

Research Paper

Influence of multiple uses of water on the sustainability of communally-managed rural water supply systems in Zimbabwe

Tendai Kativhu, Dominic Mazvimavi, Daniel Tevera and Innocent Nhapi 

ABSTRACT

The utilisation of drinking water supply systems for productive uses is not a new practice in Zimbabwe and the world over. This study sought to explore how multiple uses of water, in this case community gardening as a productive use combined with domestic uses influence sustainability of communally-managed rural water supply systems. Using the independent samples t-test, it was noted that community gardening positively influences sustainability. The test was done on institutional, technical, social and financial factors of sustainability. Results showed that there were statistically significant differences in sustainability performance between water points used for multiple uses and those used for domestic uses only. However, it was also noted that using drinking water sources for multiple uses increases the frequency of water use conflicts and water point breakdowns, which negatively impact on sustainability. This means that where water sources are used for multiple uses additional management skills and resources may be required for the water points to be sustained. The study concluded that using domestic water sources for productive purposes enhances sustainability of water supply facilities; however, consideration has to be given about the relative importance and scale of the type of productive activity to be implemented.

Key words | communally-managed systems, community gardens, multiple uses of water, rural water supply, sustainability, Zimbabwe

HIGHLIGHTS

- Using drinking water points for productive uses.
- Sustainability of water points used for multiple uses.
- Income generating from garden produces in multiple water use systems.
- Participation of men and vulnerable households in water management.
- Conflict resolution and managerial skills in water management.

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INTRODUCTION

Strategies used by non-governmental organisations (NGOs) in implementing and managing rural water supply projects have gained importance in Zimbabwe (Makoni & Smits 2007). In an effort to improve rural livelihoods by tackling the multiple dimensions of poverty, most NGOs have combined the provision of water supply with community gardening and constructing water troughs for livestock. Community garden is defined as a piece of public land that is protected, and divided into smaller plots which are allocated to and utilised by individual households. The households mainly grow vegetables primarily for household consumption and also for sale. The use of drinking water sources for multiple purposes is consistent with the Zimbabwe National Water Policy of 2013 (Government of Zimbabwe 2013) which prescribes that, 'Where water supply from a water point is abundant enough to permit productive uses, rural Water Supply Sanitation and Hygiene (WASH) programs will be integrated with productive uses such as irrigation to assist in raising funds for management of water points'. From the policy perspective, the use of drinking water points for multiple uses aims to improve the management of the water points through raising funds for operation and maintenance (O&M). However, the policy highlights that the capacity (i.e., the amount the water source can supply) of a water point to provide adequate water has to be considered so that communities are not deprived of drinking water.

Several studies reviewed reported that the use of drinking water supply systems for productive uses is not a new practice in Zimbabwe and the world over (Katsi *et al.* 2007; Makoni & Smits 2007; Smits *et al.* 2010a). For example, some communities have been using water sources universally for domestic and productive purposes at both household and community levels since time immemorial in order to meet their multiple water needs (Van Koppen *et al.* 2006). The recognition of people's multiple water needs and the increased attention to the provision of water supply services to meet both domestic and productive needs resulted in the development of the concept of multiple water use systems (MUS) (Adanki *et al.* 2012). Although the concept has been defined differently by various authors (Van Koppen *et al.* 2006; Smits *et al.* 2010a; Adanki *et al.*

2012; Fielmua & Mwingyine 2015), in the context of this study MUS refers to a situation whereby a drinking water system is used for both domestic and productive uses. Productive uses in this study refer to the non-domestic water uses, in this case community gardening while domestic uses are the consumptive uses (especially drinking and cooking) and hygiene uses (washing, cleaning and bathing).

While the benefits of community gardening to rural and urban households is well documented (Chitongo & Magaya 2013; Lovell *et al.* 2014), the impacts of gardening on the sustainability of water supply systems where MUS are used has not been adequately examined and this is one gap that this study aims to fill. Documented studies on multiple uses of water have mainly focused on the impacts of the practice on livelihoods and policy issues (Van Koppen *et al.* 2006; Makoni & Smits 2007; Smits *et al.* 2010b; Fielmua & Mwingyine 2015). With regards to sustainability of rural water supply systems, numerous studies have revealed how achieving sustainability has been a rural development challenge in many parts of Africa (Alexander *et al.* 2015; Kativhu *et al.* 2017). These studies reveal how various socio-economic factors affect sustainability in many rural contexts. It is in this context that this paper seeks to explore how multiple uses of water, in this case community gardening, as a productive water use combined with domestic uses influence sustainability of water supply systems. The main question that the paper seeks to ask and answer is: 'whether there are differences in sustainability performance between water points that are used for multiple uses (watering community gardens and domestic uses) and those used for domestic uses only'.

