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Indicators Which Attest Sustainability of Rural Water Project in Provision of Domestic Water: A Case of Ngara District Council in Kagera Region

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Abstract:
Sustainability of domestic water provision in households was carried out in Ngara District Council. Mainly focus on the indicators which attest sustainability of rural water project in provision of domestic water. A cross sectional research design was adopted involving administration of the structured questionnaire to both primary and secondary partners, complemented by relevant documentation from various levels of stakeholders in the study area. Statistical package for social science (SPSS) software was used in data analysis. The study revealed that, rural water projects were run on partnership with majority (more than 95%) of investment cost borne by the donors, while supposedly all (100%) of operational and maintenance cost borne by users, were not sustainable. Lack of fund for repair and maintenance, increasing the sabotage of the water resources, climatic change and variability and poor community participation were found to be key factors to sustainability of rural water projects. It has been strongly affirmed basing on the findings that, sustainability of rural water projects mainly relied on the operation and maintenance of water project. Generally, local community at which the water project is implemented need to actively participate for sustainability of water project.

Keywords: *Domestic water and sustainability of water project*

1. Background Information

Access to potable water is a basic need and its availability for consumer satisfaction is vital for sustainable development and a fundamental human right as enshrined in international declarations and conventions on human rights. UN Committee on Economic, Cultural and Social Rights in 2003, has stated that 'The human right to water entitles everyone to sufficient, affordable, physically accessible, safe and acceptable water for personal and domestic use' (Lane, 2004). The financial resources need to be accessible on the management and control of water resources for human consumption (UNEP, 2011).

However, at the start of the new millennium, over one billion people around the world did not have access to a safe and reliable supply of water even the existing water source become hardly to attain regular repair and maintenance (Wood, 2000). In addition (Baur, 2009) in their study on enhancing private sector participation in rural water supply state that, the number of people without an improved water supply in rural Africa was six times greater than that of the urban population. The importance of safe water to human development has again been substantiated in the Millennium Development Goals (MDGs), as one of the goals seek to reduce the proportion of people who lack potable water by the end of 2015 while addressing aspects of good management of water resources.

The global water crisis is a growing concern in our world today and continues to increase with population pressure and increasing demand. In recent statistic, about one fifth of the world's population lacks adequate access to clean water while the demand of the crises is distributed unevenly across the globe (Sun et al, 2010). The stress can be felt around the world, in both developing and developed countries. The evidence of the water crises is blatantly apparent in the developing world today; with current number showing nearly 2.5 billion people almost 50% of the developing world's population, lacking adequate access to sustainable safe and clean water (Baur, 2009).

In Africa, the number of people in rural area without an improved water supply is growing compared with urban. This directly affect the welfare of rural people, lack of access to sustainable safe drinking water also has indirect negative effects, such as reduced productivity in Agriculture and other sectors.

In Tanzania, currently statistics indicate that, 46% of Tanzanians do not have access to clean and safe drinking water, while 60% of rural population does not have access to clean and safe drinking water (Simberya, 2013). Water shortage has impact to the wellbeing and economic activities of the community; it leads to poor sanitation, lack of safe drinking water and overcrowding at water sources. The government in collaboration with different stakeholders such as Donors, Community Based Organization and Non-Governmental Organizations has maintained different efforts to minimize the problem of sustainable water supply to the people. Those efforts were supported by the Agenda 21 of Reo de Janeiro in 1992 and Development of a comprehensive framework for sustainable development and management of the Nation's water resource which could ensure full participation of beneficiaries in planning, construction, operation, maintenance and management of community based domestic water supply scheme (URT, 2006). Although Tanzania has Institutions, Policies and Regulations in place to promote proper water management, the country still faces the water stress situation related to water scarcity in different areas of the country especially in rural area. Thus, it is more important to assess the sustainability of rural water projects in provision domestic water in the household associate the implementation of the National Water Supply Policy 2002 to ensure sustainable development as stipulated in Government Development Vision 2015.

2. Materials and Method

The study was conducted in 2016 in Ngara District Council in two villages namely; Rwakalemera and Ngundusi. Ngara District is one of the seven districts of Kagera Region in the very West of mainland Tanzania. In north it is bordering the Republics of Rwanda and Burundi, Karagwe District in east, Biharamulo District in south and Kakonko District in west.
According to census of 2012, Population of the two villages was 9,494 districts have a total population of 320,056 with household average of 4.8 persons per house (URT, 2013). The main economic activities of the inhabitants are crops cultivation and livestock production. Crops cultivated include maize, beans, coffee and banana while livestock including cow, sheep and goat are available.

