Sustainability of water facilities under community based management in Zimbabwe

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ABSTRACT

Community Based Management (CBM) has been envisaged as a panacea to sustainability challenges faced in the Water Sanitation and Hygiene (WASH) sector globally. In spite of this approach having success stories, studies have shown that failures are also being recorded. This study investigated the sustainability of rural water supply facilities under the CBM approach in Chipinge District of Zimbabwe. The specific objectives were to assess the technical, financial and institutional factors influencing sustainability. A cross sectional study design was used. Data was collected using Focus Group Discussions, Key Informant Interviews, household questionnaires and an observation checklist. Quantitative data was analysed using SPSS and Microsoft Excel while qualitative data was analysed using the thematic approach. Results showed that the technical factors which are influencing sustainability are age of the water facility, frequency of carrying out preventive maintenance and existence of external support. Regression analysis showed a positive linear correlation between age and breakdown frequency ($R^2 = 0.46$) and the odds of obtaining a breakdown decreased as the frequency of preventive maintenance increased. User communities were contributing inadequate O&M funds resulting in long downtimes. Non-functionality of WPCs negatively influenced sustainability. The study recommends training of user communities on CBM and technical skills.

Key words: community based management, financial factors, institutional factors, sustainability, technical factors, water supply facilities

HIGHLIGHTS

- Lack of technical skills within local institutions.
- Poor financial contributions by user communities affected sustainability.
- Ineffective preventive maintenance contributed to frequent breakdowns.
- Poor implementation of water management rules resulted in poor financial contributions.
- Non-functional Water Point Committees impacted the financial and technical factors of sustainability.

INTRODUCTION

In the Water Sanitation and Hygiene (WASH) sector, numerous scholars have come up with specific sector-oriented definitions of sustainability (WELL 1998; Carter & Howsam 1999; Duti 2012; Marks et al. 2013). According to Harvey & Reed (2004) sustainability is the ability of a system or technology to continue working over a desired period of time (Harvey & Reed 2004) or causing little or no damage to the environment. With the concept of sustainability taking its roots from the debate on sustainable development, sustainable water supply systems or technologies should cause little or no harm to the environment so that the ability of future generations to meet their own needs is not compromised (Brundtland 1987). In the sustainability discourse, environmental harm occurs where there is overexploitation of the resource and when the facility is not protected to avoid water contamination (Ngopa 2012).

The working definition of this study which states that, ‘a water system is sustainable when its maintenance is locally financed, it is maintained in a condition that ensures reliable and adequate water supply, and benefits of the supply continue to be realized by all users’ was adapted from a study done in Zimbabwe by Kativhu et al. (2017). This definition was developed based on the most recurring issues in the literature on sustainability and it was adapted since its application was on a
country wide study on sustainability of water supply systems managed under the Community Based Management (CBM) approach. Literature has shown that under CBM, unsustainable water supply systems usually have long downtimes, high breakdown frequencies, inadequate water supply, local institutions with inadequate technical expertise and poor financing mechanisms (Opare 2011; Adams 2013; Amjad et al. 2015). Several authors used different combinations of factors and sub-factors (financial, institutional, technical, social and environmental) to assess sustainability of water facilities (Harvey & Reed 2004; Montgomery et al. 2009; Dube 2012; Kativhu et al. 2017). However, most scholars agree that sustainability is complex, hence the need for a standardized tool in sustainability studies to enable comparisons to be made across studies and regions (Harvey & Reed 2004; Mays 2006; Amjad et al. 2015). In light with this, the current study will contribute to the sustainability discourse by analysing how different factors influence the sustainability of water supply systems under the CBM approach in Chipinge District of Zimbabwe.

From a development perspective, the main agenda regarding water sustainability is to reduce huge losses in water supply investments. According to Ngopa (2012) water supply facilities which are not sustainable are normally left lying idle as white elephants even before reaching their life span which is a huge financial loss for the sector. Despite success in coverage of new rural water infrastructure in the last 2–3 decades, in many countries 35% are not functional or have poor yield (Kalulu et al. 2010). In Kenya, 25–30% of finished water facilities become dysfunctional within three years of completion (Kwena & Moronge 2015). In Sub-Saharan Africa, 30–40% of hand pumps (predominant type of water facility) are not functional every year (Duti 2012). A study by Kativhu et al. (2017) showed that in Zimbabwe only 17% of the studied water supply systems were sustainable under the CBM approach. If this evidence is coupled with the anticipated doubling or tripling of Africa’s population by 2040 or 2050 (Shapley 2008) it creates a sense of urgency in addressing water facility sustainability.

