

Factors Hindering Sustainability of Water Projects in Makueni County: A Case Study of Kwing'ithya Kiw'u Project

Jonathan Mwendwa Masombe¹

Dr. Jane Omwenga²

College of Human Resource Development, Jomo Kenyatta University of Agriculture and Technology, Kenya^{1,2}

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ABSTRACT: This study sought to establish factors hindering sustainability of water projects in Makueni County so as to make appropriate recommendations for enhancing sustainability of water projects. The descriptive survey design was employed in this study. The study population constituted the inhabitants of the two wards, key informants especially the self-help group which partnered with the NGO, Local sub-chiefs of the 7 sub-locations within the two wards. The household survey was used to reach the respondents and purposive identification of the subject matter or key informants across relevant local institutions was conducted. Both probability and non-probability sampling techniques were used in the study. Questionnaires were administered in this study to help in quantitative data collection from the respondents. Finally, the data was analyzed using descriptive statistical tools (SPSS V.17.0 and Excel) which helped the researcher to describe the data. The study established that the level of stakeholders' participation in the water projects was low which affected the sustainability of water project. Also, stakeholders' participation positively enhanced the sustainability of the rural community based water projects to a great extent. The water project has enhanced partnerships between the local community and the government or non-governmental organizations. There was insufficient technical expertise to manage the project, and human resource for sustainability of the project. The level of adoption of technology in the management of water project was very low impairing the sustainability of water projects. The study recommends that the level of stakeholders' participation in the project planning and implementation should be increased to enhance the sustainability of the water projects in the county. Also, the project management should seek to adopt modern technology through increased budgetary allocations. Government should institute stringent measures to deal with persons vandalizing the community water project.

Index Words: Community based projects, Sustainability, Stakeholders' participation, Cultural practices

1. INTRODUCTION

In the developing world there are more than 1 billion people who are unable to access, on a daily basis, a reliable source of clean and freshwater. This led to declaration of the Millennium Development Goals (MDG), which has, the specific target, of reducing by half the proportion of people without sustainable access to safe drinking water by 2015 (United Nations 2000). There have been improvements made towards meeting the water supply needs for the world's poor, in the year 2002, 79% of the population in developing countries had access to clean and safe water supplies, bringing up the total world coverage to 83%. This is an increase of 8% from 1990 to 2002 (WHO/UNICEF 2008).

According to De Regt (2005), over 75% of the Africa's poor living in rural areas the need to expand sustainable water service to these areas is imperative. Most of community based water projects fail due to a lack of understanding of the specific context of the community or a lack of effective support structures (Reif et al. 1996; Baker 2000). In Kenya access to safe clean water supply in rural areas remains low. In particular, over the past eight years access to piped water has only increased from 9 to 10 percent of rural households. Small community-based water providers are seen as part of the solution and are supported by the Water Sector Act of 2002, which introduced regulatory and tariff reforms. The recognition by the UN General Assembly, in 2010, of water and sanitation as a human right provides additional political impetus towards the ultimate goal of providing everyone with access to these vital services. With this in mind, the United Nations Millennium Development Goals (MDG) aimed at halving the proportion of people without sustainable access to safe drinking water and basic sanitation by the year 2015 (WHO, 2010).

According to Gebrehiwot (2006), in developing countries different institutions which includes; national and regional governments, local and international NGOs and other concerned organizations invest large sums every year for the implementation of rural water supply projects. It is evident that construction of water projects does not help if they are done in ineffective way and fail after a short time. The World Bank's private arm, the International Finance Corporation, found that only half of its Africa projects succeed (Associated Press, 2007). Through better integration of people who receive the water and water project suppliers in making decisions concerning planning, construction and management of water supply systems makes investment in water supplies more effective and failure rates of these systems reduced (Gebrehiwot 2006). However, in Kenya, community based water project are characterized with low or poor stakeholders involvement.

Communities have failed to take up ownership of projects which according to Williams (2003) has plunged community projects into immense financial huddles threatening the sustainability and hence threatening them to seize operations daily. In fact, most studies shows that low levels of education concerning sanitation and water supply, poor management system, limited demand and perceived lack of ownership are related to poor implementation and low sustainability rates of water supply systems (Harvey & Reed, 2007). In order for proper implementation and future sustainability there is need for genuine involvement of the targeted community whose concerns and experience are intrinsic to the project's success (Admassu *et al.*, (2002)). The willingness and the level of community support determine whether a project becomes implemented, how quickly and successfully it consolidates, and how it responds and adapts to meet changing needs (USAID, 2009). Therefore there is need to involve community in the whole project cycle from planning to closure, involving them in decisions making enhances the chances of successful sustainability of water projects. In Kenyan scenario is quite different, only the elite from community are actively involved in planning, implementation and running of such water projects.

