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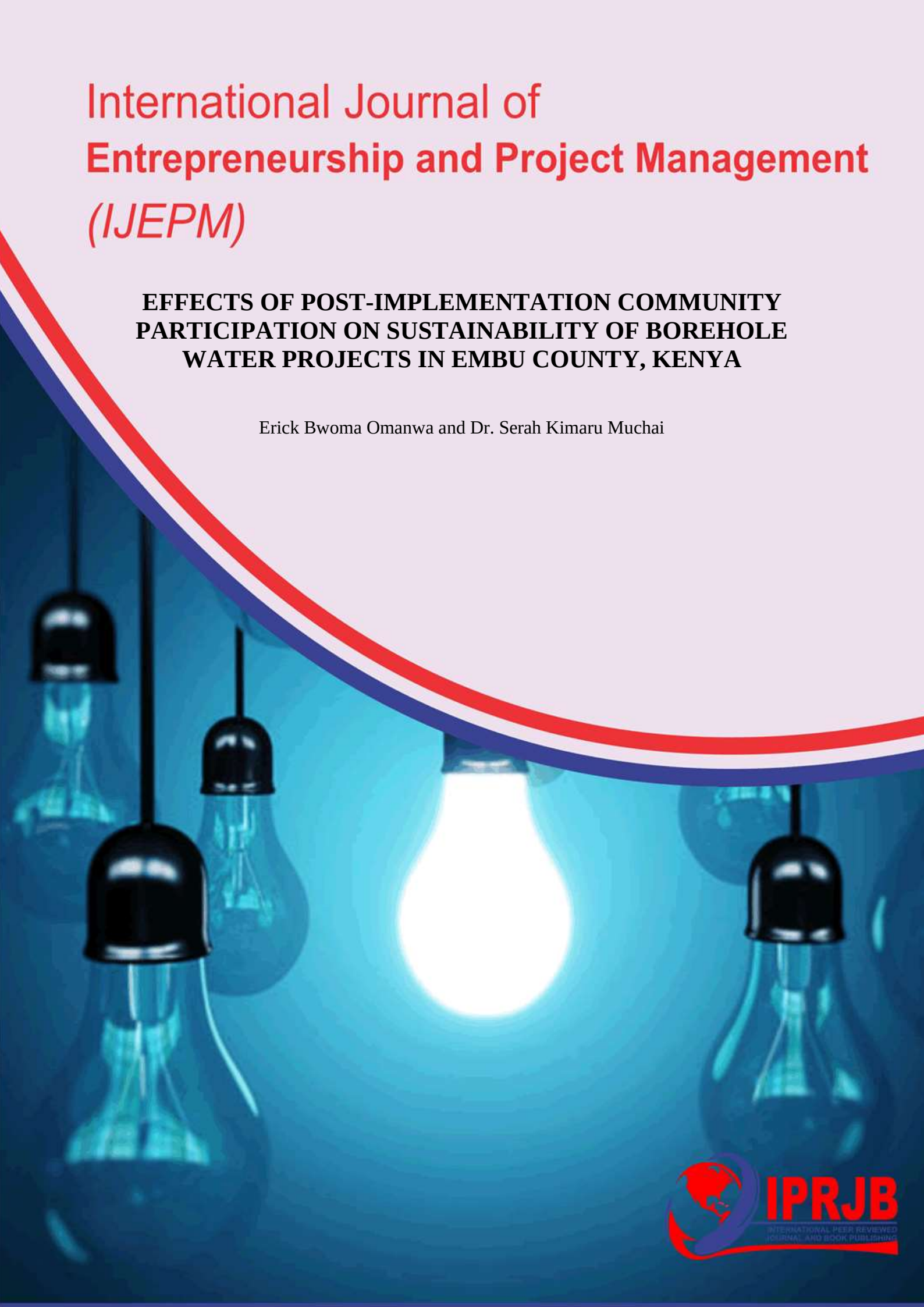

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EFFECTS OF POST-IMPLEMENTATION COMMUNITY PARTICIPATION ON SUSTAINABILITY OF BOREHOLE WATER PROJECTS IN EMBU COUNTY, KENYA

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Abstract

Purpose: The study sought to establish the effect of post-implementation community participation on sustainability of borehole water projects in Mbeere South sub county, Embu County.

Methodology: The study employed cross-sectional research design. The target population comprised of 770 executive borehole management committee members, 16,800 household borehole water users in Mbeere South Sub County, five project managers from non-state agencies involved in rural water provision and management and two government water officers. The study used utilized a sample size of 657. Krejcie and Morgan table was used to select 260 executive borehole committee members while Yamane formula was employed to sample 390 household borehole water users who were selected from the five wards in Mbeere south sub county by use of proportionate random sampling method. Census sampling was applied to select two government water officers and five project officers from non-state agencies. The study used questionnaires and interview guides to gather primary data from the respondents. The questionnaires were piloted with 70 randomly picked respondents drawn from the target population to ascertain their reliability in gathering relevant data while content validity was achieved through review by experts and professionals in the field of study. Data analysis employed descriptive statistics using Statistical Package for Social Sciences (SPSS)

Findings: Pearson Chi-Square analysis revealed that monitoring cases of vandalism and poor hand pump handling, monitoring hand pump defects and breakdowns, supervision of community-led maintenance and repair were statistically significant at 5% precision level with P- values of 0.000, 0.000, 0.020 respectively. The study also established that community caretakers technical training, availability of hand pump spare parts and technician entrepreneurs in village markets were statistically significant at 5% precision level with P-value of 0.000. In regard to financial transparency and accountability, beneficiaries' willingness to pay for water, availability of enough funds to cover maintenance and management costs, community demand for water, application of book keeping skills in borehole projects management and keeping of financial records of household payments were statistically significant at 5% precision level with P-value of 0.000, 0.006, 0.000, 0.000, 0.000 respectively. Further, 78.9% of the household water users indicated that there were no mechanisms for auditing the records prepared by the borehole management committees and regarding their involvement in financial decision making only 26.2% affirmed participation in financial decision-making process.

Unique contribution to theory, practice and policy: The study recommends that community beneficiaries should be sufficiently mobilized and prepared to facilitate effective community management of rural borehole water projects during the post-implementation period as postulated by the Community Coalition Action and Citizen Participation theories. Additionally, the borehole management committees should be supported by external stakeholders to enhance their technical and financial management skills in order to ensure technical and financial sustainability of rural community managed borehole projects through facilitative and village-level operation and maintenance and effective accountability and transparency mechanisms.

Keywords: *Community-Based Management, Community Participation, Participatory Monitoring, Financial Transparency and Accountability, Post-Implementation*

1.0 INTRODUCTION

Sustainability is important for continual enjoyment of benefits and long-term achievement of the goals and objectives of any water supply system. Sustainability can be defined as the ability to sustain the beneficial change in access to water services to achieve maintained and enhanced long term outcomes and impacts in the lives of people. Challenges of sustainability for water projects are aggravated by factors such as limited capacity, inadequate finances, lack of needed training and expertise for communities and other local institutions to efficiently manage improved water facilities after implementation, inadequacy of funds for operation, maintenance and capital maintenance for continuous use of water facilities (Sedegah, 2014). A study on sustainability of rural water supply in Zambia established availability of spare parts, community ability and willingness to pay user fees and the capability of the community to maintain and repair their water sources to be paramount for sustainability (Musonda, 2004). On the other hand, community ownership of development projects by the rural dwellers also contribute significantly to their sustainability; ownership is enhanced by involvement of stakeholders from design, implementation to monitoring and evaluation of community projects (International Fund for Agricultural Development (IFAD), 2009).

