

Research Paper

Financial and operational sustainability of a gravity-fed rural piped water supply system in Malawi

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ABSTRACT

In 2014, a gravity-fed rural piped water supply system (GFRPWSS) was constructed in the northern part of Malawi at a cost of \$6.8 million (MK5 billion). The system was designed to serve 35,007 people by 2020 but at the time of the study, the ability of water users association (WUA) to operate and maintain the system as well as the financial sustainability (i.e. if the scheme could run without external support) were unclear. Financial records showed that the WUA collected only 26% of their expected payments in 2018. Over 94% of the WUA members lacked the necessary capacity to manage contracts and human resources and only 16% of the Community Water Point Committees were trained in relevant areas of management. Several key positions had been unfilled and the parts necessary for repairs were unavailable. This is one of the few *ex-post* evaluations of a GFRPWSS and highlights several key issues for those wishing to implement similar schemes. Findings showed that the water system only partially met the water requirements of the customers, that the WUA struggled technically and operationally to maintain the system and that at the time of the study, the system was financially unsustainable. Improved record-keeping and payment collection, especially if and when quantities are increased, would likely improve all dimensions of sustainability.

Key words: capacity, distribution, financial sustainability, rural water, social acceptability, user satisfaction

HIGHLIGHTS

- A large-scale gravity-fed rural piped water supply system was constructed in northern Malawi at considerable cost.
- After project funding was removed, the community-based committee was unable to collect sufficient operating revenue.
- Community members tasked with operations, record keeping and maintenance were technically unprepared.
- Investment in financial and operational skills is required if the scheme is to continue.

1. INTRODUCTION

In Malawi, the proportion of the population with access to at least basic water services (i.e. drinking water from an improved source, collection time of <30 min including queuing) increased from 66 to 70% in 2020 at a national scale, although this progress is largely due to the increase in rural areas (62 to 67% vs. a static 86% in urban areas) (WHO & UNICEF 2021). Despite the increase, most water facilities in rural areas do not function for a period longer than 3 years and this has contributed towards poor access to safe water in such areas (Enéas Da Silva *et al.* 2013). The sustainability of rural water supply points remains a challenge in sub-Saharan Africa: only two out of three water points are functional at any given time (Jiménez & Foguet 2010). About 30% of water supply facilities in developing countries are not operational mainly due to breakdowns and are eventually abandoned by the users (Zuzani *et al.* 2013). A lack of access to improved water supply, especially for rural areas, is largely associated with the effectiveness of the operation, maintenance, financial management and the capacity of the personnel assigned to run the scheme. A study on the sustainability of piped water supply schemes in rural Malawi using a community-based management (CBM) model concluded that communities in rural areas, where gravity-fed rural piped water supply schemes (GFRPWSS) have been installed, continue to face challenges of safe water supply because the schemes are unsustainable due to political interference, age of the system and ineffective Water Point Committees (Zuzani *et al.* 2013).

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Both the willingness and ability to pay for water should be, but is rarely, considered in the design and implementation of rural water supply systems since local contributions by users are necessary to pay for operation and maintenance (O&M) (Beyene 2012). With the varying levels of economic status, especially among rural populations, it is important to ensure that access to water is affordable to all; those with the capacity to pay should be able to do so and a minimum but essential amount of water may have to be provided at a low cost to the poorest users (Münger *et al.* 2008).

In Malawi, communities typically contribute about 25% of the overall project cost in the form of local labour and resources, although the percentage may vary depending on the availability of the resources and labour (Ministry of Irrigation & Water Development 2010). While it may be difficult for communities to effectively demonstrate ownership and satisfaction with a community water supply system through the contribution of local resources, it is important to identify strong contextual indicators for user satisfaction in the community and implement interventions to ensure that these are managed in the early stages of project implementation.

To address the problem of poor access to safe water among communities in scheme's catchment area, a GFRPWSS was built at a cost of approximately MK5 billion, equivalent to \$6.8 million (funder records). According to the funder records, the construction of Phase 1 was completed in May 2014, and the scheme was officially launched in April 2015. Essentially, the project is designed to use gravity to move water from the intake points at high altitudes to communities or households at lower altitudes. Five tanks were constructed; four had a 50 m³ capacity, and the fifth had a capacity of 150 m³. In addition, a network of feeder and distribution lines and main transmission lines were constructed in the system to provide safe water to 35 villages. The system has a total storage capacity of 350 m³ and was designed to provide safe water to an estimated population of 35,007 people living in Nkhata Bay district by 2020 (Figure 1). A total of 355 water taps in villages, schools, health facilities and community-based child care centres were installed, and the system had a design life of 20 years (Ntonga 2011).