Good management contributes a lot to the success of project implementation and it's sustainability, especially when there is trust and good working relationship amongst project team, local people and professionals. In order to establish good rapport leaders need time, resources and authority to invest in a project. It is of important to note that, the project manager and the entire project team should understand their roles in the project cycles since good leadership is critical for the success of community based projects. Leadership offer management to the project and thus ensures sustainability. However, due to financial management constraints most community water projects stall. This threatens survival of the said projects. Mismanagement of community based water projects; acts as a stabling block to natural development of the project. It leads to over dependence on funding boxing community based projects into a dependency syndrome which is threatening the sustainability.

As said earlier, research has shown that rural water supplies in sub-Saharan Africa, often demonstrate low levels of sustainability (Gebrehiwot, 2006). Rural areas in sub-Saharan Africa are characterized by poor water access points, where water collection may require hours of physical effort, water sources are contaminated. Alternatively local community must purchase at rates too expensive for proper health and hygiene. In addition in rural areas water resources are managed community what is commonly referred as community management. Community based management is one of the oldest form of social organization. However, after colonial rule and westernization number of issues came up, such as dynamic political change, rapid population growth, environmental degradation, climate change, misguided development policies, and the shift from agrarian economies to market economies, community management systems are in jeopardy of losing their resilience and effectiveness (USAID, 2009).

Four major critical areas that contribute to community water project sustainability, which includes; the physical and operating environment, availability of finance, the socio-political stability of the country and community, and a community's ability to access some funding, be it private, public, or non-governmental (Niyi *et al.*, 2007). Kenya is characterized by inadequate technologies which have threatened implementation and survival of many community water projects like in other sub-Saharan Africa countries. There is insufficient of sophisticated machines like modern water powered pumps, poorly implemented water supply networks for ensuring access of water by all community members. With this problem, community members have to walk long distances searching for water from other sources hence undermining the reason for such community water projects and thus threaten sustainability of community based water projects.

Despite, the immense importance of community based water project in ensuring access to clean drinking water for all, no study has been conducted locally or internationally to establish factors hindering sustainability of water projects in Makueni County. This study therefore sought to establish various factors hindering sustainability of water projects; which was achieved through investigations on how stakeholders' participation, cultural practices, management skills and technology hindered sustainability of water projects in Makueni County.

This study was guided by the following research objectives: to establish how the extent of stakeholders' participation hinders sustainability of water projects, to assess how cultural practices hinders sustainability of water projects, to examine how management skills hinders sustainability of water projects and to examine how technology hinders sustainability of water projects.

2. LITERATURE REVIEW

According to Aras and Crowther (2008), there are four aspects of sustainability namely; societal influence, environmental impact, organizational culture and finances. When analyzed critically, societal influence measures the impact a society makes upon the corporation in terms of the social contract and stakeholder influence; environmental impact, which is the effect of the actions of the corporation upon its geophysics environment; organizational culture, which is the relationship between the corporation and its internal stakeholders and finances an adequate return for the level of risk undertaken in pursuit of sustainable development and financial sustainability.

According to Brager et al. (2001) defines participation as a means of increasing competence amongst community members through educating them. Community participation is the tool for influencing decisions that have direct impact to the lives of citizens and forms grounds for ensuring project sustainability of successful. Citizen participation is a process by which citizens act in response to public concerns, voice their opinions about decisions that affect them, and take responsibility for changes to their community, their support, he pointed out is key for the sustainability of a community project (Armitagem, 2003). Chappel (2005) suggest that stakeholders support may also be a response to the traditional sense of powerlessness felt by the general public when it comes to influencing government decisions: by their support, community ensures the success of a project through collective efforts to increase and exercise control over resources and institutions on the part of groups and movements of those hitherto excluded from control". Further, Group on Participatory Development (2001) indicated that this support ensures that stakeholders influence and share control over development initiatives, and the decisions and resources which affect them. This is vital in ensuring that resources in community based projects in Kenya are managed effective, minimizing wastes and thereby ensuring their sustainability more so financial sustainability.