Many people worldwide gained access to improved water supply services between 1990 and 2000 but the percentage disparities between the urban and rural water supply services coverage persisted due to the population increase (WHO and UNICEF, 2000). The third target of the seventh Millennium Development Goal (MDG) sought to halve the populace without sustainable access to safe drinking water by provision of universal access to basic drinking water by 2015 (UN-Water Decade Programme on Advocacy and Communication (UNW-DPAC), 2015). However by 2015, 40 percent of the people globally were affected by water scarcity and especially in Sub Saharan Africa hindering economic and social development (United Nations, 2015). The universal access to safe and affordable water for all by 2030 therefore became one of the targets of the Global Sustainable Development for the period 2015 to 2030 (UNDP, 2015). Ground water supports the achievement of the UN sustainable development agenda for 2030 by combating climate change and protection of terrestrial ecosystems (UN WATER, 2018).

Globally, Viet Nam increased access to sustainable drinking water sources by 33% between 1990 and 2012 but still the poorest rural populace had only 35% access to piped water as compared to 95 % pipeline coverage in the urban areas. A report by Food and Agriculture Organization in 2011, indicated that 1.7 percent of the rural dwellers in Viet Nam depended on ground water drawn through tube wells (Trujillo, Nguyet Hong, & Whitley, 2015). Approximately 1.5 billion people globally draw water from boreholes daily (DFID, 2001) with over 200 million worldwide rural population accessing water from community managed hand pump boreholes (Hope, 2015). According to (Trujillo et al., 2015), water supply in rural Viet Nam was of low quality and reliability due to the informal management arrangements which necessitated consumers to meet the initial capital costs of building water supply systems and the post-implementation costs of operation and maintenance.

In Sub Saharan Africa, water supply in rural areas lags behind compared to the urban areas. Therefore, there is need for intentional and deliberate effort in raising the level of access to potable water to rural communities in Africa (Ishaku, Majid, Ajayi, & Haruna, 2011). According to UNICEF/WHO (2011) report, 25 countries in sub Saharan Africa reported a gap of more than 25% between urban and rural areas in terms of use of improved drinking

water with countries such as Democratic Republic of Congo, Ethiopia, Niger and Sierra Leone recording more than 50% percentage gap. This enormous disparity not withstanding for Sub Saharan Africa, financial commitments and aid for basic water systems declined from 27% to 16% over the five years leading up to 2008. This further exacerbated the disparity between the rural and urban areas in terms of water access. Basic drinking water systems include low cost technologies such as hand pump boreholes which most rural populations in low income countries rely on (UNICEF/WHO, 2011). Despite wide use of hand pump boreholes to a accelerate provision of drinking water access in rural areas, studies have shown high failure rates with almost 30-40% of the hand pumps in Africa not working at any one time. A study in Ethiopia reported 21% of borehole hand pumps were non-functional (Moriarty, Smits, Butterworth, & Franceys, 2013). Various reasons for high failure rates and lack of sustainability for hand pumps in Africa have been proposed such as lack of preventive maintenance, unavailability of spares, low capacity of village committees to manage community services without externa support and lack of financing structures for costs of operation and maintenance (Parry-Jones, Reed, & Skinner, 2001).

In Kenya, approximately 70% of the population relied on wells, rivers, ponds and sand dams managed by volunteer water user associations (WUAs). These associations are often challenged with management of these sources and therefore at any one time one third remain mal-functional and un operational. Lack of or poor operation and maintenance arrangements for small rural water systems remains a barrier to sustainability and expansion of water supply services (Tiwari, 2013). A water report of 2005 revealed that less than 50% of the rural population had access to potable water despite the government efforts in provision of safe drinking water to households at reasonable distances. To address these water access challenges, the government and her development partners embarked on a plan to construct boreholes and other surface water harvesting structures especially in Kenya's arid and semi-arid lands where water access during dry periods was more challenging. These projects were aimed at achieving the economic and social benefits for the Kenyan rural communities without taking into account the societal needs and elaborate involvement of the beneficiaries in decision making (Ogendi & Ong'oa, 2009). According to Marks and Davis (2012), 40 percent of the rural households in Kenya obtained water from hand pump boreholes and protected wells but only 30% of all the hand pumps installed in Kenya were functioning. A report by Tana Water Services Board (2013) further opined that 25% of the borehole hand pumps in Mbeere region were non-functional due to technical breakdowns. This is a pointer that investing in hand pumps without proper operational and maintenance frame work leads to unsustainable and unhelpful water projects in community.

In light of high post-implementation technical failures of borehole projects in the globally, regionally and locally, it is necessary to understand how community participation affect sustainability of rural borehole water projects. Although there are many factors which influence community participation for sustainability of community-based and managed borehole water supply projects, this study focused on effect of participatory community monitoring, effect of community-internal technical factors and effect of transparency and accountability strategies of local management committees on sustainability of borehole water projects in Mbeere South sub county, Embu County.

1.2 Statement of the Problem

Water resource is essential for human existence as it supports all forms of live and livelihoods. Groundwater is a major source of water for rural environments due to its

reliability even in dry conditions, households draw water from boreholes for household cleaning and washing and for human and livestock drinking (Karegi, Macharia, Muthengia and Mwiti, 2018). Management of boreholes has remained a responsibility of the rural communities who are expected to operate and maintain the facilities for continual enjoyment of their benefits. Mechanical and technical breakdowns for boreholes occasioned by tear and wear challenge the local management structures due to low capacity in maintenance and repair, the communities either contribute money to purchase the spares and engage technicians to fix the spares or seek the support of the organizations in an effort to sustain their sources.

The lower region of Embu county is classified as semi-arid parts due to minimal annual rainfall amounts recorded in the area as compared to the upper region. Mbeere South Sub-County lies in the lower region and due to ever increasing population there has been increasing demand for reliable water sources since the seasonal rivers dry up during dry periods coupled with low pipeline coverage. In the ten-year period after the Millennium, great investments by the government and development partners in rural water provision in Mbeere sub counties saw drilling and installation of many boreholes and excavation of many earth dams to increase the proportion of households with access to clean water. After the projects were complete the beneficiaries took over the management of the projects and other water projects as this was expected to lead to increased ownership and and hence sustainability but as opined by Lockwood and Gouais (2015) sustainability of such projects remain a challenge due to weak operation and maintenance frameworks, lack of legal recognition for management committees, weak accountability mechanisms and low of community technical and managerial capacity.

The dependence on subsistence farming makes it difficult for households in Mbeere sub county to pay the water tariffs and therefore management committees fail to implement consistent payment tariffs leading to weak hand pump preventive maintenance arrangements occasioning mechanical failures and eventual breakdowns. In the last ten years, many management committees have disintegrated due to fatigue of volunteerism and migration of the youth folk to towns in search of better job opportunities therefore leaving elderly members of the community to struggle with management and maintenance of rural strategic boreholes.

There is currently limited research on level and form of community participation in Mbeere south sub county and its effect on sustainability of boreholes during the post-implementation period. This study therefore sought to find out the effect of community participation in management and maintenance of rural borehole water projects Mbeere South sub-county for overall sustainability with a special focus on participatory monitoring, community-internal technical factors and financial transparency and accountability strategies.