A water system is considered to be sustainable if it is maintained in a condition that ensures reliable and adequate water supply that is beneficial to all users.

METHODOLOGY

Study area and sampling procedures

The study was carried out in three provinces of Zimbabwe which are Manicaland, Matebeleland South and Masvingo.

In each of these provinces, one district with the highest number of NGOs implementing water projects at the time of the study was purposively selected. As a result, Chivi District in Masvingo Province, Nyanga District in Manicaland Province and Gwanda District in Matabeleland Province were selected. The location of the study districts in Zimbabwe is shown in Figure 1.

Water availability varies across the study districts. Gwanda and Chivi districts are characterised by low and frequently variable rainfall that ranges between 450 and 600 mm per year. The districts have experienced meteorological and hydrological droughts in the past decade. The main sources of domestic water in the two districts are boreholes fitted with bush pumps, wells fitted with windlass and sand abstraction sites fitted with rower pumps. On the other hand, Nyanga District is situated in a cool and wet region that generally receives more than 1,000 mm annual rainfall.

The main water sources include springs, boreholes, and both shallow and deep wells. In the three districts, water from protected sources is generally of good quality, although some boreholes produce hard water.

In each district four wards were randomly selected for the study. Stratified random sampling was used to select water points used for multiple uses and specifically for domestic purposes only. Notably, all of the 40 water points used for community gardening across the study wards were selected because the number was relatively small and manageable. The targeted number of water points used for domestic purposes only was the same as that of the targeted water points for multiple uses per district. Hence, a total of 80 water points was targeted. In Nyanga district 40 water points were studied while 12 were studied in Chivi and only 8 were studied in Gwanda. Other productive uses of water, such as brick moulding and livestock rearing, were