According to Oakley and Marsden (2007) stakeholders' support brings together individuals, families, or communities who assume responsibility for their own welfare and develop a capacity to contribute to their own and the community's development. Community participation can be viewed as an active process whereby beneficiaries actively take part and be part of determining the direction and execution of development projects rather than waiting the project to be completed to enjoy its deliverables. Through community participation resources are saved which can later be channeled to produce more benefits out the project. Chappel (2005), argues that if community actively participate in the project then project costs are shared that is money and labour during the project's implementation or operational stages which ensures financial sustainability.

Community participation forms the major stakeholder support in any community based project (Oakley and Marsden 2007). In fact, involvement of the communities is crucial for the sustainability of rural water supply systems (Admassu *et al.*, 2002). Nevertheless, factors that contributes to high rates of sustainability of community based projects include; communities' accepting ownership and managing these water projects, existence of management at grassroots i.e at the village level, protection of the water points, cost recovery for operation and maintenance through community small contributions, sound technology put in place and availability of the spare parts of equipment and machineries used.

Chappel (2005) indicated that community support increases project efficiency: Therefore, he recommended that there should be proper consultation with the community during project cycle implementation that is from planning to closure. In addition beneficiary involvement is paramount since it ensures proper implementation of the project enhancing its sustainability. Further, Arbitrage (2003) highlighted that community support increases project effectiveness helping in realization of project's objectives and ensuring that benefits go to the intended people. It is worthy note that community support coupled with community participation, helps in building beneficiary capacity; by ensuring that participants takes part in project planning and implementation or through formal or informal training and consciousness- raising activities.

Partnering with the communities ensures that people's problem solving capacities improves and chances for high levels for sustainability are increased.

Bhandari and Grant, 2007; Mbata, 2006, indicated that stakeholders willingness to participate through paying in cash, materials, labor, and idea can be taken as a useful indicator for the demand to sustain water projects. If willingness to pay for services as a result of completed project increases in the community, then it is possible to conclude that the awareness of the community ownership of the project has increased (Mbata, 2006). Similarly, if households are willing to contribute cash and labor useful for the management of water sources, then the service that they obtain from a source is valued; and, it is a means of promoting its sustainability.

Culture is broadly defined as the whole complex of spiritual, material, distinctive, intellectual and emotional features that characterize a society or social group of people. It includes arts, letters and mode of life, value systems, fundamental rights of human being, beliefs and traditions (UNESCO, 1995). Culture is gradually emerging out of the realm of social sustainability and being recognized as having a distinct , separate , and integral role in sustainable development. Within the sustainability sector, according to

(Roseland et al., 2005) culture is discussed in terms of cultural capital, defined as “traditions and values, heritage and place, the arts, diversity and social history”. The stock of cultural capital, can either be tangible and intangible, this is what we inherit from past generations and what we will pass onto future generations. UNESCO (2006) encompass cultural development as related to social policy and goals such as fostering rural revitalization, public housing, health, ecological preservation, cultural diversity, rural diversity, social inclusion, and sustainable development. Culture is adversely affected by globalization and market forces therefore it must be protected under all costs, as many communities fear that they will lose their cultural identity, traditions, and languages to dominant ideals and culture. To address above concerns, sustainability discussions should focus on education, community development, and locally based policy that is consistent with community culture that is open to change. In addition according to (Matthews and Herbert, 2004) sustainability discussions on cultural heritage should focus on the need to preserve what was inherited so as to pass to future generations, and to recognize the history of a place and the tangible and intangible attributes of its landscapes and communities. The creation of opportunities to expand and deepen diversity may act as a balance to this.

Cultural development in a community is a collective process, involving creativity interpreted in the broadest sense (Mills & Brown, 2004). The impact of this is to changes in people’s lives and long-term developmental benefits for a community. Cultural development in a community captures a large cross sectional area of activities that give communities the opportunity to tell their stories, build their creative skills, and be active participants in the development of their culture (O’Hara, 2002).

Doubleday et al. (2004) observe that Discussion of sustainability, as now incorporated both dynamic understandings of culture and the recognition that place matters, because the practice that is in need of sustaining, as well as those that pose threats, happen in particular communities and in specific geographic contexts. Serious discussions of sustainability require considerations of the dynamics of complex cultural arrangements in particular places, rather than assumptions of either peoples or their ecological contexts” and that fundamental debates on sustainability must contrast environmental and cultural preservation with active practices of living in culturally constituted places.