2.0 LITERATURE REVIEW

2.1 Introduction

Chowns (2017) posited that community-based management water projects in rural Sub-Saharan Africa empowered the local people for collective action through training to gain technical skills profitable for operation and maintenance and management of rural water systems through locally accountable committees. However, Ibrahim (2016) observed that weak sustainability of boreholes and other rural water facilities is attributable to poor management and financial performance occasioned by low capacity of the community

management committees in putting in place proper management and accountability strategies to build trust in the water users.

Community involvement in management and maintenance of rural water projects is a sure way of enhancing ownership but poor leadership, lack of accountability and low technical and managerial skills and capacities hinder successful implementation of community management. Rural community involvement and willingness to participate in post-implementation management and maintenance of the water projects is critical for equitable and sustainable water supply (Nyaguthi & Oyugi, 2013). Many water projects in Kenya are non-operational occasioned by failure to fully involve the community in decision-making (Ogendi & Ong'oa, 2009).

According to Tafara (2013), water projects sustainability is influenced by community involvement during all project phases and in post- implementation management which increases project ownership. In fact, the findings by UNICEF (2014) assert that community involvement in decision-making raises demand for better services to meet real needs of the local people thus improving sustainability. In a study conducted in semi-arid areas of Mozambique, Ducrot (2016) stated that sustainability of boreholes in the rural community is influenced by proper coordination of the committee members and the various levels of governance of the respective villages.

This study intended to establish the effect of post-implementation community participation on sustainability of community managed boreholes in Mbeere South sub-county.

2.2 Empirical Literature

Mwakazi (2017) conducted a study to establish the factors affecting sustainability of community-based borehole water supply projects in Kitui south sub county. He applied descriptive research design with a sample size of 154 drawn from the target population of executive and non-executive community borehole officials. The study used questionnaires and interview schedules to gather data related to influence of project management skills, social factors and technical support on sustainability of community-based borehole water supply projects. Descriptive analysis was applied in establishing the means and standard deviation while regression analysis was used to test the association between borehole projects committee members' skills in project management and how well the projects were managed while Chi square test was used to establish the difference between observed and expected borehole breakdowns in Kitui South sub county. The findings showed that project management skills, social factors and technical support had significant influence on sustainability of community-based boreholes. The study also found out that involvement of all community development stakeholders was critical for sustainability of community-based water supply systems underscoring the need for community participation, gender and social inclusion in rural community development. Local community engagement in rural water supply leads to acquisition of skills and expertise in rural development projects (Guerrero, 2016). The study recommended capacity building of community stakeholders to gain competencies in project management to enhance the level of participation for community projects ownership and sustainability.

Sakala (2016) conducted a study was in Chadiza district of Zambia to establish factors of sustainability of boreholes. The study sought to establish how community beneficiaries' perception towards contributions for maintenance of boreholes and how capacity building of water committee members and area pump minders influence sustainability. The study

targeted all people living in three villages of Chadiza district who make contributions towards the maintenance of their respective boreholes for the purpose of sustainability but sampled 80 respondents who included 30 community members, one rural water supply and sanitation coordinator from local authority and 49 committee members. Data was collected by way of focus group discussions with committee members and community members and interview with local authority coordinator. Quantitative data was analysed using Microsoft Excel application and presented in tables and figures while thematic analysis was used for qualitative data to bring out aspects related to community contributions and capacity building of committee members and area pump minders. The findings established that boreholes were in good working in Communities which perceived community contribution as a good way of sustaining the boreholes also believed that they owned the water facilities and as such they made their own decisions on matters related to boreholes as opposed to those who perceived community participation as a bad approach, and believed that the government owned the facilities. Secondly, the study established that communities which had trained water committees did not have problems with contributions and hence maintenance of the boreholes, as compared to those whose water committees were not trained and those who didn't have water committees completely. Training of Area Pump Minders (APMs) had reduced downtime on their boreholes and hence training critically influenced sustainability of boreholes in the three villages of Chadiza District and therefore it was observed capacity building of water committees, APMs and communities was essential for sustainability of boreholes.

As per USAID (2019) fact sheet, training players in the water sector and support for water users associations and community members will help Kenyans be responsible in community water resource management. Adugbire, Kuma, Suglo, and Nartey (2010) averred that trained caretakers fail to carry out preventive maintenance for hand pumps due to unavailability of spare parts and non-payment of works due to inadequacy of funds to pay for such costs and therefore deliberate efforts have to be undertaken to ensure availability of spares at local markets and also setting up of sustainable water tariffs to ensure enough funds are available. The concept of community management of water facilities as formulated in the 1980 (Hope, 2015) sort to empower local communities for collective responsibility in operation and maintenance of established projects (Chowns, 2017). However, unwillingness of community beneficiaries to manage and finance their local water systems and lack of technical skills and capacity within the community for effective community-led operations and maintenance continue to be major challenge in attainment of the intended purpose (Harvey & Reed, 2004).

Maimuna and Kidombo (2017) conducted a study on factors influencing performance of water projects in the arid and semi-arid areas with a focus on the ewaso Ngiro North borehole projects in Isiolo County, Kenya. The study sought to determine how community participation affect performance of Ewaso Ng'iro North borehole projects in Isiolo County and to establish the effect of project management on performance of Ewaso Ng'iro North borehole projects in Isiolo County. The study adopted a descriptive research design with sample population of 162 from target population of 281 comprising of employees in different management levels of the 12 development agencies including the NGOs, CBOs and RBOs and government officials from the Ministry of Water and Irrigation. stratified random sampling is to achieve the desired representation from various sub-groups in the population while simple random sampling to pick the respondents in each stratum. Quantitative data was gathered by way of questionnaire after which multiple regression analysis was used to establish the relations between community participation and project management and

performance of borehole projects in Ewaso Ng'iro North. The findings showed that community participation greatly and positively affects performance of Ewaso Ng'iro North borehole projects in Isiolo County with participation in form of monitoring and controlling, financial support and decision making moderately affecting performance of Ewaso Ng'iro North Borehole Projects in Isiolo County. The study also concluded that project management greatly and positively affects performance of Ewaso Ng'iro North borehole projects in Isiolo County and it was deduced that budgeting greatly affects and that water use charges moderately affects the performance of Ewaso Ng'iro North Borehole Projects respectively.

Community participation in monitoring facilitates dialogue, empowers the rural communities, improves local governance and leadership and strengthens ownership. It contributes to sustainability through information generated on risk factors in order to raise capacity to put in place mitigation strategies to curb vandalism, fix technical breakdowns and tackle management challenges in order to enhance effectiveness of the community boreholes (Marie, 2010). Community monitoring can be achieved through manual registers used by community water and sanitation committees for recording the names of the water users and their financial contributions as well as borehole pump schedule for operation and maintenance. However, local government staff and community leaders can also be used to provide required information (Gunning, Elbers, & Turner, 2009).

2.3 Theoretical Review

Two theories were adopted in this study

Citizen Participation theory

The historical root of citizen participation is in ancient Greece and colonial England when Government processes and procedures were designed to facilitate external participation however the concept of citizen participation was institutionalized in the mid 1960's (Mwangi, 2014). Scholars have looked at citizen participation from various prisms. For instance, Sherry Arnstein developed the first typology of public participation in 1969 which introduced a ladder of participation moving from basic to more in-depth participation: information, communication, consultation, deliberation, and actual decision making (Kim & Lee, 2019). This typology indicated that citizen participation can be viewed in three levels, that is non participation, tokenism and citizen power. The better form of participation involves joint decision making and delegation of power to the citizens to influence decisions and resources (Claridge, 2004).