Until 2014 when the GFRPWSS was constructed, people living in the project area had been using unsafe water drawn from rivers, unprotected wells and swampy areas for drinking, cooking and other domestic uses which exposed them to a number of water-borne, water-washed, water-based and water-related insect vector diseases (Nkhata Bay District Executive Committee 2009). Hospital records from Nkhata Bay District Health Office showed that on average, Health Centres in the area registered 11 diarrhoea cases per month which were above the national average of 6 (National Statistical Office 2010).

In line with the Water Works Act and the National Water Policy of 2005, the funder, in collaboration with the Nkhata Bay District Council, established the Water Users Association (WUA) to oversee scheme management, operation, maintenance and expansion with an aim of contributing towards impact and sustainability. WUA members were identified by community members from within the scheme's impact area in line with the National Water Policy of 2005 and the National Decentralization Policy. Beside the WUA, other structures were also established to enhance accountability in scheme operation in line with the Trustees Incorporation Act and the National Water Policy as described in Figure 2.

The WUA is composed of three main organs which are the General Assembly (GA), WUA Board and the Local Utility Operator (Scheme Manager) as a secretariat (Ministry of Irrigation & Water Development 2010). The GA acts as a tribunal that hears and resolves all issues, queries and problems reported by the WUA. The WUA oversees scheme management and O&M. The WUA performs the management role through the Scheme Manager who was employed to manage the scheme on its behalf. The Scheme Manager supervises the Cashier, Plumbers, Community Water Point Committees (CWPCs), Revenue Collectors and Chlorinators who provide direct services corresponding to their roles to households and communities that were supplied with water through the GFRPWSS.

Payments start from the household to the Revenue Collector to the Cashier who compiles and consolidates all payments and provides a report to the Scheme Manager. In some cases, households remit water payments directly to the Cashier. The Scheme Manager manages the scheme funds and provides financial reports to the WUA on a monthly basis and the WUA provides financial reports to the GA on a quarterly basis.

The objective of this study was to determine the financial and operational sustainability of the GFRPWSS in Nkhata Bay district (Malawi) by assessing the ability of the WUA to collect the payments, organize maintenance and operate the system in the absence of any external support. Specifically, we investigate the annual expenditures and the payment collection to determine whether or not the system can operate profitably. We also assess the skills of the staff, the completeness of the staff (unfilled positions) and the tools/resources available to the WUA to ensure that the system can function.



Figure 1 | Site of the GFRPWSS in Malawi (Source: <https://commons.wikimedia.org/w/index.php?curid=89484>).

2. METHODS

2.1. Sampling

The sample was drawn from the target population of all households situated in 35 villages that were provided with water through the GFRPWSS.

Ethical approval was acquired from the Nkhata Bay District Council before interaction with human subjects who included sampled households, members of Chikwina Mpamba WUA and members of the GA. The interactions took the form of focus group discussions (FGDs), structured interviews and key informant interviews. The approval confirmed that the language used in the data collection tools was appropriate within the study context and that the human subjects would not be harmed in any way during data collection.