As Ledwith (2005) observes, community development begins at the everyday lives of local people. Community development projects empower communities to position local issues within a larger political context. An important aspect of community development is that it is not handed down from experts or governments. Community development aims to strengthen the economy and the social ties within a community through locally based initiatives. The community development process is often characterized as a bottom line of amalgamating environmental, social, and economic well-being into a common audit. The bottom line is now expanding to include cultural well-being and good governance. The central goals of community development rely on residents having the ability to express their values, be self-reliant, satisfy basic human needs, and have greater participation and accountability in their community. This is accomplished by education, citizen participation, consensus building, and access to information. Creating a sense of place in the community is central as it empowers residents to become decision-makers over their own environment, resources, and future.

Sustainability is reflected in the capacity of the community to cope with change and adapt to new situations since change is inevitable (Williams, 2003). Community sustainability is about creating a more just and equitable community through encouraging social and cultural diversity (Roseland et al., 2005). It also calls for the community to define sustainability from its own values, culture and perspective. This cut across community participation and a collective decision-making process that meets the social, cultural, environmental, and economic needs of the community. Sustainable community development takes in consideration development of a local and self-reliant economy that does not damage the social well-being of communities. They seek methods of integrating policies, programs, and design solutions to bring about multiple objectives (Beatley & Manning, 1997). Sustainable project design utilizes essential aspects of cultural identity, can serve to synthesize the past with the present for the benefit of the future.

Management in organizations including non-profit organizations and government bodies, refers to the individuals who set the strategy of the organization and coordinate the efforts of employees or volunteers to accomplish objectives by using available human, financial and other resources efficiently and effectively. Resourcing encompasses the deployment and manipulation of human resources, financial, technological and natural resources. On other hand management of projects involves increasing the alignment of development projects with the direct beneficiaries’ priorities and coordinating aid efforts at all levels (local, national, and international) to increase ownership and efficient delivery of services. Basically it involves offering leadership to achieve certain laid objectives. Good management ensures that sufficient local resources and capacity exist internally to continue the project in the absence of external resources (McDade, 2004).

Due to complexity of community based projects multifaceted management skills are required. Therefore a project manager (PM) has to manifest both project management related skills (Kirsch, 2000) and technical and expertise as required by the project (Thite, 2001). Project management activities include; defining project scope, managing resources, and advising about technical architecture, estimating project schedule and budget, identifying specific and general project management practices and escalation procedures, ascertaining and managing risks within a project and preparing risk mitigation measures.

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The matching or fit between a PM and project extends not only to the technical skills as enumerated above, but also to other general project-PM profile attributes, such as prior exposure to the methodology experience (Swanson & Beath, 2000). A PM is senior most people within a project undertaking and is perceived to possess a sounding bank for technical and architectural decisions made for the project. In addition, according to (Bloom, 2006) observed that PM is also expected to demonstrate a deep knowledge and understanding of the business objectives of the project being undertaken. Prior literature has shown that past experience of the similar project helps in improving performance and increasing sustainability of a project (Goodman & Leyden, 2001). Having undertaken similar projects elsewhere PM possess deep understanding of project characteristics such as technology, or methodology which improve sustainability (Banker and Slaughter 2000).

According to Espinosa, *et al.* (2007) task familiarity is important in the community based projects and this is usually linked to performance which in turn is linked to sustainability. As irsch (2000) and Thite (2001) argues that, a PM should take the leadership role not only in managing the project but also leading the technological initiatives.

Fiedler *et al.* (2004) define leadership as a process by which one individual insight others toward the attainment of group or organizational goals/objectives. They emphasize three points about the definition of leadership i.e leadership is a social influence process, elicits voluntary action on the part of followers and results in followers' behavior. For leadership to exist, two parties must be involved a leader and one or more followers. Secondly, the voluntary nature of compliance separates leadership from other types of influence based on formal authority which results in followers' behavior that is purposeful and goal-directed in some sort of organized setting.

McDade (2004) states that leaders who possess good management skill are considered to be good leaders and therefore, they steer their organizations to prosperity. A definite nature of leadership and its relationship to key criterion variables such as satisfaction of subordinate, their commitment, and performance is still uncertain, leadership does remain unexplainable concept." However, not all leaders can make to be good managers. Therefore, in the quest to establish effect of management skills on implementation and sustainability of community projects, we must distinguish leadership from management. Basically management involves planning, organizing, staffing, directing, and controlling, and a manager is someone who performs these functions (Chemers & Mahar, 2004). A manager has formal authority by virtue of his or her position or office while leadership, by contrast, primarily deals with influence a person possess towards others. A manager may or may not be an effective leader. Andriessen and Drenth (2007) observe that a leader's ability to influence others to do something and achieve set objectives may be based on a variety of factors other than his or her formal authority or position.