In the quest to promote sustainability of water supply facilities the CBM approach was adopted by many countries. The approach is prevalent in most rural water sectors as it has been envisaged as a panacea to sustainability problems in Sub-Saharan Africa (Kativhu et al. 2018). However, the approach has delivered mixed results of success and failure in different localities (Kwena & Moronge 2015). The basic principles behind the CBM approach are that the community that benefits from an improved water supply should have a major role in its development, own the water system or facility, and have overall responsibility for its O&M. However, Harvey & Reed (2007) blame the failures of CBM to the blanket application of the approach within different communities. A closer look at the principles of the approach questions its suitability to be applied as a one-size-fits-all approach as has been the practice in the rural water sector (Kativhu et al. 2018).

One of the assumptions of CBM that has always been questioned in literature is that a sense of ownership improves sustainability. Cleaver (1991) in Zimbabwe found out that, a sense of ownership improved sustainability of water supply projects. Findings by Ngopa (2012) also showed that sustainability of water supply systems was significantly related to community ownership. However, there may be need to know the extent to which a sense of ownership influences the sustainability of water supply systems. Harvey & Reed (2004) contested that there is no automatic relationship between a sense of ownership, willingness to manage, and the sustainability of water supply systems. Although communities may express a sense of ownership, sustainability in the same communities may not be achieved. This shows the importance of understanding factors that influence sustainability of water supply systems under the CBM approach in different localities.

Evidence has shown that, when using the CBM approach communities should not be expected to overcome all complex challenges on their own (Whittington et al. 2008). Government departments, NGOs and the private sector are supposed to continually provide necessary external support (Bakalian & Wakeman 2009). A number of studies have indicated the importance of external support from governments for the sustainability of water supply systems to be achieved (Whittington et al. 2008; Bakalian & Wakeman 2009). This is however, against the ideology of limited external support to communities when using the CBM approach. According to Kativhu et al. (2017) some communities in Zimbabwe were not repairing minor breakdowns as they relied on external support from NGOs. Ngopa (2012) also revealed that, where external support was expected, communities were not planning for O&M of water points which increased the downtime. Furthermore, Naughton (2017) found out that dependence on external support under the CBM approach caused lack of scalability of water supply projects. Results from these studies question the effectiveness of external support in promoting the sustainability of water supply facilities.

Despite the weaknesses that CBM has demonstrated in sustaining water supply systems the approach has undoubtedly brought many benefits (Lockwood et al. 2003). In light of its weaknesses, practitioners in the WASH sector have advocated for other approaches such as self-management and Private Public Partnerships (PPPs) to be considered for sustainability to be achieved. According to Butterworth et al. (2013) the proposed approaches should not replace CBM, however they have to complement CBM where it is failing.
Professionalization of CBM where some water services will be provided through PPPs and provision of services is paid for, is another suggestion that has been put forward by scholars (Lockwood & Le Gouais 2011; Moriarty et al. 2013). Moriarty et al. (2013) argued that CBM has to be professionalized not principally because the approach has failed, but because it is reaching the limits of what can be achieved in an approach based on informality and voluntarism. Rising standards of living and education are leading to an inexorable rise in expectations of rural water users, wanting (even where they cannot or are not willing to afford) more than the very basic levels of service provided under CBM (Moriarty et al. 2013). These trends affect community cohesion and volunteerism that form an underlying assumption behind community management (Lockwood & Le Gouais 2011). Therefore, professionalizing CBM may enhance sustainability.

