
>4.5 years			1.6 (0.5-5.6)	0.5
Well type				
Deep borehole with Afridev			1	
Other			0.5 (0.1-1.9)	0.3
Installing organization				
CARE			1	
Other			0.9 (0.2-3.9)	0.8
Perceived water quality			**0.08 (0.02-0.4)**	**0.003**

*Multivariable adjusted model controlling for district, age of system, pump type, and implementing agency.
† Significant results in bold at the 95% significance level.

Responsiveness was the only category to be associated with current functionality (p=0.0001) when controlling for other covariates. For every one point increase in the responsiveness score, there is a 78% increase in odds of functionality. The district, age of

system, implementer, and pump type were all assessed for interaction and confounding; however, these components did not affect the model (Table 2.8).

Table 2.8: Results of Logistic Regression Model categories of governance in Namuno and Montepuez Districts, Cabo Delgado, Mozambique, 2013.

Governance Category	Point Estimate OR (95% CI)*	p-value
Responsiveness	**1.8 (1.4-2.2)**	**0.0001**
Finances	1.1 (0.9-1.4)	0.5
Management	0.9 (0.7-1.2)	0.5
Accountability	0.9 (0.7-1.3)	0.6

*OR calculated using logistic regression controlling for district, age of system, pump type, and implementing agency. Significant results in bold.

Women's Experience and Sustainability

A total of 59 (82%) surveyed communities had at least one functioning water point, and 13 had no functioning water points (18%). As depicted in Table 2.9, the difference in means showed an association between women's experience and functionality of the hand pump. There was both an association between both direct and indirect impacts and functionality. The mean score for total women's experience was greater for communities with at least one water point functioning (79.9) than those with no water points functioning (62.7) (p=0.0008), meaning that they reported an overall more positive impact following the WASH intervention.

Table 2.9: Characteristics of Women's Experience Scores and Proportion of Functional Water Points Per Community in Namuno and Montepuez Districts, Cabo Delgado, Mozambique, 2013. (n=72)

	Mean (SD)	Difference in Means*	p-value
Proportion of Water Points that are Functional Per Community	65.7% (39%)		
Total Women's Experience Score	76.8 (10.8)		
At least one functioning	79.9 (6.8)	**17.2**	**0.0008**
None functioning	62.7 (14.0)		
Direct Impacts Score	34.0 (5.1)		
At least one functioning	35.4 (3.4)	**7.9**	**0.001**
None functioning	27.5 (6.6)		
Indirect Impacts Score	32.0 (4.7)		
At least one functioning	33.1 (3.8)	**6.1**	**0.001**
None functioning	27.1 (5.1)		

Overall Impacts Score	10.8 (2.5)		
At least one functioning	11.4 (1.5)	**3.3**	**0.001**
None functioning	3.1 (4.0)		

* Difference in means calculated using a two-sample t-test, and all p-values calculated using Satterthwaite method. Significant differences at the 95% significance level in means in bold.

Results from Semi-Structured Interviews

Communities voiced a number of potential barriers to making repairs and sustaining their water points. Respondents, both WASHCo members and water point users alike, listed a number of key challenges of governance, which included spare parts supply, demand for community water points, and support from external agencies. Interviews with government agencies and trained hand pump artisan groups revealed challenges in coordination in responding to communities' needs.

Many communities reported minor problems with their pump, such as needing to replace the "sola" or rubber seal, which at most parts stores in northern Mozambique cost approximately one USD. Other parts that needed replaced were the central rods, the foot valve, and the centralizer. Many local WASHCo mechanics reported having the technical knowledge to replace these parts themselves and having done so in the past with parts given to the WASHCo by the implementing agency. However, when the spare parts that were given ran out, they were unable to buy new ones either because they did not know where to purchase spare parts or they did not have the financial means for transport to a spare parts supply. Another potential barrier was lack of knowledge of general prices of spare parts.

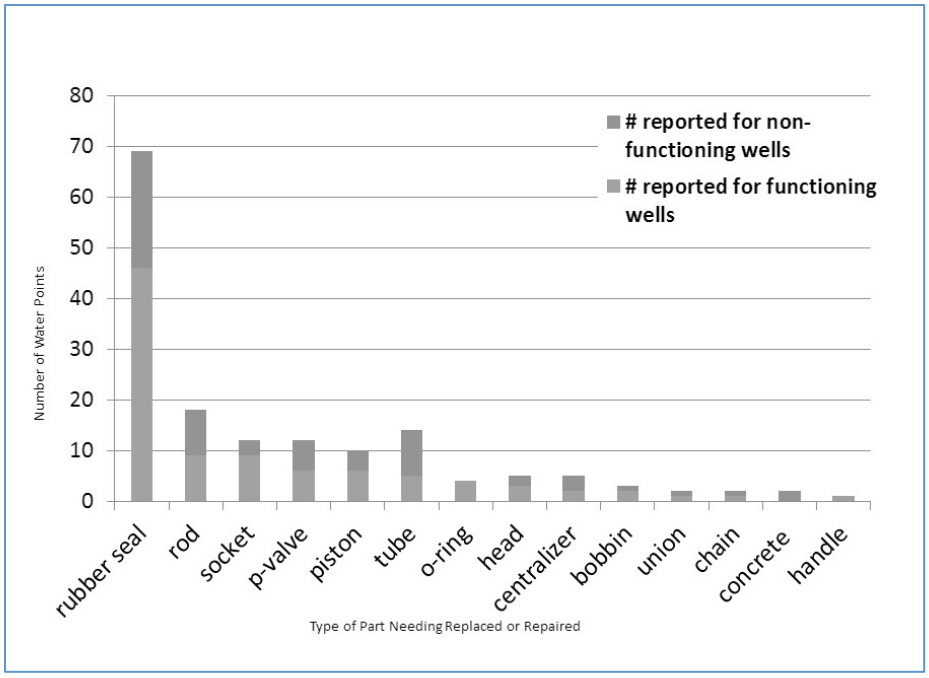

Figure 2.3: Approximate number of water points with parts needing replaced or repaired, as reported by community members and stratified by functionality in Namuno and Montepuez Districts, Cabo Delgado, Mozambique, 2013. Multiple communities reported having multiple breaks or multiple parts they needed replaced or repaired. The figure includes all parts reported. (n=77 communities)

Many water point users reported not using the hand pumps year round for a variety of reasons. Some lived and worked on their farms during certain times of the year and used nearby unimproved sources of drinking water. Others said that they stopped using it in the rainy season when it was easier to obtain water from shallow hand-dug wells in their yards than carry water from the community hand pump. Additionally, some respondents chose to use other sources year round for proximity, preferences in taste, or the tariffs for the improved water source. Many WASHCos only collected tariffs during the dry season when demand for water from the deep boreholes was higher. In communities that did not collect tariffs year round, there was general confusion from water point users about which months they were supposed to pay.

A common theme that emerged from user interviews was that many communities did not take a proactive approach to fixing their hand pump or reporting the break to the

NGO or government agency. Many participants stated that the hand pump was not the community's water point and instead was owned by the implementing agency, so they would wait until someone from an NGO or government would arrive in their community to fix it. Other WASHCos reported that they did not know whom to contact from the NGO or government agency in order to get help. Some mentioned that technicians previously working in the area had moved on and could no longer be reached.

Interviews with governmental officials from the Ministry of Infrastructure revealed that there was a general lack of knowledge of their roles in supporting rural community water supplies. District officials said that they did not have the resources, either human or transportation, to visit communities on a regular basis or to the financial resources to make repairs, but rather, they visit communities when they are able. This corroborated what WASHCos said in the rural communities that visits from officials were irregular, unexpected, and often only resulted in a technician examining their water points but making no repairs. The ministries worked with artisan groups that were trained by CARE in maintenance of Afridev hand pumps. However, the coordination between the ministries and artisan groups differed by district. In the Namuno district, it was a much more collaborative environment. The typical protocol for communities when they had a break was to report to the Ministry, who then contacted the artisan group to visit the community. Both artisan groups expressed difficulty in obtaining spare parts, as well as with transportation in getting to communities to make the necessary repairs, especially to more remote communities. Communities were responsible for paying the artisans for transportation and spare parts.

D. Discussion

We found evidence that local governance is associated with water point functionality. Functioning hand pumps had a higher governance score than nonfunctioning hand pumps in all four domains of governance, as well as total governance. Of the categories of governance, responsiveness and finances had the largest difference in mean scores between functioning and nonfunctioning hand pumps, meaning that these categories had a potentially larger effect on sustainability than the others.

Responsiveness was found to be the category of governance most strongly associated with sustainability. It was to be expected that those WASHCos with high responsiveness scores also had high rates of functionality, as responsiveness deals with the timeliness of repairs and whether or not a WASHCo repaired the hand pump and paid for the fix themselves,. One surprising result, however, is that having funds saved in advanced for a repair had a negative association on past functionality. Those WASHCos that paid for a repair with saved funds were predicted to have a 10% decrease in functionality. This corresponds with research done in Liberia and Sierra Leone where advance revenue collection showed no improvement to those who collected funds from the community in response to a breakdown (Foster 2013).

The finance category included revenue collection, preventative maintenance, and whether or not WASHCos had funds available for a small or large repair. When comparing older and newer systems, the governance score was not found to be significantly different; however, newer systems did perform better in the category of finance than older systems. This may be indication that components of finances are more likely to degrade over time than other categories and could potentially be an area to focus

on when retraining communities post-construction to ensure long-term sustainability. When visiting the water points, it was found that many only needed a rubber seal or other small spare part in order to repair their hand pumps. As most communities reported not having available funds for major repairs or replacement costs, complete financial sustainability of the system may be unobtainable, but better training on revenue collection and financial management may allow WASHCos to have the funds for preventative maintenance and to replace the small parts that are regularly needed to maintain their systems.

In the category of management, our study, produced some counterintuitive results. For example, those communities who reported to have a caretaker who controlled who collected water from the hand pump were significantly less likely to have a functioning water point. There could be several reasons for these unexpected results. One possible explanation is that hand pumps with poorer water quality or those without a caretaker present may be underutilized in the community and therefore do not suffer the wear and tear of more heavily used hand pumps. Another potential explanation is the voluntary basis of the caretakers in northern Mozambique made them less responsible to maintain the hand pump in good working order. While the large majority of caretakers assessed in northern Mozambique were unpaid, researchers in Tanzania found that higher wages of caretakers who collected revenues were associated with functionality (Haysom 2006).

As our models produced varying results, it is difficult to conclusively identify any specific components of governance that are associated with sustainability. Using the two different proxy outcomes for sustainability, different components were found to be significant. The only overlapping significant components between the two models were

perceived water quality, which was negatively associated, and WASHCo rules that are established and followed, which were positively associated with functionality. The most conclusive factor is that of well established rules and regulations that are written and kept to date, as this was found to be significant in all models. Other components of accountability that were found to be significant predictors in previous research done by CARE, such as having regular meetings with the community, were not found to be strongly associated with functionality in this study (CARE 2012).

While direct comparison of our results with past CARE studies is not possible, as the data collection and analysis were performed differently, the main difference from past CARE studies is that this study controls for external factors, such as location of the hand pump and the type of pump installed. Our models produced several significant individual components of governance in the crude model, but when adjusting for these factors, they were no longer significant.

Other studies in sub-Saharan Africa have found an association between distance from district capital and hand pump functionality [4], so the differing results by district in this study may partially be explained by the location of the sites. In the case of our results, the capital city of Montepuez district was a commercial hub for the area, so spare parts and hand pump technicians were easier to find. However, both districts had communities that were very remote, and actual distance from an area of commerce was not controlled for in this study.

Limitations

Both the logistic and linear regression models have limitations. One major limitation of the logistic regression model is that our outcome of current functionality is

only a one-day snapshot; therefore it does not reflect other factors that affect the long-term provision of water such as level of service delivery provided at the pump or past functionality before the day of the visit. Past functionality was approximated to get a better measure of sustainability. The conflicting predictors found from the two models provide insight that using different proxy outcomes for sustainability will vary results. There are limitations to our proxy outcome of past functionality, as well, as it depends on the recall of the study participants on how many times their hand pumps had broken down and for how long they were broken.