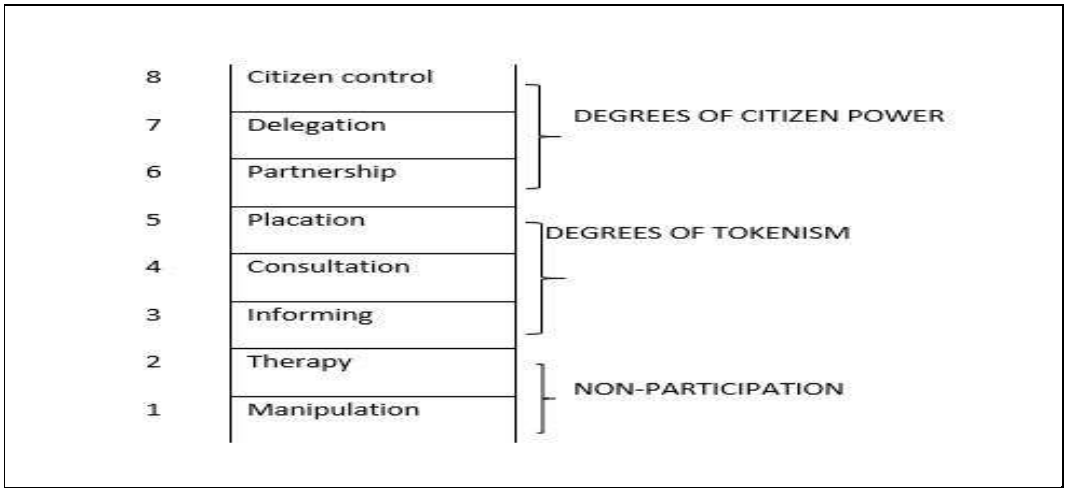


Figure 1: Arnstein's ladder of citizen participation (Claridge, 2004)

According to Verba, Schlozman, and Brady (1995) as cited in Kim and Lee (2019) citizen participation is any voluntary action by citizens aimed at influencing the management of collective affairs and administrative decision making. Citizen participation approach was earlier practiced in Platos Republic where freedom of speech, assembly, voting and equal representation were regarded as essential in development and consequently democracy in the United States. In America, the town assembly brought together all the citizens in the community to decide on issues. According to this theory, access to enough and relevant information regarding project issues and relevant benefits to community members makes them enthusiastic to participate in implementation of projects. Citizen participation in community is enhanced by things such as visible positive benefits, better knowledge and group comforts. (Mwangi, 2014).

The World Bank recognizes that meaningful social change in rural development cannot be achieved by external experts alone in the development process. Citizen participation affords the local communities opportunities to take part in development process and therefore eliminating domination by external development partners (Ako, 2017). According to Mwangi (2014), Citizen participation theory magnifies the importance of participation as a mandatory requirement for of all community development initiatives. The precepts from this theory can be adopted in both implementation and management of community managed water projects through ensuring maximum involvement of beneficiaries in both implementation and post implementation project phases in order to enhance project ownership and sustainability.

Community Coalition Action Theory

Community coalition action theory (CCAT) is a theory regarding effectiveness of partnerships in community development. The theory was developed by Butterfoss and Kegler in the year 2002 based on experience and vast knowledge in action-oriented community coalitions. They opined that in order to create social change, a coalition focuses on solving a community problem by gathering data, analysing the data to develop an action plan clearly stipulating solutions and implementing the identified solutions to achieve desired outcomes. The CCAT model provides a framework for building and evaluating effective coalitions by providing guidance on coalition building, coalition structure and process formation, coalition maintenance, indicators for analysing coalition effectiveness indicators (Osmond, 2009). The model proposes twelve factors including leadership, decision-making, communication, conflict resolution, benefits and costs, organizational climate, staffing, capacity building, member profile, recruitment pattern, organizational structure and community capacity. Member participation, satisfaction, and quality of action plan measures coalition effectiveness (Mwangi, 2014).

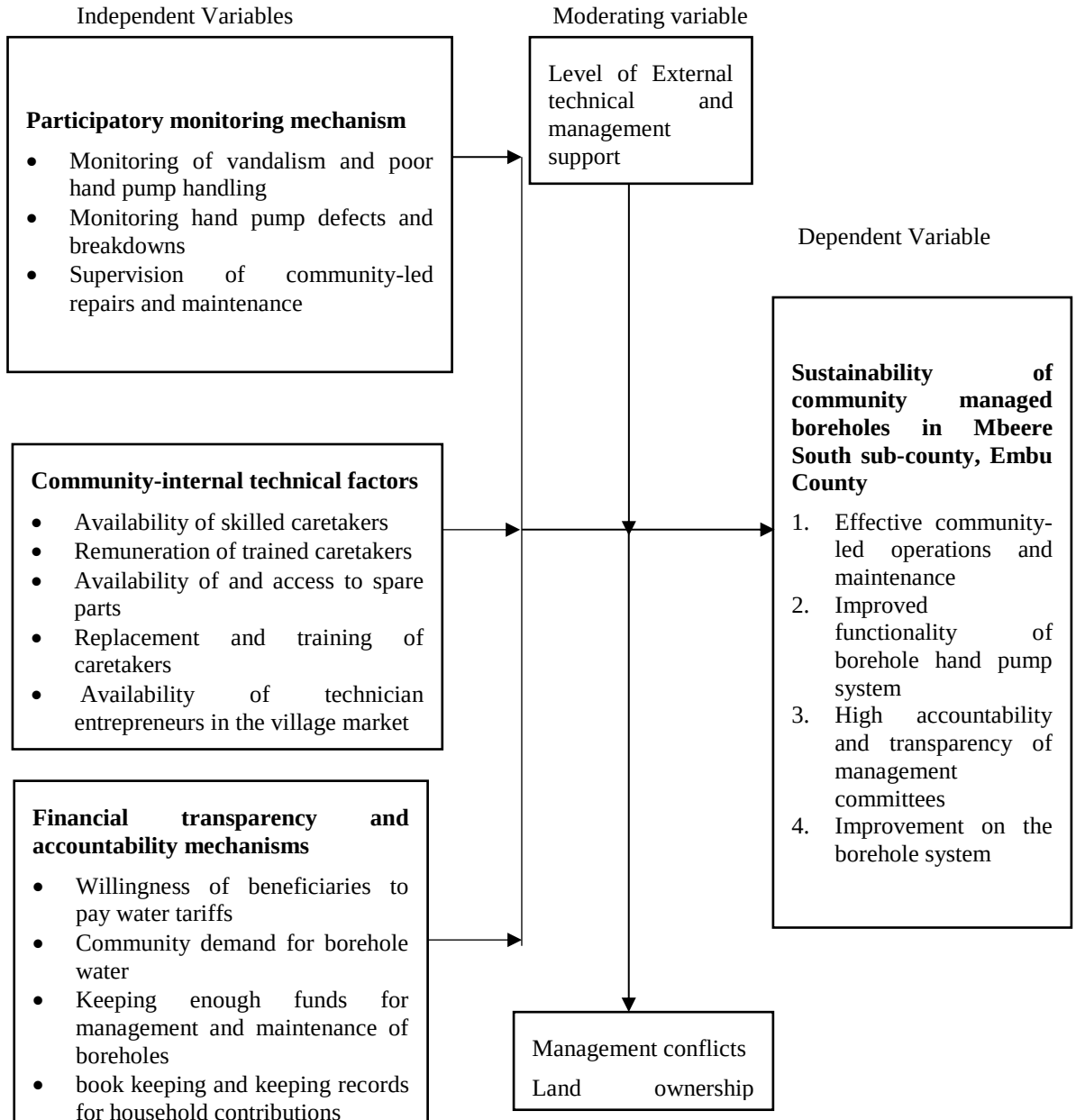
CCAT is comprised of fourteen major constructs and twenty-three propositions. The constructs and propositions provide an underlying framework for understanding the processes, structures, and outcomes experienced by effective community coalitions right from coalition formation, maintenance and institutionalization. In reference to this study, at the formation phase, community members come together to form Community Based Organizations in order to improve water accessibility. Here water projects proposals are generated, constitution and by-laws to govern community organization actions are prepared and approved. At the implementation phase, water projects designs are made and construction works begin in order to deliver the objectives. It is imperative that the community coalitions participate in making decisions on the technology choice, and agree on making contributions