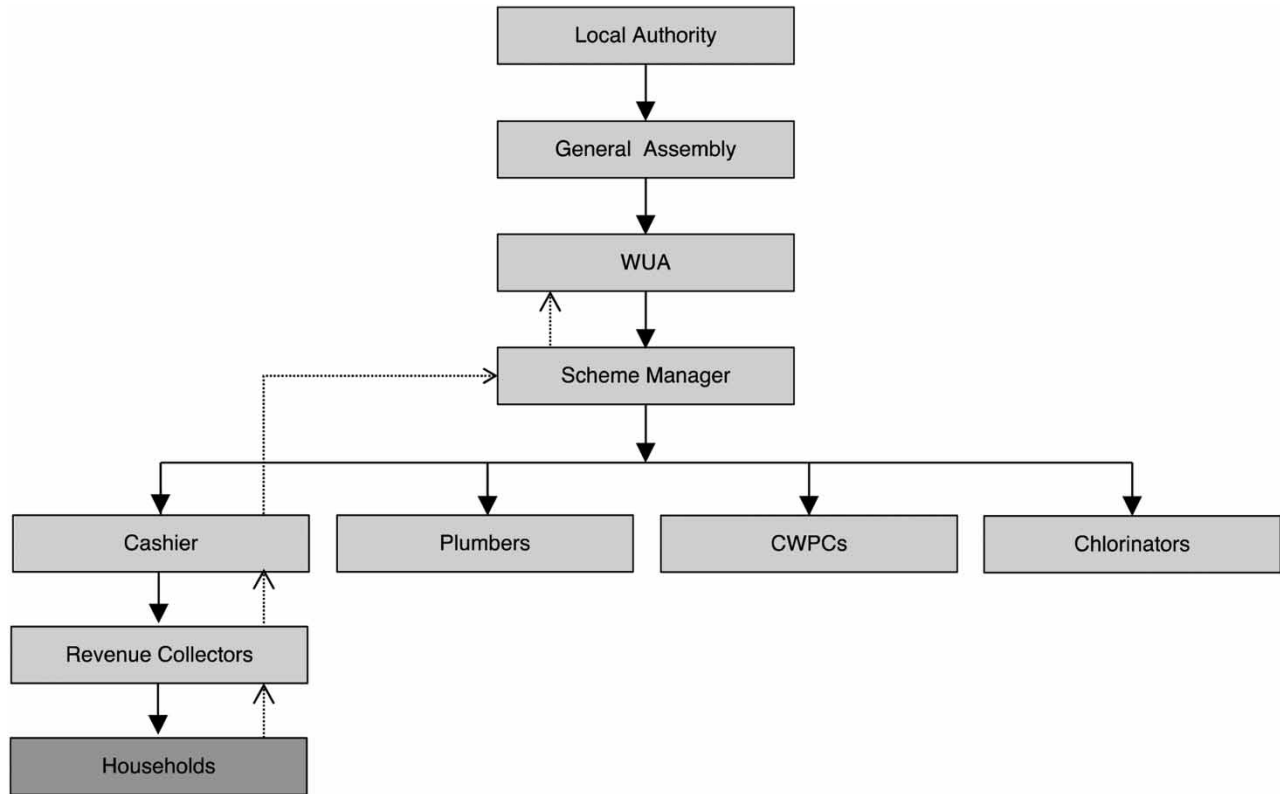


Figure 2 | Financial and operational accountability structure of the WUA. Solid lines indicate a transfer of responsibility; dashed lines indicate a financial flow. Adapted from Chikwina Mpamba WUA (2014).

The target population is located in Nkhata Bay district at a latitude of 11°26' and a longitude of 34°15' and another location at a latitude of 11°32' and a longitude of 34°11' (Ntonga 2011). The scheme has five tanks with each tank serving six to seven villages. According to the GFRPWSS Project Design Document (2011), the maximum village population designed to be supplied with water was 2,544 people, and the maximum number of taps per village was 27 (Ntonga 2011). Stratified sampling was used to ensure that villages supplied by all the five tanks in the scheme were represented in the sample. A random sample of 5 households per village (35 villages) were enrolled into the sample for a total sample size of 175 households. Beside the households, data were collected from the WUA and two CWPCs with one CWPC selected from the first tap in the scheme and another CWPC selected from the last tap constructed in the scheme.

2.2. Data collection and analysis

Data on water payments and other sources of income were collected from the hard copies of the WUA financial records and tabulated in Microsoft Excel.

Demographic and water-use data were collected using structured questionnaires which were collected by health surveillance assistants from the Nkhata Bay District Health Office.

FGDs were used to collect data from two WPCs, while key informant interviews with the Scheme Manager and the WUA Chairperson were conducted to obtain an in-depth understanding on the scheme's operations and management. The FGDs were recorded in Chichewa (the local language), translated into English and transcribed by the author. FGDs were conducted with community members in Timbiri (8/10 attended) and Lilazi (9/10 attended). The transcriptions were imported into the NVivo software 11 and coded by identifying themes, sub-themes and codes that appeared in the transcripts and assigning sections of the transcripts to the themes and codes.

The capacity of the WUA to manage and self-operate was measured by considering knowledge and skills, staffing levels, and the availability of tools and resources for work. The data were collected using a checklist which was generated based on WUA roles, responsibilities as stipulated in the WUA training manual by the Ministry of Irrigation and Water

Development of 2010. Observations and key informant interviews were used to collect data on staffing levels, availability of tools and resources for work.