This study did not include an exhaustive list of potential governance components and our data were limited in scope to not include other factors that could further confound the relationship between governance and functionality, such as technical issues with the pump infrastructure, environmental and hydrogeological conditions, distance to spare parts supply, support from external agencies, as well as community demand. As revealed in the qualitative analysis, many hand pump users choose to use alternative nonpotable sources over improved sources of drinking water for a variety of reasons. If there are other available water resources in close proximity that are more amenable to users, there may be less incentive to maintain and repair their hand pumps.

The interpretations of these results are subject to certain limitations. First of all, the cross-sectional design of the study does not allow for us to determine causal relationships. Although we assume that good governance predicts functionality, the study design does not rule out whether the reverse is true instead, that rather well functioning hand pumps are a precursor of WASHCos with good governance practices. Secondly, our convenience sampling design limits our ability to generalize beyond our

sampling frame. We sought to reach full coverage in the two chosen districts for CARE's purposes. Without a comprehensive list of project sites, it was not possible to determine if this was achieved. In addition, given our small sample size, we had very large confidence intervals for our odds ratio calculations. A larger study would be necessary to generalize this information to other areas.

Another limitation of the survey design was the mixed group approach. In groups of five participants, it was difficult to obtain the opinion of all group members, particularly those that were not WASHCo members and those that were female. As the study was conducted in conjunction with CARE Mozambique staff, there may have been a courtesy bias in responses, as implementers and technicians of the CARE Haupa project themselves. Finally, translation in the field was another major limitation to this study.

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Chapter 3: Summary

Public Health Implications

This study has the potential of both improving training and programming of CARE's existing and future projects, as well as those of other implementing agencies. Data on poorly performing WASHCos was given to the CARE Mozambique office who will be able to target communities with low governance scores.

The biggest discrepancy in the functionality outcomes was between the two districts. Montepuez had a higher rate of functioning and higher governance scores in all categories. These results were highly unexpected by CARE Mozambique staff. This could be partially explained by the difference in district level support. From our key-informant interviews, it was revealed that the Montepuez Ministry of Infrastructure, the agency responsible for managing water and sanitation facilities in the district, had much more financial and human resources available for supporting rural water points than the Namuno Ministry. Also, the CARE Haupa project began earlier in the Namuno district; thus, the mean system age in years for systems in Namuno was greater than that for Montepuez. Lower functionality rates may be a result of aging infrastructure or furthermore of differences in implementation strategies on the part of CARE. In contrast, the artisan groups trained by CARE Haupa had a much stronger and more active presence in Namuno than in Montepuez. It is unknown as to why this didn't translate to better functionality outcomes. The differences in functionality rates between Namuno and Montepuez is something that should be addressed by CARE Mozambique staff.

Conclusions and Recommendations

There has been increased attention in recent years on the sustainability of water points. Past studies have done by CARE have shown an association between good governance and current functionality; however, this has resulted in little change to date. Several themes have emerged to inform recommendations based on the data presented above.

The first issue is that of community demand and ownership. Fostering a sense of ownership appears very important for improving sustainability of water points. Though the Mozambican Water Policy dictates a 2500 meticais fee (about $100 USD) be paid by the community to the implementing agency to demonstrate demand for a water point, many communities did not know the reason for paying this fee. Some thought they were paying for the construction, and others thought they did not need to continue to collect funds for repairs after paying this fee. Clear communication of the reason for this policy could help develop a sense of ownership as well as clear up confusion over revenue collection for repairs. As many communities waited until someone from the NGO or government arrived to help rather than contact someone proactively to assist them, a better understanding of the roles of each entity could help this situation.

Besides fostering ownership and a sense of responsibility, support networks could be strengthened so that WASHCos know to whom to turn if they need assistance with repairs. Our interviews with WASHCos and leaders of the artisan groups revealed that many communities made use of the artisan groups for both purchasing spare parts and getting help with repairs; however, the effectiveness of these groups was hindered by the interference of local government officials attempting to divert spare parts. Transportation

was also an obstacle to more remote rural communities, since the artisans relied on communities to provide transport to make repairs.

Additionally, many communities reported wanting more training, especially for mechanics to repair water points. Many hand pump breaks occur long after WASHCos have been trained, and much of their knowledge may be lost due to lack of practice. Steps for performing preventive maintenance and the importance of doing so should also be outlined and communicated to WASHCos. The need for retraining was particularly high in the Namuno District, not only for mechanic skills, but governance and finance skills as well. During WASHCo trainings, the method for choosing a financial scheme should be clearly communicated so that the WASHCo lets the water point users decide how often they will pay and how much.

Certain Afridev pump parts break much more frequently than others; thus, mechanic training should at a minimum focus on these common problems. Additionally, information on where to purchase spare parts and the costs of each part should be provided to WASHCos to enable them to plan ahead and save appropriate funds.

Appendix 1: Survey Tools

A. GiFT (English)

B. GiFT (Portuguese)

C. IWWT (English)

D. IWWT (Portuguese)

GiFT (Governance into Functionality Tool)

Purpose: We are two university students from the United States working with CARE Mozambique. The objective of this research is to learn how communities manage their water points, and which practices result in sustainable water points. WE would like to ask some questions about your community water point. This survey is voluntary and you may refuse to participate. You can stop at any time or skip questions you do not want to answer. Do you agree to participate? (Make sure that each participant gives his or her own answer.)

Data Type	Answers	Notes
1. **Basic Data**		
1.1 Identification of scheme		
a. Snapshot No.		
b. Community		
c. District, Administrative Post		
d. Country		
e. GIS ref		
1.2 Date of interview (dd/mm/yy)		
1.3 Type of scheme		
1.4 Date of establishment (or years since establishment) :		
1.5 Date of major repair/expansion (or years since) :		
1.6 Financed by:		
1.7 If registry exists, number of registered users (households)		
1.8 Total number of households in community		
2. Functionality snapshot		
2.1 Is the scheme working and providing water today?	i. Yes _____ ii. No _____ If no, how long has it not been working?:_ (approx. # of days)	
2.2 How many times has the scheme broken down since establishment?	Number_____	
2.3 If the scheme has broken down since establishment, how long was it broken?	# of weeks / months/ years for each failure _____(1st time)_____(Year) _____(2nd time)_____(Year) _____(3rd time)_____(Year)	
2.4 If it has been broken for more than 6 months, why?	i. No demand for scheme ii. Lack of funds iii. Mechanical failure iv. Poor management v. Conflict vi. Other, please specify:	
2.5 If the water point has broken down, who fixed the problem?	i. Committee mechanic ii. NGO technician iii. Government technician iv. Local business v. Other, please specify:	

2.6 If the water point has broken down, how was the repair paid for?	i. Committee had saved available funds ii. Committee asked for funds from community iii. Government iv. NGO v. Other, please specify:		
2.7 Have there been any major problems/breakdowns which were beyond the community's ability to repair?	i. Yes_____	ii. No_____	
2.8 How would you rate the quality of water provided for human consumption?	i. very poor ii. poor iii. fair iv. good v. very good		
2.9 Do community members use water from the water point to produce things to sell?	i. Yes_____	ii. No_____	
2.10 If yes, what is it used for?	i. Horticulture ii. Animals iii. Brick making iv. Food/drink preparation v. Other, please specify:		
3.Sanitation Sustainability			
3.1 What proportion of the community has access to sanitation?	i. ¼ of households ii. ½ of households iii. ¾ of households iv. All latrines		
3.2 If a household's latrine stops functioning, what does the household usually do?	i. Return to open defecation ii. Use a neighbor's latrine instead of building a new one iii. Build a new latrine		
3.3 What proportion of latrines have accompanying handwashing facilities with water and soap or ash available?	i. ¼ of households ii. ½ of households iii. ¾ of households iv. All latrines		
3.4 If there are new community members, what have they done to access sanitation?	i. Build their own latrines ii. Use existing latrines instead of building a new one iii. Don't use latrines		
4. Scheme Financing			
4.1 Does the community raise funds to maintain water and sanitation facilities?	i. Yes _____	ii. No _____	
4.2 If yes, how are funds raised?	i. pay per use ii. pay at regular interval (per month) ii. Other, please specify:		
4.3 Do all households pay the same rate?	i. Yes _____	ii. No _____	
4.4 If the water needed a small repair, does the committee have funds to cover this cost?	i. Yes_____	ii. No _____	

4.5 If the water point had a major breakdown, does the committee have funds to cover this cost?	i. Yes_____	ii. No _____	
4.6 Is there a rotating savings and loan scheme linked to the water supply scheme?	i. Yes_____	ii. No _____	
4.7 Has there been preventative maintenance carried out in the past year?	i. Yes_____	ii. No _____	
5. Management approach			
5.1 Does the water and sanitation committee exist?	i. Yes_____	ii. No_____	
5.2 Have the water and sanitation committee members been trained?	i. Yes_____	ii. No_____	
5.3 Does the water and sanitation committee hold meetings with members?	i. Regular meetings ii. Sometimes hold meetings iii. Never holds meetings		
5.4 Is there a designated person who controls who collects water?	i. Yes_____	ii. No _____	
5.5 If yes, what is the situation regarding care-taking?	i. Does not function ii. Functions and caretaker is unpaid iii. Functions and caretaker is paid		
5.6 Is there a mechanic within the community who undertakes repairs?	i. Does not exist ii. Exists and has repaired, but not successfully iii. Exists and has repaired successfully		
5.7 What is the role of women within water and sanitation committee decision making?	i. No role ii. Limited role iii. As important as men iv. Main decision makers		
6. User group			
6.1 Approximately how many households use the water point in the dry season?	Number or percent_____		
6.2 Approximately how many households use the water point in the rainy season?	Number or percent_____		
6.2 Compared to past years, the number of households using the water point is:	i. Fewer ii. About the same iii. More		
7. Accountability and Responsiveness			
7.1 Have water and sanitation committee elections been held open and transparent?	i. No ii. Elections are held but they are neither open nor transparent iii. Yes		
7.2 After the first water and sanitation committee elections have there been re-elections?	i. Yes_____	ii. No _____	

7.3 Does the water and sanitation committee have clear rules and procedures that are known and updated?	i. no ii. Yes, but there is uncertainty over them iii. Yes, known and updated but not written iv. Yes, known and updated and written		
7.4 Does the water and sanitation committee hold meetings with the community?	i. Regularly ii. Sometimes iii. Never		
7.5 Does the committee report back to users about the financial status of the water point?	i. Regularly ii. Sometimes iii. Never		
7.6 Are written financial records kept up-to-date?	i. No ii. Some records are kept but they are incomplete iii. Yes, full records are kept		
7.7 Are there audits and/or other financial checks carried out every year?	i. No ii. Yes, but not every year iii. Yes, every year iv. Do not know		
8. Follow-up Actions			
8.1 What does the water and sanitation committee need to do to maintain functionality and ensure future sustainability of the water point?		Goal for completion: i. In the next 6 months ii. In the next 1 year ~~iii. Other (specify)~~	
8.2 How important is this to future sustainability?	(Rank between 0 and 5. 0 not important, 3 important, 5 very important.)		
8.3 What support is required of the government to maintain functionality and ensure future sustainability?		Goal for completion: i. In the next 6 months ii. In the next 1 year ~~iii. Other (specify)~~	
8.4 How important is this to future sustainability?	(Rank between 0 and 5. 0 not important, 3 important, 5 very important.)		
8.5 What support is needed from NGOs or private sector to maintain functionality and ensure future sustainability?		Goal for completion: i. In the next 6 months ii. In the next 1 year ~~iii. Other (specify)~~	
8.6 How important is this to future sustainability?	(Rank between 0 and 5. 0 not important, 3 important, 5 very important.)		