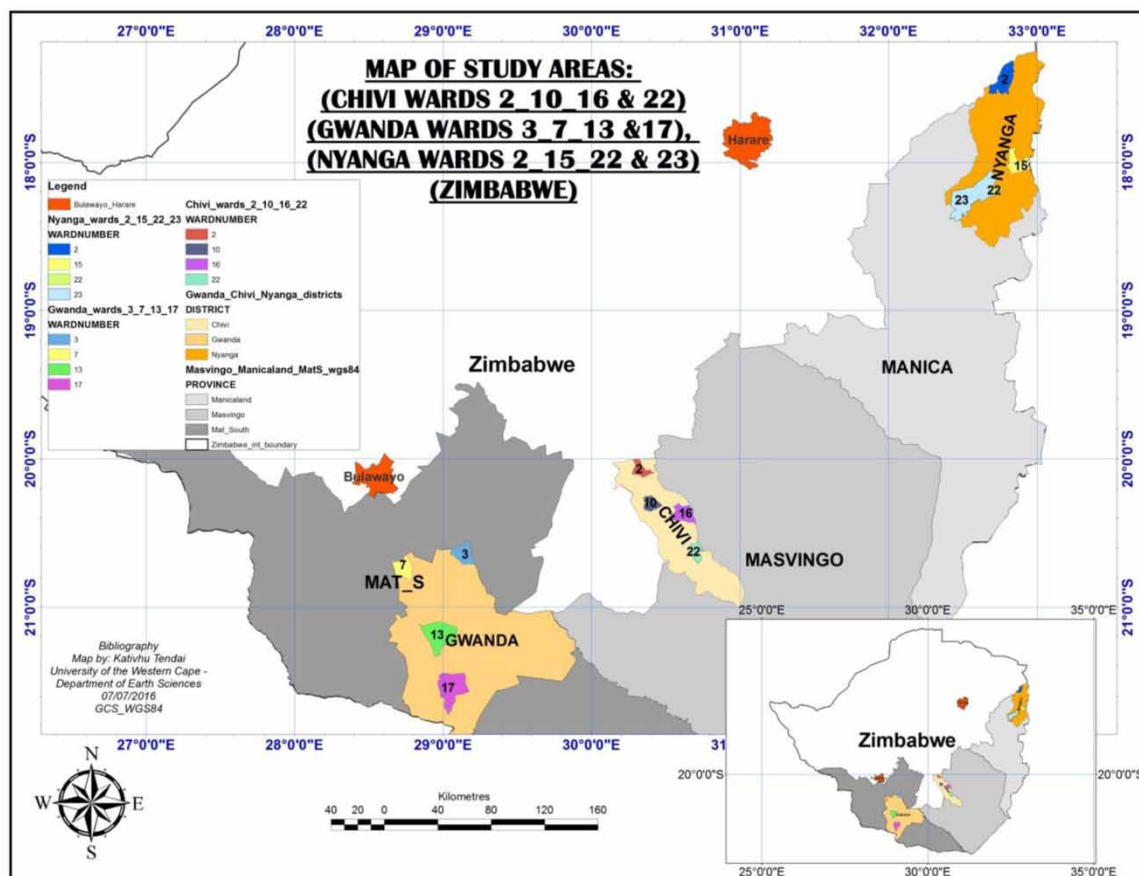


Figure 1 | The location of study districts in Zimbabwe.

found in Chivi and Gwanda districts, respectively. However, such uses were not included in the study due to low incidence of such water use activities in both districts.

Data collection methods

Questionnaires

Stratified random sampling was used to select participants for questionnaire interviews which were administered at the household level. A total of 300 households were sampled across the three districts. From the sample, 150 households were water users whose water points were used for gardening while the other 150 households were those whose water points are used for domestic purposes only. In Nyanga District 150 households were interviewed, while in Chivi District and Gwanda District 90 and 60 households, respectively, were interviewed. At each water point, seven to eight households were interviewed. The household questionnaire was divided into sections which collected information on socio-economic characteristics, water access, and influence of multiple uses of water on the sustainability of water supply systems.

Key informant interviews (KIIs)

Purposive sampling was used to select the key informants whose interviews were predominantly semi-structured. These were drawn from NGOs implementing water supply projects, government departments, water user committees and community leaders. Four interviews were conducted in each ward while eight interview sessions were conducted at district level in each district.

Document analysis

The types of documents reviewed in this study include meeting agendas, meeting attendance registers, and minutes of meetings which were obtained from Water Point Committees (WPCs). Various documents of water points used for community gardening provided background information on how multiple uses of water have positively or negatively affected sustainability. This allowed comparisons of sustainability to be made between pre-garden and during-garden in the study area.

Data analysis

Quantitative analysis

Statistical Package for Social Sciences (SPSS) version 23 was used to analyse quantitative data.

Descriptive statistics: Descriptive statistics on mean, minimum, maximum and standard deviation were generated on the different factors and sub-factors. Inferential statistical analysis such as Chi square tests were used to determine if there were significant differences on selected variables across districts. A p value of ≤ 0.05 was taken as statistically significant.

Multi-criteria analysis (MCA): Following [Panthie & Bhattarie \(2008\)](#), MCA was used to assess the level of sustainability of water points. To determine weights for the different sustainability factors for this study, the analytic hierarchy process (AHP) method was used. In this study, field experts at the district level compared the different factors in terms of how important they are in influencing sustainability. Pairwise comparisons were done between sustainability factors, which are financial, technical, social and institutional and their sub-factors as shown in [Table 1](#). These factors and sub-factors were derived from the literature on

Table 1 | Factors and sub-factors used in the analytic hierarchy process

Factors	Sub-factors
Technical	Availability of spare parts Affordability of spare parts Functionality Water point status
Social	Community participation in planning Community participation in O&M Participation of men and women in Water Point Committees Frequency of conflicts
Institutional	Existence of committees Functionality of committees Training in community based management Level of external support Availability of rules
Financial	Presence of O&M funds Frequency of making financial contributions Transparency on use of funds Presence of rules on fee collection

rural water supply and they were found to be the most recurring ones.

During performance scoring, several questions were asked to WPCs and water users to assess the field performance of each sub-factor. Data were assigned scores using the methodology developed by Kaliba (2002). The methodology is based upon the principle that a value of 1 represents a positive contribution towards a sub-factor and 0 represents no contribution. The methodology was adopted since it is suitable for the assessment of the sustainability of rural water supply systems (Peter & Nkambule 2012).

The weight of each factor which was assigned through the AHP was then multiplied by the factor's performance score obtained in the field to get the sustainability score for that factor. The summation of the sustainability scores for all the factors then gave the overall sustainability score of an individual water point so that it was classified as highly sustainable, sustainable, partially sustainable or not sustainable, as shown in Table 2.

All the water points were then classified according to their sustainability scores.