3. RESULTS AND DISCUSSION

3.1. Sample summary

The sample size of 175 households contained 116 females of which 95 (81.90%) were household heads and 59 males of which 58 (98.30%) were household heads, who are most likely responsible for the payment of water. All sampled respondents were above the Malawi legal maturity age of 18 and hence more likely to take part in routine system O&M activities. The overall mean age of the respondents was 42.34 years.

Respondents took an average of 32.53 min to travel to and from an alternative water source compared to an average of 6.88 min they take to travel to and from the tap. The time to the alternative water source varied between 2 and 120 min (mean = 33 min). The time to the tap ranged between 1 and 30 min (mean = 7 min). When water stops flowing at the tap, 10.86% of the respondents indicated that they are not affected because they fully depend on the alternative source and consider the tap as complimentary, while the remaining 89.14% of the respondents indicated that they are affected because their alternative water sources are further away from their homes than the tap is. The sampled households stored a mean of 111.24 litres of water (minimum of 10 litres and maximum of 420 litres) and this water was used for an average of 1.79 days (minimum of 1 day and a maximum of 7 days). During the previous 7 days at the time of the study, the mean number of days that taps in the scheme had not run for a period of more than 3 h was 4.02 days with 34.86% of the households experiencing no water flow for the entire 7 days, while 12.0% of the households had water running in their taps for the whole week prior.

Almost half (47.43%) of the sampled households used the tap installed through the GFRPWSS as their main water source, and 98.91% of households that do not use the tap as their main water source cited no or irregular water flow as the main reason that they do not consider their tap as the main source of water. In addition, all sampled households mentioned having an alternative water source that they depend on during the downtime of their tap.

3.2. Financial health

In 2018, the WUA's income came exclusively from the water payments collected from households that were supplied with water through the GFRPWSS. The Association did not receive any donations, funding or other forms of monetary support from any stakeholder, agency or NGO to support its operations and activities. Table 1 gives a summary of total income generated by the WUA from January to December 2018 through payments collected from all categories of taps installed in the system.

The WUA generated an annual revenue of MK1,734,309 compared to the target of MK6,732,000 which was only 25.76% of the targeted annual income. Private taps installed at 77 households in the 35 villages contributed 32% of the annual target. Compared to the other four categories, private taps generated the most revenue. One Health Centre Committee which was supplied with one tap did not make any payment for the water used in 2018. In addition, there were no payments made by the users of 14 taps (3.94% of the taps installed). Financial records from the WUA also showed that households using 13.52% of the taps in all categories made a payment of equal to or above 50% of their annual target. No payments were collected from 7.73% of the communal taps or from 13 taps private taps). The one church that was supplied with a tap contributed 8.33% of its annual water payment target.

Table 1 | Water fees collected by the WUA in 2018

Tap category	Monthly fee (MK)	No. of taps	Users/HH	Total collected (MK)	Target for 2018 (MK)	%Fee collected
Church	3,500	1	2,234	1,000	12,000	8.3
Communal	500	181	732	1,041,100	4,494,000	23.2
Health centre	3,500	1	163	0	42,000	0
Private	1,000	168	77	648,209	2,016,000	32.2
School	3,500	4	612	44,000	168,000	26.2
Total		355	3,818	1,734,309	6,732,000	25.8

3.2.1. Annual expenditure

Salaries were paid to one Scheme Manager, one Plumber, one Cashier, three Revenue Collectors and one Watchman. Expenses incurred under the budget line for administrative costs were transportation, airtime, stationery, refreshments and lunch for board meetings. O&M costs were spent to purchase equipment and supplies used for repairs. Thus, the WUA used 58.06% of its annual expenditure on salaries, 32.43% on administration and 9.51% on O&M. Figure 3 shows the overall monthly expenditure made by WUA on various categories of operation in 2018.

