Assessing the Sustainability of Rural Water Supply Programs:

A Case Study of Pawaga, Tanzania

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INTRODUCTION

With its slogan “Water and Sanitation for All”, the International Drinking Supply and Sanitation Decade (1981-1990) brought to the international stage the estimated 1.8 billion people – around 40% of the world’s total population – that lacked a safe drinking water supply. Access was most limited to those living in rural communities, Africa being the worst where only 22% of rural people had access to a safe supply (Black 1985). While the Decade, and other similar efforts over the past 30 years, succeeded at shedding light on this ongoing global problem, it did little in the way of achieving any significant quantifiable goals. Today, over 1 billion people still lack access to a clean, safe, and reliable drinking water supply (RWSN 2010). Consequently, nearly 1.5 million people (mostly children) die each year from waterborne illness (water.org 2011).

With the help of foreign donors, many attempts have been made to provide safe drinking water supplies to communities throughout the developing world. Unfortunately, many of these have failed. For example, it has been estimated that the handpump, which provides nearly half of the protected water supplies for Africa’s rural population, has an estimated functionality rate of approximately 66% (RSWN 2010). A closer look at the issue revealed that communities where such systems had been installed lacked a sense of ownership for the infrastructure and its service. As a result, when they broke down the community did not see the problem as being theirs. Even if they had, the community lacked the knowledge, resources, and capacity to repair the system (Black 1985). The key issues that emerged from the failure of these centralized systems have dominated the water and sanitation sector for the past three decades.

To address this crisis, the United Nations launched another global initiative to tackle the ongoing failures of water supply projects in developing countries. In 2000, the UN established the Millennium Development Goals (MDGs) to reduce poverty, improve health, and promote sustainability. Target 10 of Goal 7 – ensuring environmental sustainability - sets a target to halve the proportion of people in the world who lack access to safe drinking water by 2015 (UNDP 2011). Though great strides have been made since the MDGs were adopted in 2000, much of Africa, especially the Sub-Saharan region, is not on track to meet the MDG drinking water target (UN 2006).

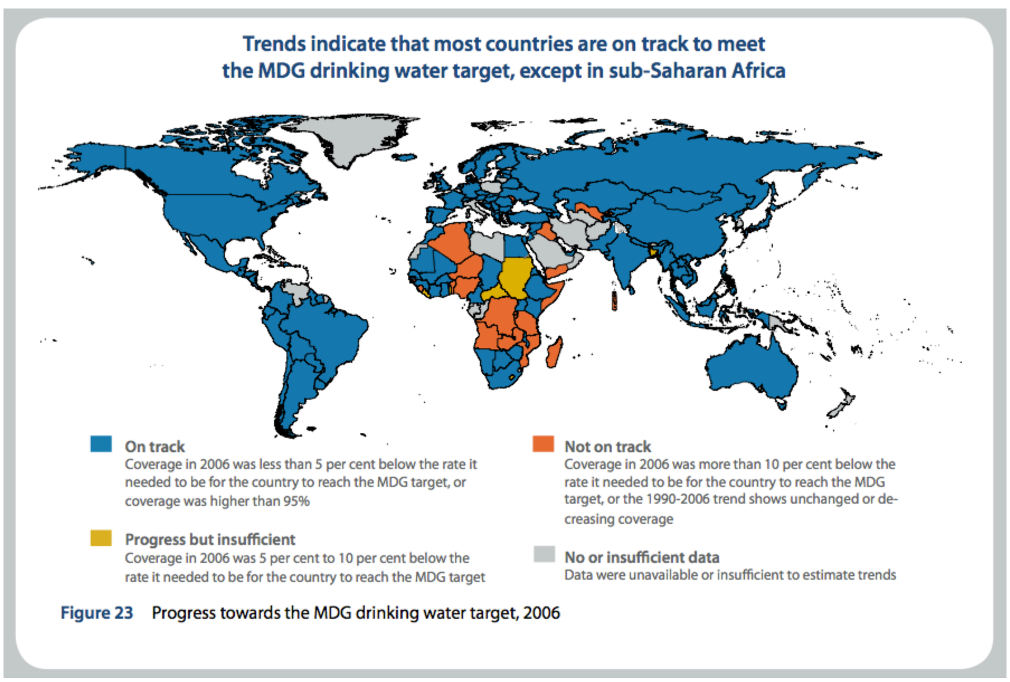

Figure 1. Progress toward MDG drinking water target (UN 2006)

The goal of this paper is to identify, through the literature and *in situ* research, which aspects of these projects are failing and which are most vital in ensuring a robust water supply program is implemented. This paper outlines a comprehensive framework for assessing the sustainability of rural water supply programs, incorporating the successes and failures of previous attempts. To view this framework through the lens of an existing rural water supply program, we apply it to the Pawaga Sustainable Development Programme in Tanzania as specified by our Masters Project client, Tearfund UK. Tearfund is an agency that funds relief and development projects worldwide, including that in Pawaga, and is interested in pursuing and supporting sustainable programs.

While the paper is primarily focused on Africa, the goal of this project remains two-fold: (1) to develop a framework for assessing the sustainability of rural water programs that will help educate and inform rural water supply stakeholders, globally, about the importance of sustainability and means to achieving it; (2) to provide our partner, Tearfund UK – one of the donors of the case study - with an in-depth analysis of the robustness and sustainability of Pawaga Program.

Sustainability

The concept of "sustainable development" exploded in the literature after the World Commission on Environment and Development 's landmark report, *'Our Common Future'* was published by in 1987 (Black 1985). 'Sustainability' was soon adopted by those providing water and sanitation services to mean service and "management should be cost-effective, taking into account constraints on the resource itself, and on the availability of financial resources" (Black 1985). Sustainability is now a common term in the rural water supply sector. However, sustainability rhetoric is often just that, as governments, non-governmental organizations (NGOs), and external agencies lack a tangible plan for actually achieving the concept. In an effort to concretize the goal, Harvey and Reed (2003) have offered this definition for a sustainable rural water supply, which will be referred to throughout this paper:

> *The water sources are not over-exploited but naturally replenished, facilities are maintained in a condition which ensures a reliable and adequate water supply, the benefits of the supply continue to be realized by all users over a prolonged period of time, and the service delivery process demonstrates a cost-effective use of resources that can be replicated.*

Case Selection

For the purpose of this analysis, we have focused on the region of Pawaga, Tanzania, which is situated in the Iringa Rural District. The research site was selected for its connection to the client organization, Tearfund UK, and for its exemplification of the water supply and sanitation problems facing much of sub-Saharan Africa.

As seen in Figure 1, this Sub-Saharan country is not currently on track to meet the MDG drinking water target. As of 2006, drinking water coverage was 50-60% in Tanzania (UN 2006) with only 45% of rural residents and 54% of the entire country having received improved water sources (WB 2008). As a result, residents of rural Tanzania suffer from many of the typical waterborne diseases, such as diarrhea, cholera, and typhoid fever. The government reports diarrhea and intestinal worms as two of the top five diseases affecting residents of

Figure 2. Map highlighting Iringa Rural District

the area. In 2005, over 20,000 individuals living in the Iringa Rural District (where Pawaga is located) were suffering from one of these two diseases (TZ 2010).