Administraçãoda Funcionalidade da Ferramenta (Governance into Functionality Tool)

Proposito: Estamos trabalhando com a organização CARE e estamos a dois estudantes de uma universidade a partir dos Estados Unidos. O objetivo desta pesquisa é aprender como as comunidades gerenciam seus pontos de água, e que um comitê de água práticas resultam em pontos de água sustentáveis. Nós gostaríamos de fazer algumas perguntas sobre o ponto de água em sua comunidade. Esta pesquisa é voluntária e você poderá recusar-se a participar. Você pode parar a qualquer momento, ou ignorar perguntas que não quer responder. Você concorda em participar? (certifique-se que cada membro dá sua própria resposta)

Tipo de Dado	Respostas	Notas
1. **Dados Basicos**		
1.1 Identificação da fonte:		
a. Numero de ordem		
b. Comunidade		
c. Distrito, Posto Administrativo		
d. País		
e. coordenadas geograficas		
1.2 Data da Intervista (dd/mm/ano)		
1.3 Tipo de fonte		
1.4 Data de estabelecimento (ou anos) :		
1.5 Data da rehabilitação maior (ou anos) :		
1.6 Financiado por:		
1.7 Se existe um registro, Nº de usuarios registrados de fonte de agua (casas)		
1.8 Numero total de casas de comunidade		
2. Utilidade Instantanea		
2.1 A fonte está funcionar e providenciar água hoje?	i. Sim _____ ii. Não _____ Se não, a quanto tempo que não está funcionando:_____(aproxi. # de dias)	
2.2 Quantas vezes é que a fonte de água ha variou desde a estabelecimento?	Numero_____	
2.3 Se a fonte tinha parado, há quanto tempo foi variado?	Numero de semanas / meses / anos para cada vez _____(Primeira vez)_____(Ano) _____(Segunda vez)_____(Ano) _____(Terceira vez)_____(Ano)	
2.4 Se a fonte tinha parado por mais de 6 meses, por quê?	i. Não há demada na fonte de agua ii. Falta de fundos iii. Fracasso no mecanismo iv. Má gestão v. Conflicto vi. Outros, por favor especifique:	
2.5 Se a fonte tinha parado, quem reparou o problema?	i. Mecânico de comitê de agua e saneamento ii. Técnico de ONG iii. Técnico de governo iv. Empresarial local v Outro, por favor especifique:	

2.6 Se a fonte tinha parado, quem pagou a reparação?	i. Comitê salvou fundos disponíveis ii. Comitê solicitou fundos da comunidade iii. Governo iv. ONG v. Outro, por favor especifique:		
2.7 Já houve grandes problemas / avarias que estavam além da capacidade da comunidade para resolver?	i. Sim_____	ii. Não_____	
2.8 Qual é o grau de qualidade da água providenciada para o consumo da população?	i. muito pobre ii. Pobre iii. Imparcial iv. bom v. muito bom		
2.9 Os membros da comunidade usam a água da fonte de água para produzir coisas para vender?	i. Sim_____	ii. Não_____	
2.10 Se sim, é para o quê?	i. Horticultura ii. Animais iii. Fabrico de tijolos iv. Preparação de comida e refrigerantes v. Outros, favor especifique:		
3.Sustentabilidade de Saneamento			
3.1 Qual é a porpoção da comunidade que aderiu ao saneamento?	i. ¼ das famílias ii. ½ das famílias iii. ¾ das famílias iv. todas as famílias		
3.2 Se latrina de uma família deixa de funcionar, o que a família costuma fazer?	i. Retornar para fecalismo a céu aberto ii. Usa latrina de um vizinho, em vez de construir um novo iii. Construir uma nova latrina		
3.3 Qual é porpoção das latrinas que tem acompanhado facilidades de lavagens a mão com agua, sabão ou sinza?	i. ¼ das latrinas ii. ½ das latrinas iii. ¾ das latrinas iv. todas as latrinas		
3.4 Se há novos moradores na comunidade, o que eles fazem para aceder ao saneamento?	i. Eles constroem suas próprias latrinas ii. Eles usam as latrinas existentes em vez de construir um novo iii. Não usam latrinas de vez		
4. Esquema do Financiamento			
4.1 A comunidade angaria fundos para manter as fontes de água e saneaemento?	i. Sim _____	ii. Não _____	
4.2 Se sim, como é que os fundos são angariados?	i. pagar por cada utilização ii. pagar em intervalos regulares (por mês) ii. Outros, favor especifique:		
4.3 Todas as famílias pagam o mesmo montante?	i. Sim _____	ii. Não _____	
4.4 Se a fonte de água necessita uma pequena reparação, a comitê tem fundos agora para cobrir este custo?	i. Sim_____	ii. Não _____	

4.5 Se o ponto de água teve uma avaria grave a comitê tem fundos agora para cobrir este custo?	i. Sim_____	ii. Não _____	
4.6 Existem grupos de poupanca e credito rotativo ligado ao processo de abastecimento da água?	i. Sim_____	ii. Não _____	
4.7 Alguma manutenção preventiva ocorreu durante os anos passados?	i. Sim_____	ii. Não _____	
5. Modelo de Gestão			
5.1 Existe um o comite de agua e saneamento?	i. Sim_____	ii. Não_____	
5.2 Os membros de comite da água e saneamento foram capacitados?	i. Sim_____	ii. Não_____	
5.3 O comite de agua tem promovido encontros com membros do comite?	i. Regularmente ii. As vezes iii. Nunca promove encontros		
5.4 Existe uma pessoa especificada que controla quem tira a água?	i. Sim_____	ii. Não _____	
5.5 Se existe, o sistema funciona?	i. Não funciona ii. Funções e a pessoa não é remunerada iii. Funções e a pessoa é paga		
5.6 Existe algum mecanico na comunidade que vela pela manutenção?	i. Não existe ii. Existe e tem feito a manutenção mas não adequadamente iii. Existe e tem feito a manutenção adequadamente		
5.7 Qual é o papel da mulher no proceso de tomada de decisão no comite de agua e saneamento?	i. Não faz parte ii. Tem um pape llimitado iii. Importante como os homens iv. Tomam decisões muito importante		
6. Grupo de usuarios			
6.1 Aproximadamente quantas famílias usam o ponto de água no tempo seca?	Numero ou proporção_____		
6.2 Aproximadamente quantas famílias usam a fonte de água no tempo chuvoso?	Numero ou proporção _____		
6.2 Em relação a anos pasados, o número de famílias que utilizam o ponto de água é:	i. menos ii. aproximadamente a mesma iii. mais		
7. Responsabilidade e Correspondencia			
7.1 As eleições de comite de agua e saneamento foram abertas e transparentes?	i. Não ii. As eleiçoes foram feitas mas não foram abertas nem transparentes iii. Sim		
7.2 Depois das primeiras eleiçoes do comite de agua e saneamento, houveram mais eleições?	i. Sim_____	ii. Não _____	

7.3 O comite de agua e saneamento tem regras claras e procedimentos reconhecidos e actualizados?	i. não ii. Sim, mas há incertezas nelas iii. Sim, conhecido e atualizado, mas não está escrito iv. Sim, conhecidos e atualizado e escrito		
7.4 A comitê de água tem promovido encontros com a comunidade?	i. Regularmente ii. As vezes iii. Nunca promove encontros		
7.5 A comitê de água dá um relatório aos usuários sobre a situação financeira da fonte de água?	i. Regularmente ii. As vezes iii. Nunca promove encontros		
7.6 Os registros financeiros por escrito são mantidos atualizados?	i. Não ii. Alguns registos estão guardados mas, estão incompletos iii. Sim,todos registos estão guardados		
7.7 Auditorias e / ou outros comprovativos são levados a cabo anualmente?	i. Não ii. Sim, mas não anualmente iii. Sim, anualmente iv. não sei		
8. Acções de acompanhamento			
8.1 O que a comité de água e saneamento precisam fazer para manter a funcionalidade e garantir a sustentabilidade futura da fonte de água?		Terminar dentro de: i. Nos próximos 6 meses ii. No próximo I ano iii. Outros (especifiq.)_____	
8.2 Quão importante é isso para a sustentabilidade futura?	(grau entre 0 e 5. 0 não importante, 3 importante, 5 muito importante)		
8.3 Que tipo de apoio é exigido do governo para manter a funcionalidade e garantir a sustentabilidade futura da fonte de água?		Terminar dentro de: i. Nos próximos 6 meses ii. No próximo I ano iii. Outros (especifiq.)_____	
8.4 Quão importante é isso para a sustentabilidade futura?	(grau entre 0 e 5. 0 não importante, 3 importante, 5 muito importante)		
8.5 Que tipo de apoio é necessário que as ONGs ou do sector privado para manter a funcionalidade e garantir a sustentabilidade futura da fonte de água?		Terminar dentro de: i. Nos próximos 6 meses ii. No próximo I ano iii. Outros (especifiq.)_____	
8.6 Quão importante é isso para a sustentabilidade futura?	(grau entre 0 e 5. 0 não importante, 3 importante, 5 muito importante)		

Impact of WASH on Women Tool (IWWT)

We are working with the organization CARE and two students from an American university. The goal of this research is to understand how WASH interventions affect the lives of women. CARE will be using this information to guide their practices. We would like to ask you some questions about your experiences with the water point in your community. This survey is voluntary and you may refuse to participate. You can stop at any time or skip questions you do not wish to answer. Do you agree to participate? (Make sure each member gives her own response.)

Data type		Answers		Notes
1. General Information				
1.01	Identification of scheme:			
a.	Snapshot no			
b.	Community			
c.	Administrative Post, District			
d.	Country			
e.	Geographic Coordinates			
1.02	Date of interview (dd/mm/yy)			
2. Impact of the WASH Intervention: Comparison before the WASH Intervention and Now				
2.01	Comparing before and now: The time to fetch water:	i. It takes longer ii. It is not very different iii. It takes a bit less time iv. It takes half the time it used to take or even less v. No answer		
2.02	Compare before and now: The amount of water generally used is:	i. Less than before ii. Around the same iii. A bit more iv. Double or more v. No answer		
2.03	Compare before and now: The water quality is:	i. Worse than before ii. Not very different iii. A bit better iv. Significantly better v. No answer		
2.04	Compare before and now: Community use of latrines is:	i. Less than before ii. Not very different iii. A bit more iv. Significantly more – many more people are using latrines v. No answer		
2.05	Compare before and now: The community's personal hygiene practices are:	i. Worse than before ii. Not very different iii. A bit better iv. Significantly better – hand washing by latrine which is always used v. No answer		
2.06	Compare before and now: The health of the women in the community is	i. Worse than before ii. Not very different iii. A bit better iv. Significantly better v. No answer		

2.07	Compare before and now: Overall, the health of the whole community is	vi. vii. viii. ix. x.	Worse than before Not very different or some better and some worse A bit better Significantly better No answer		
2.08	Compare before and now: Production of vegetables, livestock, food, and drinks for sale is:	i. ii. iii. iv. v.	Less than before Around the same A bit more Significantly more No answer		
2.09	Compare before and now: Women's control over household resources is:	i. ii. iii. iv. v.	Less control than before Around the same A bit more Significantly more No answer		
2.10	Compare before and now: Women's opportunities for education and training are:	i. ii. iii. iv. v.	Fewer than before Not very different A bit better Significantly improved No answer		
2.11	Compare before and now: Women's roles in the WASH Committee are:	i. ii. iii. iv. v.	Taken away because of the project Not very different Occasional more significant role Ongoing significant increased role No answer		
2.12	Compare before and now: Women's opportunities within the community for paid employment are:	i. ii. iii. iv. v.	Had previously paid jobs been taken away because of the project Not very different roles Occasional paid roles Regular paid jobs No answer		
2.13	Compare before and now: The dignity and respect of women are:	i. ii. iii. iv. v.	Reduced now – more ashamed Not very different Some sense of improved dignity Increased No answer		
2.14	Compare before and now: Women's personal safety when going to collect water or to the latrine is:	i. ii. iii. iv. v.	Worse than before Not very different A bit better Significantly better No answer		
2.15	Compare before and now: The time women have for socializing on their way to the water point or waiting at the water point is:	i. ii. iii. iv. v.	less than before Not very different A bit more Significantly more No answer		
2.16	Compare before and now: The amount of women's social groups in the community is:	i. ii. iii. iv. v.	Fewer than before, Some existing groups disbanded Not very different, A few more groups More groups of importance No answer		