In Zimbabwe the CBM approach has been reported to be failing to provide sustainable water services for rural populations apart from very few isolated cases of success (Hoko et al. 2009; Dube 2012; Kativhu et al. 2018). A study by Hoko et al. (2009), noted that 38 percent of the water supply systems in Mt. Darwin District were unsustainable. On the other hand, Dube (2012) observed that 60 to 70 percent of the water supply systems under the CBM approach in Gwanda District were unsustainable. This raises the question of why rural water supply facilities are having low sustainability levels under the CBM approach despite it being envisaged as a solution to sustainability challenges. Kativhu et al. (2018) established that the CBM approach is applied differently in different parts of Zimbabwe which had an influence on sustainability. In Chipinge District, reports from the Rural District Council (RDC) show that despite having an elaborate legal, regulatory and institutional framework that supports CBM models of service delivery, the water sector continues to experience low levels of sustainability and stagnation in levels of access to water for domestic use in rural areas. Against this background, this study sought to assess the technical, institutional, and financial factors affecting the sustainability of water supply facilities under the CBM approach in Chipinge District of Zimbabwe. It is envisaged that assessing these factors at a local scale will be a starting point to facilitate careful considerations when applying CBM principles. This is critical since communities in different localities may have different capabilities for sustainability to be achieved under the approach hence its principles should not be homogeneously applied.

The CBM implementation guide/framework used in the rural water sector in Zimbabwe

The CBM implementation guide was prepared by the National Action Committee (NAC), for use by the institutions and organizations in the water and sanitation sector (National Action Committee 2005). The NAC is an inter-ministerial committee responsible for the overall coordination and management of the WASH sector in Zimbabwe. The purpose of the guide is to provide water and sanitation programmes with a framework on how to implement CBM. The CBM implementation guide also aims to give direction to stakeholders to empower communities to manage, make decisions, and provide the necessary resources needed to develop, operate and maintain their water and sanitation facilities. Notably, the framework is a reflection of some of the legal and policy frameworks used in the water sector in Zimbabwe.

According to the CBM framework, the District Water and Sanitation Sub Committee (DWSSC) co-ordinates planning and assists in the management of rural water supply activities in a district. The committee consists of all relevant sector agencies represented in the district and representatives from NGOs which may be co-opted by the committee. The sub-committee is chaired by the District Development Fund (DDF) and the Rural District Council (RDC) is the secretariat. DWSSC reports to the Provincial Water and Sanitation Subcommittee (PWSSC) and the Rural District Development Committee (RDDC). The DWSSC is responsible for the monitoring of WASH facilities’ performance as well as monitoring the implementation of CBM by different stakeholders across their district. The sub-committee is also supposed to hold planning meetings once every month.

The CBM framework stipulates that the RDCs are accountable for water supply and sanitation at local level. They own and manage public rural water and sanitation assets, whether developed by central government, local government or NGOs. In this regard, the RDCs should establish a Revolving Fund to provide loans and grants to communities intending to develop or improve their water supply systems under the CBM approach. The RDCs are also expected to support the establishment of community structures responsible for water management and they should also put in place legal instruments such as by-laws to support the established structures. The CBM guidelines also stipulate that NGOs and other implementation organizations are supposed to build the capacity of the major stakeholders to effectively play their roles in water management.

According to the CBM guidelines the communities are responsible for the development, and O&M of water points. The communities are also supposed to monitor the performance of water supply systems and repair non-functional ones. The CBM guidelines also stipulate that decision making on the type of technology rests with the community of users. To facilitate
this, water projects implementation organisations should provide information to the community on possible choices and their long term financial implications especially on O&M. Communities should also develop village based plans which should be the basis of channelling support from the government and donors.

The CBM framework with these stipulated roles for all stakeholders in the WASH sector was envisaged to promote sustainability of rural water supply facilities. However, a study by Kativhu et al. (2018) revealed that there is a dichotomy of theory and practice in the implementation of the CBM approach in different districts of the country. This dichotomy negatively impacted financial, technical, social and institutional factors of sustainability.

**METHODOLOGY**

**Study area**

The study was carried out in Ward 4 of Chipinge District. The ward was purposively selected since it had more water supply facilities than the other wards in the district. Figure 1 shows the location of the study area.