A non- experimental (cross-sectional) research design was adopted. The study used a combination of both probability and non-probability sampling techniques. The probability sampling techniques included cluster, simple random and systematic sampling procedure were used to collect respondents from respective areas. Cluster sampling procedure was applied where the settlements were not evenly distributed but settled in clustered households near the water projects. Simple random sampling was applied within the clusters to randomly pick the first household for administration of questionnaires. The first household was randomly identified; Systematic sampling procedure was used to collect data through questionnaires in the subsequent households within the cluster. The systematic procedure was continually applied where the settlements exist in some linear order and a total number of 99 respondents were obtained. Data were collected through administered structured questionnaires, observations, interview of key informants and documentary reviews. Checklists and observation kits were used for interviews and key informants. Data collected were summarized, coded and analyzed both qualitatively and quantitatively. Statistical Package for Social Science (SPSS) programme version 20.0 and simple regression model were used to analyze qualitative data.

A simple regression model to study the relationship between consumer satisfaction, operation and maintenance and financial management in sustainability of rural water projects. The study believes that regression method was useful to test the nature of independent variable on how influences the dependent variable. Regression was estimated the coefficients of the linear equation which involving more than one independent variables to predict the value of the dependent variable.
The regression model was as follows:
Where: Y = measure of sustainability (dependent variable);
β_0. β_3 = intercept and slope terms; X_1=Consumer satisfaction, X_2 = Operation and maintenance, X_3= Financial management; and = stochastic [random] error term.

3. Findings and Discussion

4.1. An Overview

This chapter presents the findings and discussion of the study on the sustainability of rural water projects in provision domestic water in the households. The chapter first is presented by profile of the respondents and the indicators which attest sustainability of rural water project in domestic water provision

4.2. Profile of the Respondents

In order to have a wide view of respondents it is important to consider factors like sex, age - group, education level, marital status and occupation of respondents to ensure validity and reliability of the study findings.

4.2.1. Respondent Distribution by Sex and Marital Status

Results showed that 53(53.5%) and 46(46.5%) of the respondents were female and male respectively refer (Table 1), this indicates that female participated more on provision of information concerning the sustainability of rural water projects in provision domestic water in the households. Similar observation being reported by Sanders and Fitts (2011) that females tend to engage in social activity and even unpaid one also female are the main user of water in the household. From this observation with respect to sustainability, women play various roles related to provision, management and safeguarding of water resources. In most cases women spends more time in the environment, this is the opportunity if taped well for the sustainability of water project the various water project expected to produce benefit in sustainable manner for the entire local community. Also, Kwena and Moronge, (2015) found that women are also responsible to collect water for various family uses, it means are mostly contacting with the water project most frequently, in that respect are more related to the management, maintenance and even controlling of water project while respondents distributed by marital status indicates that 90(90.9%) of the respondents were married; married respondents are serious as key water users. A small proportional 4(4%) of respondents were single and 2(2%) were divorced, 2(2%) were separated and widows accounted for 1(1%) of respondents. This information collected on the sustainability of rural water projects in provision domestic water in the households. It indicates that marital status balance helped to avoid biasness the study conducted by Haysom (2006) found that problem related to safe and clean water sustainability in rural areas are almost associated with married respondents that appeared to be more because are the key water use at the household level.

Sex	**Marital Status**					**Total**
	Single	Married	Divorced	Widower	Separate	
Male	2(2%)	42(42.4%)	0(0%)	0(0%)	2(2%)	46(46.5%)
Female	2(2%)	48(48.5%)	2(2%)	1(1%)	0(0%)	53(53.5%)
Total	4(4%)	90(90.9%)	2(2%)	1(1%)	2(2%)	99(100%)

Table 1: Sex and Marital Status of Respondents

4.2.2. Age Group and Level of Education of Respondents

Finding showed that 44(44.4%) of the respondents were found in the age group of 31-40 years compared to 13(13.1%) of the respondents fall in the age group of 51-60 years refer (Table 2). This indicates that people of different age groups provided information on the sustainability of rural water projects in provision domestic water in the households. Also, the active and energetic age were appeared to provide information on the factors affecting water supply in rural area. Similarly, the study conducted by Clarke (2004) found that Seeking for safe and clean water is the responsibility of the active age group in the rural community for food preparation and even cattle drinking. Therefore, respondents from age group of 31-40 years appeared majority due to the fact that sustainability of water supply in rural areas tends to be collected by the active age group to search for solution. But the findings distribution of education level indicates a large proportional 51(51.5%) of respondents had primary education level, followed by 32(32.3%) of respondents who had secondary education. These because primary education is basic and compulsory in Tanzania, also 2(2%) not educated, 10 (10.1%) had certificate, 3(3%) had diploma and 1(1%) had bachelor degree education level. These findings indicate that local community level of education is the main obstacle to water sustainability in rural area projects. This is congruent with Morita and Hiroko (2008) who observed that community members with lower level of education become the barriers in achieving the sustainability of rural water project, that at least community members with technical knowledge that relate with project repair and maintenance.