Methodology

In the course of building our framework, we traveled to Iringa, Tanzania to study a rural water supply program being implemented in 8 villages of the Pawaga Rural District. Our assessment of the program was conducted during the summer of 2010, when construction of the infrastructure was still underway. The primary component of our research was traveling to the site and conducting interviews with three important stakeholders: program leaders, engineers, and community members in the program region. We worked closely alongside the women of the Diocese of Ruaha (based in Iringa Town, TZ), who shared with us a narrative history of the region, the community's need, and the program up to that point. We conducted open-ended interviews with the two primary leaders and accompanied them on several trips to the Pawaga region to participate in community-training sessions and other routine business.

Our time in the field coincided with visits from both the Director and the Project Engineer of Christian Engineers in Development (CED), the technical partner for the program. Our interaction with both the program leaders and the engineers were invaluable, but there was still much to be learned from the community members themselves. To get their perspective, we interviewed 46 families (usually the female of the household) in 3 of the 8 villages. Survey questions are included in Appendix A. After conducting all interviews, notes and audio recordings were analyzed to identify common themes and any divergent points of view. Elicited information, attitudes, and perspectives of all three parties are woven into the sustainability framework below.

BACKGROUND

In the years following the colonial era, many African governments rapidly installed rural water supply systems, most of which failed, in large part due to the issues formally discussed. As was tradition at the time, governments continued to implement projects using top down bureaucratic behavior and practicing upward accountability (AfDB 2010). This essentially left citizens without responsibility for their own wellbeing, and the wellbeing of their nearby drinking water schemes. As Whittington (2009) said of developing countries:

> *Systems were not being repaired and were falling into disuse. Cost recovery was minimal and revenues were often insufficient to pay for even operation and maintenance, much less capital costs. Communities did not have a sense of ownership in their water projects and households were not satisfied with the projects that donors and national governments installed (p 697).*

In the wake of this water supply structure and its many failures, the 1980s were a time of major emphasis, both within development agencies and national governments, on increasing in local participation throughout the sector (AfDB 2008). In spite of this improvement, common sector strategy has focused on fast production of new systems, sidestepping issues of prolonged participation and community empowerment (Morita-Lou et al. 2008). Given that much of Africa is not on track to meeting the MDGs drinking water target, there remains an ongoing need to implement community-based water supply programs in rural regions.

The Pawaga Region

The Pawaga region is located in the Southern Highlands of central Tanzania, within the Iringa Rural District. It is home to approximately 23,000 people, many of whom lack consistent access to safe water, and is situated about 800 km above sea level, where rainfall is low and semi-arid conditions dominate the climate. In the 1950's and 1960's, the national government put in a water supply system with help of local authorities. After independence in 1961, this system continued to work under the governmental structure for a few years. During this time, the Native Authority was an important part of indirect government rule, responsible for maintaining water supply in rural and tribal areas. Tribal Chiefs were leaders of various communities and government administration was done through district tribal councils. As a move toward local governance, district committees worked through tribal chiefs; later, this organization formed the Central Executive Council. Once the Central Executive Committee was formed, the Native Authority was deemed no longer appropriate for local governance, and its responsibilities abandoned (Holloway 2010). As similar changes occurred in many other regions around Africa at this time, thousands of people were again unable to access safe water.

Responding to these needs, the Diocese of Ruaha, which was established in 1990 under the leadership of Rev. Donald Mtetemela to support local community development (Tearfund 2009), decided to undertake a water supply and sanitation program in Pawaga District. In 2008, the Diocese of Ruaha partnered with Christian Engineers in Development (CED), a UK-based charitable organization that provides engineering expertise for water supply projects, on the Pawaga Sustainable Development Program. The goal of the project was to alleviate poverty and enhance quality of life and health through the construction of a water supply scheme. Phase I of the project, which is the focus of this case study, was designed to provide a water supply to 8 villages and approximately 16,000 people - Luganga (population 1,436), Magozi (population 415), Ilolompya (population 467), Mkombilenga (population 1,525), Mbuyuni (population 3,033), Kimande (population 2,051), Itunundu (population 3,327), and Mboliboli (population 3,819). The following schematic shows the water distribution plan throughout these villages.

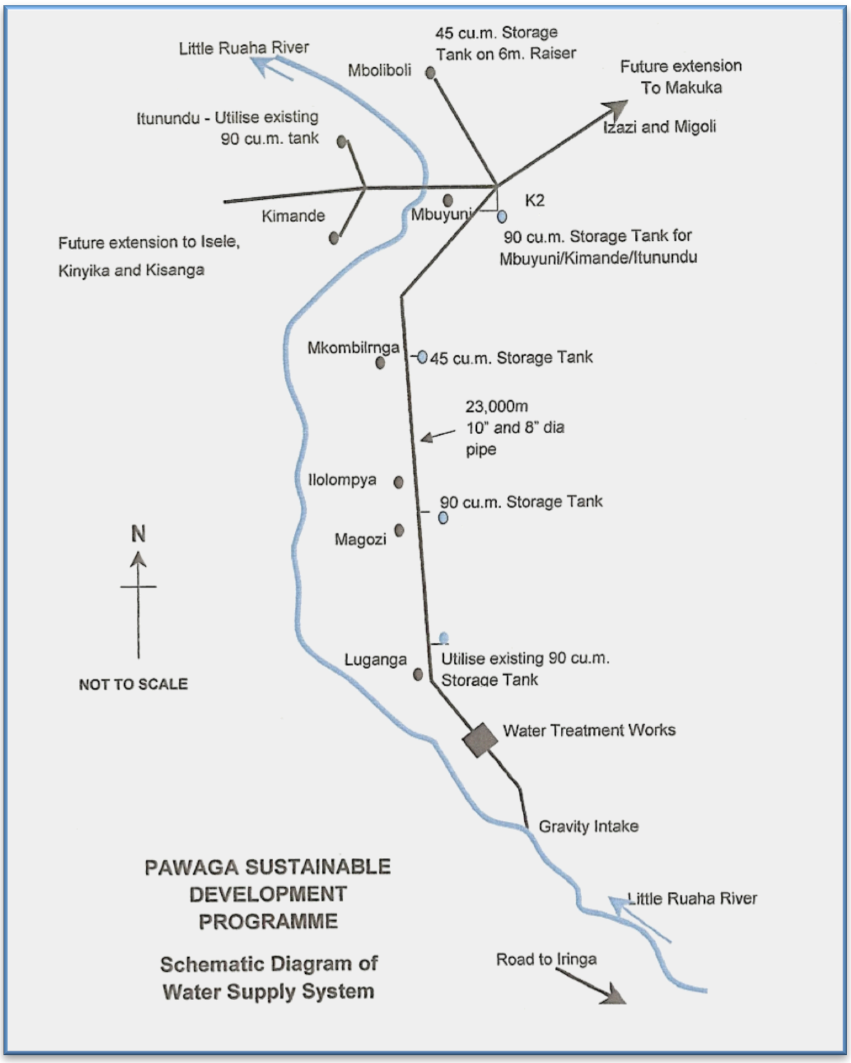

Figure 3. Schematic of Pawaga Sustainable Development Programme

FRAMEWORK

There has been much theoretical work done on assessing the sustainability of rural water supply programs and community-based resource management projects, and several opinions on the best approach have been offered. In this paper we draw upon the existing literature to create a more comprehensive framework for assessing program sustainability. Table 1 identifies the five key areas of rural water supply programs most commonly mentioned in both literature reviews and during our on-the-ground interviews and surveys.

