Journal of Sustainable Development in Africa (Volume 14, No.6, 2012)
ISSN: 1520-5509
Clarion University of Pennsylvania, Clarion, Pennsylvania

SUSTAINABILITY OF RURAL WATER SCHEMES IN SWAZILAND

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ABSTRACT

In rural parts of Africa water supply systems serving rural communities are not operational due to breakdown and are eventually abandoned. This is largely due to the traditional approach of Governments to rural water supply. The focus has been on designing and constructing systems based on prescribed needs rather than sustainable development and sustainability of water services. The main objective of the study was to assess the sustainability of rural water schemes in Swaziland using Multi-Criteria Analysis Approach to capture the amalgam of financial, social, technical, environmental and institutional factors which affect sustainability of rural water schemes. The study area is located in the southern part of Lubombo region in Swaziland. Fifteen functional water schemes were studied in eleven communities. A total of 174 heads of households were interviewed using a questionnaire. Information was solicited through observation and focused group discussions. Statistical Package for Social Sciences was used to analyze the data and to calculate sustainability scores for water schemes. Sustainability score ranges from non sustainable (0%-30%), partially sustainable (30%-70%) and sustainable (70%-100%). The results revealed that only one (6.7%) of the water schemes was sustainable. The majorities were either partially sustainable (60%) or unsustainable (33.3%). The study concluded that majorities of the water schemes and water services are not sustainable therefore unlikely to achieve sustainable development in rural water supply. There is need to identify the precise factors which render rural water schemes unsustainable and come up with policy measures and actions to save the current water schemes as well as improve the sustainability of those to be constructed in the future.

Keywords: Millennium Development Goals**,** Multi-Criteria Analysis, Rural Water Schemes, Sustainable development, Sustainability, Swaziland.

INTRODUCTION

Sustainable development is a mode of human development in which resource use, including water, aims at meeting human needs while preserving the environment so that these needs can be met not only in the present but also for generations to come. However, as population grows and economic expansion accelerates and intensifies, the use and abuse of water resources over the past few decades, a greater and greater imbalance between water availability and water demand has resulted. This imbalance has brought a veritable crisis with regard to water in many regions of the world, including but not limited to such problems as widespread water scarcity, water quality deterioration, and the destruction of freshwater resources thus questioning the sustainability of water services. It is projected that by 2025, about 3.5 billion people approximately 6.5 times as many people as in the year 2000 will live in water-stressed countries. The crisis with regard to water also casts a shadow on sustainable development in Africa, Asia and the Pacific regions (Kataoka, 2002).

Since water is a resource that sustains all life on earth and is a key element of sustainable development and sustainability, it is essential if human beings are to enjoy healthy and safe lives or realize social and economic development. Reflecting the importance of sound water management in the promotion of sustainable development, international and regional conferences highlight water issues as a priority area for achieving sustainable development (Kataoka, 2002). Likewise, the United Nations has long been addressing the global crisis caused by insufficient water supply to satisfy basic human needs and growing demands on the world's water resources to meet human, commercial and agricultural needs. The crucial importance of water to so many aspects of human health, development and well-being led to the inclusion of a specific water-related target in the Millennium Development Goals (MDGs). At the same time, every target of the MDGs depends on the achievement of the water and sanitation target: eradicating extreme poverty and hunger; achieving universal primary education; promoting gender equality and empowering women; reducing child mortality; improving maternal health; combating HIV, AIDS, malaria and other diseases; and ensuring environmental sustainability (Millennium Development Goals Report, 2010).
However, in sub-Saharan Africa, 30% of the water supply systems serving rural communities are not operational as they have broken down and eventually abandoned. In many African countries an operational failure rate of between 30% - 60% has been observed (Carter and Howsam, 1999).

Such failure has been attributed to the traditional approach of focusing on building water facilities rather than focusing on the importance of involving communities in all aspects of water service delivery, the use of appropriate technologies and the role of governments as service promoter than provider so as to achieve sustainable development. This traditional approach has resulted in water services that have not been sustained (Sara et. al. 2008). Unless sustainability levels are improved and change to new approach, the Millennium Development Goal 7 target to reduce the proportion of people without access to safe water will not be achieved. Lack of community management has been identified as the main factor responsible for the failure of the water schemes in most African countries (Harvey and Reed, 2006). It has also been noted that community participation in some parts of Africa has not been able to solve the problem of unsustainable water services. Reasons given for the low levels of sustainability are related to community issues such as: limited demand, lack affordability or acceptability, ownership and limited community management structures.