The mean monthly expenditure was MK143,370. Overall, the WUA spent MK998,870 on salaries which represents 58.01% of the overall annual expenditure of MK1,720,440. Expenses for salaries were higher than administrative expenses (32.42%) and O&M expenses (9.57%). Despite spending the majority of the budget on salaries, none of the seven employees working in the scheme managed to receive their salary every month from January to December 2018. The mean number of months that the employees did not receive their salaries was 6; the Scheme Manager did not receive his salary for 7 months. In the absence of the Cashier who resigned in May 2018, the Scheme Manager handled all cashier roles. From January to May, all employees received their salary every month except the Plumber who was not employed during that period. From July to December, the number of employees who did not receive their monthly salary increased. The expenditure pattern for salaries appears to follow the pattern of water availability in the scheme and consequently the amount of money collected from households. The greater number of water payments collected from January to May can be attributed to the fact that more water was available for distribution. Communities paid consistently during that period since they had uninterrupted access to water during the period from January to May.

The association spent MK20,000 on administration costs from January to May and MK537,850 from June to December. According to a key informant interview with the Scheme Manager, administrative costs were incurred during WUA meetings, some payments were made to cover meal and travel costs for the Manager and some WUA members during routine supervision visits and scheme monitoring. Based on the trends in tariff collection and water availability in the rainy season, it would be expected that a higher percentage of administrative costs would be incurred during the high-volume period of January to June when more taps were running and more payments were made than the period from July to November when water flow and payments decreased. However, the trends in administrative expenditures show a different pattern with

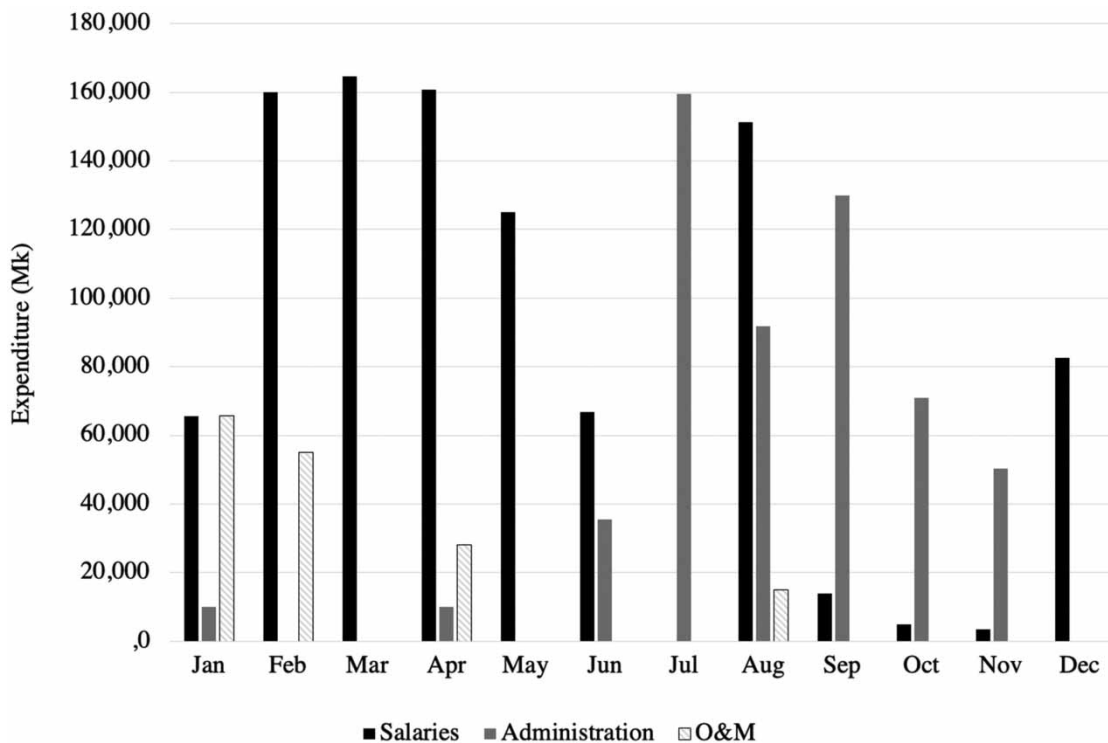


Figure 3 | Monthly expenditure per month, allocated to salaries, administration and O&M.

3.59% made from January to June 2018 and 96.41% of the annual administrative expenditure made from June to December. Demographic information of WUA members who took part in the study showed that 93.75% of the members depended on farming food and cash crops to meet the needs of their households. Thus, it is very likely that the WUA members would spend much of their time attending to field activities during the rainy season from December to June and this might have had an effect on their availability to attend meetings and issues affecting the performance of the GFRPWSS. The WUA managed to conduct one meeting out of the planned three meetings during the period from August 2018 to February 2019.