Table 1. Summary of Sustainability Framework

Sector	Program and Community Qualities
Operation and Maintenance	*Type and Appropriateness of the System* *Water Treatment* *Availability of Spare Parts* *Technical Know-how*
Monitoring and Evaluation	*Management Assessment* *Infrastructure Assessment* *Health and Wellness Monitoring*
Financial and Economic Considerations	*Cost Recovery* *Ensuring Equitability* *Fair Tariffs* *Fiscal Responsibility*
Community and Civil Society	*Program Demand* *Social Capital* *Capacity Building*
Institutional Capacity	*Governance* *Female Participation* *Informal and Formal Sanctions* *Complaint and Recourse* *Assurance of Service Standards*

For the purpose of this paper, each key area is discussed in terms of its role in strengthening the sustainability of rural water supply programs. This is followed with an evaluation of the Pawaga Program's performance.

Operation and Maintenance

Type and Appropriateness of the System

Though greater emphasis has recently been placed on institutional capacity and human capital (discussed below), the type and appropriateness of the physical system remains a critical consideration in the development of a sustainable rural water supply. The technology options, which are low-cost, easy to understand, and easy to maintain and repair, are likely to be more sustainable than those that require expertise and special equipment (Harvey & Reed 2006). Water attainment in Africa has largely relied on external support. As a result, decisions regarding the type of water supply system implemented have fundamentally been donor-driven. The tendency amongst donors has been to focus their efforts solely on the static infrastructure, placing priority on engineering techniques, in large part because MDGs promote this strategy. Donor demand for low-cost technology has contributed to technical problems, as suppliers have no incentive to improve the quality and durability of parts when the purchaser is primarily concerned with pricing. The sustainability of their completed water supply systems is further undermined when the donors leave the operation, maintenance, and management to regional personnel who lack the budget and capabilities necessary to maintain the water scheme.

A water supply is only useful if it is available all the time. Common low-cost rural water technologies in African countries can be grouped under the following three water service ‘providers’: piped networks, point sources, and mobile distributers. Given the high cost of transport, the sparsely populated nature of rural communities, and the tendency for corruption and high prices amongst distributors, reliance on tankers to deliver water to consumers is not a sustainable solution.

Depending on the region, the nearby water source may primarily be surface water, or where aquifers exist, groundwater may be extracted to serve the surrounding population. As a result of the International Drinking Water and Sanitation Decade, handpumps became largely recognized as an appropriate technology for rural water supply in Africa given its low-cost; ease of operation and maintenance; and because of the availability of shallow groundwater resources (Harvey & Reed 2003). Yet in Sub-Saharan Africa, it has been estimated that between 20%-70% of handpumps are not functional (RWSN 2010). The appropriateness of handpump technology should not be discredited, but these statistics do reveal that concerns with sustainability, such as the availability of spare parts and technical know-how, should be evaluated.

Unlike many of its African counterparts, Pawaga does not have a readily accessible supply of groundwater. The groundwater in the Pawaga District is found in fissures of granite located at depths of approximately 100m. To extract this supply would require diesel-driven engines, which are more complex to operate, often need frequent maintenance, and have high running costs. Previous attempts by the government to implement this scheme failed, due to the limitations formerly mentioned. With the understanding that a water supply is only useful if it’s constantly available, project engineers, Christian Engineers in Development (CED), sought to utilize a more reliable source of water. The only permanent source of water is the Little Ruaha River, located no further than 5km from any of the 8 villages. Given the topography of the Ruaha Region, CED, in collaboration with government technicians, strategically decided to construct a gravity-fed, piped water supply system. The systems' low running costs, simplicity of operation, and the permanent nature of the Little Ruaha River validated that the choice was a sustainable one.

The Little Ruaha River has a very large catchment, extending to some 2,500 square kilometers. The Little Ruaha River serves as the intake site; the system was designed to draw water directly from the river, through an off-take weir located a short distance downstream. While the region utilizes a great deal of water from the River for irrigation, the supply for this project will be drawn before its diverted into irrigation canals, minimizing the threat to ongoing water supply in the villages. The design capacity of the delivery main is sized to cater for the eventual 2026 population, as well as for the 6 villages of the project's second phase. However, work on the project has been limited to meeting the needs of the current population. The idea behind this has been to allow for a period of training for operational staff to ensure they are equipped to operate the entire treatment works. Once training has concluded and confidence in the sustainability of the system has been built, expansion will commence. The Pawaga project follows the targets established under the NAWAPO therefore a water point will serve no more than 250 people, at a distance of not more than 400m from any household, at a rate of 25 liters per person per day.

Water Treatment

Delivery of the water supply is only one aspect of sustainable systems. Aside from improved access, water supply services are intended to provide safe, clean water. To produce safe drinking water, there must be a treatment process aimed at removing soil, bacteria, and viruses (Thompson 2010). In the developed world, treatment is traditionally a three-step process. First, inorganic chemical coagulants, most commonly aluminum sulfate (alum), are added. Settling typically follows this step with sand filters often used to remove remaining material. Lastly, a form of chlorine is added which provides disinfection and ongoing protection during delivery and storage (Thompson 2010). Though effective at providing safe drinking water to billions, this centralized treatment process is capital and labor intensive and is therefore not economically feasible in many areas of developing countries. Along with high costs, rural communities are generally sparsely populated, making decentralized drinking water treatment systems the most practical option. While the concept of decentralized treatment is similar to the centralized treatment used in industrialized nations, the costs are generally lower and operation and maintenance is less intensive. Table 2 presents the advantages and disadvantages of common decentralized treatment techniques in the developing world.