In Swaziland, 22.9% (national) and 27.9% (Lubombo region, the study area) of the water schemes were non-functional (Government of Swaziland (GOS), Rural Water Supply Board, 2005). The high proportion of non-functional schemes questions the approach to sustainable development and sustainability of water schemes in the country. Previous studies in the country focused on the assessment of the impact of water schemes on health or food security (Peter, 2010 and Manyatsi, 2004) or on how individual variables like community participation affect sustainability of the water schemes (Hlophe, 2004 and Ndwandwe, 2005). There is a whole amalgam of factors which affect the sustainability of water schemes, including: financial, institutional, technical and social/environmental aspects (Panthie and Bhattarie, 2006). Assessment of sustainability of water schemes requires a holistic approach which considers all possible factors. The main objective of this study was to address this limitation by assessing the sustainability of rural water schemes in Swaziland using a Multi-Criteria Approach.

METHODOLOGY

Study area

The study was based in Swaziland, a small country in Southern Africa located between latitudes 25^0 39’ N. and 27^0 25’ S. and longitudes 30^0 48’ E. and 32^0 10’ E. The country has an estimated area of 17,364 km^2 with four administrative regions: Hhohho, Manzini, Shiselweni and Lubombo. The study was conducted in the southern part of Lubombo region (Figure1). Lubombo region is basically a plateau, with average temperatures of about 28^0c and receives rainfall that ranges between 500mm to 800mm. There are three major rivers: Mbuluzi, Usuthu and Ingwavuma and four dams (Sand river dam, Mjoli, Nyetane and Hedrick van Eck dam). The dams are mainly used for large scale sugar cane irrigation in Big Bend, Simunye and Mhlume plantations. A total of 11 communities with functioning water schemes were purposefully selected. The selected communities were: *Madubeni, Sigcaweni, Mdumezulu, Mambane, Sibusisweni, Nsubane, Mbutfu, Victoria, Magedeni, Madzakeni* and *Mdabukeni* (figure 2).