Independent samples t-test: The independent samples t-test was used to answer how multiple uses of water influence sustainability. The 5% level of significance was used to determine if two sample means were significantly different. The hypotheses which were tested using this test were on average performance scores of sustainability factors which are social, technical, financial and institutional. Below is an example of the hypotheses:

H₀: There is no difference in the average financial scores of water points used for multiple uses and those used for domestic purposes only.

H₁: There is a difference in the average financial scores of water points used for multiple uses and those used for domestic purposes only.

Table 2 | Sustainability classification of water points

Classification	Range of measurement	Sustainability category
Very good	76–100%	Highly sustainable (HS)
Good	51–75%	Sustainable (S)
Fair	26–50%	Partially sustainable (PS)
Poor	Below 25%	Not sustainable (NS)

Qualitative analysis

The thematic approach was used in the analysis of qualitative data. After coding, data were 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 and rules on fee collection formed one theme. This was done for all the other factors of sustainability.

RESULTS

Socio-economic status of households

The study had a total of 80 water points and a total of 300 households participating in the study across the three districts. The number of interviewed women was 211 while only 89 men were interviewed. This is largely a reflection of the prevalence of female-centred households in the rural areas of Zimbabwe. The socio-economic status of the households is shown in Table 3.

The family sizes across the districts ranged between 1 and 14 people. The chi square test results ($\chi^2 = 4.210$, $df = 2$, $p = 0.102$) show that there is no significant difference in the family sizes across the three districts. However, the level of education attained by the respondents across the

Table 3 | Socio-economic status of the households

Variable	Minimum	Maximum	Mean	S.D.
Chivi District				
Age (years)	20	74	39.3	5.88
Family size (persons)	1	11	5.2	1.75
Monthly income	USD\$10	USD\$420	USD\$38	15.54
Nyanga District				
Age (years)	21	70	38.6	33.86
Family size (persons)	1	10	4.8	1.32
Monthly income	USD\$16	USD\$400	USD\$61	52.52
Gwanda District				
Age (years)	19	68	38.5	23.41
Family size (persons)	2	14	4.5	1.81
Monthly income	USD\$21	USD\$500	USD\$54	33.21

districts did not vary, where secondary level was the mode. The chi square test results ($\chi^2 = 6.591$, $df = 4$, $p = 0.271$) show that there is no significant difference in the level of education of the respondents across the districts.

The majority (90%) of the respondents considered themselves to be unemployed. The striking minority who considered themselves employed reported to be formally employed (2%), self-employed (3%) and informally employed (5%). Due to the high level of unemployment, the households in the study districts had low levels of income which were below the national poverty datum line of US\$481 for a household of five (ZimStat 2016).

The main source of income in the three districts was crop production. Although the respondents showed that they had several sources of income, the sources contributed very little towards the total household income, leaving the households susceptible to poverty. Across the three districts, women were the main participants (72%) in community gardening.

Sustainability classification for water points

Sustainability scores were calculated by multiplying the sub-factor weights by the performance scores as explained in the Methodology section. The results show a major difference in the sustainability of water points used for multiple uses and those used for domestic uses only, as shown in Figure 2.

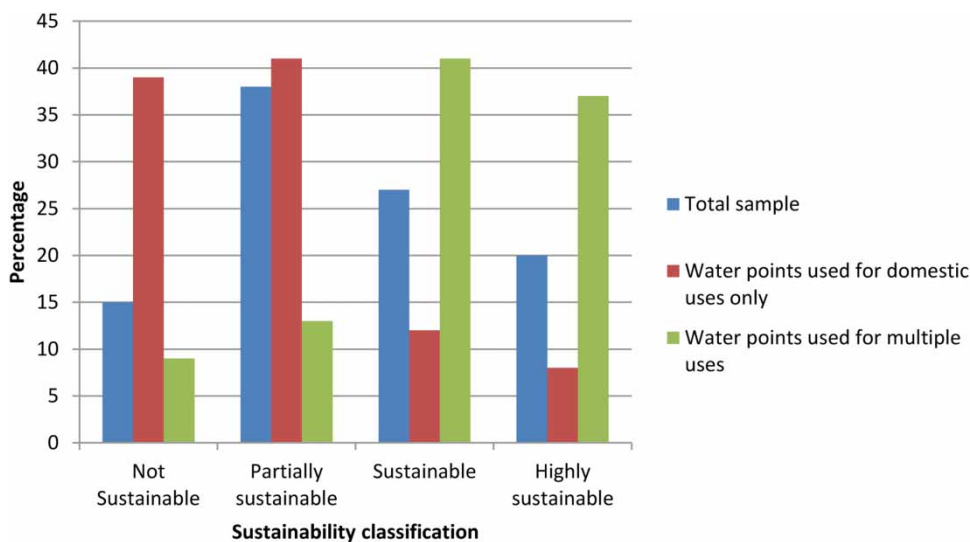


Figure 2 | Sustainability classification of water points used for multiple uses and those used for domestic purposes only.