towards project implementation in form of cash, materials and labor. The institutionalization phase focuses on management, operation and maintenance to ensure long term benefits (Mwangi, 2014)

The CCAT constructs advocate for full participation of community framework and a set of guidelines from conceptualization through implementation and post implementation so as to ensure project sustainability. The community capacity should be enhanced through training, leadership skills and excellent management skills in order to achieve long-term sustainability for community water projects. According to the citizen participation theory, community involvement in all project phases, adequate technical and managerial skills as well as excellent leadership and management skills are essential for community managed water projects (Mwangi, 2014). Therefore, this theory was adopted in this study regarding effects of post-implementation community participation on sustainability of rural borehole water projects in Embu County.

2.4 Conceptual Framework

This conceptual framework depicts the correlation between dependent and independent variables a study. These variables are depicted in the conceptual framework below;



Intervening variable

Figure 2: Conceptual framework (Author, 2020)

3.0 RESEARCH METHODOLOGY AND DESIGN

This study was carried out using a cross sectional research design with a target population of 17,577. The sampling frame comprised of borehole water users, executive borehole management committee members and government officers and project officers from non-state agencies working in Mbeere south sub county. A sample size of 657 was used in the study. 390 household borehole water users according to Yamane (1967) formulae with Proportionate stratified random sampling used to sample households from each of the five targeted wards, 260 executive borehole management committee members identified by use of Krijcie and Morgan table, two government officers and five project officers from non-state agencies identified by use of census sampling method. Quantitative Primary data was gathered using semi-structured questionnaire with dichotomous nature questions and open-ended questions administered to 260 executive borehole management committee members and to 390 household water users from within the study area. The interview guides on the other hand were used to gather data from the key informants who included two government officials and five project officers from non-state agencies involved in implementation and support to management committees of rural borehole water projects in Mbeere South sub county.

Content validity was used to critically examine the research tools developed whereby questionnaires was assessed by help of experts and professionals in the area of study thereby establishing whether the interpretation by the targeted respondents was as intended (Kumar, 2011). Pilot testing was used to check reliability of the tools. Pilot test sample comprised of 40 household water users and 30 executive management committee members from the study area. Kudar-Richardson 20 (KR-20) test in SPSS software was applied (Korb, 2010). KR-20 coefficient of **0.79** was achieved from the pilot data implying that the questionnaires were well designed and questions well corrected. The questionnaires and interview guides were administered to the respondents by the researcher and research assistants. After data collection the questionnaires and interview guides were coded and input into the Statistical Package for Social Sciences (SPSS) version 20 and analysis done using descriptive statistics such as frequencies, percentages, and cross tabulation. Pearson Chi-Square test and Fisher's Exact test were used to establish the relationship between the study variables while the Cramer's V value was used to deduce the level of significance of the relationship. The study findings were presented using tables.

4.0 RESULTS AND DISCUSSION

4.1 Response rate

Out of a total of 657 questionnaires produced and issued, 645 were dully filled and returned.

Table 1: Questionnaires return rate

Target respondents	Issued	Returned	Percentage
Household borehole water users	390	389	99.7
Executive committee members	260	250	97
Non -state agencies project officers	5	5	100
Government water officers	2	1	50
Total	**657**	**645**	**98.2**

4.2 Cross Tabulation Analysis

The study sought to establish the significance of the relationship between the three independent variables of this study and sustainability/functionality of community managed boreholes in Mbeere South Sub County. The Chi-Square test for independence was carried out since the variables were nominal in nature with either yes or no answers. The calculated asymptotic value (P value) was then compared with the probability error value of 0.05 allowed for the study. Pearson Chi-Square was checked for each independent indicator variable in the study to establish independence or dependence and the Cramer's V value was applied to check the level of significance in each case. The results are presented below.

4.3 Effect of community participatory monitoring on sustainability of rural borehole water projects

Table 2: Relationship between monitoring against vandalism and sustainability of boreholes

Monitoring vandalism	Borehole continuous functioning and meeting water demand		Total	Chi Square (X^2)	P value	Cramer's V
	No	Yes		23.656	0.000	0.308
Yes	43 (20.9)	163 (79.1)	206 (100)			
No	25 (56.8)	19 (43.2)	44 (100)			
Total	**68 (27.2)**	**182 (72.8)**	**250 (100)**			

N.B: Numbers in parentheses indicate percentage of responses

The Pearson Chi test findings, $x^2(1) = 23.656, P = 0.000$<0.05, implied that there was a significant relationship between borehole functionality and community monitoring of vandalism cases. Among the committee respondents who consented to putting in place strategies of monitoring vandalism cases, 79.1% indicated that it influenced borehole functionality and water supply while only 20.9% indicated that it didn't influence at all. The borehole committees had secret community monitoring observers who reported cases of vandalism and poor hand pump handling for action to be taken. Some of the punitive measures against culprits included imposition of fine (72%), denial of access to water (15%) and reporting to local government administration (13%).

Vandalism compromises on the functionality of the hand pump and the water supply systems thereby hindering functionality and consequently sustainability. These findings agreed with the findings from a study by Dan-hassan (2017) which opined that vandalism and theft of borehole water scheme components affected smooth operation and maintenance of rural water facilities and recommended extra security measures to the borehole facility in order to ensure safety and sustainability.

Table 31: Relationship between hand pump defects monitoring and sustainability of boreholes

Monitoring defects	Borehole continuous functioning and meeting water demand			Chi Square (X^2)	P value	Cramer's V
	No	Yes	**Total**	22.722	0.000	0.302
Yes	37 (19.6)	152 (80.4)	189 (100)			
No	31 (50.8)	30 (49.2)	61 (100)			
Total	**68 (27.2)**	**182 (72.8)**	**250 (100)**			

N.B: Numbers in parentheses indicate percentage of responses

The Pearson Chi test findings, $x^2(1) = 22.733, P = 0.000$<0.05, implied that there was a significant relationship between borehole functionality and community monitoring of borehole hand pump system defects. Among the committee respondents who consented to putting in place strategies of monitoring defects for hand pump system, 80.4% indicated that it influenced borehole functionality and water supply while only 19.6% indicated that it didn't influence at all. These results clearly indicated that borehole sustainability is dependent on early detection of failures and defects for early action especially for the boreholes that have been in existence for long and hence prone to tear and wear and mishandling practices from the users. The findings indicated that there was a high participation of the community in monitoring initiatives in regard to borehole water provision in Mbeere South sub county thus influencing sustainability significantly This was in agreement with findings of Etongo et al., (2018) which put reporting of defects at the center of effective preventive maintenance.