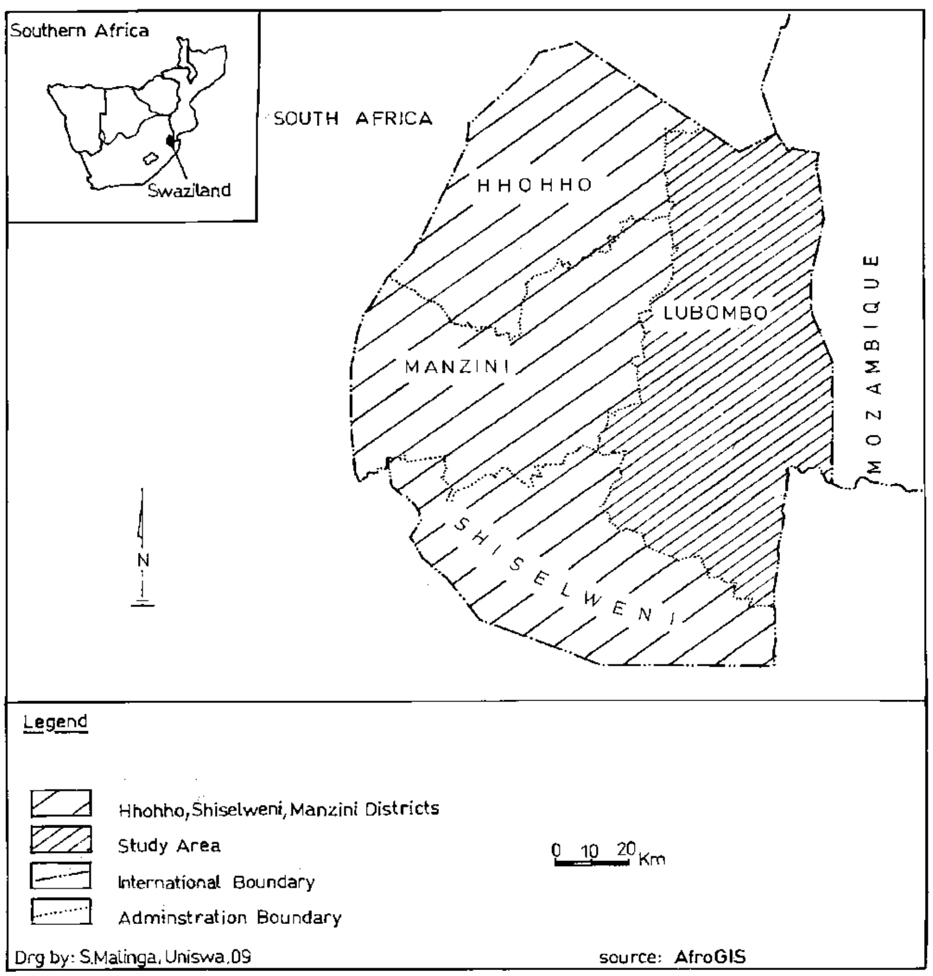

Figure 1: Swaziland administrative regions and study area

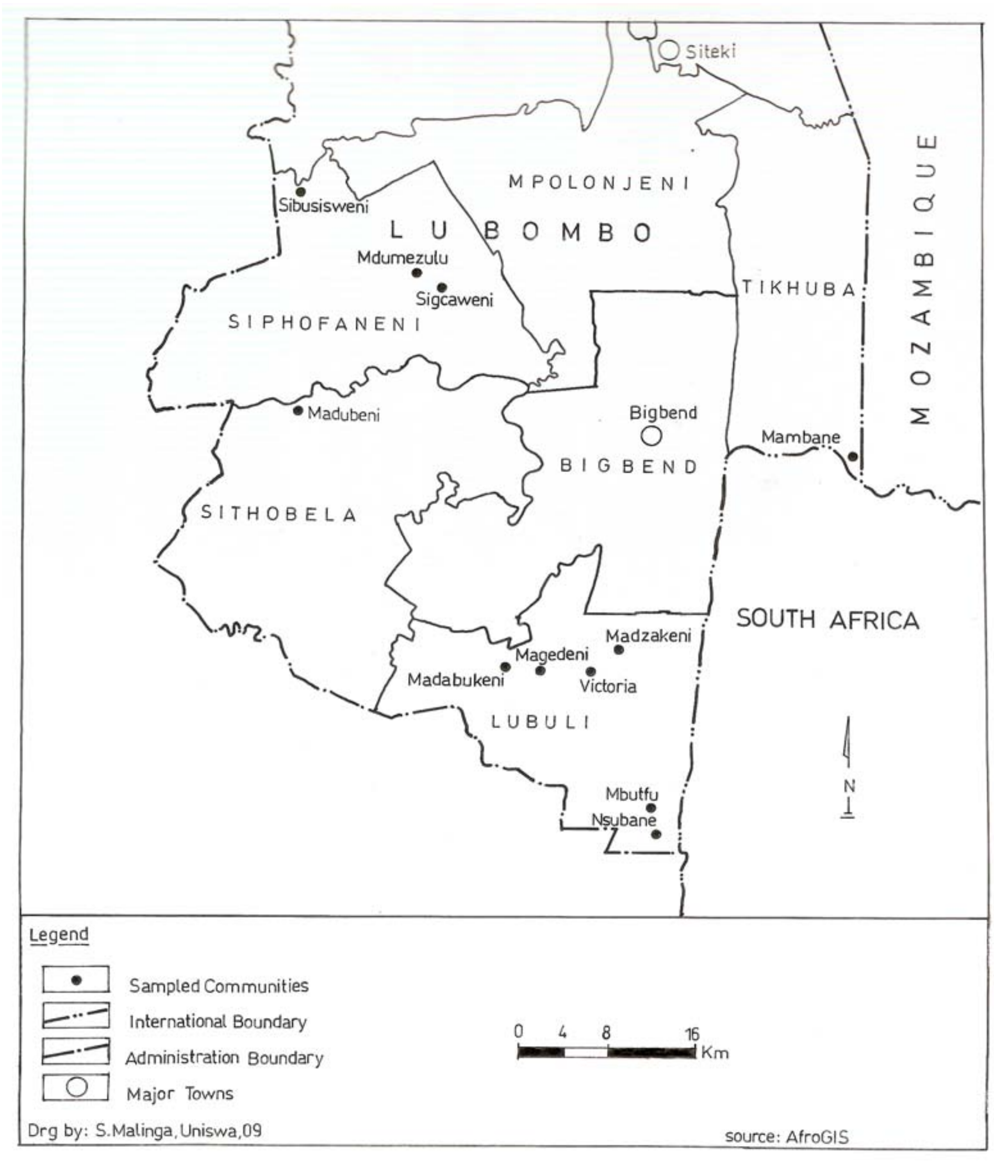

Figure 2: Study area and sampled communities

Study approach

A Multi- Criteria Approach adopted from Panthie and Bhattarie (2006) was slightly modified to fit the situation in Swaziland and applied in this study. The Multi-criteria Approach is a sustainability monitoring framework which consists of four criteria: financial, social, technical and institutional. The four main criteria used were further separated into thirteen factors and twenty-six sub-factors aspects on crucial aspects of water projects (Table1). The sub-factors were the main variables assessed to establish the sustainability of the water schemes. The sub-factors (variables) were assigned weights (Table2) and rated during field survey on a five point scale: excellent (80-100%), very good (70-79%), good (50-59), fair (30-49), and poor (< 30). Each variable rate was then multiplied by the weight of the variable to establish the score for the variable. In each water project assessed, the scores for all variables were added together to give the sustainability score of the individual project (Table 3). Sustainability scores range from 0 (un-sustainable) – 100 (highly sustainable). The scores for the individual projects were classified in the following manner: below 30% (not sustainable); 30-69% (partially sustainable); and 70-100% (sustainable) (Table 5).

Table 1: Criteria, factors and sub-factors used to assess sustainability of water projects