Table 2. Advantages and disadvantages of common water treatment options

	Technology	Advantages	Disadvantages
Point-of-Use (POU) Treatment	Ceramic Filters (CFs) – specially manufactured clay pots	- Effective at removing particulates and protozoa - Cost between $8-$10 - Widely acceptance among users	- Less effective at removal of pathogens and viruses - Susceptible to breaking and clogging - Difficult to afford/find replacements - Does not produce any cost savings
Point-of-Use (POU) Treatment	Biosand Filters, or Slow Sand Filtration– water percolates through sand	- Effective at removing particulates and protozoa - Widely accepted and durable - Capital costs and O&M costs	- Less effective at removal of pathogens and viruses - Sand must be properly cleaned and replaced
Point-of-Use (POU) Treatment	Solar (SODIS)	- Considered second most cost-effective approach (WHO 2008)	- Process of rotating and cooling bottles is labor intensive; may result in low rates of adoption - Less effective for virus removal
Centralized Disinfection	Chlorine	- Considered most cost-effective approach (WHO 2008) - Provides disinfection during storage and distribution	- Concentrations must be between 0.2 – 0.5 mg/L to be effective
Centralized Disinfection	Ultraviolet Light (UV)	- Effective at eliminating pathogens and viruses	- Does not provide a residual form of disinfection during storage or distribution

In Pawaga, before water is delivered to the villages (the route covers a distance of 1,968m) it goes through a series of treatment works. The Little Ruaha River is heavily contaminated, making water treatment a vital component of the supply system. Much of the river passes through populated areas, giving rise to high levels of excrement pollution and, at times, a heavy silt load. The gravity-fed system takes water through the following processes: a coagulant dosing race, settlement tanks, slow sand filters, and chlorine dosing. Water is first treated in the settlement tanks where it is mixed with alum and phosphate sulfate and spends approximately 2 hours meandering through the chambers, allowing any sediment to settle at the bottom. Treated water is skimmed from the top and moves to the next phase – a slow sand filter. The final stage of treatment is chlorine dosing, which occurs in two 45 cubic meter water storage tanks constructed just below the settlement tanks. To ensure that households are using safe, clean water, the community is encouraged to continue treating their supply using solar disinfection as they have been instructed to do during community health and sanitation training.

Once the water has passed through the various treatment works, it is delivered to 8 storage tanks that have been constructed along the route, 2 of which were part of the previous scheme and have been refurbished and incorporated into the new system. These circular concrete structures are designed with reinforced concrete floor slabs and a roof. This design is common in Tanzania and has proven successful in other water supply projects, some of which were implemented by the Diocese and Tearfund UK. Water stored in these tanks is distributed to the 100 standpipes throughout the 8 villages.

It is important to note that there is no single solution to improving coverage in Africa; however, the WHO call for the chief aim of any water supply system to be to "protect and improve public health through the sustainable provision of drinking water of adequate quality in sufficient quantities to all the population continuously at a price which is affordable (AfDB 2008). Governments, NGOs, and external agencies should invest the time to properly evaluate the needs and characteristics (such as population and service density, and community wealth) of the project community and select the most suitable technology. These evaluations should also consider the availability of spare parts and technical know-how.

Availability of Spare Parts

High operational failure rates, particularly handpumps in Sub-Saharan Africa, have been widely recognized in the literature (Black 1985, Harvey & Reed 2006, Morita-Lou et al. 2008, AfDB 2008, Harvey & Reed 2003). The availability of spare parts has been a major threat to the sustainability of rural water supply projects. According the Harvey and Reid (2006) there are a number of key reasons for this, which are specific to the rural African context. These include: the separation of the supply of pumps from the supply of associated spares; low pump density resulting in low profits; poverty and immobility among end-users; inflexible approaches to technology choice; and restrictive policies and maintenance systems.

The separation of supply of pumps from the supply of associated spare parts can be attributed to the tendency to purchase imported technologies. Implementing agencies, concerned with cost, commonly purchase technologies in bulk from overseas manufacturers with the lowest prices. Since spare parts provide negligible profits (Harvey & Reed 2006), most manufacturers do not supply spare parts. This has led to a small, isolated spare parts supply chain where high prices and inaccessibility are prohibitive. It is not commercially viable to deliver a minimal number of spare parts to small, rural communities; therefore, a push is being made to create spare parts supply chains at a more local level.

Harvey and Reid (2006) suggest that an effective and sustainable spare parts supply has to be: (i) available – required components are in stock or rapidly delivered; (ii) accessible – awareness of where to find spares outlets and their proximity to the community; (iii) affordable – priced within the means of the community; and (iv) appropriate – of correct specification and good quality. The best choice is to simply choose technologies that are not imported or require specialized components. Ensuring sustainability also requires selecting options that can be managed at a community level, without high levels of technical expertise and training.

In Pawaga, we found that prior to the commencement of the project there was uncertainty about commodity price trends. Concerned that the price of materials may increase, the Diocese of Ruaha decided to purchase the full quantity of PVC pipe, approximately 21km, upfront. Bids from valid tenders, both nationally and internationally, were accepted. In 2009, the Diocese awarded a contract to DPI Simba Ltd. in Dar es Salaam, which is approximately 600km from the Pawaga District. While the impacts of commodity price increases were initially bypassed, throughout the duration of construction, the budget has been seriously affected by increases in the cost of cement, piping, transport, and labor.

The design features chosen for this project were based on an understanding of the technical expertise of the community. Several steps where taken to ensure the sustainability of the project including: (1) trained local community members to be technicians, though they worked as laborers alongside the government technicians until they were comfortable assuming full responsibility; (2) stationed two full-time, permanent operators to manage the treatment tanks at all times; and (3) constructed the water treatment works in Pawaga similar to the one used in Iringa Town; therefore, the Water Department personnel, familiar with the system, will be able to offer assistance to the Pawaga WUA, should they need it. An added benefit of this latter aspect of the project design is that alum and chlorine is available nearby should an immediate supply be needed.

The availability of technical know-how is an important aspect of rural water supply sustainability. Training and empowering locals to become local technicians encourages the community to be self-sustaining. While mobilizing communities to instill a sense of ownership and responsibility has its advantages, shifting operation and maintenance from facility-provider to end-user should not be taken lightly.

Monitoring and Evaluation

With regard to sustainability, monitoring is a key aspect to ensuring a successful project from the beginning and continued success into the future. Essentially, monitoring and evaluation are "the mechanisms in place to track water resource consumption and availability; measure access to WSS services; analyze project inputs, outputs and outcomes; and collect data for sector planning purposes" (AfDB 2008: 34). Initial assessments of sanitation and hygiene level are necessary to establish baselines against which to compare the effectiveness of the program outcomes. DeWilde et al. (2008) claim that safe water programs are not effective without baseline measurements, as improvements cannot be known. Within monitoring and evaluation, we contend that there are three primary components: management assessment, infrastructure assessment, and health and wellness monitoring. Data on each of these should be gathered initially and throughout the life of the program to ensure continued health improvements, create mechanisms for good governance, and facilitate planning (WPP). While the need for monitoring and evaluation is not highly contentious, there is some question as to whose responsibility it should be. Ideally, the community could gather this information itself and make appropriate alterations to the program, but realistically, this responsibility might fall to the organizing agency or donor. It admittedly requires a great deal of time and energy, and may be among the most difficult aspects of the program in which to keep community members interested.“

A water supply is a service, and any service requires ongoing management” (Harvey and Reed 2003: 116). Management is only useful if it is relevant to the program, and can only be relevant if the needs of the program are known. Therefore, one of the primary aims of regular assessment is to find out how well the program is being managed and what, if anything, can be done to make management practices more effective. This type of system can essentially force transparency and allow stakeholders to hold the appropriate party accountable for any issues in management or governance of the program. Additionally, this transparency fosters participation in planning and administration and controls for corruption (AfDB 2008), which in turn promotes sustainability.