Table 4: Relationship between supervision of O&M works and sustainability of boreholes

Supervision of O&M works	Borehole continuous functioning and meeting water demand			Chi Square (X^2)	P value	Cramer's V
	No	Yes	**Total**	5.415	0.020	0.147
Yes	45 (23.6)	146 (76.4)	191 (100)			
No	23 (40)	36 (60)	59 (100)			
Total	**68 (100)**	**182 (100)**	**250 (100)**			

N.B: Numbers in parentheses indicate percentage of responses

The Pearson Chi-test findings, $x^2(1) = 5.415, P = 0.020$<0.05, implied that there was a significant relationship between borehole functionality and supervision of community led O&M works. This is true since supervision of operation and maintenance works ensures quality of the work done by either the trained caretakers or the contracted village technicians. Among the committee respondents who consented to supervising community led O&M works, 76.4% indicated that it influenced borehole functionality and water supply while only 23.6% indicated that it didn't influence at all. This was in agreement with the findings by

Wanyera (2016) that supervision of maintenance work for a WASH project in Kiambu County ensured long term sustainability by avoiding of sub-standard contractors .

4.4 Effect of community-internal technical factors on sustainability of rural borehole water projects

Table 5: Relationship between caretakers' technical training and sustainability of boreholes

Caretakers technical training	Borehole continuous functioning and meeting water demand			Chi Square (X^2)	P value	Cramer's V
	Yes	No	**Total**	97.973	0.000	0.626
Yes	55 (67.1)	27 (32.9)	82 (32.8)			
No	13 (7.7)	155 (92.3)	168 (100)			
Total	**68 (27.2)**	**182 (72.8)**	**250 (100)**			

N.B: Numbers in parentheses indicate percentage of responses

The Pearson Chi-test findings, $x^2(1) = 97.973, P = 0.000$<0.05 indicated that there was a significant relationship between borehole functionality and community caretakers training during the post implementation period. Among the committee respondents who consented to caretakers having been trained, 67.1% indicated that it positively influenced their borehole functionality and water supply while only 32.9% felt that it did not positively influence functionality. On the other hand, a large percentage (92.3%) of the committee respondents indicated that caretakers did not undergo technical training and hence negatively affected on the functionality of boreholes occasioning low supply of water to meet the demand. The finding concur with the findings of Munyao (2016) that technical skills need continuous upgrading up until the post-implementation period. This was in agreement with the findings from a study in Isiolo County by Maimuna and Kidombo (2017) that management competencies affected borehole performance and hence sustainability.

Table 6: Relationship between remuneration of caretakers and sustainability of boreholes

Caretakers remuneration	Borehole continuous functioning and meeting water demand			Fisher's Exact significance
	Yes	No	**Total**	1.000
Yes	1 (20)	5 (80)	6 (100)	
No	67 (27.5)	177 (72.5)	244(100)	
Total	**68 (27.2)**	**182 (72.8)**	**250 (100)**	

N.B: Numbers in parentheses indicate percentage of responses

The calculated Fishers' Exact significance was 1.000>0.05 which implied that there was no significant relationship between borehole functionality and remuneration of community trained caretakers. Among the 20% of committee respondents who consented to caretakers being remunerated, 80% indicated that it did not influence their borehole functionality and water supply while only 20% did agree that it positively influence functionality. On the other hand, 72.5% of the committee respondents that did not consent to existence of remuneration and that it did not influence positively on the functionality of boreholes. This findings deviated from the proposition by Braimah, Amponsah, and Asibey (2016) that the voluntary

nature in the operation of local water supply systems committees led to members unwillingness to invest their time and resources into the works of the committees. According to Sehring (2005), positions in the water user associations (WUAs) take a lot of members time to the extent that they may not get time to engage in normal farming work on their fields and therefore lack of incentives in form of financial or societal way (social respect) leads to disinterest by farmers to be elected to work in WUAs or fill the vacancies that arise in WUA leadership. Upon further interrogation during interaction with committee respondents, it was established that the majority of the borehole projects were initiated during the Economic Stimulus Programme and as such focus of the implementers was on provision of water for social good to impact on health and sanitation of the community residents. After hand over of the projects to the community for management, it was not expected that borehole committees would generate income to pay for allowances and salaries of the managers and caretakers. However, caretakers as part of the borehole water beneficiaries did not prioritize remuneration for duties undertaken and additionally felt regarded with high esteem in the community and were excused from contributions whenever the borehole pump needed repair or maintenance.

Table 7: Relationship between replacement of caretakers and sustainability of boreholes

Replacement of caretakers after exit	**Borehole continuous functioning and meeting water demand**			**Exact significance**
	Yes	No	**Total**	0.349
Yes	3 (50)	3 (50)	6 (100)	
No	65 (26.6)	179 (73.4)	244 (100)	
Total	**68 (27.2)**	**182 (72.8)**	**250 (100)**	

N.B: Numbers in parentheses indicate percentage of responses

The results indicated that Fisher's Exact significance was 0.349>0.05 implying that there was no significant relationship between replacement of exited caretakers during the post implementation period and borehole functionality in Mbeere South sub county. Among the committee respondents who never consented to replacement of caretakers after exit, 73.4% indicated that it did not influence their borehole functionality and water supply while only 26.6% did agreed that it positively influence functionality. On the other hand, there was an equal divide on those who consented on replacement of caretakers and its influence on functionality of boreholes. These findings differed with the findings of Sun, Asante, and Birner (2010) regarding water and sanitation committees in Ghana which posited the importance of replacement of exited, dead and retired members in order to sustain the initial composition for achievement of the committee goals. This was observed due to the fact that even when the caretakers left without formal replacement, other community members with interest in technical aspects of hand pumps filled the gaps albeit informally in order to ensure continuous flow of water. It was reported in almost 60 percent of the boreholes visited that there was at least an individual that seemed very committed in providing services of a caretaker not withstanding the fact that they may have not been in the initial training of caretakers. It was therefore evident that refresher trainings were necessary for the serving caretakers.

Table 8: Relationship between availability of technicians in locally and sustainability of boreholes

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Availability of technicians in village markets	Borehole continuous functioning and meeting water demand			Chi Square (X^2)	P value	Cramer's V
	No	Yes	**Total**	65.650	0.000	0.512
Yes	29(15)	165(85)	194(100)			
No	39 (69.6)	17 (30.4)	56 (100)			
Total	**68 (27.2)**	**182 (72.8)**	**250 (100)**			

N.B: Numbers in parentheses indicate percentage of responses

The Pearson Chi-test findings, $x^2(1) = 65.650, P = 0.000$<0.05 implied that there was significant relationship between borehole functionality and availability of hand pump technicians in the community markets to handle repairs and maintenance works which are beyond the trained caretakers during the post-implementation period. Among the committee respondents who consented to availability of technicians in the community markets, 85% indicated that it positively influenced their borehole functionality and water supply while only 15% felt that it did not positively influence functionality. The issue of availability and access to spare parts was found out to be critical for boreholes sustainability with 85.4 percent of the household water users indicating that they were not readily available in the local markets and hence needed to be sourced from markets situated 100-150 kilometers away thereby raising the costs of repairs and maintenance. This was a true reflection since hand pumps often needed spares change and other major maintenance works mainly due to the high tear and wear rates occasioned by water salinity and technical breakdowns which the community caretakers could not be able to carry out.