Project managers must possess influence capacity to others so as to increase the probability of successful project implementation and its sustainability. However, they need not only to possess good management skill but leadership skills as well. On daily basis PMs interacts with many stakeholders, they must build a good relationship with internal project teams, their peers and superiors, clients, using skills that are non-technical in nature and which aren't be easily imitable for the project to succeed. According to (Kirsch, 2000) these skills include; tacit knowledge, leadership and management skills, organizational knowledge, and customer handling skills. Within project management teams, as project team progress from technical to more managerial jobs within the project, these skills come into play, and help in effective and efficient project management. Wagner and Sternberg (1985) argue that tacit skills are more effective that are gained through experience rather than being acquired in a classroom. Tacit skills are classified as skills related to managing self, career and others. They find that differences in these skills between a novice and an expert are consequential for career performance in professional and managerial career pursuits. Both hard and soft management skills are required for successful project management especially in implementation and sustainability (Kirsch, 2000). Hard skills are tangible which comprise project management experience, technological skills, domain expertise, and project management skills such as planning, risk management, monitoring and scheduling. Soft skills are intangible, and are normally concerned with working and managing people and fostering inter- and intra- organizational "relationships." These skills include; tacit knowledge, leadership and management skills, organizational knowledge, and customer handling skills. Both technical and transformational leadership skills are required of IT managers for effective leadership (Thite, 1999) also Byrd and Turner (2001, shared the same sentiments. However, no study that measures direct correlation between direct impacts of the PM's skills especially soft skills, on project success have been done yet.

A project manager can use general human capital to increase productivity in many firms or project. These general human capitals includes technological skills, risk management, coordination, domain expertise, project management experience, and project management skills such as planning and monitoring. Some of human capital utilizes skills that are soft, which are specific to a particular firm or environment (Becker, 1975; Lee *et al.*, 1995; Kirsch, 2000). Project team members play a crucial role in determining project performance as well as the PM's hard skills. When team members familiarize themselves with each other, it calls for lower coordination effort, because familiarity can provide information about the task and task stakeholders (Espinosa *et al.*, 2007). For example, if team members interact with each other during project implementation and sustainability, a road map of expertise is developed, that is, they know where and how to locate the expertise needed when in the next project activity (Boh *et al.*, 2007).

Because coordination is easier to accomplish in a more familiar team, we expect that the PM's soft skills to be more helpful for less familiar teams, in terms of facilitating project performance and therefore ensuring sustainability of the community based water projects.

Previous literature has investigated the relationship between personnel's management skills and project success (Pagell *et al.*, 2000). The approach assumes that there is a direct relationship between the performance, organization, and context, and thus predicts a unidirectional effect between skills and performance of any project. While the direct impact of these skills is anticipated, it is important to explore the correlation between PM skills and the project characteristics and its impacts to project sustainability. Page II *et al.*, (2000) find that the impact of fit between skills and environment on performance is more significant compared to the direct impact of skills on performance.

Matching of resources with the project needs is paramount therefore Project managers should perform that role. Resource allocation requires a matching of project characteristics with the skill sets possessed by the Project Manager. Such a matching can be viewed as a strategic choice in response to the (project) environment. Venkatraman and Prescott (1990) and Martin *et al* (2004), suggest that any deviation from an optimum resource allocation patterns should be significantly and negatively related to performance of any community based project and thus sustainability will be impossible.

Sampat, 2006 observes that project managers have always appreciated the role technology in the production process, project performance, and human welfare, that is, when inappropriate technology is put in place then sustainability of water projects becomes a challenge. Poor management and accountability forces unprecedented equal distribution of resources which arises due to repeated economic crises and steadily increasing failure in water projects (Hagedoorn & Cloudt, 2003). Sustainability has been a challenge to all water projects. At the same time, technology is developing with supersonic speed and is becoming the principal instrument for addressing these challenges. This is the reason why many community water based projects are allocating large amounts of money in implementing modern technology like information systems. However, the advantages offered by technologies, especially in increasing productivity, depend upon how well these technologies are a lined into the projects objectives.

Recently, Information Technology (IT) has undergone transformation from implementation of IT applications to an age of IT-enabled change that is technology working for us. The fundamental question is how we can manage our IT projects better in order to maximize their economic benefits and value. The importance of technology on sustainability of water projects shows that, sustainability of rural water supply system is influenced by both factors controlled by the project and those which are not controlled by the project; factors controlled by the project may include; training, technology, cost of the project and construction quality. However, on the other hand, factors that are not controlled by the project include communities' poverty level, access to technical assistances and spare parts (Mbithi & Rasmuson, 1999).