If unfavorable responses are obtained from management-related questions, the community should be in a position to make changes to ameliorate the problem (for example, instate a new committee member, enforce rules more strongly, shift responsibilities, etc.). As the village water committee is the heart of the program, making necessary shifts in management, doing so will help keep it functioning properly and sustain the program overall. The same evaluation should take place of the physical infrastructure, and while there should be someone, or several people, dedicated to the system’s upkeep, third-party evaluation is important to ensure that general maintenance is indeed being done and the system is running as expected. This, too, can help limit corruption (or simply laziness) and expose any changes that need to be made in the operation and maintenance department.

"The functional integrity of the systems and the capacity of communities to maintain and manage the systems need to be evaluated" before you can make judgments on the effectiveness of safe water programs (deWilde 2008: 455). That remains true over time. It cannot be deemed a success, long-term, unless the functional integrity is consistently satisfactory and the community is always capable of maintaining and managing the system.

In the Pawaga program, there is currently no system set up to assess the management or infrastructure of the program. In principal, members of the different villages can elect new representatives for the Water Users Association (WUA)—the local governing body, discussed in further detail below—but it remains to be seen whether this activity can be effectively organized. During one site visit, we actually witnessed a bit of dissatisfaction with the organization of the WUA from within (some members believing others to be neglecting their duties). In terms of infrastructure, local individuals are trained as mechanics for the purpose of keeping up the system, and individuals are directed to share any problems they witness with their WUA representatives, but there is no formal assessment to seek out potential problems before they develop.

Finally, with respect to sustainability, health and wellness of the community needs to be monitored to check for water safety, program infiltration, and the effectiveness of capacity-building efforts (such as community training sessions). Besides providing the outcomes hoped for (and paid for) by donors, this type of data could give important insight into the sustainability of the program. Impact evaluations contribute to sustainability by recognizing program failures and allowing for change. If, for example, rates of diarrheal infection begin increasing after some amount of time, one could assume that some element of the system has broken. Infrastructure and management assessments could also help shed light on the problem, allowing it to be resolved before a complete breakdown—and abandonment—of the system occur. Health is the primary outcome variable in a water supply and sanitation program, so monitoring it is arguably the most important element of ensuring continued use and effectiveness of the water supply system.

Compared to the other necessary types of assessment, health and wellness monitoring is on track in Pawaga. As a baseline, independent individuals came in to assess health and general wellbeing in the community. Still, the primary goal of these interviews was to collect data for project funders, rather than to inform and improve the program from within. In our survey, every household claimed to have decreased diarrhea and malaria since the beginning of the program (education on each were part of the training sessions and bednets were distributed early on). Nearly half also cited secondary benefits such as fewer days of missed work or school, or money saved on health expenses. Abridged results from the survey are in Appendix B.

As discussed, monitoring is a likely aspect of the program to fall by the wayside, but its inclusion and implementation are essential to program sustainability. This is not only for the immediately obvious reasons of 'proving' success, but to allow for more intricate changes to be made to keep management practices relevant and honest, and to keep infrastructure as functional, as possible.

Financial and Economic Considerations

As our definition states, cost-effectiveness plays a central role in program sustainability. The term 'cost recovery' has become a common term in the literature, implying that the costs of service (the water supply system) should be partially or wholly recovered. Cost recovery is achieved through tariffs and water user fees, charged to both high and low income communities. While discussions about the ethical nature of water fees still linger, the primary issue is ensuring that the fees charged are reasonable and realistic, especially for households in low-income communities.

Programs require monetary contributions from beneficiaries for operation and maintenance costs of the infrastructure (and occasionally sharing capital costs as well) (Whittington 2009). One of the strongest arguments in support of the demand-responsive approach is than an expression of demand is an expression of value (UNDP 2011). Demand for access to safe water determines how willing individuals are to pay for the service (Harvey & Reed 2003: 117). The transition from 'supply-driven' to 'demand-responsiveness' follows marketplace economics: people will pay for something they value. When they do not value it and will not pay for upkeep, installations deteriorate and therefore become 'unsustainable' (Black 1985).

The Pawaga program is working to generate a reasonable and fair fee for households to access water. Continuing with the idea of fairness, stakeholders and the WUA have agreed to provide subsidized water supply service to the elderly, poor, and widowed households. Our household surveys and interviews did reveal that villages are ready and willing to pay for the water supply; however, the majority of households explicitly said they would be willing to pay 250Tsh, suggesting that this fee had been previously advertised. During our interviews with the WUA, unexpected budgetary issues (increased cost of PVC pipes and cement due to rising fuel costs) would likely force the fee to be raised to approximately 500Tsh. Though the price had not yet been established, and the community reaction had not been documented, it is important to point out that misleading communities about what they will be expected to pay may have consequences on willingness-to-pay and consequently, on program sustainability.

Community and Civil Society

In an assessment of program potential or sustainability, the characteristics of civil society must be evaluation because as deWilde et al. (2008) put it, 'beneath the technical construction and performance of such systems are the economic, social, and behavioral foundations on which they are built.'

Program Demand

Over the past decades there has been a fundamental shift from centralized ownership of systems to local ownership and control (Black 1985). Along with the shift came a move away from 'supply-driven approaches' to 'demand-based approaches'. This idea of demand-responsiveness came, in large part, during the 1990's when it had become clear that the success or failure of low-cost water and sanitation programs was dependent upon the level of consumer demand in the region (Black 1985). True demand is generally affected by: the distance to, quality of, and perceptions surrounding existing water sources (Harvey and Reed 2003).

Demand for community water supply is localized; therefore, a demand-responsive approach requires that managerial decisions about levels of service, location of facilities, cost recovery and O&M should be made locally as well. The main role of government should be to establish institutional rules and processes that encourage such local decision-making. There is still some dissent regarding whether demand-driven programs are proving to be more effective than supply-driven programs; for example, Isham (2002) found that local demand does not significantly affect a program's service design and Harvey and Reed (2003) note that "expressing interest in obtaining an improved water supply does not automatically mean that demand will be sufficient to finance operation and maintenance." Improved local governance and involvement, together with demand, does contribute significantly to the sustainability of water supply programs.

In the 1970's, the concept of 'participatory development' began to encourage the water and sanitation sector to view all parties to a development project or service as a stakeholder – from investors and managers to community members (Black 1985). The World Bank defined 'participatory development' as a process through which stakeholders, particularly the poor, influence and share control over development initiatives, decisions and resources that affect them (World Bank 2011). The World Bank (2011) suggests that there is growing evidence that participation improves the quality, effectiveness, and sustainability of projects, while strengthening the ownership and commitment of governments and stakeholders. This coincides with the ongoing push among the rural water supply sector for community-based strategies, which call "for collaborative design and construction among community members, government officials, and NGO staff" (Isham 2002: 671). By generating the authority to establish and enforce rules, "in many respects, civil society participation in water resources management and water supply and sanitation is the key to successful sector governance, encompassing management, quality service provision, and sustainability" (AfDB 2010: 52).