These findings corroborated the findings by SNV Netherlands Development Organisation (2013) which found out that presence of artisan enterprises in the local communities improved the level and range of post construction water services available to the communities by providing them with easier access to local affordable services during times of borehole repairs and maintenance.

4.5 Effect of borehole committees' financial transparency and accountability on sustainability of rural borehole water projects

The study sought to establish measures of financial transparency and accountability put in place by borehole management committees and its effect on sustainability. The aspects that were considered here included beneficiaries' willingness to pay for water, community demand for borehole water, keeping enough funds to cater for maintenance and management costs, keeping updated records for household contributions, application of book keeping skills and community involvement in auditing and financial decisions. The relationship between these factors and borehole functionality was analyzed to establish their effect on boreholes functionality and their ability in meeting community water demand.

Table 9: Relationship between beneficiaries' willingness to pay for water costs and sustainability of boreholes

Beneficiaries willingness to pay for water	Borehole continuous functioning and meeting water demand			Chi Square (X^2)	P value	Cramer's V
	No	Yes	**Total**	105.605	0.000	0.650
Yes	11 (6.6)	155 (93.4)	166 (100)			

No	57 (67.9)	27 (32.1)	84 (100)
Total	**68 (27.2)**	**182 (72.8)**	**250 (100)**

N.B: Numbers in parentheses indicate percentage of responses

The Pearson Chi-test findings, $x^2(1) = 105.605, P = 0.000$<0.05 indicated that there was a significant relationship between borehole functionality and beneficiaries' willingness to pay for water during the post implementation period. Among the committee respondents who consented to willingness of beneficiaries to pay for water costs, 93.4% indicated that it positively influenced their borehole functionality and water supply while only 6.6% felt that it did not positively influence functionality. These findings were in agreement with findings from Apeli (2015) that the willingness to make regular contributions towards operation and maintenance enhance financial sustainability during the post-implementation period and by Mimrose, Gunawardena and Nayakakorala, (2011) that community managed water schemes exhibit aspects of non-sustainability where the payment for water services by beneficiaries is low. This implied that willingness of the beneficiaries to pay for water directly influenced the preventive maintenance of hand pumps and hence sustainability. This same conclusion was postulated by Braimah et al., (2016) who asserted that community involvement in contributing financially towards maintenance of water facilities was key to ensuring sustainability of rural water supply. However, Naiga and Penker (2014) asserted that water users are always willing to for operation, management and maintenance costs whenever they are sure that the fees contributed will be put into the intended use.

Table 10: Relationship between community demand for borehole water and sustainability of boreholes

Community demand for borehole water	**Borehole continuous functioning and meeting water demand**			**Chi Square (X^2)**	**P value**	**Cramer's V**
	No	Yes	**Total**	65.222	0.000	0.512
Yes	40 (18.3)	178 (81.7)	218 (100)			
No	28 (87.5)	4 (12.5)	32 (100)			
Total	**68 (27.2)**	**182 (72.8)**	**250 (100)**			

N.B: Numbers in parentheses indicate percentage of responses

The Pearson Chi-Square test findings, $x^2(1) = 65.222, P = 0.000$<0.05 implied that there was a significant relationship between borehole functionality and community demand for borehole water during the post implementation period. Among the committee respondents that never consented to community demand for boreholes, 85.7% indicated that such boreholes were negatively affected in functionality and water supply. This was further confirmed by 81.7 of the committee respondents who consented and admitted that it positively affected the boreholes functionality and water supply. This can be explained by the fact that demand influenced the ownership of the water source and hence willingness to support its continued operation and improvement.

Table 11: Relationship between availability of enough money for maintenance and management costs and sustainability of boreholes

Availability of enough money for O&M and management	**Borehole continuous functioning and meeting water demand**			**Chi Square (X^2)**	**P value**	**Cramer's V**
	No	Yes	**Total**	7.505	0.006	0.174

Yes	62 (25.7)	179 (74.3)	241 (100)
No	6 (66.7)	3 (33.3)	9 (100)
Total	**68 (27.2)**	**182 (72.8)**	**250 (100)**

N.B: Numbers in parentheses indicate percentage of responses

The Pearson Chi-test findings, $x^2(1) = 7.505, P = 0.006$<0.05 implied that there was significant relationship between borehole functionality and availability of enough money to meet for management and O&M costs during the post implementation period. Among the committee respondents who consented to availability enough money to meet costs, 74.3% indicated that it positively influenced their borehole functionality and water supply while only 25.7% felt that it did not positively influence functionality. This implies that without the community willingness to raise enough funds for all the costs, their boreholes would be highly affected by technical breakdowns and the beneficiaries would stay for longer without accessing water from the boreholes at times when they remain non-functional. This findings agree with assertion by Braimah et al., (2016) that unsustainable and lower revenue obtained from households is often not enough to cover maintenance and repair costs of facilities due to high cost of spare parts and repairs therefore borehole committee must be able to mobilize resources from the community and other agencies to support effective operation and maintenance.

Table 12: Relationship between keeping records for household contributions and sustainability

Keeping record of household contributions	**Borehole continuous functioning and meeting water demand**			**Chi Square (X^2)**	**P value**	**Cramer's V**
	No	Yes	**Total**	41.898	0.000	0.409
Yes	33 (17.2)	159 (82.8)	192 (100)			
No	35 (60.3)	23 (39.7)	58 (100)			
Total	**68 (27.2)**	**182 (72.8)**	**250 (100)**			

N.B: Numbers in parentheses indicate percentage of responses

The Pearson Chi-Square test findings, $x^2(1) = 41.898, P = 0.000$<0.05 implied that there was a significant relationship between borehole functionality and records of household contributions during the post implementation period. Among the committee respondents that consented to keeping household contribution records, 82.8% indicated that such boreholes functioned continuously and met the rural water demand. This was further confirmed by 60.3 of the committee respondents who never consented to the aspect of keeping records of contribution made by households. This is true depiction since many of the water users interviewed expressed reservation in participating in financial matters where records were either missing or inconsistent which in turn had a direct implication on the willingness of the community to pay water tariffs hence affecting sustainability. A study by Braimah et al., (2016) revealed that borehole management committees that held frequent meetings and kept meeting and financial records were able to quickly attend to broken down borehole water facilities.

Table 13: Relationship between application of book keeping skills and boreholes sustainability

Application of book keeping skills	Borehole continuous functioning and meeting water demand			Chi Square (X^2)	P value	Cramer's V
	No	Yes	**Total**	88.786	0.000	0.596
Yes	18 (10.2)	159 (89.8)	177 (100)			
No	50 (68.5)	23 (31.5)	73 (100)			
Total	**68 (27.2)**	**182 (72.8)**	**250 (100)**			

N.B: Numbers in parentheses indicate percentage of responses

The Pearson Chi-test findings, $x^2(1) = 88.786, P = 0.000<0.05$, implied that there was a significant relationship between borehole functionality and committee members training in book keeping during the post implementation period. Among the committee respondents that consented to application of book keeping skills, 89.8% indicated that such boreholes functioned continuously and met the rural water demand. This was further confirmed by 68.5% of the committee respondents who never consented to the aspect of keeping records of contribution made by households. This could be explained by the fact that the committees kept book of contributions and other financial expenses albeit not in an elaborate manner, they were able to refer to the records and point to specific short comings for a period of time. It was evident that for committees to manage the resources prudently, they needed to be equipped with book keeping skills and be refreshed periodically on book keeping practices.