2.17	Compare before and now Household relationships are:	i. Now more conflictual, ii. Not very different, iii. With minor improvements, iv. With significant improvements, v. No answer,		
2.18	Compare before and now: The equality in the household between men and women is:	i. More unequal than before, ii. Not very different, iii. A bit more equal, iv. Significantly more equal, v. No answer,		
2.19	Compare before and now Women's time for leisure is:	i. Less than before, ii. Not very different, iii. A bit more, iv. Significantly more, v. No answer,		
2.20	Compare before and now: The ability of women to make decisions and voice opinions is:	i. worse than before, ii. Not very different, iii. Somewhat greater, iv. Significantly greater, v. No answer,		

3. Overall Summary Assessment of the WASH Impact				
3.01	How has the intervention affected the day to day life of women? The situation is:	i. Worse than before, ii. Not very different, iii. A bit better, iv. Significantly better, v. No answer,		
3.02	Financially how has the intervention affected the women of the community? The situation is:	i. Worse off compared to before, ii. Not very different, iii. A bit better off, iv. Significantly better off, v. No answer,		
3.03	In terms of empowerment/ disempowerment: what has been the overall effect of the intervention? Women:	i. Feel less empowered compared to before, ii. Feel not very different, iii. Feel a bit better, iv. Feel significantly more empowered, v. No answer,		
4. Comments:				

Ferramenta do Impacto do PROJECTO DE AGUA E SANEAMENTO nas Mulheres

Estamos trabalhando com a organização CARE e dois alunos de uma universidade Americana. O objetivo desta pesquisa é conhecer como as intervenções de água afetam a vida das mulheres. CARE vai estar usando essas informações para orientar suas práticas. Nós gostaríamos de lhe fazer algumas perguntas sobre suas experiências com a fonte de água em sua comunidade. Esta pesquisa é voluntária e você poderá recusar-se a participar. Você pode para a qualquer momento, ou ignorer perguntas que não quer responder. Você concorda em participar? (sertifique-se que cada membro dá sua própria resposta)

Tipo de Dados		Resposta	Notas
1. Informação Geral			
1.01	Identificação da fonte:		
a.	Numero de ordem		
b.	Comunidade		
c.	Poste Administrativo, Distrito		
d.	Pais		
e.	Coordenadas geograficas		
1.02	Data de entrevista (dia/ /ano)		
2. Impacto de interveneções do projecto de agua e saneamento: Comparação antes de intervenção do projecto de água e saneamento e Agora:			
2.01	Comparação antes e Agora: Tempo para buscar água	i. leva muito tempo ii. não é tão diferente iii. leva muito pouco tempo iv. leva metade de tempo que é usado para tomar ou mesmo menos v. Sem resposta	
2.02	Comparação antes e Agora: A quantidade de água geralmente usada é:	i. pouco que antes ii. quase o mesmo iii. um pouco mais iv. O dobro ou mais v. Sem resposta	
2.03	Comparação antes e Agora: A qualidade de água é:	i. pior que antes ii. não é tão diferente iii. um pouco melhor iv. significativamente melhor v. Sem resposta	
2.04	Comparação antes e Agora: Uso comunitário de latrinas é:	i. pior que antes ii. não é tão diferente iii. um pouco mais iv. O dobro ou mais – muito mais pessoas a estão usar latrinas v. Sem resposta	
2.05	Comparação antes e Agora: As prácticas comunitárias de hygiene pessoal são:	i. pior que antes ii. não é tão diferente iii. um pouco melhor iv. significativamente melhor – lavar mãos sempre que são usadas as latrinas v. sem resposta	
2.06	Comparação antes e Agora: A saúde das mulheres na comunidade é:	i. pior que antes ii. não é tão diferente iii. um pouco melhor iv. significativamente melhor v. sem resposta	

2.07	Comparação antes e Agora: No geral, a saúde de toda comunidade	vi. pior que antes vii. não é tão diferente viii. um pouco melhor ix. significativamente melhor x. sem resposta		
2.08	Comparação antes e Agora: A produção de hortaliças, pecuária, alimentos e bebidas para venda é:	i. poucos recursos que antes ii. Around the same iii. Um pouco mais iv. significativamente maior v. sem resposta		
2.09	Comparação antes e Agora: Controle das mulheres sobre os recursos domésticos é:	i. pouca que antes ii. quase os mesmos iii. um pouco mais iv. significativamente maior v. sem resposta		
2.10	Comparação antes e Agora: Oportunidades da mulher para educação e formação	i. pouco que antes ii. não ha muita diferença iii. um pouco melhor iv. melhorias significativas v. sem resposta		
2.11	Comparação antes e Agora: Papel das mulheres nos comité de projecto de agua e saneamento:	i. terminaram por causa do projecto ii. não é tão diferente iii. papel ocasionalmente muito signifcante iv. em curso o papel significativo acresido v. sem resposta		
3.12	Comparação antes e Agora: Oportunidades de mulheres dentro da comunidade para os trabalhos renumerados são :	i. foram pagos previamente os trabalhos ou empregos terminados por causa do projecto ii. Papeis não é tão diferentes (ex: sem papel, em seguida, ouagora) iii. papeis ocasionalmente pagos iv. Empregos regularmente remunerados		
2.13	Comparação antes e Agora: A dignidade e o respeito das mulheres são :	i. agora reduziu – muita vergonha ii. não é tão diferente iii. algum senso de aumento da dignidade iv. significativamente melhor v. sem resposta		
2.14	Comparação antes e Agora: A segurança pessoal das mulheres quando buscam agua ou usam a latrina é:	i. pior que antes ii. não é tão diferente iii. um pouco melhor iv. significativamente melhor v. sem resposta		
2.15	Comparação antes e Agora: O tempo que as mulheres têm para socializer em seu caminho para a fonte de água ou de espera na fonte de água é:	i. pior que antes ii. não é tão diferente iii. um pouco melhor iv. significativamente melhor v. sem resposta		
2.16	Comparação antes e Agora: A quantidade de groupos sociais das mulheres na comunidade é:	i. Menos do que antes, alguns grupos existentes dissolvidos ii não é tão diferente iii. Mais agluns grupos iv. Mais grupos de importáncia v. sem resposta		

2.17	Comparação antes e Agora: Relações familiares são:	i. tão conflictuosas agora ii. não é tão diferente iii. com pouco aumento ou crescimento iv. com crescimento significativo v. sem resposta		
2.18	Comparação antes e Agora: A igualdade na familia entre homens e hulheres é:	i. mais desigualdade que antes ii. não é tão diferente iii. um pouco mais igual iv. tão igual significativamente v. sem resposta		
2.19	Comparação antes e Agora: As oportunidades das mulheres para o tempo livre é:	i. menos do que antes ii. não é tão diferente iii. um pouco mais iv. significativamente maior v. sem resposta		
2.20	Comparação antes e Agora: A capacidade das mulheres para tomar decisões de expressar opiniões é:	i. pior do que antes ii. não é tão diferente iii. Mulheres tem un pouco mais de voz iv. Significativamente maior v. sem resposta		

3. Overall Summary Assessment of the WASH Impact				
3.01	Como é que practicamente as intervenções afectaram o dia-a-dia da vida das mulheres? A situação é:	i. pior do que antes ii. não é tão diferente iii. um pouco melhor iv. significativamente melhor v. sem resposta		
3.02	Como é que financeiramente a intervenção afectou as mulheres da comunidade? A situação é	i. situação piorou quando comparada a anterior ii. não é tão diferente iii. um pouco melhor iv. significativamente melhor v. sem resposta		
3.03	Em termos de empoderamento ou não empoderamento quai foi o efeito geral da intervenção das mulheres?	i. Sentem pouco empoderadas que antes ii. Sentem não é tão diferente iii. Sentem um pouco melhor iv. Sentem significativamente mais empoderadas v. sem resposta		
4. Comentarios:				

Appendix 2: Additional Tables & Figures

Table A.1: Scoring System for GiFT categories of governance.

Responsiveness	
Break time. The amount of time the water point was dysfunctional before being repaired before any given break.	If ≤30 days……..……2 If > 30 days……..……0
Past functionality. Proportion of time functional since implementation.	If >90%.....2 If >80%.....1 If ≤80%.....0
By whom was the water point fixed?	If fixed by community mechanic for any given break……..……2 If never fixed by community mechanic but fixed by NGO, government technician, or local businessperson for any given break……...1 If never repaired……0
Who paid for the repair?	If WASHCo had funds saved for any given break……3 If WASHCo raised funds for any given break……...2 If government or NGO paid for repair……...1 If never repaired……..….0
Has the WASHCo ever had a problem they were unable to fix themselves?	If no……1 If yes……..0
Possible Total Responsiveness Score	10
Finances	
Revenue collection. Does the WASHCo collect fees for water?	If yes……..2 If no..……..0
Small repair. Does the WASHCo have funds available for a small repair?	If yes……..2 If no..……..0
Large repair. Does the WASHCo have funds available for a large repair?	If yes……..2 If no..……..0
ROSCA. Does the WASHCo operate with a rotating savings and loan scheme?	If yes……..2 If no..……..0
Maintenance. Does the WASHCo conduct preventative maintenance?	If yes……..2 If no..……..0
Possible Total Finances Score	10
Management	
WASHCo. Does the WASHCo exist?	If yes……..1 If no..……..0
Trained WASHCo. Was the WASHCo trained?	If yes……..1 If no..……..0
WASHCo Meetings. Does the WASHCo have meetings with members?	If regularly……2 If sometimes……..1 If never……...0

Caretaker. Does the water point have a caretaker?	If yes……..1 If no..……..0
Caretaker 2. Does the caretaker system function?	If yes……..1 If no..……..0
Mechanic. Does the WASHCo have a water point mechanic?	If yes and mechanic makes repairs adequately……2 If yes but does not make repairs adequately…….1 If no……0
Women. What is the role of women on the WASHCo?	If women make important decisions……..2 If women are important as men……1 If women have a limited role……..0.5 If women have no role……0
Possible Total Management Score	10
Management	
Open Elections. Were elections conducted and were they open and transparent	If yes……..1 If yes, but they were not open or transparent……..0.5 If no……0
Multiple Elections. After the WASHCo was originally elected, have there been more elections?	If yes……..1 If no..……..0
Rules. Does the WASHCo have rules and procedures that are known and realized?	If yes, and rules are written……2 If yes, but rules are not written……..1 If yes, but there are some uncertainties……...0.5 If no……0
Community Meetings. Does the WASHCo have meetings with the community?	If regularly……2 If sometimes……..1 If never……...0
Financial Reporting. Does the community give a report to users about its finances?	If regularly……2 If sometimes……..1 If never……...0
Financial Records. Does the WASHCo keep financial records written and up to date?	If yes……..1 If some records are kept but are incomplete……..…0.5 If no……0
Audits. Are financial audits conducted?	If yes, annually……..1 If yes, but not annually……...0.5 If no……0
Possible Total Accountability Score	10
Possible Total Governance Score	40

Table A.2: Questions from IWWT, both direct and indirect impacts. Each question was scored between one, for worse than before the intervention, and four points, for much better than before the intervention. The total women's experience score ranged from between zero and ninety-two points.

Impact of WASH on Women Tool (IWWT)	
Direct Impacts	Comparing before the intervention with the present: • The time to fetch water • The amount of water generally used • The water quality • Community use of latrines • Community's personal hygiene practices • The health of women in the community • The overall health of the community • Women's role in the WASH committee • Women's personal safety when going to collect water or to the latrine • The time women have for socializing on their way to the water point or waiting at water point
Indirect Impacts	Comparing before the intervention with the present: • Production of vegetables, livestock, food, and drinks for sale • Women's control over household resources • Women's opportunities for education and training • Women's opportunities within the community for paid employment • The dignity and respect of women • The amount of women's social groups in the community • Household relationships • The equality in the household between men and women • Women's time for leisure • The ability of women to make decisions and voice opinions
Overall Impacts	• How has the intervention affected the day to day life of women? • Financially how has the intervention affected the women of the community? • In terms of empowerment/disempowerment: what has been the overall effect of the intervention?