Demand in the Pawaga region was high prior to the program, and the community worked together to voice their felt needs. Before the initiation of this program, the female of each household spent between 2 and 8 hours a day traveling to and from the Little Ruaha

River to access water necessary for cooking, cleaning, and other household uses. A few remaining standpipes from the government's past attempt at providing water access still allowed for sporadic access, but this water was unsanitary, and in either case, waterborne diseases were a tremendous burden for the community. As the Diocese of Ruaha was an established presence in the region (it had worked on an irrigation project before), community members came to the organization for assistance with their water access problem. This program is the epitome of demand-driven, and thus more likely to receive continued community support and participation.

Social Capital

Social capital has meant many things across the sociological fields, but the basic definition upon which all others are built involves "relations of trust, reciprocity, and exchange; the evolution of common rules; and the role of networks" (Adger 2003: 389). Social capital can represent informal ties between family and friends or more formal ties between the different actors within civil society.

We must keep in mind that civil society does not exist apart from the political framework within which it is created. The ties binding community and civil society can be arranged in many different ways, and there are consequently several different types of social capital. In the case of community-based resource management, the most significant type is *networking social capital*.[1] This brand of social capital is slightly more formalized and more externally oriented than others. It is characterized by economic or professional

[1] Adger suggests *networking social capital* in cases of "dynamic mobile communities," "managing collective resources" and "absence of state" (pg 392).

ties (rather than friendship or familial ties) connecting people within the group to those outside it, along with a formal or legal basis for the trust and reciprocity (Adger 2003).

Since community-wide implementation and management are the intended outcome of these programs, the degree of social capital maintained by the community is of utmost importance and plays a large part in the success or failure of a project. This is the case for a variety of reasons. First, social capital is likely to help community members develop and enforce rules (Isham 2002). With the presence of pre-existing organizations and networks, it is likely that community members will know how to interact with one another, both personally and more professionally, toward mutually beneficial ends. Additionally, either formal or informal mechanisms of sanction may already be in place, which would provide the weight essential to creating and enforcing rules and regulations associated with the new project. Individuals are less likely to act as free-riders within a social atmosphere that has established sanctioning mechanism (such as public shaming). Finally, higher pre-existing levels of social capital can simplify the establishment and regulation of a water committee (a key component of most programs) as well as act as primary networks for information dissemination and access to necessary skills, parts, or tools.

Research has shown that in previous community-based water supply programs, social capital has been a determinant positively associated with design participation and construction monitoring. Complementing this is the fact that local decision-making significantly improves satisfaction with the project's service design (Isham 2002). This does not mean that they should not be focused in areas of low social capital, but that the existing social infrastructure should be acknowledged and the process shifted accordingly to ensure the highest likelihood of success. This could be in the form of increased investments in social mobilization efforts (e.g. through strengthening local organizations) or more active organizational supervision.

For Phase I of the Pawaga program, we found that within each of the eight villages, there seems to be a fairly high level of internal social capital, as witnessed through community observation. While there is not a formal social infrastructure, the family and friendship ties connecting individuals are strong and intricate. That being the case, we expect the community to have experience with informal sanctioning, and thus promote adherence to the program expectations and deter free-riders.

Social capital between villages is a different matter, however. We did not witness any outright animosity, but there are a variety of tribal affiliations (Maasai, Hehe, Barabaig, Sukuma, Magante, and others) represented by the villages, and informal ties are much less resilient between them. This program was modeled off another in the nearby region of Kilolo, which consists primarily of one tribe, but it may be unrealistic to expect the same level of inter-village social capital.

Capacity Building

Capacity building is an essential component to the sustainability framework, but it is not a stand-alone community characteristic; rather it draws upon the others to create an atmosphere conducive to continuous learning and improvement. Wertz defines capacity building as "a coordinated process of deliberate interventions to (1) upgrade skills (2) improve procedures and (3) strengthen organizations" (Wertz 2011: 21-22). Water supply systems inevitably require maintenance and repair. In light of the primary goal of community ownership and operation, members of the community need to be trained to refill, repair and replace as necessary to keep the system running smoothly.

Beyond the physical infrastructure, people need to be trained in effective sanitation and hygiene practices. Understanding the value of safe water, and reiterating this fact, is important for individuals to continue reaping the benefits of the program (deWilde et al. 2008). Therefore, sustainability cannot be expected unless the program incorporates community training sessions and the community members are both receptive and willing to train others.

A water supply program's success, reduced exposure to waterborne pathogens, and its sustainability, success in the future, relies in large part on the behavioral, social, and institutional factors of the recipient community. Every community will have a different existing social structure and civil society, and each should be understood before beginning a program that requires so much of this sector. Initially, each program should be designed in a way that is context-specific. Even so, "these factors change over time with economic development and its associated social effects, resulting in further spatial and temporal variations in performance and utilization" (deWilde et al. 2008: 462). Successful programs will take this change into account to stay relevant to the community's needs.

In Pawaga, program leaders and community members alike recognize capacity building as the most influential part of the program. In response to interview questions regarding their satisfaction with the program so far and the changes they have made, nearly all respondents (92%) mentioned sanitation strategies learned at these meetings. Additionally, though not in response to any formal interview question, community leaders spoke of these activities as being highly influential. Initially, five day-long capacity-building seminars were conducted for the general public in each of the 8 villages. Since the beginning of construction, there have been many shorter training sessions for the Water Users Association (in hopes that they would pass along the information) regarding use of solar water purification methods, pit latrine construction, and general discussion on the status of the program. During our site visits it was evident that training techniques were being utilized in the villages as community members were eager for us to see their water bottles sitting in the sun and to view their new pit latrines.

Institutional Capacity

According to Ostrom (2009), if a community exhibits strong social capital in the form of organized institutions, local leaders are in a position to organize effective rules and are therefore more likely to manage their resources properly. Institutions are defined as "the formal and informal rules and practices that govern behavior of different groups" (Isham 2002: 671). The strength of the community's institutional capacity is its ability to affect rules and foster an environment of self-monitoring and enforcement. To this end, the establishment of a village water committee fosters institutional strength in a water supply program because it is built on this tenet of self-regulation, and as such, is a primary component of a sustainable program.

Institutions did not exist in this region at the beginning of the Pawaga program. However, one of the program's highlights is that it creates a Water Users Association (WUA), which is responsible for operation and maintenance of the system, setting and collecting tariffs, and perpetuating the educational components of the program. In an effort to promote gender and village equality, the association was made up of one man and one woman from each of the 8 villages as elected by its members. This has given the community the means to enact and enforce their own water policies and encourage sustainable governance of the program.

Governance

Recent studies have shown that a direct correlation exists between the countries most lacking water services and those with the weakest governance (AfDB 2008). Centrally managed rural water supply programs have largely proven inadequate. During the 1990s, attention shifted to local governance as the water sector began to see that "meaningful and rapid development is possible only if it is planned and implemented from below by the people expected to be the beneficiaries of such development, and development from below is best achieved through decentralization" (Morita-Lou et al. 2008). This concept refers to the transfer of political, financial, and administrative authority, including decision-making and management, from central government to lower levels. However, if this transfer is to be successful, local governments have necessary capacity, resources, and authority to carry out the new responsibilities if the transfer is to be successful (AfDB 2008). In other words, the national and local governments must work together to ensure that authority and responsibility is not left to the communities until they are ready.