The WUA used 90.84% of the annual O&M expenditure between January and June. The pattern of expenditure on O&M costs follows the same pattern as water availability and tariff payment. According to a key informant interview with the Scheme Manager, the O&M payments were made to replace broken valves, pipes, and taps which came about as a result of high flows in the system.

3.2.2. Payment collection process

According to the WUA Strategic Plan (2014–2019), the responsibility for collecting payments was given to Revenue Collectors. The Revenue Collectors were chosen by the WUA through a competitive recruitment process among community members from villages that were supplied with water by the GFRPWSS. At the time of the study, the system had three Revenue Collectors spread across the scheme catchment area.

Based on information from FGDs, the Revenue Collectors conduct door-to-door visits at the end of each month to collect water payments from households and institutions according to the set procedure and rate. The Revenue Collectors move with duplicated receipt books which they collect from the Cashier, and each household/institution is given a receipt that corresponds to the amount paid in a given month. The Revenue Collectors then hand over the payment to the Cashier who records the amount and banks the funds to the WUA account. The account signatories are the Chairperson and Treasurer.

If no household for a given tap makes a payment, the Scheme Manager organizes a Plumber to disconnect water until the households settle their bill for that month. If only few households make a payment during a given month, the balance is carried over to the next month and the tap is not disconnected. However, the WUA does not have an organized and structured system to ensure that such balances are followed up and collected.

3.2.3. Profitability

The WUA financial records showed that the Association had an annual expenditure of MK1,720,440 compared to MK1,734,309 collected. The association made a profit of MK13,869 (1.6% profit) despite the fact that the WUA Strategic Plan (2014–2019) projected a profit of MK875,000. The [Ministry of Irrigation & Water Development \(2010\)](#) recommends that to remain sustainable a water system should turn a profit of 10% to cater for scheme expansion and unexpected expenditures.

3.3. Capacity of WUA to self-operate the water system

Capacity to self-operate was measured by considering knowledge and skills, staffing levels, and availability of tools and resources for work. The underlying principle for this consideration was based on [Horton *et al.* \(2003\)](#) who described organizational capacity as its ability to acquire and apply its knowledge, skills, resources and abilities to achieve pre-identified goals and satisfy its stakeholders' expectations.

3.3.1. Knowledge and skills of the WUA, GA and CWPCs

Four main categories of structures were instituted to oversee the overall management and O&M of the GFRPWSS: GA, WUA (Secretariat), employed staff and CWPCs.

According to the [Ministry of Irrigation & Water Development \(2010\)](#), the GA plays an oversight role on the operations of WUA Board through audit, decision-making and approval processes. Although the GA is not directly responsible for the operational management of the system like the WUA Board, it promotes accountability in the operation of the system which is important in achieving financial sustainability and social acceptability. According to the [Ministry of Irrigation & Water Development \(2010\)](#), the following are the roles of the GA:

1. Reviewing and approving the reports of the WUA Board.
2. Making a final decision regarding any major changes in policies.
3. Adopting or amending articles of incorporation or by-laws of the association.
4. Exercising final authority in all matters affecting the association.

5. Disciplining the WUA Board.
6. Electing and replacing trustees for a just cause.
7. Reviewing and approving water tariffs.

However, interviews with GA members indicated that some had worked in their positions for over 5 years without having been trained in the relevant areas stipulated by the Ministry of Agriculture, Irrigation and Water Development. In comparison, the WUA Board is responsible for:

1. Calling for the General Assembly meeting as required by the Constitution.
2. Soliciting funds for the association.
3. Submitting the financial statement of the association to the General Assembly.
4. Entering into contracts and signing the Memorandum of Understanding with different partners.
5. Ensuring that resolutions of the General Assembly are complied with and implemented.
6. Applying for water licence and lease on behalf of the association.
7. Hiring or firing local operator for a just cause.

These all require a significant amount of not only training, but of practice. For example, negotiating salary increases and benefits with the employees and setting up a performance management system for the scheme require nuanced and deft handling which come from more than short workshops. So, although human resource management skills are known to be one of the most critical factors in predicting the effectiveness, efficiency and morale of staff working in a community water supply system (Aarnoudse *et al.* 2018), skills are difficult to measure. Therefore, we instead quantified the trainings that the members went through since appointment or election as a proxy for the capacity development that was taking place. The list of trainings was generated from the WUA Training Manual by the Ministry of Irrigation & Water Development (2010). The results are summarized in Table 2.