Table A.3: Questions and Response Frequencies for GiFT survey, administered in Montepuez and Namuno districts, Cabo Delgado, Mozambique, 2013.

Question	Response						
2.1 Is the water point functioning and providing water today?	Yes	90 (62.9%)					
	No	53 (37.1%)					
2.1b If no, how long has is it not been functioning?	Mean (SD) = 586.3 (605.4)						
2.2 How many times has the water point broken since establishment?	Mean (SD) = 1.5 (1.3)						
2.3 If the water point has broken down, how long was it broken?	1st time	Mean (SD) = 61.6 (164.1)					
	2nd time	Mean (SD) = 28.5 (56.3)					
	3rd time	Mean (SD) = 72.4 (207.9)					
	4th time	Mean (SD) = 11.2 (23.1)					
	5th time	Mean (SD) = 3.4 (7.0)					
	6th time	Mean (SD) = 3.5 (6.5)					
	7th time	Mean (SD) = 21.4 (56.7)					
2.4 If the water point has broken for more than 6 months why?	There is no demand	2 (3.9%)					
	Lack of funds	8 (15.7%)					
	Mechanical failure	15 (29.4%)					
	Poor management	12 (23.5%)					
	Conflict	5 (9.8%)					
	Other	9 (17.7%)					
2.5 If the water point has broken down, who repaired the problem?		1st fix	2nd fix	3rd fix	4th fix	5th fix	6th fix	7th fix
	WASHCo mechanic	53 (60.2%)	27 (56.3%)	12 (48.0%)	5 (100%)	3 (100%)	2 (100%)	1 (100%)
	NGO technician	29 (33.0%)	11 (22.9%)	5 (20.0%)				
	Government technician	3 (3.4%)	1 (2.1%)	0 (0%)				
	Local business	1 (1.1%)	1 (2.1%)	1 (4.0%)				
	Other	2 (2.3%)	2 (4.2%)	1 (4.0%)				
2.6 If the water point has broken down, who paid for the repair?		1st fix	2nd fix	3rd fix	4th fix	5th fix	6th fix	7th fix
	WASHCo saved	49 (55.7%)	27 (60.0%)	3 (60.0%)	3 (60.0%)	2 (66.7%)	2 (100%)	1 (100%)
	WASHCo solicited	4 (4.6%)	3 (6.7%)	0	0			
	Government	1 (1.1%)	0	0	0			
	NGO	24 (27.3%)	12 (26.7%)	1 (20.0%)	1 (20.0%)	1 (33.3%)		
	Other	10 (11.4%)	3 (6.7%)	1 (20.0%)	1 (20.0%)	0		
2.7 Has there ever been a big problem or breakdown that was out of the capacity of the community to resolve?	Yes	69 (49.6%)						
	No	70 (50.4%)						
2.8 What is the quality of water that provided for the consumption to the population?	Very Poor	1 (0.7%)						
	Poor	6 (4.3%)						
	Fair	30 (21.3%)						
	Good	26 (18.4%)						
	Very Good	78 (55.3%)						
2.9 Do members of the community use the water point to produce things to sell?	Yes	101 (71.6%)						
	No	40 (28.4%)						
3.1 What is the proportion of	¼ of the households	1 (0.7%)						
	½ of the households	12 (8.4%)						

the community that has sanitation?	¾ of the households	73 (51.1%)
	All of the households	57 (39.9%)
3.2 If the family latrine stops working, what does the family customarily do?	Return to open defecation	12 (8.4%)
	Use a neighbor's latrine	0 (0.0%)
	Construct a new latrine	131 (91.6%)
3.3 What is the proportion of latrines that have accompanying facilities to wash hands with water, soap, or ash?	¼ of the households	14 (9.8%)
	½ of the households	12 (8.4%)
	¾ of the households	17 (11.9%)
	All of the households	100 (69.9%)
3.4 If new people move to the community, what do they do for sanitation?	Construct their own latrine	135 (94.%)
	Use existing latrines	0 (0.0%)
	Don't use latrines	8 (5.6%)
4.1 Does the community collect funds to maintain the water points?	Yes	83 (58.4%)
	No	59 (41.6%)
4.2 How are funds collected?	Pay per use	4 (4.7%)
	Fixed amount for each user	75 (87.2%)
	Other	7 (8.1%)
4.3 If the water point needs a small repair, does the WASHCo have funds to cover this cost?	Yes	64 (46.4%)
	No	74 (53.6%)
4.4 If the water point needs a large repair, does the WASHCo have funds to cover this cost?	Yes	21 (15.2%)
	No	117 (84.8%)
4.5 Do groups of rotating savings and credit exist in the process of water provision?	Yes	4 (2.8%)
	No	137 (97.2%)
4.6 Has some preventative maintenance occurred during the past years?	Yes	77 (54.6%)
	No	64 (45.4%)
5.1 Does the WASHCo exist?	Yes	120 (85.1%)
	No	21 (14.9%)
5.2 Was the WASHCo trained?	Yes	113 (84.3%)
	No	21 (15.7%)
5.3 Does the WASHCo meet with its members?	Regularly	67 (48.2%)
	Sometimes	37 (26.6%)
	Never	35 (25.2%)
5.4 Does a specific person exist that controls who collects water?	Yes	116 (82.3%)
	No	25 (17.7%)
5.5 If it exists does the system function?	Doesn't function	0 (0.0%)
	Functions and the person is paid	6 (5.2%)
	Functions and the person is not paid	110 (94.8%)

5.6 Does a community mechanic exist who takes care of maintenance?	Doesn't exist	25 (17.9%)
	Exists and performs maintenance but not adequately	25 (17.9%)
	Exists and performs maintenance adequately	90 (64.3%)
5.7 What is the role of the women in the process of decision making in the WASHCo?	Doesn't play a role	26 (18.7%)
	Has a limited role	18 (13.0%)
	Important as men	76 (54.7%)
	Makes very important decisions	19 (13.7%)
6.1 Approximately how many families use the water point in the dry season?		Mean (SD) = 74.4 (163.6)
6.2 Approximately how many families use the water point in the rainy season?		Mean (SD) = 39. 1 (87.5%)
6.3 In relation to past years, is the number of families using the water point:	Less	6 (5.6%)
	Approximately the same	6 (5.6%)
	More	96 (88.9%)
7.1 Were the WASHCo elections open and transparent?	No	40 (28.8%)
	Elections were held but not open and transparent	1 (0.7%)
	Yes	98 (70.5%)
7.2 After the first elections of the WASHCo, were more elections held?	Yes	17 (12.0%)
	No	121 (85.2%)
7.3 Does the WASHCo have clear procedures that are known and kept up to date?	No	14 (10.1%)
	Yes, but with some uncertainties	15 (10.8%)
	Yes, known and up to date but not written	43 (30.9%)
	Yes, known and up to date and written	67 (48.2%)
7.4 Does the committee have meetings with the community?	Regularly	55 (39.6%)
	Sometimes	43 (30.9%)
	Never	40 (28.8%)
7.5 Does the WASHCo give a report to users about the financial situation of the water point?	Reegularly	28 (20.1%)
	Sometimes	35 (25.2%)
	Never	76 (54.7%)
7.6 Are written financial records kept up to date?	No	41 (29.5%)
	Some records are kept but are incomplete	13 (9.4%)
	Yes, all records are kept	85 (61.2%)
7.7 Have audits or other financial checks been performed annually?	No	111 (79.9%)
	Yes, but not annually	10 (7.2%)
	Yes, annually	17 (12.2%)
	Don't know	1 (0.7%)

Table A.4: Questions and Response Frequencies for IWWT, administered in Montepuez and Namuno Districts, Cabo Delgado, Mozambique, 2013.

	At least one functioning	None functioning	Mean for at least one functioning	Mean for none functioning	p-value*
Time to fetch water			**3.1**	**2.2**	**0.0001**
It takes longer	0	1			
It is not very different	4	8			
It takes a bit less time	43	4			
It takes half the time it used to take or even less	12	0			
Amount of water generally used			**3.5**	**2.3**	**0.001**
less than before	5	2			
around the same	3	8			
a bit more	6	0			
double or more	45	3			
The water quality:			**3.6**	**2.6**	**0.002**
worse than before	3	0			
not very different	3	8			
a bit better	10	2			
significantly better	43	3			
Community use of latrines is:			**3.8**	**3.1**	**0.02**
less than before	0	1			
not very different	2	3			
a bit more	5	3			
significantly more - many more people are using latrines	52	6			
Community's personal hygiene practices are:			**3.9**	**3.2**	**0.02**
worse than before	0	1			
not very different	0	3			
a bit better	3	2			
significantly better	56	7			
The health of the women in the community:			**3.7**	**3**	**0.03**
worse than before	2	1			
not very different	3	4			
a bit better	3	2			
significantly better	51	6			

Overall th ehealth of the whole community is:			**3.7**	**2.7**	**0.005**
worse than before	1	2			
not very different	3	4			
a bit better	6	3			
significantly better	49	4			
Women's Roles in the WASH committee are:			3.2	3	0.6
taken away because of project	2	0			
not very different	14	5			
occasional more significant role	13	2			
ongoing significant increased role	27	5			
Women's personal safety when going to collect water or to the latrine is:			**3.9**	**2.8**	**0.004**
worse than before	0	1			
not very different	0	5			
a bit more	6	2			
significantly more	53	5			
The time women have for socializing on their way to the water point or waiting at the water point is:			2.9	2.8	0.8
less than before	17	0			
not very different	3	7			
a bit more	5	1			
significantly more	34	5			
TOTAL DIRECT IMPACTS			**35.4**	**27.5**	**0.001**
Production of vegetables, livestock, food, and drinks for sale is:			**3.6**	**2.9**	**0.03**
less than before	1	0			
around the same	10	5			
a bit more	3	4			
significantly more	45	4			
Women's control over household resources is:			**3.8**	**3.2**	**0.04**
less than before	1	1			
around the same	0	2			
a bit more	8	4			
significantly more	49	6			

Women's opportunities for education and training are:			3.1	2.6	0.1
fewer than before	6	1			
not very different	11	7			
a bit better	12	1			
significantly improved	30	4			
Women's roles within the community for paid employment are:			2.1	2	0.2
had previously paid jobs been taken away because of the project	0	0			
not very different roles	51	13			
occasional paid roles	6	0			
regular paid jobs	1	0			
The dignity and respect of women are:			3.3	3	0.3
reduced now - more ashamed	9	1			
not very different	3	4			
some sense of improved dignity	7	2			
increased	40	6			
The amount of women's social groups in the community is:			**2.8**	**2.1**	**0.03**
fewer than before	12	2			
not very different	8	8			
a few more groups	18	3			
more groups of importance	21	0			
Household relationships are:			**3.4**	**2.3**	**0.008**
now more conflictual	8	4			
not very different	1	4			
with minor improvements	10	2			
with significant improvements	40	3			
The quality in the household between men and women is:			3.5	3.1	0.2
more unequal than before	3	1			
not very different	5	3			
a bit more equal	9	3			
significantly more equal	42	6			
Women's time for leisure is:			**3.9**	**2.9**	**0.006**
less than before	0	1			
not very different	0	4			

a bit more	6	3			
significantly more	52	5			
The ability of women to make decisions and voice opinions is:			**3.7**	**3**	**0.008**
worse than before	1	0			
not very different	2	4			
somewhat greater	9	5			
significantly greater	47	4			
INDIRECT IMPACT SCORE			**33.1**	**27.1**	**0.001**
How has the intervention affected the day to day life of women?			**3.9**	**2.8**	**0.01**
worse than before	1	2			
not very different	1	3			
a bit better	1	2			
significantly better	56	5			
Financially how has the intervention affected the women of the community?			**3.7**	**3.1**	**0.06**
worse off compared to before	0	1			
not very different	5	2			
a bit better	7	4			
significantly better off	47	5			
In terms of empowerment/disempowerment: what has been the overall effect of the intervention?			**3.8**	**2.8**	**0.02**
feel less empowered compared to before	2	2			
feel not very different	1	3			
feel a bit better	6	2			
feel significantly more empowered	50	5			
OVERALL IMPACT SCORE:			**11.4**	**8.1**	**0.01**
TOTAL IMPACT SCORE:			**79.9**	**62.7**	**0.0008**

* Difference in means calculated using a two-sample t-test, and all p-values calculated using pooled method. Significant differences at the 95% significance level in means in bold.