In 1991 the Tanzanian government, in response to the failures of the International Drinking Water Supply and Sanitation Decade (1981-1990), introduced the National Water Policy (NAWAPO). The NAWAPO is based on (i) the process of 'decentralization by devolution; (ii) cost-recovery; and (iii) the issue of ownership (Whittington 2009). This policy proposes that sustainability can be achieved if: water supply and sanitation facilities are owned and managed locally by organizations that are both close to, and accountable to the consumer; water projects are financed through the application of water user fees; autonomy is promoted at the basin level; and if stakeholders, including community members, have a broader role in planning, operation, management, and decision making (USAID 2007). This National Water Policy assigns the government (though sometimes NGOs assume this role) the responsibility of providing technical and financial support, and coordination and regulation of water supply activities while the private sector should provide support to the communities in planning, design, construction, and operations (USAID 2007).

In 2006, the Ministry of Water, responsible for the country's water sector, launched the National Rural Water Supply and Sanitation Program (NRWSSP), which set an objective of 90% sustained access to water supply amongst the rural population by 2025 (Whittington 2009). Unfortunately, the NRWSSP's implementation is suffering considerable delays. With the NAWAPO and the NRWSSP's push towards community and local level management, the rural WSS continues to develop. The RWSSP, which focuses on community ownership and management, has been supported by user associations and Local Government Authorities (LGAs), on the local level, and by the Rural Water and Sanitation Division (RWSD), on a more national level. The RWSD, which is housed within the Ministry of Water, promotes demand responsive approaches, participatory planning, and decentralization of services (USAID 2007). In the Pawaga District, Water Users Association (WUA) has been established to handle local governance issues. These WUA were established through the involvement of both local and national level authorities: the Pawaga Ward Divisional leader, the Ward leader from each of the three wards, the Ward

Councilor from each of the 3 wards, and 8 government extension workers. While the success of the WUA in Pawaga has yet to be seen, members of the water sector are optimistic about the overall move from macro to micro level governance in Tanzania.

Female Participation

With respect to sustainability, one aspect of governance that has been receiving increased attention is the role that women play in the provision, management, and safeguarding of water (AfDB 2008). The Dublin Statement (1992) addressed their role, the Rio Declaration (1992) recognized that their participation is essential to sustainable development, and more recently the World Summit on Sustainable Development established a MDG target for gender equality and empowerment of women (AfDB 2008). Within the context of the Millennium Development Goals, gender equality is considered an end in itself. In this case, as in many others, it is also a means of achieving the primary goal of sustainable access to safe water. In traditional cultures, women often have the responsibility of collecting water for the family's various uses. As such, it is appropriate that they have a voice in the decision-making process for a water supply program. A successful program will involve both women and men in the administrative process. This provides women the agency to make choices that will improve their lifestyles, as well as those of the men, and put them into effect (Kabeer 2003). Empowering women in this fashion supports both the goals of gender equality as well as program sustainability. More importantly, improved water access will allow women and girls to be educated and engage in more productive activities.

Female participation is not easily established, however. In communities that are struggling with this goal, water supply programs may not be able to appoint women to decision-making positions. As such, a foundation of female participation in decision-making roles is important to the success of a program. Like a lack of social capital, the presence of gender inequality necessitates additional resources be used toward this end in fostering a social structure conducive to program sustainability.

The Pawaga region is fairly advanced on most of the community measures, but it falls short on female participation. According to a CED report, the region displays "a serious lack of gender integration and community empowerment. It is estimated that women's involvement in community decision-making is no higher than 30%" (CED 2009). Because the topics of concern—water access and health—fall squarely within the traditional woman's role, it follows that women should be at least equally involved in the program.

Two women at the Diocese of Pawaga played an instrumental role in coordinating the program, educating the communities, and acting as liaison between the various stakeholders. Though females are disadvantaged in terms of voice and decision-making power, the Pawaga community certainly embraces its resourceful, effective female leadership. Despite a lack of existing empowerment, women and men were also given equal representation in managing the program (in the form of the Water Users Association, discussed below) upon completion of construction and training.

DISCUSSION AND RECOMMENDATIONS

The Pawaga Sustainable Development Programme has taken considerable steps to ensure sustainability of the water supply system through intensive community training sessions, establishment of a Water Users Association, application of a water user fee, and implementation of a system that can be easily operated and maintained by trained community technicians. Community training and capacity building exercises have already been successful at improving health and strengthening a sense of ownership. However, with the program still in the construction phase there is a great deal of uncertainty regarding how sustainable it will ultimately be. Some initial concerns have already been noted. During our interviews and surveys it became clear that while the WUA had been established and elections for members held, community members remained unclear about how to use the WUA to channel their questions and concerns. The government technicians, CED and Diocese of Ruaha personnel, and at the time, the two of us, were more commonly elicited for answers. This suggests that the 16 members of the WUA are not yet seen as authorities of the system.

Another concern involves the push towards a 'self-sustaining' system. Field research conducted by Harvey & Reed (2003) indicated that a "sense of ownership does not necessarily lead to a sense of responsibility for, or willingness to manage [operation and maintenance]." In the same article the authors also make the following two claims: successful community programming requires continued institutional support; and community capacity building does not automatically lead to a willingness to manage or financially support a water supply over the long term. These statements suggest that the application of a water user fee, technical training, and capacity building exercises have the potential to only produce short-term benefits. To improve the chances that the Pawaga program remains sustainable into the future, we offer several recommendations to both the implementing agencies (Diocese of Ruaha and CED) and donors (Tearfund UK and EU).

Table 3. Sustainability of the Pawaga Sustainable Development Programme

Aspects of Sustainability	Pawaga Programme
Resources aren't over-exploited and are naturally replenished	*Little Ruaha River is a permanent water source* *Drinking water supply is diverted prior to be diverted for irrigation canals*
Ensures a reliable and adequate water supply	*A series of water treatment works have been constructed* *Community health, sanitation, and government training*
Benefits continue to be realized by all users	*A water fee will be set and collected* *Subsidies for the poor, elderly, and widowed* *Decreases in health* *Time savings and income generation*
Benefits received over a prolonged period	*Design capacity is for the projected 2026 population*
Service delivery is cost-effective	*Cost recovery* *Use of existing infrastructure to save on capital costs*
Replication	*Similar to system in Iringa Town* *Will be replicated during Phase II*

Recommendations for the Pawaga Sustainable Development Programme

Based on the discussion above, we offer several recommendations for further improvement of the Pawaga Sustainable Development Programme. These include:

- Establish a path of supported sustainability
- Continue capacity building and training sessions
- Strengthen female participation in the WUA and other community decisions
- Carry out monitoring & evaluation measures
- Firmly establish water use tariffs
- Foster relationships between stakeholders
- Improve lines of communication between stakeholders

As discussed, many aspects of social and institutional development—especially the establishment of the Water Users Association—are on track for creating a sustainable program. However, one of the greatest tests of the sustainability of the Pawaga Program will be how the system continues to operate once the Diocese of Ruaha has ended its involvement. We recommend that the Diocese establish a path of supported sustainability whereby communities are able to prioritize their own needs and address them incrementally. Users should not be simply left to manage their own supplies but support should be sustained until it can gradually be reduced over time (Harvey & Reed 2003). Therefore, we suggest that the Diocese continue capacity building and training sessions and gradually faze them out over time as community leaders display the knowledge and confidence to continue. Concurrently, female participation in decision-making (both within and outside the WUA) should continue to be encouraged and their role in the community should continue to be strengthened.