Education Level	**Age Group**				**Total**
	21-30	31-40	41-50	51-60	
Informal Education	0(0%)	0(0%)	0(0%)	2(2%)	2(2%)
Primary Education	3(3%)	27(27.3%)	18(18.2%)	3(3%)	51(51.5%)
Secondary Education	2(2%)	12(12%)	13(13%)	5(5%)	32(32.3%)
Certificate	3(3%)	4(4%)	1(1%)	2(2%)	10(10%)
Diploma	1(1%)	1(1%)	0(0%)	1(1%)	3(3%)
Bachelor Degree +	0(0%)	0(0%)	1(1%)	0(0%)	1(1%)
Total	9(9%)	44(44.4%)	33(33.3%)	13(13%)	99(100%)

Table 1: Age Group and Level of Education of Respondents

4.2.3. Occupation of the Respondents

The findings on Figure 1 shows that a large proportional (44.44%) of respondents were farmers, entrepreneurship was (37.37%), employed (11.11%) and a small proportional (7.07%) were self-employed respectively. These findings imply that farmers are the main use of water in various source therefore factors for sustainability of water resources are important to consider these group. As Doungmanee (2016) reported that water use for agricultural purposes usually takes (70%) is in

the agricultural sector. The water conflicts among all types of water users mainly dominated with farmers and pastoralists in agriculture sector in general.

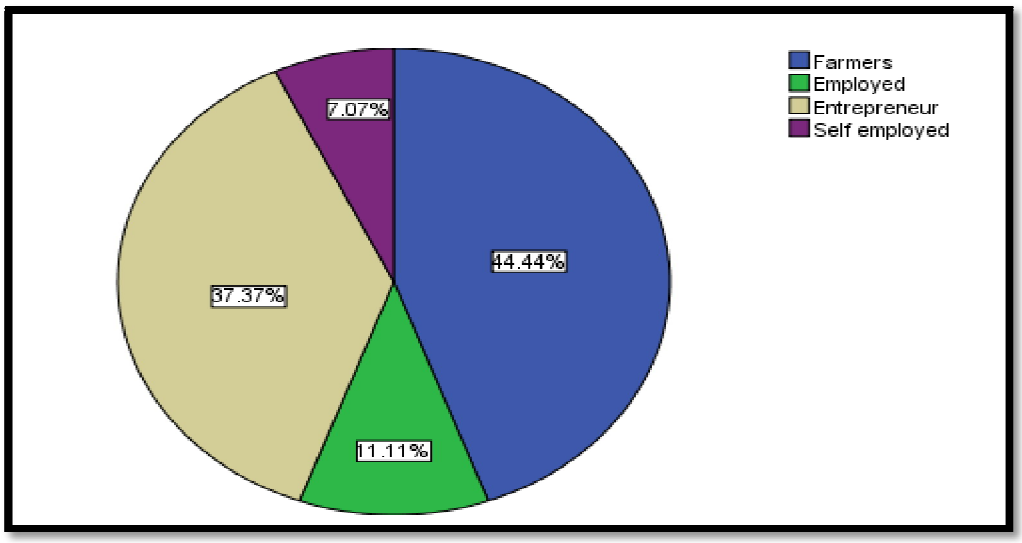

Figure 1: Occupation of the Respondents

4.3. Indicators for Sustainability of Rural Water Project in Domestic Water Provision

This section presents the regression estimates on the indicators for sustainability of rural water projects as follows;

4.3.1. Regression Estimates on Indicators for Sustainability of Rural Water Project

The regression analysis was run to test on the existence of relationship between the consumer satisfaction, operation and maintenance and financial management on the water project sustainability in the rural context.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
	(Constant)	3.258	.422		7.728	.000		
	Consumer satisfaction	-1.131	.193	-.482	-5.867	.000	.968	1.033
	Operation and maintenance	.781	.158	.410	4.943	.000	.952	1.050
	Financial management	-.540	.235	-.187	-2.294	.024	.983	1.018

Table 2: Regression Estimates on Indicators for Sustainability of Rural Water Project

4.3.2. Consumer Satisfaction

The coefficient of consumer satisfaction (CS) in the regression was -1.131 which implies that consumer satisfaction has no relationship with sustainability of water project, in other way around, increasing or decreasing consumer satisfaction does relate with increasing or decreasing sustainability of rural water project. It means that consumer satisfaction variable rejected at the regression model. These findings are contrary with that of UNEP (2011) pointed out that increase in access of water for consumer satisfaction are mostly connected to sustainable development, under the respective water intervention.