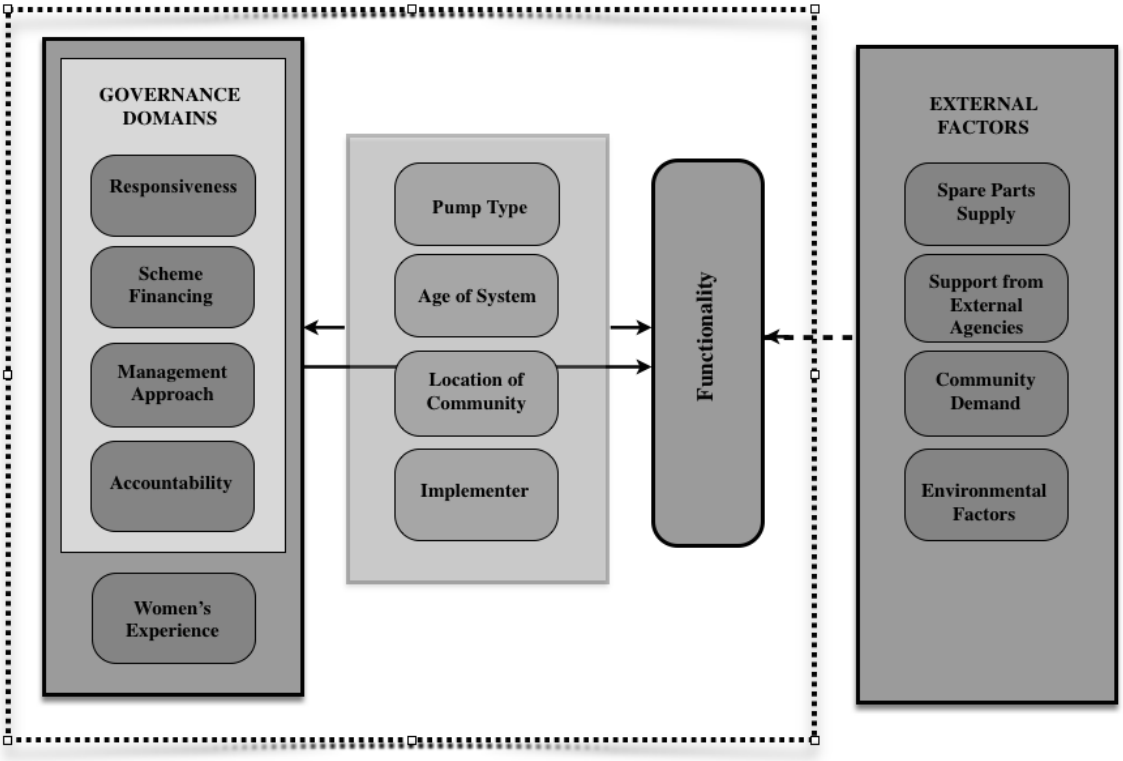

Figure A.1: Study Conceptual Framework

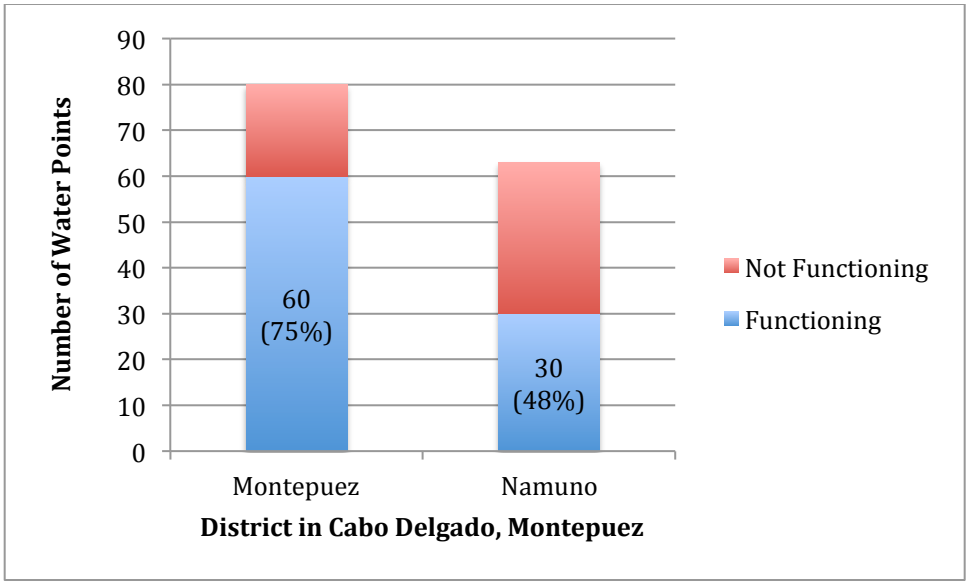

Figure A.2: Current Water Point Functionality Stratified by district in Montepuez and Namuno Districts, Cabo Delgado, Mozambique, 2013 (n=143)

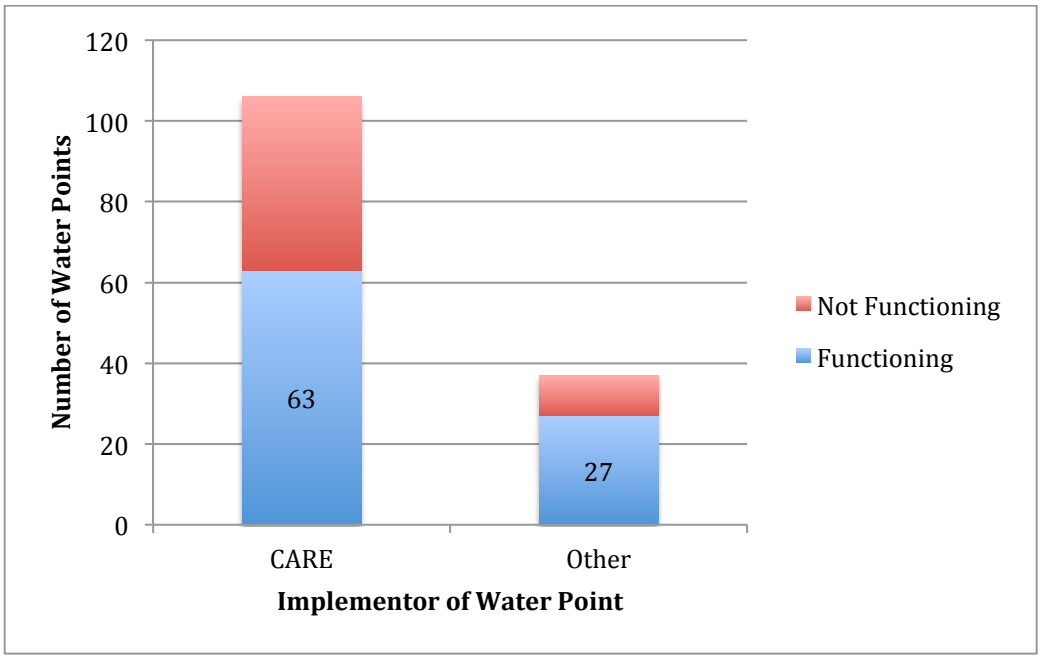

Figure A.3: Current Water Point Functionality Stratified by implementing agency in Montepuez and Namuno Districts, Cabo Delgado, Mozambique, 2013 (n=143)

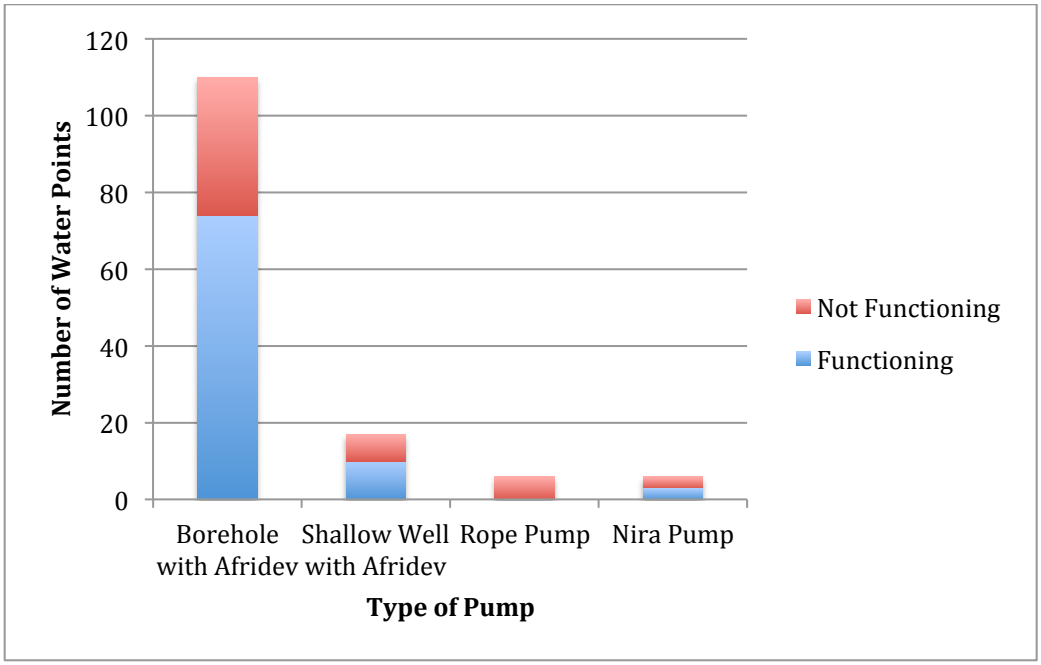

Figure A.4: Current Water Point Functionality Stratified by type of hand pump in Montepuez and Namuno Districts, Cabo Delgado, Mozambique, 2013 (n=143)

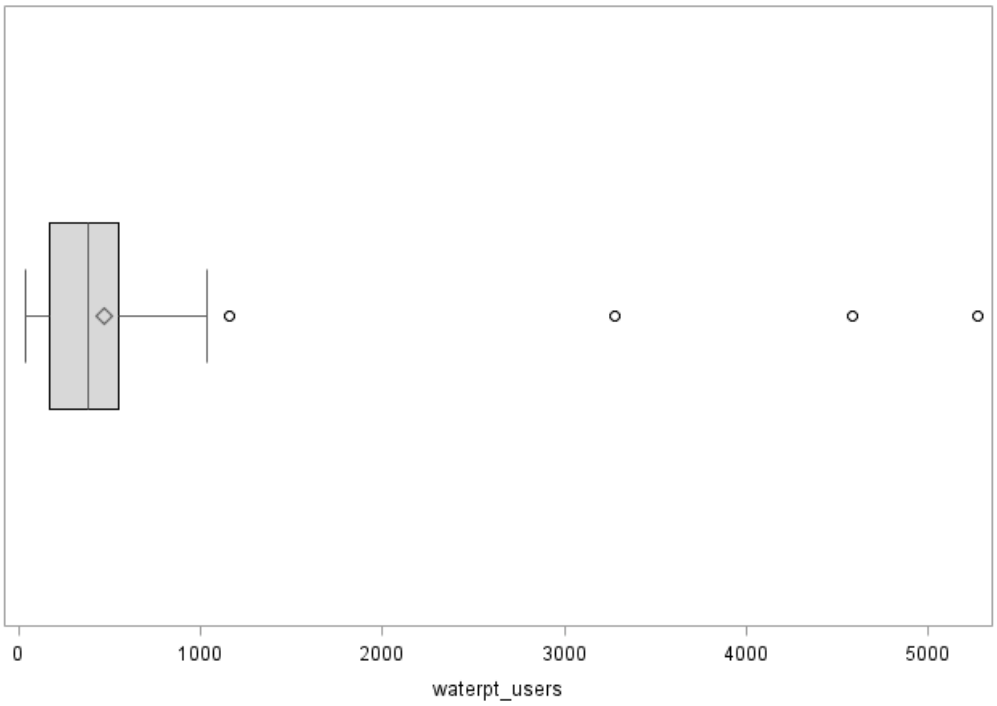

Figure A.5: Distribution of Number of Users per Water Point in Montepuez and Namuno Districts, Mozambique, 2013.