Criteria	**Factors**	**Sub-factors**
A1: Technical	A1.1:Source yield & quality	A1.1.1: Reliability, adequacy, depletion A1.1.2: Water quality at source A1.1.3: Accessibility, chance of contamination & conflict
	A1.2: Physical condition of system	A1.2.1: Design adequacy, site & technology A1.2.2: Condition and functionality of system A1.2.3: Natural threat to physical system
	A 1.3: Water point functioning	A1.3.1: Maintain design flow A1.3.2: Water quality A1.3.3: Maintaining design flow
	A1.4: Meeting demand	A1.4.1: Water fetching time A1.4.2: Status of meeting additional demand
A2: Social / Environmental	A2.1: Use of water facility	A2.1.1: Status of use by population
	A2.2: Community participation	A2.2.1: Decision making, operation & maintenance
	A2.3: Environmental	A2.3.1: Mitigation measures & drainage
	A2.4: Social inclusion & equity	A2.4.1: Inclusion (ethnic groups) A2.4.2: Equity (men, women)
A3: Financial	A3.1: Availability of fund	A3.1.1: Establishment of O & M fund A3.1.2: Regularity and saving
	A3.2: Use of fund	A3.2.1: Use of savings/surplus fund
A4: Institutional	A4.1: Users' committee	A4.1.1: Existence, functioning & meetings A4.1.2: Ownership of scheme & activities A4.1.3: Representation on committee
	A4.2: Maintenance committee/caretaker	A4.2.1: Existence of the committee A4.2.2: Functioning of the committee
	A4.3: Coordination & linkage	A4.3.1: Co- ordination with local leaders A4.3.2 Training & external support

Source: Panthie and Bhattarie (2006)

Table 2: Weights assigned to the variables (factors) assessed in each water scheme.