Figure 2 shows that 79% of the water points used for domestic purposes only were in the 'not sustainable' and 'partially sustainable' categories, while water points used for multiple uses had 21% in the same categories. The independent samples t-test results ($t = -4.684$, $p = 0.000$) show that there is a significant difference in the sustainability scores between water points used for multiple uses and those used for domestic purposes only.

Influence of multiple uses of water on sustainability of water supply systems

The results of the independent sample t-test showed differences in sustainability performance between water points used for multiple uses and those used for domestic purposes only in financial, social, technical and institutional factors as presented in Table 4. Variations were also shown in sub-factors tested under each factor.

Influence of multiple uses of water on financial factors

Table 4 shows that there was a significant difference in the financial performance of water points used for multiple uses and those used for domestic purposes only, thereby rejecting the null hypothesis that there is no difference in the average financial scores between water points used for multiple uses and those used for domestic purposes only.

Table 4 | Independent samples t-test results for water points used for multiple uses and domestic purposes only

	Water points used for multiple uses	Water points used for domestic purposes only	t-value	p-value
<i>Factors investigated</i>				
Financial (%)	87.7	43.6	6.133	0.000
Technical (%)	66.8	48.2	4.602	0.000
Social (%)	71.4	49.2	3.451	0.000
Institutional (%)	78.1	42.7	5.136	0.000
<i>Sub-factors investigated</i>				
<i>Institutional</i>				
Number of community water management meetings/year	9.3	3.02	10.992	0.000
Number of WPC meetings/year	9.7	3.2	8.503	0.000
Percentage of households attending meetings/session	74	59	2.684	0.010
<i>Financial</i>				
Percentage of households making financial contributions/year	81	57	5.705	0.000
Percentage of vulnerable households making financial contributions/year	86	42	6.703	0.000
Amount in O&M fund (USD)	23.6	3.5	10.565	0.000
<i>Technical</i>				
Frequency of breakdowns/year	6	11	9.756	0.010
Maintenance frequency/year	4.7	2.0	3.482	0.001
<i>Social</i>				
Frequency of water use conflicts/month	3.7	2.1	5.045	0.020

The sub-factors which were studied under the financial factor are the percentage of households making financial contributions per/year, the percentage of vulnerable households making financial contributions per year, frequency of making financial contributions and the amount of O&M funds collected per month at each water point. Most (81%) households using water points which were used for multiple uses were contributing towards O&M using the money they were earning from selling garden produce. According to rules set by the garden members, all garden farmers were expected to contribute towards O&M of water points.

Furthermore, where water points were being used for multiple uses, financial contributions were done on a monthly basis as compared to after a breakdown where water points were used for domestic purposes only. The difference in frequencies of making financial contributions explain why the difference in the downtime between the two groups was also statistically significant ($t = 7.979$, $p = 0.001$). The mode of the downtime for water points used for multiple uses was one week while for water points

used for domestic purposes only was two months. Results from 85% of the key informants showed that garden farmers made efforts to have short downtimes due to the absence of alternative water sources for their crops. The presence of rules on fee collection and the frequency of making financial contributions contributed to the higher amounts (\$21) of O&M funds for water points used for multiple uses as compared to \$3 for water points used for domestic purposes only. The tariffs which were contributed at each water point varied between \$USD0.50 and \$USD1 per household per month. These tariffs were agreed upon by the water users at each water point.

Influence of multiple uses of water on social factors

There was a significant difference in the social factor scores of water points used for multiple uses and those used for domestic purposes only ($t = 3.451$, $p = 0.000$). The null hypothesis that there is no difference in the average social factor scores between water points in the two groups was

rejected. Gardens being a source of livelihoods and income diversification are of great importance to the communities, hence the participation of more vulnerable households in the management and maintenance of the water sources used to water the gardens. The sub-factors which were studied under the social factor were percentage of vulnerable households participating in water management through making financial contributions and number of conflicts recorded at a water point per month. It was noted that the participation of vulnerable households in making financial contributions was higher (86%) where water points were used for multiple uses than where water points were used for domestic purposes only (42%). Participation of vulnerable households was mainly influenced by the establishment of community gardens targeting such households. It was noted that vulnerable households were given garden inputs by NGOs and 90% of them were selling their garden surplus, increasing their capacity to make financial contributions towards O&M.