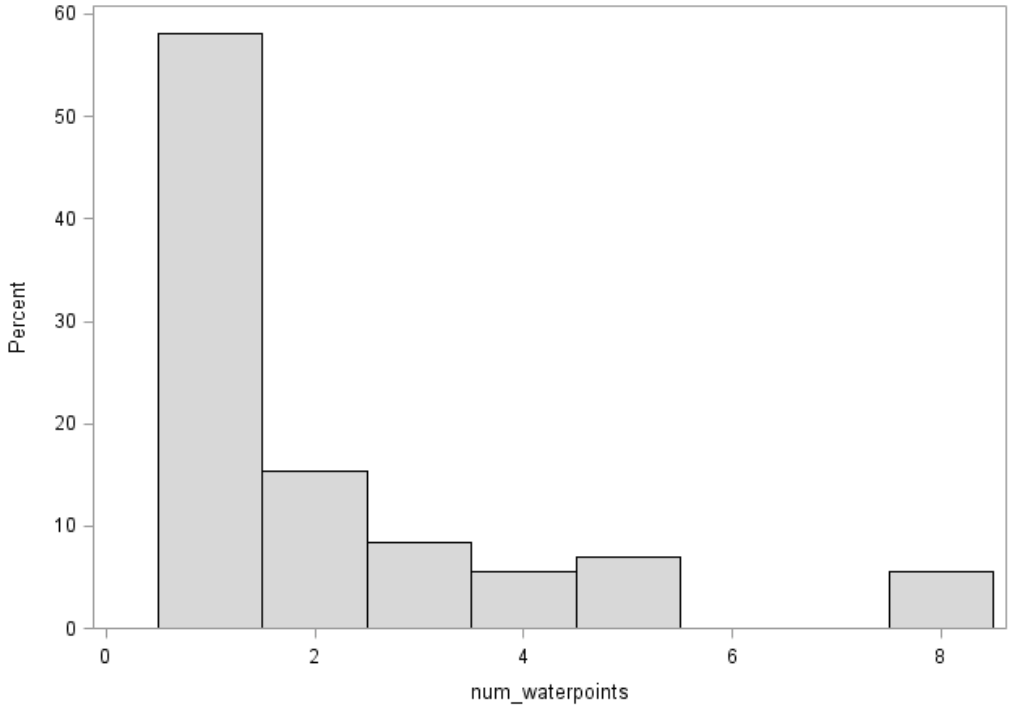

Figure A.6: Distribution of Number of Water Points per Community in Montepuez and Namuno Districts, Cabo Delgado, Mozambique, 2013.

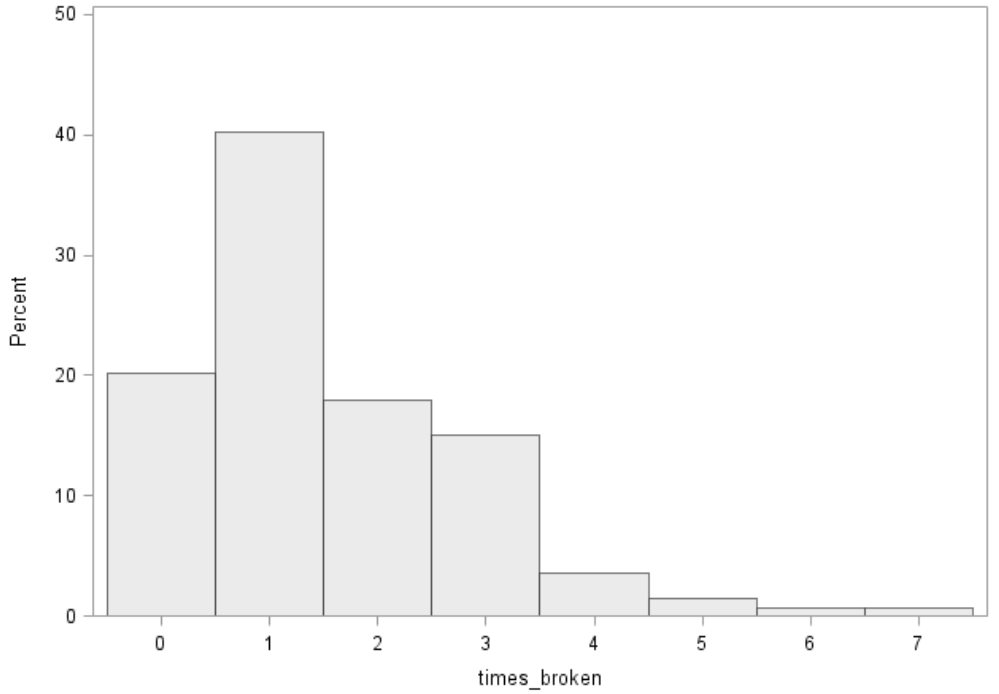

Figure A.7: Distribution of Number of Times Broken per Water Point in Namuno and Montpuez Districts, Cabo Delgado, Mozambique, 2013.

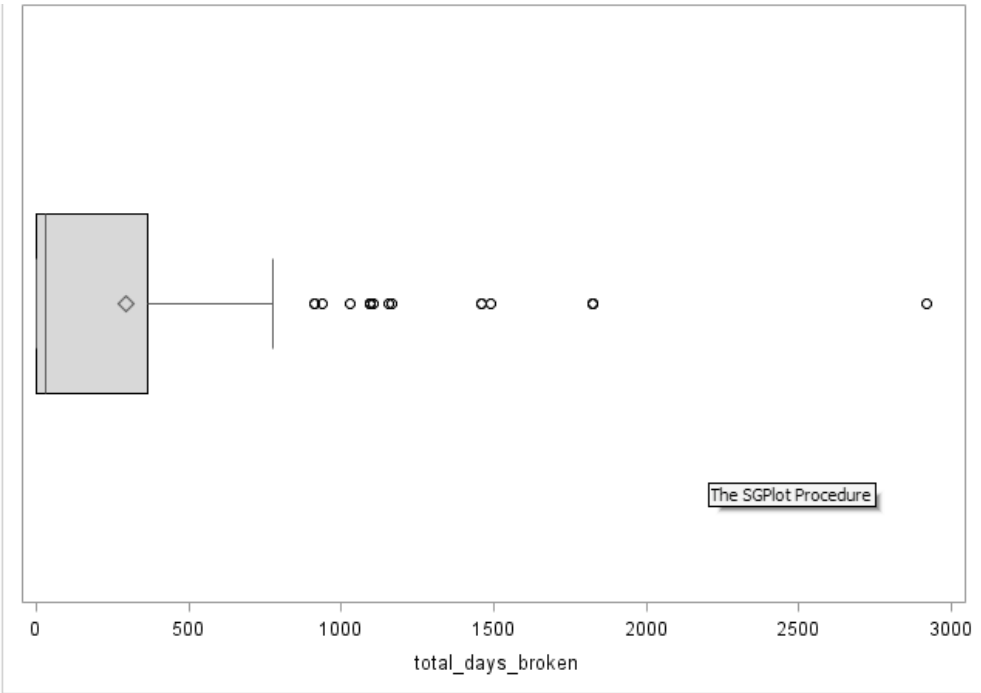

Figure A.8: Distribution of Number of Total Days Broken per Water Point in Namuno and Montpuez Districts, Cabo Delgado, Mozambique, 2013.

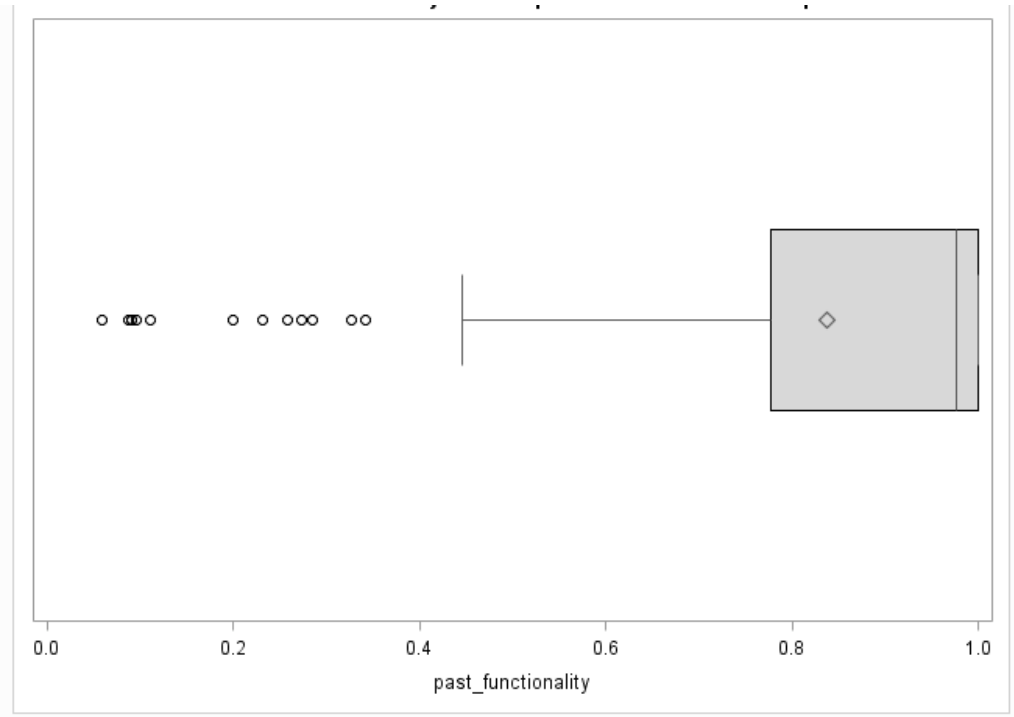

Figure A.9: Distribution of Past Functionality (the proportion of time functioning since implementation) for all water points in Namuno and Montpuez Districts, Cabo Delgado, Mozambique, 2013.

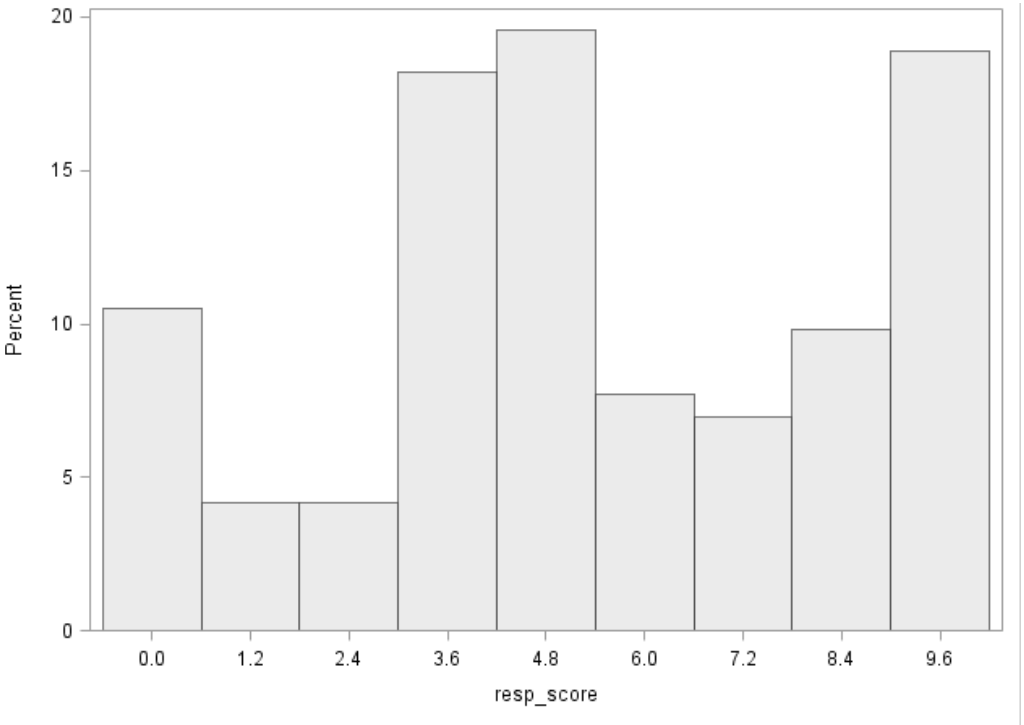

Figure A.10: Distribution of Responsiveness Score for all WASHCos in Namuno and Montpuez Districts, Cabo Delgado, Mozambique, 2013.