4.3.3. Operation and Maintenance

The regression coefficient of operation and maintenance in the regression was 0.781 which implies that project beneficiaries upon concentration on maintenance and operation of the water project expected to increase its sustainability. There is a positive relationship between the operation and maintenance of water project and its sustainability impact in the rural area where the project implemented. It means that operation and maintenance variable was accepted on the regression model, to influence water project sustainability in the local area context. As Wood, (2000) observed similar findings that regular repair and maintenance of the water project are connected with access to a safe and reliable supply of water even the existing water source become sustainable for the local people consumption.

4.3.4. Financial Management

The coefficient regression of financial management was -0.540 in the regression, this indicates that there is a negative relationship between financial management and sustainability of rural water project, or in other ways around sustainability of rural water project mostly is not connected to financial management, it means that financial management rejected in the regression model, in fact it does not necessary means that sustainability of rural water project connected to its financial management. Also, Samra (2006) found that being effective in the management of water project fund increases the chance of sustainability and failure to do so water project become in a chance of collapse before the second phase of evaluation.

4.3.5. General Observation

The VIF ranged from 1.018 to 1.050, starting from Financial management (FM) =1.018, Consumer satisfaction (CS) = 1.033 and Operation and maintenance (OM) = 1.050. These imply that each variable had some correlations with independent variables, but operation and maintenance appear to correlate more with independent variables in the regression.

4.3.6. Multicollinearity Test

The tolerance ranges from 0.952 to 0.983, Where Financial management (FM) = 0.983 Consumer satisfaction (CS) = 0.968 and operation and maintenance (OM) = 0.952. This implies that there was no problem of Multicollinearity. It is the general fact that Multicollinearity problem is presence for the tolerance less than 0.1.

The ascertained regression equation is:

Rural water project sustainability = 3.258 + -1.131 CS + 0.781 OM + -0.540 FM

4.3.7. The R Square Test

In these regressions other tests were used; the R square test ($R^{2)}$. The R^2 found to be = 0.379 which implies that impact of the independent and control variables included in the model on rural water project sustainability was weak. The impact of independent variables to dependent variables was 37.9% in the regression, but the rest is influenced by others factors.

In line with these findings IRC, (2011) reported that water committee need to supervise the various activities more specially maintenance and repair of the water intervention periodically and even to mobilize community effort to rectify problems based on the water projects.

4.3.8. Factors for Sustainability of Rural Water Project

The findings on Table 6 showed the factors for sustainability of rural water project, under the use of multiple responses analysis, a large proportional 92.9% suggested on the demand and supply of water, followed by 76.8% on the ability of contributing and a small proportional 43.4% suggested on the reliability of sources of water. Similar observation also reported on the overall percent in the multiple responses results. From these findings it has been deduced that sustainability of rural water mostly affected by the demand and supply of water, it is important to observe on the ability of the project to supply water, in relation to the demand or consumption levels of water users. The sustainability is mostly affected on the failure to control the water uses that reflect the demand, it is important to control the demand while maintaining the water supply based on the population requirement.

Factors	Frequency	Overall %	Individual case
Reliability of sources of water	43	20.4	43.4
Ability of contributing	76	36	76.8
Demand and supply of water	92	43.6	92.9
Total	211	100.0	

Table 3: Factors for Sustainability of Rural Water Project

5. Conclusions and Recommendations

5.1. Conclusion

- It has been strongly affirmed basing on the findings that sustainability of rural water project mainly relied on the operation and maintenance of water project, this need to be actively participated the whole project stakeholders. In addition of that financial resource need to be well controlled to handle the project maintenance and repair that are required from time to time. The project stakeholders need to know from the early that water resources sustainability based on the rural water project mainly attained by two factors maintenance and repair in connection with financial resource management to handle any project shock.
- From the findings has been deduced that water project sustainability is the result of actively participation of various stakeholders in Ngara DC, among others the first and very important stakeholders towards the rural water project sustainability was the village Government and recognized to play the large portion on the management, control and

supervision of water projects and its resources to ensure remain sustainable in the foreseeable future. But it is not village government in isolation but participate towards the water project sustainability with others stakeholders including water user group/ committee, District Council, NGO/Donors and Ward Management (WDC).

5.2. Recommendations

Recommendation to villagers, to enhance participation in terms of effort and monetary contribution as it leads to water supply sustainability and enhance the water accessibility at all time. With villager's participation in water project management and control will result in more water and services availability and accessibility to all users at the local context. It mainly, needs to enhance community participation that collaborates with other stakeholders at the district levels and regional level to ensure water project remain sustainable on the foreseeable future.

Recommendations to Village government should add more effort in financial contribution and legal protection based on the existing by-laws to anyone who sabotage the water source, either economically or by any means should be reliable based on the by-laws. It should supervise towards the by-laws implementation; essentially village government remained to be the major player in water project sustainability.

Recommendation to water authority under the Ngara district level should thoroughly control any indicator for adverse effects based on the climate change and variability. The water authority should conduct a research to check on the climatic change and variability purposely to address the problem through the findings.

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