Water points used for multiple uses had more water use conflicts per month than those used for domestic purposes only. The independent samples t-test show a significant difference in the number of conflicts recorded per month between the two groups ($t = 5.045$, $p = 0.000$). Water use conflicts at water points used for gardening were mainly between garden farmers and non-garden farmers. It was reported that non-garden farmers were sometimes refusing to make financial contributions, attributing breakdowns to the use of water points for gardening. Interview results show that some community members (59%) perceived that using water points for gardening puts pressure on the infrastructure resulting in physical breakdowns. Conflicts between garden farmers and non-garden farmers were also experienced during the dry season when garden farmers continue to water their crops depriving community members of water for domestic purposes.

Influence of multiple uses of water on institutional factors

Water points used for community gardening had an average institutional score of 78.1% while those used for domestic purposes only had 42.7%. The independent samples t-test results showed a significant difference in the average

institutional scores between the two groups ($t = 5.136$, $p = 0.000$), thus rejecting the null hypothesis testing the institutional factor. The sub-factors which were studied under the institutional factor were presence and functionality of WPCs, number of community water management meetings per year, number of WPC meetings per year and the percentage of households attending water management meetings per session. All the water points used for multiple uses had functioning WPCs while 61% of the water points used for domestic purposes only had such committees. All WPCs of water points used for multiple uses were functioning compared to 48% for water points used for domestic purposes only. The Chi square test showed a significant difference in the functionality of WPCs between the two groups ($\chi^2 = 10.09$, $p < 0.01$). The presence and functionality of WPCs is key in the management of water points as the committees organise water management meetings and facilitate the collection and keeping of O&M funds. This also contributed to the high number of community and WPC water management meetings at water points used for multiple uses than those that are used for domestic purposes only.

Influence of multiple uses of water on technical factors

The independent samples t-test results ($t = 4.602$, $p = 0.000$) show a significant difference in the average technical scores between the two groups, resulting in the rejection of the null hypothesis that there is no difference in the average technical scores of water points between the two groups. Maintenance frequency is one of the technical variables which was analysed and the independent samples t-test showed a significant difference in maintenance frequency between water points used for multiple uses and those used for domestic purposes only ($t = 3.482$, $p = 0.001$). The variables which were included under the technical factor were frequency of breakdowns per year and the maintenance frequency per year. The frequency of maintaining water points was high at water points used for multiple uses due to the presence of maintenance committees.

Water points used for multiple uses had more breakdowns per year than those used for domestic purposes only. The independent samples t-test shows a significant difference in the breakdown frequency of water points in the two groups ($t = 6.328$, $p = 0.000$). Key informant interview

results from 54% of the respondents showed that breakdowns were high at water points used for multiple uses during the dry season when the demand for water by garden farmers is high. However, although frequencies of breakdowns were found to be high at water points used for multiple uses, the downtime period was low as garden farmers attended to the breakdowns quickly.

DISCUSSION

This paper sought to explore how the use of drinking water sources to irrigate community gardens as a productive use influences sustainability of water supply systems. There was a distinct sustainability performance of water points used for multiple uses and those used for domestic purposes only. The results showed a statistically significant difference on the sustainability performance of water points across the studied districts.

The independent samples t-test showed that water points used for multiple uses were performing better than those used for domestic purposes only in all the financial variables with a statistically significant difference. However, these results differ from those by *Smits et al. (2010b)* in their study in Honduras where water points which were used for multiple uses were not sustainable due to poor financial performance. The improved financial performance of water points in the current study could be due to the presence of rules on making financial contributions which were found at all the water points used for community gardening. Although gardening may provide small amounts of income per given time, it was noted that the income was considered to be steady as it was coming on a weekly or monthly basis, enabling households to make monthly financial contributions. 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. *Van Koppen et al. (2006)* noted that using domestic water sources for gardening improves the willingness to pay for the O&M costs of water supply systems, showing how financial factors are influenced by multiple uses of water.

Water points used for multiple uses had an average downtime of one week while the downtime for water points used for domestic purposes only was two months.