The availability of knowledge and spare parts in nearby Iringa Town will be critical to the sustainability of the Pawaga system, but we strongly recommend implementing monitoring and evaluation measures to compliment regular maintenance. Furthermore, the Director of CED stated that the water treatment remains the weakest aspect of the program. To ensure that the water treatment works and the rest of the physical infrastructure remains functional, the monitoring and evaluation measures established should be carried out regularly and thoroughly.

In the next phase of the program, the goal of cost recovery should continue. However, water use tariffs, (to fund evaluations and upkeep) need to be firmly established before construction begins, or must only be advertised when the WUA is certain the fee established will not be impacted by unexpected increases in capital costs. It is also recommended that the water tariff be advertised as a fee for the service of water access as opposed to a fee for maintaining the operation of the physical system.

For all parties involved, we recommend that relationships formed in the process be nurtured to limit future miscommunication and misconceptions. The first phase of the program had government approval and support (though somewhat loose), and Phase II is expected to receive the same. The WUA should be actively involved with the program and should work towards building a long-lasting relationship with government personnel. Additionally, communication lines between the Diocese of Ruaha and Tearfund UK should be strengthened to avoid further delays in funding.

Recommendations for Tearfund UK and other Stakeholders in the WSS Sector

Overall, we believe the Pawaga Sustainable Development Programme is on the right track to ensuring this rural region receives a sustainable water supply, and all the associated health and social benefits. Table 3 presents how the Pawaga Program is performing in accordance to the definition of sustainability presented earlier.

Aside from the lessons that can be learned from the recommendations presented to the Diocese and the community members of Pawaga, we suggest all stakeholders in water supply and sanitation programs consider the recommendations presented in this section before installing a system.

- Plan for future scenarios (such as population growth)
- Evaluate existing infrastructure for its re-use possibilities
- Utilize sustainability framework for evaluating programs

With the knowledge that the population around the world is continually increasing, we recommend that implementing organizations develop a design capacity that plans for population growth. In terms of system design, we also recommend evaluating the region to determine whether an existing infrastructure, from a failed project, can be utilized in the new project. This would save resources and time and would likely save on capital costs.

As was previously discussed, communication lines with *in situ* partners should be strengthened to ensure that funds are being properly used and delivered. On this note, we do encourage funding agencies to uphold their financial commitments and deliver funds in the designated timeframe, as the project may slow down, or even halt, if funds are delayed.

Lastly, but perhaps most importantly, donors and implementing agencies can greatly benefit by utilizing this framework. Donors and NGOs have been largely responsible for implementing systems with only the physical, engineering, goals in mind and have thus contributed significantly to the failure of many water supply projects throughout the developing world. The social and economic aspects of rural water supply programs are vital to sustainability. Therefore, we feel that stakeholders take responsibility for adequately educating themselves on what makes a water supply sustainable before moving forward. With the knowledge of the five key areas of sustainability presented in this paper, funding agencies can make educated decisions about where their money would be most effective. Likewise, implementing agencies can make educated decisions about how to properly implement a program from construction to robust operation and maintenance.

CONCLUSION

To achieve the MDG drinking water target, and work towards providing everyone with access to a clean and reliable water supply, donors, NGOs, and governments need to implement programs that reach target populations, establishing a system of actors and institutions that are capable of carrying out the program goals long-term, empower local communities to take responsibility, and selecting appropriate and cost-effective systems.

Predicting the sustainability of community-based water supply programs has its challenges. Institutional capacity and social capital are heavily dependent upon the community in which the program is being implemented; therefore, this framework will play out differently in every context. Because the community plays such a central role in the program's sustainability, continued effort needs to be put into providing community members with the appropriate skills and capacity to operate and maintain the system over the long-term.

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APPENDICES

Appendix A. Household Survey Questions

1) Number of people in your household, how many children?
2) How often do you go to collect water?
3) How far do you go to collect water?
4) How many days have you gone without water in the nearby pipe?
5) When the pipe isn't working, how far do you walk to get water? How much time does it take?
6) What are your household uses for water?
7) How are you cleaning/treating the water?
8) Did you treat the water prior to training?
9) Did your family suffer from any illnesses before treating the water? What type?
10) Currently, is your family suffering from any illnesses? What type?
11) What other benefits of clean water have you noticed?
12) Would you be willing to pay for closer access to water (i.e. the project)?
13) How much do you think you can afford per month?
14) What are your general thoughts on the project?
15) Do you have any other comments/anything you'd like to share?
16) Any questions you may have for us?

Appendix B. Survey Results

Survey Questions	Responses
1) Number of people in your household, how many children?	- 60% had 2 parents - 3-9 children in each household - A few had additional dependents
2) How often do you go to collect water? 3) How far do you go to collect water?	- Visit old standpipe 3-5 times per day - 10-30 minute trip
4) How many days have you gone without water in the nearby standpipe?	- Yes, at times for 1-2 weeks - Standpipe only working in the first 2 villages
5) When the pipe isn't working, how far do you walk to get water? How much time does it take?	- Collect water at the Little Ruaha River - 1-2 hours away
6) What are your household uses for water?	- Washing, drinking, cooking - Amounts unknown
7) How are you cleaning/treating the water?	- Collect and let dirt settle overnight - Use the water from the top to put in bottles - Leave in sun for 6 hours, then let cool before drinking
8) Did you treat the water prior to training?	- Before training, didn't clean the water
9) Did your family suffer from any illnesses before treating the water? What type? 10) Currently, is your family suffering from any illnesses? What type?	- Many stomach diseases before - Now quite rare
11) What other benefits of clean water have you noticed?	- Children can go to school - Men can farm and earn more money - Women can participate in weaving/crafts
12) Would you be willing to pay for closer access to water (i.e. the project)? 13) How much can you afford per month?	- "We will pay!" - don't know how much, depends on the government - 200-5000 Tsh (usually 250 Tsh)
14) What are your general thoughts on the project? 15) Do you have any other comments/anything you'd like to share?	- "Feel well" - Happy and thankful "because people are suffering in this village." - Training should continue

Appendix C. List of Abbreviations

CED – Christian Engineers in Development
MDGs – Millennium Development Goals
NAWAPO – Tanzania's National Water Policy
NGOs – Non-governmental Organizations
UN – United Nations
WUA – Water Users Association
WSS – Water Supply & Sanitation