Criteria	Factors	Sub-factors	Weights
A1: Technical	A1.1:Source yield & quality	A1.1.1: Reliability, adequacy, depletion A1.1.2: Water quality at source A1.1.3: Accessibility, chance of contamination & conflict	0.054 0.023 0.023
	A1.2: Physical condition of system	A1.2.1: Design adequacy, site & technology A1.2.2: Condition and functionality of system A1.2.3: Natural threat to physical system	0.008 0.054 0.038
	A 1.3: Water point functioning	A1.3.1: Maintain design flow A1.3.2: Water quality A1.3.3: Maintaining design flow	0.12 0.04 0.04
	A1.4: Meeting demand	A1.4.1: Water fetching time A1.4.2: Status of meeting additional demand	0.07 0.03
A2:Social/ Environmental	A2.1: Use of water facility	A2.1.1: Status of use by population	0.0
	A2.2: Community participation	A2.2.1:Decision making, operation & maintenance	0.05
	A2.3: Environmental	A2.3.1: Mitigation measures & drainage	0.05
	A2.4:Social inclusion/equity	A2.4.1: Inclusion (ethnic groups) A2.4.2: Equity (men, women)	N/a 0.05
A3: Financial	A3.1:Availability of fund	A3.1.1: Establishment of O & M fund A3.1.2: Regularity and saving	0.025 0.01
	A3.2:Use of fund	A3.2.1: Use of savings/surplus fund	0.02
A4: Institutional	A4.1:Users' committee	A4.1.1: Existence, functioning & meetings A4.1.2: Ownership of scheme & activities A4.1.3: Representation on committee	0.02 0.03 0.03
	A4.2:Maintenance committee	A4.2.1: Existence of the committee A4.2.2: Functioning of the committee	0.025 0.025
	A4.3:Coordination & linkage	A4.3.1: Co- ordination with local leaders A4.3.2 Training & external support	0.025 0.025

Methods of data collection, sampling and analysis

From the 11 communities selected, 15 functional water projects were purposely sampled and 174 households using the water sources were conveniently selected and interviewed using a questionnaire. The questionnaire solicited information on: reliability of the water; water fetching time; whether demand was met; O&M fund and its use; whether attended meeting. The technical aspects of the selected water projects were observed and recorded during the survey using a checklist. Focus group discussions (FGDs) were held with women, men and water committee members using a discussion guide and collected information on: decision making on O&M; mitigation measures, equity; regularity and saving; ownership of schemes and activities; representation on committees; coordination with local leaders and training and external support.

Data was analyzed using Statistical Package for Social Scientists (SPSS) and the results summarized in tables. Results from household interview, FGDs and observation checklists were used to finalize the rating of the variables studied. The rate of each variable was then multiplied by its weight to get the variable scores. The variable scores were then added to get the sustainability score for the individual scheme (Table3).

Table 3: The calculation of variable scores and sustainability score for *Madzakeni* 1 water project.

Variables	Weights	Rating	Rating × weight	Score
A 111: Reliability/depletion /adequacy	0.054	51	0.054×51	2.8
A 112: Water quality at source	0.023	55	0.023×55	1.3
A 113: Accessibility, chance of contamination,& conflict	0.023	68	0.023×68	1.6
A121: Design adequacy, site & technology	0.008	58	0.008×58	0.5
A122: Condition, functionality of system	0.054	90	0.054×90	4.9
A123: Natural threat to physical system	0.038	95	0.038×95	3.6
A131: Maintain design flow	0.12	70	0.12×70	8.4
A132: Water quality	0.04	40	0.04×40	1.6
A133: Surroundings/drainage system.	0.04	56	0.04×56	2.2
A141: Water fetching time.	0.07	70	0.07×70	5
A142: Status of meeting additional demand.	0.03	78	0.03×78	2.3
A211: Status of use by population.	0.1	88	0.1×88	8.8
A221. Decision making operation and maintenance.	0.05	70	0.05×70	3.5
A231: Mitigation measure& drainage	0.05	80	0.05×80	4
A242: Equity (men & women)	0.05	88	0.05×88	4.5
A311: Establishment of O&M fund	0.025	70	0.025×70	1.8
A312: Regularity and saving.	0.015	53	0.015×53	0.8
A321: Use of savings/surplus fund	0.01	42	0.01×42	0.4
A411: Existence, functioning and meetings.	0.02	90	0.02×90	1.8
A412: Ownership of scheme & activities	0.03	85	0.03×85	2.6
A413: Representation on committee.	0.03	70	0.03×70	2.1
A421: Existence (maintenance committee)	0.03	90	0.03×90	2.7
A422: Functioning	0.03	60	0.03×60	1.8
A431: Coordination with local leaders	0.025	83	0.025×83	2.1
A432: Training & external support	0.025	59	0.025×59	1.5
Sustainability score				**72.5%**