4.5.1 Involvement of community in auditing and financial decision making

The study sought to establish the level of involvement of beneficiaries in auditing of financial books and records and in financial decision making as a means of ensuring accountability of borehole management committees in Mbeere South sub county.

With regards to auditing the financial books and records kept by management committees, 78.9 percent of the household felt they were not involved in any form of auditing while only 21.1 percent of them affirmed being involved in auditing the operations of management committees (Table 14). The main form of involvement was through local development sub committees review of processes and documents and dissemination of recommendations through village chiefs *barazas*. This was reported in areas where boreholes were the major source of water and the local administration was interested with supporting the boreholes committees succeed. Participation of stakeholders in decision making increases accountability of water and sanitation committees in water service delivery as asserted by UNDP Water Governance Facility/ UNICEF (2015) and enhances sustainability of rural water services.

Table 14: Auditing of financial books and records

Response	Frequency	Percent
Yes	82	21.1%
No	307	78.9%
Total	**389**	**100%**

With regard to level of community involvement in financial decision making by the committees, 73.8 % of the household respondents indicated low involvement in decision

making while only 26.2 percent indicated high involvement (Table 15). The household water users felt that the borehole committees were less accountable of their dealings as demonstrated by low involvement in auditing of the financial books and records

Table 15: Level of involvement of water beneficiaries in financial decision making

Response	Frequency	Percent
High	102	26.2%
Low	287	73.8%
Total	**389**	**100%**

From the above findings, community water users' involvement was low in committee financial decisions and auditing the committee expenditure. This lowered the participation of the users in making contribution to meet the management and maintenance costs. This was in agreement with the findings from Zambia by SNV Netherlands Development Organisation (2013) which postulated that most rural water management bodies never keep the communities informed of the expenditure of their financial contributions towards O&M leading to mistrust.

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the findings

The findings indicated that cases of vandalism were promptly reported and action taken. In regard to identification of borehole system failures and defects, use of community observers to identify defects proved to be successful and necessary precautions were taken by management committees. In regard to supervision of repair and maintenance works, committee members attested low dedication by borehole committees due to disinterest occasioned by volunteerism and hence maintenance works were not supervised sufficiently enough to assure quality of works.

The study established that there was no evidence of programme for replacement of exited caretakers. Remuneration of caretakers was non-existent as many borehole committees did not put in place water paying tariffs sufficient to finance payment of committee caretakers and maintenance costs. It was further established that caretakers needed continuous technical training to enhance their skills and induct any newly recruited caretakers since analysis revealed a significant relationship between caretakers' technical skills and boreholes functionality during the post implementation period as chances of technical breakdown increase with continued operation of hand pumps.

Whenever major repairs and maintenance was required, skilled artisan technicians had to be sourced from major towns far away since skilled artisans were lacking in the communities. Likewise, hand pump spares were also accessed from further away markets as shops within the village did not stock such accessories. This increased the cost of carrying out such work and therefore occasioning long term technical breakdowns for boreholes in Mbeere South sub county.

There was low payment of water by the community beneficiaries as many only contributed on need basis when the hand pumps were broken down. However, majority of the household representatives interviewed expressed willingness to make regular payments once accountable payment structures are put in place by management committees. Pearson Chi-Square analysis revealed a strong relationship between willingness to pay for water and

borehole functionality and sustainability in the post implementation period. This was true since raising enough funds to cater for O&M and management costs depended enormously on the willingness of the users and beneficiaries. It was established that willingness of beneficiaries to pay for water costs was determined by the demand for borehole water which also significantly affected borehole functionality and sustainability.

The study found out that borehole committees kept inadequate financial records hence low trust from the community despite existence of a significant relationship between household financial record keeping borehole sustainability. From the findings it was evident that book keeping skills and auditing mechanisms were low amongst borehole management committees hence many borehole water projects in Mbeere South Sub County were financially unsustainable despite a strong relationship between book keeping skills and auditing by management committees and boreholes functionality and sustainability.

5.2 Conclusion of the Study

There was great utilization of participatory monitoring mechanism to curb vandalism and borehole system defects in addition to supervision of O&M works to ensure quality works. This monitoring was facilitated by a good collaboration of the management team and the water users who gave information freely to assist nab the offenders and take action. Some of the actions included imposition of fine, denial of access to water and reprimand by local chiefs. The water users were enthusiastic to report any happenings that would cause failure of water pumps or lead to borehole technical breakdowns. Both factors were found to be significantly critical for boreholes sustainability. There was general recommendation for enhanced collaborative measures in the community for successful community participatory monitoring.

There was scarcity of trained community caretakers across all the visited boreholes. This implied that there was a critical need to empower the water beneficiaries with technical skills necessary for hand pump boreholes functioning. Pearson Chi-Square test revealed a significant relationship between the availability of trained community caretakers and boreholes sustainability. This is true since the community needs to be able to handle the simple issues that lead to breakdowns and failure. In regard to availability of skilled technicians and spare parts in the local markets, the committee respondents and water users unanimously agreed that it was challenging to find the technicians able to handle major repairs and maintenance works in addition to lack of hand pump spare shops at the village level. It was therefore suggested by both respondents that local artisans must be equipped with the necessary skills and the village entrepreneurs encouraged to venture into stocking of spare parts for hand pumps. Availability of technicians and hand pump spares within the community markets is critical for sustainability as this reduces the cost of repairs and maintenance.

On financial transparency and accountability, the study established that community demand for water, willingness of the beneficiaries to pay for water provision costs were strongly significant for hand pump boreholes sustainability. The demand for borehole water created a sense of ownership by the water users and hence increased readiness of the beneficiaries to pay for O&M and other management costs. The study established that accountability is enhanced with the effective and transparent utilization of the mobilized community funds and it further attracts external support when needed.

5.3 Recommendations of the Study

The study recommends that the county governments mandated with the responsibility of rural water provision should formulate policy to ensure the service level agreements for the technologies adopted in the rural borehole projects are facilitative in provision of technical support in form accessibility to spare parts and continuous capacity training. The study recommends that the rural water user associations and water and sanitation committees should be registered with the relevant government agencies in order to gain recognition to enable them solicit for external technical, financial and management support. The study recommends that borehole management committees should have documented sustainability frameworks including setting up of sustainable and affordable water payment tariffs with elaborate accountability measures. The study recommends that non-governmental organizations and other non-state agencies should implement community projects in collaboration with the government in order to apportion the responsibilities appropriately after the organizations exit from the communities

5.4 Suggestions for Further Research

This study focused on post implementation community participation effects on sustainability of community managed boreholes. Further studies should be carried out to ascertain

1. The effect of solarization of boreholes on functionality and sustainability of boreholes in the arid and semi-arid counties in Kenya.
2. The effectiveness of participatory monitoring and evaluation systems on the success of government supported community development projects in Embu County.
3. The effect of pipeline water extension and connection on the demand for boreholes in Embu County.

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