Based on roles and responsibilities of the GA as stipulated in the WUA Training Manual of 2010, the GA is not responsible for financial management, contracts management, community engagement, O&M, water quality and pollution control, and sanitation and hygiene. Therefore, data for these trainings were not collected from GA members.

Activity/training reports from the WUA showed that 16.34% of the CWPCs were trained using the CBM and WUA manuals which cover all areas that are applicable in the operation, safety and record-keeping of community water supply facilities. FDGs with the CWPCs identified the lack of capacity building as one of the challenges affecting the CWPCs ability to ensure effective operation and the sustainability of water supply facilities in the scheme: 'We don't know our roles and duties and how we should coordinate with WUA, we have not been trained ever since we were selected' (Participant #3). The WUA members showed knowledge gaps in the areas of resource mobilization, contracts management and human resource

Table 2 | Trainings attended by 16 WUA and 25 GA members

Name of training	Number of WUA trained, <i>n</i> (%)	Number of GA trained, <i>n</i> (%)
Financial management	15 (93.75)	8 (32.00)
Resource mobilization	3 (18.75)	Not measured
Contracts management	1 (6.25)	Not measured
Human resource management	1 (6.25)	4 (16.00)
Water sector regulation	14 (87.50)	5 (20.00)
Community engagement	15 (93.75)	Not measured
O&M	12 (75.00)	Not measured
Water quality and pollution control	15 (93.75)	Not measured
Sanitation and hygiene	15 (93.75)	Not measured
WUA Board roles and responsibilities	15 (93.75)	10 (40.00)
Leadership	15 (93.75)	10 (40.00)
Report writing and review	15 (93.75)	4 (16.00)
Constitution development/review	15 (93.75)	6 (24.00)

management, while GA members had knowledge gaps in financial management, human resource management, knowledge of the water sector regulation and policy in Malawi, roles and responsibilities of the WUA Board, leadership, report writing and review, and constitution development and review. WUA operational records (signed attendance registers and signed training reports) showed that 58 (16.34%) of the CWPCs were trained in relevant areas of interest as described by the Ministry of Agriculture, Irrigation and Water Development.

Furthermore, only 16.34% (28) of CWPCs that were established to assist the WUA in managing communal water points were trained. According to a key informant interview with the WUA Chairperson, the 28 CWPCs were trained in 2015 using the CBM and WUA manuals. Based on feedback from the FGDs, knowledge gaps among the CWPC brought several challenges in the O&M of the scheme. Key themes that were identified were a lack of coordination with the WUA, poor sanitation and hygiene of water points, and poor documentation. 'As you can see, this water point is surrounded by bush all over and yet a CWPC is available. Since our selection in 2014, we have not been trained on our roles and how we should coordinate with WUA in the management of our water point and what you see are the consequences of such capacity gaps' (Participant #7). More troubling than the training gaps, WUA members demonstrated little commitment in the application of knowledge or skills imparted on them to improve scheme performance. During the study, commitment to work was measured by considering the number of meetings attended by WUA members over the previous 6 months, the percentage of meetings that were organized and successfully conducted by the WUA to discuss matters relating to the scheme and motivational factors among the WUA members. Over the last 6 months of 2018, the association managed to hold one meeting out of the three meetings that were planned. According to a key informant interview with the Chairperson for the WUA, the meeting was attended by 5 out of 16 WUA members. The poor attendance was attributed to lack of interest and motivation among the members. Considering the size of the scheme, the nature of operations and issues reported from communities, a meeting with such an attendance cannot provide an objective and practical assessment of reports, feedback and progress on operations of the scheme.

In terms of motivation, 18.75% of the WUA members were motivated by the monetary benefits they get from the association, 100% were motivated by desire to bring positive change and impact to their fellow community members, 6.25% were forced by their family or community members, 75% had no income-generating activity to do and hence had a great deal of free time to attend to WUA duties and 6.25% were motivated by the desire to learn new things in the management and O&M of the system. Since a majority of the respondents stated that they became involved because of their current surplus of free time, the possibility of a WUA member becoming inactive or completely ceasing to execute his or her role after finding an income-generating activity is high. 'For the past year, 5 WUA members migrated to South Africa in search of income-generating activities and had to be replaced' (Key Informant Interview with WUA Chairperson, 2019).