RESULTS AND DISCUSSION

Based on the results (Table 4), sustainability scores for the 15 water projects studied ranged from as a low as 21.8% (*Victoria 1*) to as high as 72.5 % (*Madzakeni* 1). Based on the framework used, sustainability scores range from zero to 100 percent. The lower the percentage scored, the lower the sustainability levels of the scheme and the higher the percentage score, the higher the sustainability level of that particular scheme. The classification of sustainability scores attained by individual water project was arranged into three categories of sustainability levels: < 30 % (not sustainable); 30-69 % (partially sustainable) and 70-100 % (sustainable) showed that only 1 (6.7%) of the 15 schemes was sustainable (M*adzakeni 1*).

Table 5 Sustainability scores and status of water projects under study

Project Number / Name	**Project score (%)**	**Sustainability status**
1. *Mhlangeni*	41.7	Partially Sustainable
2. *Madzakeni 2*	45.4	Partially Sustainable
3. *Makilogo*	45.1	Partially Sustainable
4. *Sikhaleni*	22.8	Not Sustainable
5. *Madabukeni*	51.5	Partially Sustainable
6. *Madubeni2*	62.8	Partially Sustainable
7. *.Magedeni*	57	Partially Sustainable
8. *Madubeni 1*	55.5	Partially Sustainable
9. *Victoria 1*	21.8	Not Sustainable
10. *Ka-Ndwandwe*	22.4	Not Sustainable
11. *Msabane*	31.4	Partially Sustainable
12. *Kholwane*	29.6	Not Sustainable
13. *Kudzaka*	26.6	Not Sustainable
14. *Madzakeni 1*	72.5	Sustainable
15. *Mbahane*	31.2	Partially Sustainable

The results on the sustainability scores and status of the water projects assessed (Table 5) shows the majority of the schemes were either partially sustainable, 9 (60%) or not sustainable, 5 (33.3%). The sustainability score of the only one sustainable water project was not very high (72.5%), and among those partially sustainable their sustainability score were very low and likely to drop into the unsustainable category. These results partly explain the observed high proportion of water projects which were not functioning both at national and regional levels in the country (GOS, Rural Water Supply Board, 2005).

An earlier study (Mwendera, 2006) showed Swaziland had made significant progress towards meeting the national targets of providing water and sanitation to the entire rural population and was likely to achieve 100% coverage of both water supply and sanitation by the year 2022. UNICEF and WHO (2008) also noted that coverage of improved drinking water had increased to 60% national and 51% rural. The message from these earlier studies is that Swaziland is on track and likely to achieve the Millennium Development Goal (MDG) to halve the proportion of people without sustainable access to safe drinking water and basic sanitation by 2015. However, the high percentage of unsustainable water projects and observed mal-functional water projects nationally depicts the use of the traditional top down approach and focus on providing more water schemes rather than the sustainable use of the existing water sources. In order to achieve sustainable development, the water supply must be sustainable.