This result was partially due to the presence of O&M funds at most water points used for multiple uses. Garden farmers across the three districts were giving water point breakdowns urgent attention because long downtimes affect their garden crops. Absence of alternative water sources forced the farmers to give breakdowns immediate attention. On the other hand, where water points were used for domestic purposes only, households were using alternative water sources, hence the prolonged downtime. Some households were using unprotected water sources in their proximity as alternative sources despite the associated health risks. These results resonate with findings by *Demberere et al. (2015)*, where households were reported to be relying on unprotected shallow wells when their protected water sources were not functioning. Availability of alternative water points also contributed to long downtimes in Mt Darwin District of Zimbabwe (*Hoko et al. 2009*). This suggests that the short downtimes for the water points used for community gardening are also due to the socio-economic benefits that the communities derive from the activity. With the current harsh economic climate in Zimbabwe, obtaining food and income for survival are central to household activities. The situation is worse in rural areas under study as households were living far below the poverty datum line. Thus, when communities find themselves rooted in deep poverty, their actions are maximised on livelihood activities, in this case, gardening. This has resulted in the water sources that are used for livelihood activities being better managed than those which are only used for domestic purposes. This result implies that, when implementing water sources for multiple uses, considerations should be given to the livelihood activities which are of importance to the local communities for the water points to be sustained.

Furthermore, more vulnerable households were found to be participating in O&M where water points were used for gardening as they were targeted in the selection of garden farmers. This shows that community gardens created space for inclusion of the poor and vulnerable households in the management of water sources. Therefore, accessing productive use activities, in this case, gardening, is one way that can be scaled up in rural communities of Zimbabwe to address the barriers that hinder the participation of vulnerable and poor households in water management. Such projects should be coupled with capacity building

programmes to enable the households to develop the required skills in productive activities for maximum benefits to be achieved.

Where water points are used for multiple uses, frequencies of water use conflicts were higher than where water points were used for domestic purposes only. This result concurs with results by *Smits et al. (2010b)* in Honduras. Where water points will be used for multiple purposes, domestic purposes have to be prioritised during water-scarce times since access to water is a basic human right. Imparting conflict management skills in the communities may also be a solution to challenges caused by conflicts. Another key finding of the study was the high breakdown frequencies of water points used for multiple uses, especially during the dry season when the demand for water by garden farmers is high. Although this has a negative influence on sustainability, this study argues that this could be solved by putting measures in place to rapidly attend to breakdowns so that communities are not deprived of accessing drinking water.

On socio-economic characteristics of garden participants there was an unbalanced participation of men and women in community gardening. The results concur with findings by *Mutambara et al. (2013)* and *Lovell et al. (2014)* where women participants were about 60% of garden farmers. The inclusion of women in community gardening has the potential to economically capacitate them as the majority were unemployed. Women were found to have two-fold interests in the water points, hence their commitment to make financial contributions. Despite the productive uses, the same water points were also used for domestic purposes. With the results showing that women are the primary water collectors for domestic uses at household level, maintaining the water points through financial contributions is of great benefit to them. It is therefore imperative that although men may participate in community gardening activities, the gender dynamics surrounding the commitment in water point management and maintenance where multiple uses of water is practised have to be considered.

CONCLUSION

This paper has shown that using drinking water sources for multiple uses such as community gardening positively

influences sustainability of water points. Based on the t-tests results of institutional, technical, social and financial factors, there was a significant difference in sustainability performance of water points used for community gardening and those used for domestic purposes only. Generally, water points used for community gardening had functional water user committees and O&M funds as compared to those used for domestic purposes only. The average downtime of water points used for community gardening was lower than that of water points used for domestic purposes only, mainly due to high maintenance frequency of water points used for community gardening. However, it was discovered that using drinking water sources for multiple uses increases the frequency of water use conflicts and water point breakdowns, which negatively impact on sustainability. This means that where water sources will be used for multiple uses, additional management skills and resources may be required for the water points to be sustained.

The foregoing sections show that sustainability of rural water supply systems, which is a rural development challenge in Zimbabwe and other countries in Southern Africa, can be improved by using drinking water points for multiple uses. In light of this, policies and programmes in the water sector should promote the use of drinking water points for productive uses whose relative importance to the water users may influence better management of the water facilities. Where multiple water uses would have been promoted, water practitioners should capacitate the user communities with appropriate skills, especially in conflict management for the benefits of multiple water uses to be maximised.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