3.3.2. Staffing

The WUA employed one Scheme Manager who, based on the scheme size, was enough to manage the scheme. Beside the Scheme Manager, the WUA also employed two plumbers, three Revenue Collectors and one Watchman. The Association had a vacancy of one Plumber, one Cashier, two Chlorinators, and one Stores Clerk. Overall, the WUA had an overall staffing percentage of 53.85%. Fully occupied positions were that of Scheme Manager/Local Utility Operator (1) and Revenue Collectors (3). Of these positions, only the Scheme Manager and Cashier had documented job descriptions or guides which are important since they act as reminders to the one performing the job, are used as a basis for evaluating performance, facilitate transition or handovers when an employee resigns and are used in the recruitment process.

Considering the scheme size, number of beneficiaries and intensity of operations, positions such as Plumber, Cashier and Chlorinator are important for the continuity of services and responding to queries and issues raised from communities. Such water systems are prone to failures as a result of pipe bursts, siltation at intake points, theft of materials, ineffective monitoring and inadequate O&M. Plumbers play a central role in addressing many of these challenges, and hence their absence can significantly affect operations of the scheme. Based on a key informant interview with the Scheme Manager, the 32 km scheme was divided into three zones with each zone allocated to one Plumber. On average, each zone has 115 taps across 10 villages. Thus, the absence of one Plumber means that hundreds of people could remain unserved. Feedback from an FGD with the CWPC identified slow response times to water problems as one of the key themes in the provision of water to communities. 'It takes close to 3 weeks for a broken-down water point to be fixed in our village. Since the time that the Plumber responsible for this area resigned, we have these problems and sometimes villagers just report to fixing the taps themselves which compromises the quality of service' (Participant #2).

Table 3 | Work tools and resources for the WUA

Position	Job description/job guide available	Work resources available for the position
Scheme Manager	Yes	2 Tables, 8 Chairs and Office Drawers
Plumbers	No	None
Revenue Collectors	No	Pens, receipt books
Cashier	Yes	Notebooks, pens, 1 office desk, 1 office chair, office drawers
Chlorinator	No	25 litres chlorine, comparator for measuring chlorine dosage, 2 buckets (20 litres)
Stores Clerk	No	None
Watchmen	N/A	None

3.3.3. Work tools and resources

Resources and tools used by the various categories of staff in the scheme were sourced or provided with support from the funder. Table 3 shows the work tools and resources available for use by each cadre of staff working in the GFRPWSS.

All of the resources and tools that are available for use were bought with support from the funder. The association did not have spare parts for maintenance work. In cases of breakdowns, the Plumber and Scheme Manager used the funder's tools to do the work. Based on a key informant interview with the Scheme Manager, these tools were sufficient to enable the WUA to execute its duties of operating and managing the scheme, but it was unclear how long they would be able to access them. Apart from the tools, the WUA had sufficient chlorine, buckets and comparators.

4. CONCLUSIONS

At the time of the study, the WUA, which is responsible for the overall management and O&M of the scheme, was failing to collect sufficient water payments from the 355 taps that were installed in the system; only 25.76% of the targeted annual income was collected, 32% of which was from just 77 households, while no payments had been made by the users of 14 taps. The ability of the WUA to continue operating without this funding is uncertain.

To improve the financial sustainability, the WUA should further investigate the reasons for late/absent payment and determine if the timelines (i.e. when to pay), mechanisms (i.e. who to pay) and consequences of missed payments (i.e. disconnection) are clear. To remain of service to those customers that do pay, the WUA must develop, communicate and implement policies for non-paying customers, including the ability to book service hours in the WUA against water payments. Ideally, the system should be fitted with flow meters in order to adopt a volume-based billing system, rather than a flat-rate connection fee.

To enhance its capacity to self-operate, the WUA needs further skills development in the areas of contracts management, resource mobilization and human resource management. Tailored trainings specifically designed for GA members should be implemented by the project implementor with help from other, more successful WUAs who can speak directly to the practical side of system management. The decentralization of water management to communities may empower local decision-making and ownership, but the skills and resources required should not be underestimated; without them, such schemes may require significantly more money to rehabilitate, and then limited, on-going support would cost, especially considering the social and political costs of project failure.

DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

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