Three out of seven villages in the ward were purposively sampled (maximum variation purposive sampling) based on a number of factors. Firstly, Water Point Committees (WPCs) were supposed to be present at each water facility, and secondly the areas were supposed to contain mainly boreholes or deep wells with hand pumps in order to achieve the desired objective (determining technical factors affecting water facilities).

**Data collection methods**

The researchers used a questionnaire with semi-structured and structured questions, observation checklists, Key Informant Interview (KII) and Focus Group Discussion (FGD) guides as tools for data collection. A total of 15 water facilities were studied. Observations were made to obtain evidence on O&M of the water facilities. A total of 86 household individuals were conveniently sampled. The researcher and the research assistants waited at the water facilities for persons (above 18 years of age) who came to fetch water. These individuals would act as representatives of their households. The information

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**Figure 1** | Location of Ward 4 in Chipinge District.
required was related to the technical, financial and institutional performance of the water points. The semi-structured questions were used to capture respondents’ opinions and responsibilities regarding the CBM approach.

Key Informants (KIs) interviewed were the District Water and Sanitation Sub-Committee (DWSSC) members and Water Point Committees (WPCs). Expert purposive sampling was used to select 10 key informants at district and ward level to gain an in depth view of the overall CBM approach. FGDs were used to acquire in depth information from the user community on the planning of O&M of the water facilities. One FGD session was conducted per village.

Observations using an observation checklist were done. Observations were used to triangulate information given by respondents in the questionnaires, during interviews and FGDs. The data collected was deemed important as it clearly shows the factors that were affecting the sustainability of water facilities managed using the CBM approach in Chipinge District.

Data analysis
Quantitative data was analysed using Statistical Package of Social Sciences and Microsoft Excel. A one sample t-test at 95% Confidence Interval was used to denote a significant difference between the household financial contributions and the recommended amount. Excel was also used to calculate the R² value denoting correlations between variables such as age and water facility yield and age and water facility breakdown frequency.

A Chi squared test was performed to determine whether there were significant relationships between borehole maintenance and the estimated number of breakdowns that were reported by respondents in a year. The strength and direction of association was then determined through performing the Multiple Logistic Regression (MLR) Analysis to compute Odds Ratios (OR), Confidence Intervals (CI) and MLR-P Value.

Qualitative data was analysed using the thematic approach. The analysis entailed sifting data from KIIs, FGDs, and observations according to pre-defined and emerging themes. The themes were from both the field data (an inductive approach), and from the researcher’s prior theoretical understanding of the phenomenon under study (deductive approach). The use of the deductive approach was enabled by an extensive literature review which was done before data collection. Coding was then done where data sets were labeled into categories based on the research objectives. After coding, data was then grouped into themes. For example, all information related to financial factors of sustainability such as presence of an O&M fund, regularity of making financial contributions, adequacy of funds and rules on fee collection formed one theme. This was done for all the other factors of sustainability which were studied.

Data collection tools’ testing and validation
To test for the data collection tools and research process, a pilot study was done in ward 2 of Chipinge District. Any potential challenges with the research process and tools that could have contributed to the failure of the main research study were identified and addressed. The pilot study was valuable in identifying unclear questions in the data collection tools. The pilot study was also used to train 2 research assistants in data collection. To enhance reliability and validity of the present study the researchers used multiple strategies as recommended by Creswell (2003). The different methods which were used are triangulation of data collection, prolonged engagement in the field and member checks.

RESULTS
Overview of the facilities studied
A total of 15 water points were studied. These were boreholes (13) and deep well (2). The bush pump was the type of lifting device used in the study area. The pump was adopted as the National Standard Hand Pump in the 1980s by the Zimbabwean government (Morgan et al. 2002). The bush pump can be fitted on wells and boreholes, and its high prevalence was due to the IRWSSP which installed the water lifting device on most communally-managed systems which were developed under the programme.