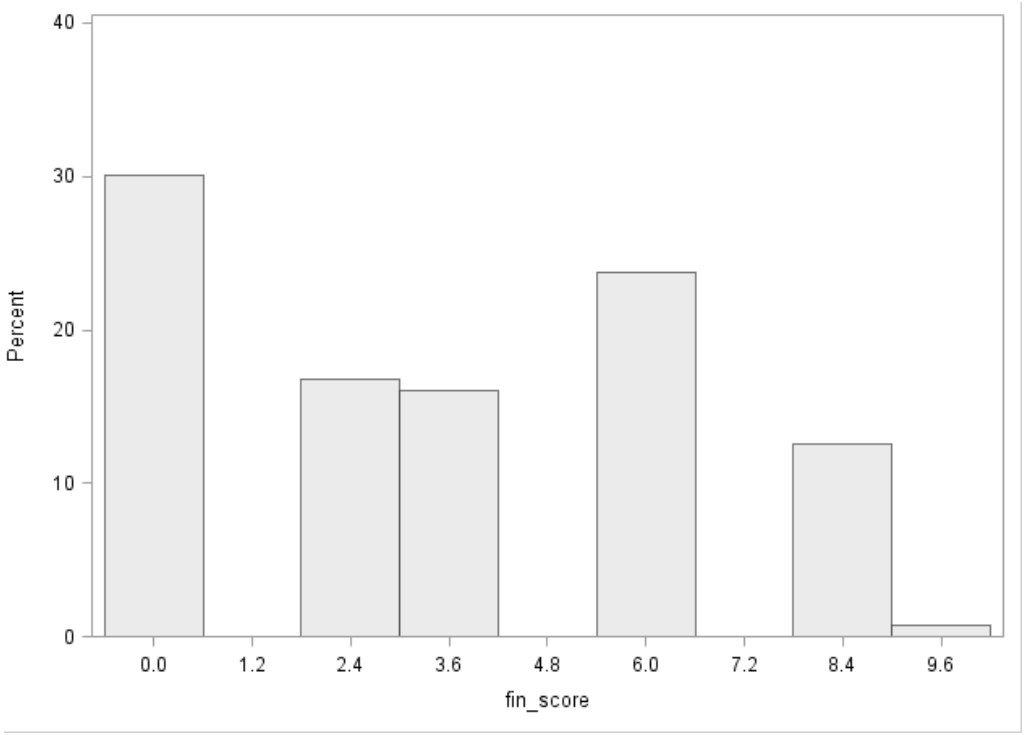

Figure A.11: Distribution of Finance Score for all WASHCos in Namuno and Montpuez Districts, Cabo Delgado, Mozambique, 2013.

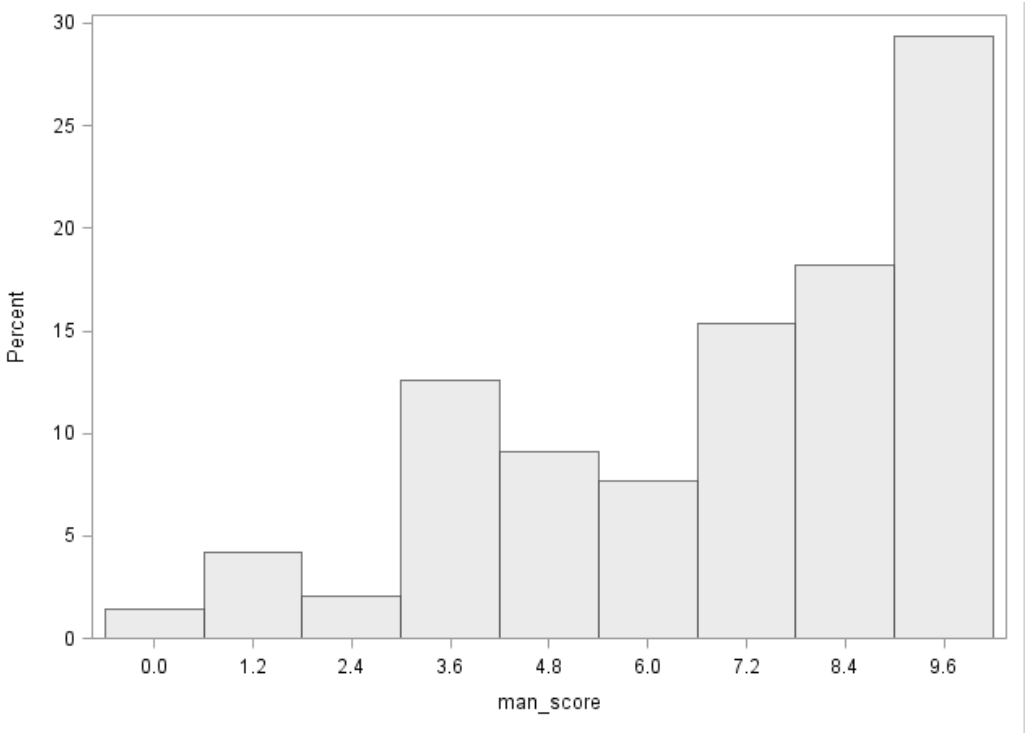

Figure A.12: Distribution of Management Score for all WASHCos in Namuno and Montpuez Districts, Cabo Delgado, Mozambique, 2013.

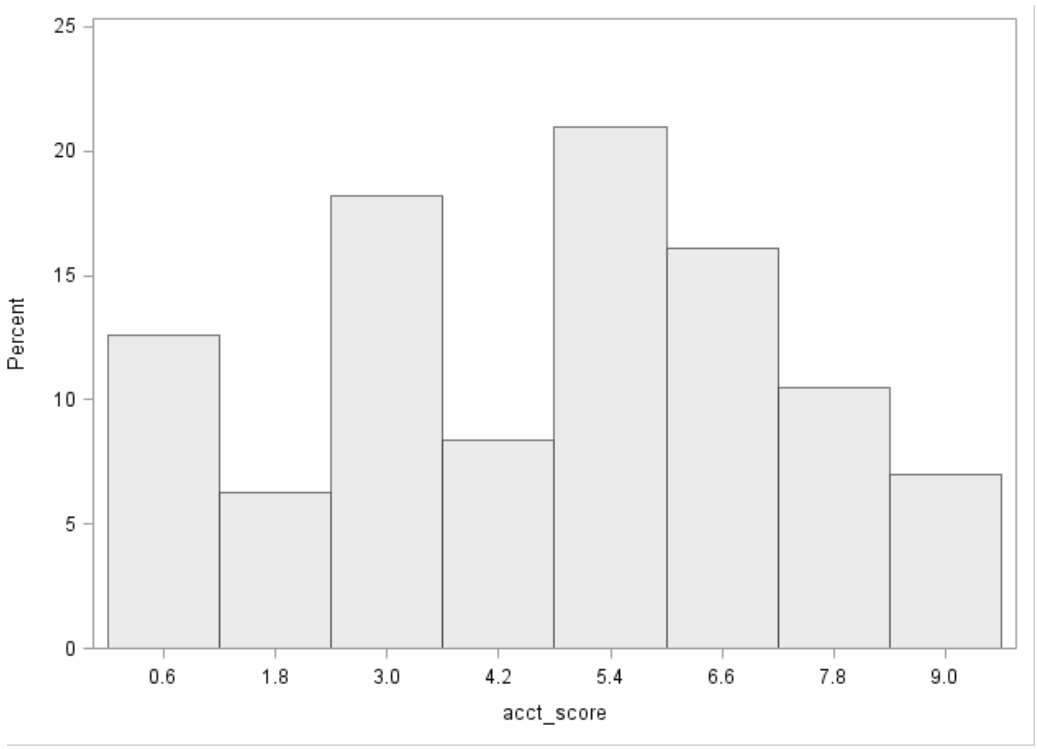

Figure A.13: Distribution of Accountability Score for all WASHCos in Namuno and Montpuez Districts, Cabo Delgado, Mozambique, 2013.

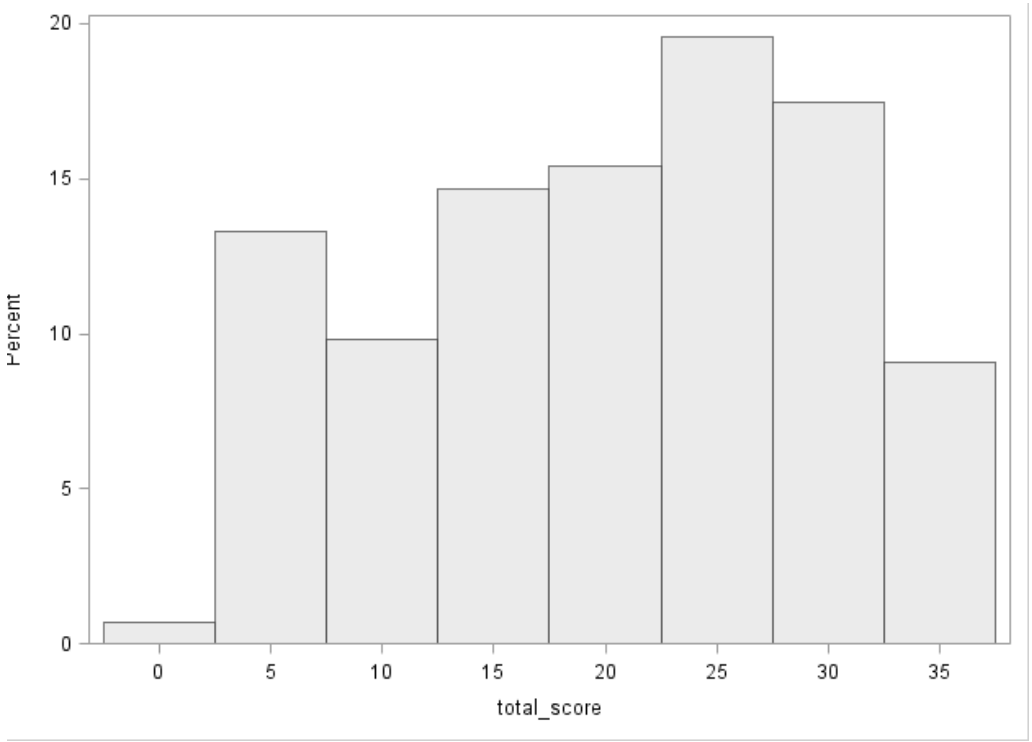

Figure A.14: Distribution of Total Governance Score for all WASHCos in Namuno and Montpuez Districts, Cabo Delgado, Mozambique, 2013.

Appendix 3: Acronyms

GiFT: Governance into Functionality Tool

IWWT: Impact of WASH on Women Tool

JMP: Joint Monitoring Programme

MDG: Millennium Development Goal

O&M: Operation and Maintenance

VLOM: village level operation and management of maintenance

WASH: water, sanitation, and hygiene

WASHCo: water, sanitation, and hygiene committee