DATA AVAILABILITY STATEMENT

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

REFERENCES

- Adanki, M., Van Koppen, B. & Smiths, S. 2012 *Guidelines for Planning and Providing Multiple-use Water Services*. IRC, International Water and Sanitation Centre and International Water Management Institute, The Netherlands.
- Alexander, K. T., Tesfaye, Y., Dreibelbis, R., Abaire, B. & Freeman, M. C. 2015 **Governance and functionality of community water schemes in rural Ethiopia**. *International Journal of Public Health* **60** (8), 977–986.
- Chitongo, L. & Magaya, E. V. 2013 Cooperative gardens and rural development the case of Help German in Gutu Ward 25 Zimbabwe. *Journal of Agriculture and Sustainability* **4** (2), 191–217.
- Demberere, T., Chidziya, T., Manyeruke, N. & Ncozana, T. 2015 **Knowledge and practices regarding water, sanitation and hygiene (WASH) among mothers of under-fives in Mawabeni, Umzingwane District of Zimbabwe**. *Physics and Chemistry of the Earth* **92**, 119–124. Available at: <http://dx.doi.org/10.1016/j.pce.2015.09.013>.
- Fielmua, N. & Mwingyine, D. T. 2015 Reducing rural poverty through multiple-use water services: the women's perspective in north-western Ghana. In *Conference Water and Society*, Milan, Italy, pp. 353–364. Available at: <http://library.witpress.com/viewpaper.asp?pcode=WS15-030-1>
- Government of Zimbabwe. 2013 *Zimbabwe National Water Policy*. Government Printers, Harare, Zimbabwe.
- Hoko, Z., Demberere, T. & Siwadi, J. 2009 An Eevaluation of the sustainability of a water supply project in Mt. Darwin District: Zimbabwe. *Journal of Sustainable Development in Africa* **11** (2), 98–112.
- Kaliba, A. R. M. 2002 *Participatory Evaluation of Community-Based Water and Sanitation Programs: The Case of Central Tanzania*. ProQuest Dissertations and Theses, pp. 155–155. Available at: <http://search.proquest.com/docview/305559668>.
- Kativhu, T., Mazvimavi, D., Tevera, D. & Nhapi, I. 2017 **Factors influencing sustainability of communally-managed water facilities in rural areas of Zimbabwe**. *Journal of Physics and Chemistry of the Earth* **100**, 247–257. Available at <http://dx.doi.org/10.1016/j.pce.2017.04.009>.
- Katsi, L., Siwadi, J., Guzha, E., Makoni, F. S. & Smiths, S. 2007 **Assessment of factors which affect multiple uses of water sources at household level in rural Zimbabwe - A case study of Marondera, Murehwa and Uzumba Maramba Pfungwe districts**. *Physics and Chemistry of the Earth* **32** (15–18), 1157–1166.
- Lovell, R., Husk, K., Bethel, A. & Garside, R. 2014 **What are the health and well-being impacts of community gardening for adults and children: a mixed method systematic review protocol**. *Environmental Evidence* **3** (20), 20–31.
- Makoni, S. F. & Smiths, S. 2007 *Policies and Institutional Framework for Multiple use of Water in Zimbabwe*. MUS Working Paper. IWSD, Harare, Zimbabwe.
- Mutambara, J., Satambara, T. & Masvongo, J. 2013 **Impacts of nutritional gardens on health of communal households; a case study of Nyanga North District**. *Greener Journal of Agricultural Sciences* **3** (7), 579–584.
- Panthie, K. & Bhattarie, S. 2008 *A Framework to Assess Sustainability of Community Based Water Projects Using Multi Criteria Analysis*. Florida International University, Miami Press.
- Peter, G. & Nkambule, S. E. 2012 Factors affecting sustainability of rural water schemes in Swaziland. *Physics and Chemistry of the Earth* **50–52**, 96–204.
- Smiths, S., Mejia, T., Rodriguez, S. & Suazo, D. 2010a **Effects of multiple-use of water on users' livelihoods and sustainability of rural water supply services in Honduras**. *Waterlines* **29** (1), 37–51.
- Smiths, S., van Koppen, B., Moriarty, P. & Butterworth, J. 2010b **Multiple-use services as an alternative to rural water supply services: a characterisation of the approach**. *Water Alternatives* **3** (1), 102–121.
- Van Koppen, B., Moriarty, P. & Boelee, E. 2006 *Multiple-use Water Services to Advance the Millennium Development Goals*. Research report 98. International Water Management Institute, Colombo, Sri Lanka. Available at: <http://search.ebscohost.com/login.aspx?direct=true&db=llh&AN=2009>
- Zimbabwe National Statistics Agency (ZimStat). 2016 *Poverty Analysis – Overview*. World Bank, Washington DC, USA, pp. 1–2.

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