Technical factors
The study results show that water facilities involving mechanical parts are susceptible and depreciate in their efficiency with age. The age of the water facilities was calculated from the time the water facility was installed/rehabilitated to the time of data collection. The ages of water facilities ranged from 1 year to 20 years. It was noted that 26.2% of the water facilities were between the ages of 1–3 years, 47.3% were between the ages of 5–10 years and 26.1% were between 12–20 years. The mode age was 10 years. The study also measured the yield of the boreholes based on the time taken to fill a 20 litre
container. A total of 10% of the water facilities were in the range of 80–90 seconds and 21% were in the range of 110 to 115 seconds. A total of 21.1% ranged from 120–140 seconds and 5.3% were in the range of 140–150 seconds. According to UNICEF (2012) boreholes should have a minimum discharge of 0.25 litres per second, that is, a 20 litre bucket is to be filled in 80 seconds for optimum boreholes. The time taken to fill up a container is significant as it reduces the queuing time at a water point. Where more time was required to fill up containers, water users tended to wait longer to have their chance to collect water than where containers were taking less time. According to the Sphere Standards- Minimum Standards in Water Sanitation and Hygiene Promotion, the maximum queuing time at a water source should not be more than 15 minutes. Excessive queuing time which is used as an indicator of insufficient water, in this case due to low borehole yield, reduces time for water collectors to attend to other essential survival tasks and reduces the per capita water consumption. According to the t-test results there is a significant difference between the mean average yield of the hand pumps and the optimum yield recommended by UNICEF Zimbabwe (t=6.041, df=14, p<0.00).

Hand pumps of age 1–5 had an average time of 110 seconds to fill in a 20 litre container while those between 6 and 10 years had an average of 114 seconds and age 10–20 years had an average of 130 seconds. When the two variables of age and yield were analysed, results show a linear regression model with (R²=0.46). Thus there is a positive linear correlation between age and yield. That is, as the water facilities age they are more prone to a reduction in yield as shown in Figure 2.

These results are in line with findings by Ngopa (2012), which showed a decrease of borehole yield with age of a water facility. The result shows the need to rehabilitate and replace old water supply facilities for sustainable water supply to be achieved. However, it should be acknowledged that rehabilitation and replacement of the water facilities can be a solution where over extraction is not the cause the decrease in yield.

A total of 31.6% of the WPCs indicated that there was no preventive maintenance being carried out. A similar percentage of the WPCs carried out preventive maintenance once per year, 10.6% after 6 months and 26.2% after 4 months. The rate of preventive maintenance was reported to have an impact on the frequency of breakdowns experienced. Preventive maintenance is when WPCs or the District Development Fund (DDF) which is a government technical department in the water sector, are supposed to dismantle a pump after every three months to check for any parts that could be tearing or wearing out so that they can be replaced (Harvey & Reed 2007). WPCs (71%) reported that there was no need to do preventive maintenance when a water point is functioning well. Fears of failing to put back pump parts correctly were also raised by 55% of the committees. Poor performance by WPCs in technical roles could be due to limited technical skills within the committees. This finding resonates with findings by Kativhu et al. (2018) where technical skills within local institutions were found to be important under CBM for water points to receive immediate attention after a breakdown. Such rapid responses reduce the downtime of water supply systems.

The DDF disclosed that their last routine service was carried out ten months prior to the time of data collection. The main reasons highlighted by DDF for the failure to perform frequent preventive maintenance included shortage of tools and spare

![Figure 2](http://iwaponline.com/aqua/article-pdf/doi/10.2166/aqua.2021.089/964317/jws2021089.pdf)
parts and incompetent WPCs. However, WPCs blamed the shortage of tools as the main cause of the failure to perform preventive maintenance. These findings are not exceptional from findings from other sustainability studies done in Africa which showed that unavailability of spares and tools affects preventive maintenance which is key in sustaining water facilities managed by user communities (Harvey & Reed 2007; Hoko et al. 2009).

Through observations it was noted that 13.3% of the boreholes showed no signs of greasing, 6.7% had loose bolts and 46.7% had cracks on the head works that required repairs at the time of study. The area around all the water facilities was generally clean. However, 47.4% of the water facilities did not have a fence at all and 42.3% of the water facilities were poorly fenced, that is, the fence had fallen at some sides or all of the sides as a result of poor maintenance. Only 5.26% of the water facilities had a dura-wall with all its sides upright and a cattle trough on the other end. A total of 47.4% of the water facilities had no troughs for livestock watering. This presents a challenge to sustainability of the water facilities as free ranging livestock can easily damage the head works.