Table 4: Summary of variable and sustainability scores for sampled water schemes

Variables	Sampled Water Schemes (Numbered 1 – 15)														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
A 1.1.1	1.7	2.3	2.7	1.6	2.2	2.3	1.6	2.6	1.9	1.6	2.2	2.3	1.5	2.8	2.6
A 1.1.2	0.7	1.2	0.9	1.3	1.6	1.3	0.9	1	0.9	0.8	1.3	0.9	0.7	1.3	0.9
A 1.1.3	1.4	1.4	1.6	1	1.5	1.4	1.3	1.4	1.3	1.3	1.6	1.6	1.4	1.6	1.4
A 1.2.1	0.5	0.5	0.5	0.3	0.4	0.4	0.4	0.3	0.5	0.4	0.5	0.3	0.5	0.5	0.4
A 1.2.2	2.4	4.3	3.8	1.8	4	3.2	3.2	4.1	3.2	2.8	3.2	2.4	2.5	4.9	3
A 1.2.3	3	1.4	3.8	2.3	3	3.6	3.4	3.3	3.4	3.4	3.4	3.5	3.5	3.6	3.4
A 1.3.1	3.6	5.3	5.4	2.4	3.5	2.4	3.6	9.1	0	0	7	6.6	4.8	8.4	3.6
A 1.3.2	1.6	1.2	1.7	1.5	1.6	1.8	1.5	2	2.3	0.8	1.6	1.6	1.5	1.6	2
A 1.3.3	0.8	1.2	1.4	0.8	2.2	1.3	1.6	2.3	1.2	0.4	2.2	1.5	1.2	2.2	1.8
A 1.4.1	4.2	3.4	0	0	4.8	5.6	5	4.6	0	0	0	0	0	5	0
A 1.4.2	1.2	1.6	1.1	0.9	1.3	1.2	2.2	1.1	1.2	1.8	1.7	0.9	0.9	2.3	0.9
A 2.1.1	4	5.8	3.3	3	7.3	9	7	5	4.6	5	0	4.1	3.8	8.8	5
A 2.2.1	2.3	3.7	2.9	0.5	2.3	3.6	3.1	2.4	0	1.5	1.4	1.3	1	3.5	1.9
A 2.3.1	3	3.1	2.9	1	3.8	4	3.9	3	0	0	2	0	0	4	0
A 2.4.2	2.8	3.7	2.4	1.5	3	4.8	2.8	3.1	1	2	2.9	2	3	4.4	3.1
A 3.1.1	1.7	1	1.5	1.3	1.4	1.7	1.7	1	0	0	1	0	0	1.8	0
A 3.1.2	0.6	1.1	0.5	0.5	0.7	0.6	0.6	0.7	0	0	1.5	0	0	0.8	0
A 3.2.1	0.7	0.8	0.7	0.3	0.7	0.7	0.7	0.5	0	0	0	0	0	0.4	0
A 4.1.1	1	0.9	1.2	0	1.5	1.6	1.4	1.4	0	0	0	0	0	1.8	0
A 4.1.2	2	2.3	1.7	0.8	1.4	2	1.8	2.3	0.3	0.6	0	0.3	0.3	2.6	1.2
A 4.1.3	1.3	0	2.3	0	1.7	2.3	2	2.3	0	0	0.8	0	0	2.1	0
A 4.2.1	0	0	0	0	0	2.6	2.3	0	0	0	0	0	0	2.7	0
A 4.2.2	0	0	0	0	0	1.8	1.7	0	0	0	0	0	0	1.8	0
A 4.3.1	1.2	1.4	1.1	0	1.7	1.8	1.5	2	0	0	0	0	0	2.1	0
A 4.3.2	0	0	0	0	0	1.8	1.8	0	0	0	0	0.3	0	1.5	0
Total (%)	**41.7**	**45.4**	**45.1**	**22.8**	**51.5**	**62.8**	**57**	**55.5**	**21.8**	**22.4**	**31.4**	**29.6**	**26.6**	**72.5**	**31.2**

CONCLUSIONS AND RECOMMENDATIONS

Water availability is an essential component in socio-economic development and sustainable development, therefore must be sustainable. Majorities of the water projects in Lubombo region (study area) were not sustainable, which is a major challenge for the country. This implies that sustainable development cannot be achieved without sustainability in the use of water in the country. As the water projects are not sustainable, they are not likely to perform well and will eventually collapse like the many others in the country. The high percentage of un-sustainable water projects and observed mal-functional water projects nationally and in the study region will limit the achievement of the MDG to halve the proportion of people without sustainable access to safe drinking water. For the country to achieve this MDG and ensure sustainable development, there is need to look into measures, including policy interventions, that will make the existing water projects more sustainable. Further research and analysis is needed to establish the factors that affect sustainability of rural water projects.

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