Based on the data from the WPCs survey, 13% of the committees reported no breakdowns in the previous year at the time of data collection. Amongst these, 75% of them were of ages between 1 and 2 years while the rest were between 2 and 3 years. Most (60%) WPCs which reported breakdowns in the previous year had water facilities which were above 6 years of age. Further investigations showed that among the facilities which were above 6 years, 58% of them reported multiple breakdowns. Figure 3 shows a relationship between age and breakdown frequency. Through regression analysis there is a weak positive linear relationship between age and breakdown frequency ($R^2 = 0.11$).

Findings also showed that the maintenance of boreholes was key in reducing the number of breakdowns. Boreholes that were not maintained had an 8-time chance more likely to breakdown as compared to those that are maintained at least three times a year. Those that were maintained once a year had a likelihood of 1.75 to breakdown as compared to those that are maintained at least three times a year. The results are presented in Table 1.

Maximum acceptable downtime is the longest time estimated between the on-set of a disruption event to the resumption of critical services. A total of 13% of the hand pumps never had a breakdown the previous year and 19.1% had a downtime of 2–7 days. However, 23.4% had a downtime of 1–2 months, another 23.4% had a downtime of 3–4 months and 6.7% had not been functional for more than 4 months. Some of the respondents indicated that long downtimes were contributed by the presence of alternative water sources such as rivers and shallow wells. Communities were using the alternative water sources when a borehole would have broken down despite the health risks associated with using unsafe water sources. However, the DWSSC highlighted that the reason for the long downtime was shortage of tools among WPCs. The other contributing factor of long downtime was poor planning as some WPCs only met when there was a breakdown. WPCs were not taking opportunities of meetings to remind and educate water users on maintenance issues. According to Kativhu et al. (2017) meetings are also an appropriate platform to account for previous contributions so that trust between user communities and WPCs can be strengthened. Where trust is a challenge between water users and the local institutions willingness to contribute towards O&M for water points under CBM is threatened (Ngopa 2012).
The availability of external support was also found to be contributing to the short downtime (less than a week). At some instances NGOs were mentioned to have assisted community members with resources for O&M of water facilities. A total of 26.3% of WPCs received spares from NGOs, 36.8% received knowledge through training from different institutions, and 21.0% received building material such as cement and fence. The external support was vital in maintaining water supply. However, the interaction between the stakeholders giving the external support and the community might have led to the confusion within the user community in terms of ownership of water facilities. These results are similar to the findings by Whittington et al. (2008) that ongoing technical support contributed to sustainability in Bolivia, Peru and Ghana. However, it should be acknowledged that, although the average downtime of 2 months found in the current study is above the stipulated downtime for sustainable water points (2 days), it is lower than that of the centrally managed three-tier O&M system, which was 6 months (National Action Committee 2005). This shows an improvement brought about by CBM in rural water supply in Zimbabwe. The three-tier O&M system was a centrally managed system which was used to manage water supply systems in Zimbabwe before the adoption of the CBM approach. The system had challenges of accelerated increase in water points, continued rise in O&M costs, and increased work load for pump minders who were responsible for the repairs and maintenance of water points.

Financial factors
The annual financial contributions towards O&M of water facilities varied from one household to another. With the majority (68%) of the study population having a monthly income of less than USD20, the financial contributions they made towards water management was considered to be low. The amounts contributed ranged between USD0.20 and USD1 per household per year. The results showed that a total of 37.6% of the households claimed that annually they pay a USD1, 17.6% pay USD0.50, 12.9% pay USD0.20 while 8.2% pay whatever they could afford. A total of 23.7% who did not make financial contributions claimed that they did not know that money collections for water facility repairs were carried out in their area. According to the key informants, the money contributed by the user communities was very low as compared to their annual costs on water points maintenance. There was a general consensus among the key informants that if each household would contribute a minimum of USD5 per annum, the contributions will be enough to cover the O&M costs. The international guidelines propose a range of expenditure on water provision in a rural set up to be USD2-USD3 per person per year (IRC 2011). Therefore, a mean of USD2 was used as a benchmark for a significance test. T test results show that there is a significant difference between the annual expenditure per person and the recommended IRC standard mean of USD2 (t=-3.329, df=84, p=0.001). The mean difference between the population mean and the sample mean was -0.66471. The low financial contributions by households in Chipinge District negatively impact the sustainability of water supply facilities as WPCs were always collecting inadequate funds when faced with a breakdown. Prokopy (2005) also found similar results where sustainability of water points was negatively influenced by inadequacy of O&M funds in India. In the same regard, Ngopa (2012) also found out that water points which were contributing inadequate funds for O&M were not sustainable in Tanzania. The inadequacy of O&M funds increases the downtime period as more time will be required to mobilize the funds (Hoko et al. 2009).

This result on the inability of households to make adequate financial contributions is a cause of concern making it pertinent to find solutions to directly address the economic performance of rural water users under CBM. Studies have shown that in resource constrained communities, the use of drinking water sources for productive uses such as gardening (Multiple Uses of Water) is a possible solution to economically capacitate poor rural communities. In a study by Kativhu et al. (2021), although gardening provided small amounts of income per given time, it was noted that the income was considered to be steady as it

| Number of Times Borehole is maintained per year | Breakdown (Yes) | Breakdown (No) | Chi Square P-Value | MLR Odds Ratios | MLR CI | MLR P-Value |
|------------------------------------------------|-----------------|----------------|-------------------|-----------------|-------|-------------|
| Three times or more                             | 1               | 5              | 0.001*            | ***             |       |             |
| Twice                                           | 13              | 15             | 0.2               | 0.01-2.56       | 0.063 |             |
| Once                                            | 17              | 11             | 1.75              | 1.02-8.56       | 0.003*|             |
| None                                            | 19              | 5              | 8                 | 1.85-23.30      | 0.000*|             |

***Comparison Group. *Significant Result.

Table 1 | Odds ratio for obtaining breakdowns at different preventive maintenance rates (n=86)
was coming on weekly or monthly basis, enabling households to make monthly financial contributions towards O&M of water points. In this regard, gardens can be considered to be dependable socio-economic safety nets for household food security and financial requirements where water points are used for multiple uses. Fielmua & Mwingyine (2015) also noted that where domestic water points were used for community gardening, poor communities had the capacity to make financial contributions for O&M in Ghana. Van Koppen et al. (2006) also noted that using domestic water sources for gardening improves the willingness to pay for the O&M costs of water supply systems, showing how the use of drinking water sources for community gardening can improve the financial capacity of rural households in managing their water sources. However, where boreholes will still be costly to maintain, other low-cost methods such as rain water harvesting may be implemented to increase water availability (Mekdaschi Studer & Liniger 2013).

Another key issue to note regarding the financial factor is that, although these communities do not have high income levels, they have strength in sharing workloads, collective action and self organization. These strengths when supported with appropriate approaches to socio-economic development, they may impact positively on the sustainability of water facilities under the CBM approach.

A total of 34% of the studied water points had constitutions which gave a set of rules on water management. The constitutions allowed the contribution of non-monetary materials such as bricks, rocks, sand, water, labour and food. However, it was noted that non-monetary contributions are only essential in the installation and repair of water facilities, and do not play a key role in big activities such as hiring pump mechanics or the purchasing of spares. Where constitutions were not available, the study revealed that rules were available and were known by all water users although they were not documented. These rules included no laundry to be done at a water point were laundry facilities are not available and reducing the amount of water collected by households during water scarce periods. However, it was noted that in most cases those who break the rules were only given warnings and no punishments. This was mainly due to kinship ties within the communities. Some respondents noted that this caused high rates of defaulters when making O&M contributions, resulting in few households participating in O&M. This finding resonates with a study by Kativhu et al. (2017) which revealed that weak implementation of water management rules in Gwanda, Chivi and Nyanga districts of Zimbabwe contributed to the collection of inadequate O&M funds affecting the financial sustainability of the studied water systems.

**Institutional factors**

A total of 84% of the studied water points had functional WPCs responsible for managing the water facility while the remainder did not. However, from the household survey the rating of the performance of WPCs was as follows; very good (56.5%), good (21.2%), fair (12.9%) and poor (3.5%). A total of 5.9% could not rate the WPCs because they had never met them and knew little or nothing about them. Some of the reasons why WPCs were rated as poor were because of speculations that they were misusing funds for their own interest or the lack of democracy within the committee. WPCs which were rated good or very good was because they did not impose sanctions on households that default in the payment of O&M, and the opposite. Those that were rated are fair were new water facilities and committees, and thus it was too early to judge. Lastly, those who were rated as good were mainly because they never had complaints on the functionality of their water facilities. According to Kativhu et al. (2017) where water points had functional WPCs, sustainability was high and the opposite for water points without functional WPCs. This implies that, sustainability is threatened by the non-functionality of user committees.

The study also revealed that 46% of the WPCs were trained in CBM. The WPC training involves refresher training for those who would have been trained before and introductory training for new committee members. It was indicated that WPCs who had their last training in the last 12 months from the time of data collection were 26.3%, 21.1% had their last training in the last 2 years while the rest had their last training more than 3 years before. According to the key informants at district level, CBM training was donor driven. No budget was allocated by the local stakeholders for CBM training hence the trainings were conducted as and when there are NGOs who have the training component in their programs. However, the study noted that where WPCs were not trained on CBM, it negatively impacted other factors of sustainability such as technical, financial and social factors. Such inter-linkages show the need of addressing sustainability in a holistic manner since an investment or a weakness in one factor may influence the other factors. These results resonate with findings by Marks et al. (2013) when they concluded that, communities in Ghana that had trained user committees had more sustainable water supply systems than those who did not.
CONCLUSIONS

This study found that technical, financial and institutional factors are affecting the sustainability of water facilities in Chipinge District. Technical factors studied were age of water facilities, frequency of preventive maintenance and availability of external support. Age of water facilities contributed to a reduced yield and increased breakdown frequencies of water facilities. The results also showed that the rate of preventive maintenance contributed significantly to the rate of breakdowns of a water facility. This conclusion shows the need for frequent preventive maintenance which is usually done by user communities under CBM. In user communities where there was external support by NGOs in providing spare parts and training, the downtime was reported to be less than a week. This implies that for CBM to be a success in promoting sustainability of water facilities, user communities should be assisted by higher institutions through spare parts provision and training.

Financial factors contributing to the sustainability of water facilities were the amount of O&M funds contributed by user communities. It was noted that the total expenditure of the user communities on water management was below the recommended range to achieve financial sustainability, thus poor implementation of the financial sustainability concept. Inadequacy of O&M was also as a result of absence of water management rules and poor enforcement of constitutions due to kinship reasons.

Inadequacy of O&M was also contributing to long downtimes of water supply facilities. Institutional factors identified in this study include the functionality of WPCs and training of WPCs on CBM. Non functionality of WPC was noted to be negatively influencing sustainability while where WPCs were not trained on CBM, it negatively impacted other factors of sustainability such as technical, financial and social factors. The conclusions drawn from the results of this study suggest that if these factors of sustainability are addressed, the CBM approach will be a success in the rural WASH sector.

The study recommends effective timed preventive maintenance in order to reduce breakdown rates and improve water facility yield thus ensuring reliable water facilities. There is also need to equip WPCs with ideas of money generating projects, for example, money loaning and livestock rearing projects in order to boost their expenditure on water supply as a community. Water management rules should also be enforced to enhance sustainability. There is need for user community training on CBM approach and increased meetings between WPCs and user community in order to remind and educate water users on maintenance issues. Although the study explained some of the key social components that underpin sustainability, it recommends further studies that will help in understating all the key factors that are necessary to increase sustainability of water supply systems under CBM.

DATA AVAILABILITY STATEMENT

Some or all data, models, or code that support the findings of this study are available from the corresponding author upon reasonable request (questionnaire and observational checklist data). Some or all data, models, or code generated or used during the study are proprietary or confidential in nature and may only be provided with restrictions (key informant notes).

CONFLICT OF INTEREST

The authors would like to declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data cannot be made publicly available; readers should contact the corresponding author for details.

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