Use of modern technology is key in sustainability of water projects because makes operations and maintenance easy. One of the most crucial elements for sustainability of community based water projects is the effective operation and maintenance (O & M) of rural water supply systems. According to Binder (2008) in case financial resources are inadequate and frequent supports unavailable then, the community management of rural water supply systems on operation and maintenance (O & M) is not successful. Budgeting sufficient funding for rural water supply systems is an importance for successful sustainability.

Enormous influence on water project is felt due to technological innovation (Nohria & Gulati, 2006). For instance, technological innovation plays an important role in influencing the improvement of performance and therefore ensuring successful project sustainability. With more rapid technical transformation, it is evident that the ability of organizations to innovate new products and services is a crucial influence on sustainability (Hitt & Rothaermel, 2003). As depicted in many studies, there exist a very strong positive correlation between a project's technological innovation and project sustainability, and concluded that technological innovation is important factor for implementation, performance and sustainability (Foster, 1986).

Some of desirable characteristics of water projects sustainability includes; value, rarity and inimitability. The economic value of many firms and community project is increasingly derived from intangible assets (Dunning & Lundan, 2010; Kramer *et al.*, 2011), what this means is that more emphasis should focus on dynamic resources, which include knowledge and inimitable and distinct technologies (Prahalad & Hamel, 1990). These innovations drive performance.

According to Hagedoorn and Cloudt (2003) defines innovation in two broad sense; they argues that innovation performance refers to knowledge of technological, inventive and innovative operations. On the hand, innovation performance can also be expressed in product performance and process performance (Cockburn *et al.*, 2010). Hopkins and Brynjolfsson (2010) observe that a performance gap exists between companies that embrace technology and those that resist it; therefore, innovation directly correlated to technologies. Similarly, community water projects that integrate technology with the lied objectives exhibits better implementation, performance and sustainability than those that doesn't. Sustainability of community based water projects driven by technology

depends largely on; the effective management of the innovation process, and managers should continue to identify, develop, protect, and allocate resources and capabilities in order to gain a sustainable competitive advantage (Amit & Schoemaker, 1993). The advances in IT have significantly of importance which has adversely changed the way computerized information systems can be used in water projects. Its role in service-sector firms and its impact on the effectiveness of the firm's operations and sustainability have been identified (Rubenstein & Greisler, 2000).

In addition, stakeholders require frequent updates of the progress of the project so as to ease assessment of those projects. Therefore the water projects have no option rather than to invest in information systems. Information technology supports a number of functions in community based project; which includes; significant change on the way projects interact with stakeholders. Secondly; provision of information extracted from their records to improve members' satisfaction (Li, 1997); this ensures personalized service delivery to members. With the help of IT Stakeholders can track the effects of automated admissions into the project for those who were not there on onset of the project, reporting project faults, and the improved efficiency and accuracy of billing and office systems.

3. RESEARCH METHODOLOGY

Descriptive survey was employed in this study. According to Schindler (2003) descriptive survey it attempts to describe or define a subject, often by creating a profile of a group of problems, people, or events, through the collection of data and tabulation of the frequencies on research variables or their interaction as indicated by Cooper and Thus, this approach was appropriate for this study as it helped in collection without changing the environment. Sometimes is referred as "correlational" or "observational" studies. The study employed descriptive design in this study since it sought to establish the factors that hinder sustainability of water projects in Makueni County, a case of Kwing'ithya Kiw'u water project.

Kwing'ithya Kiw'u water project was taken as the study project which was funded by ACTION AID which cuts across two wards that is Kikumbulyu North and South. Both qualitative and quantitative data was used to explain the sustainability issues was explained used focusing a wide cross section of characteristics including those of households, and socio-economic activities, technological and structural issues affecting projects' sustainability. Data gathered and analyzed was used to make generalization with regard to the sustainability factors for water projects.

The study population constituted the inhabitants of the two wards, key informants especially Kwing'ithya Kiw'u Self Help group which partnered with Action Aid (NGO), Local sub-chiefs of the 7 sub-locations within the two wards. This included cross section of people involving those who have been involved in the development of the projects, use, management, as well as those with expert information or data about these community based projects. The respondents were reached through household survey and purposive identification of the subject matter or key informants across relevant local institutions. In terms of the exact population size, according to population (2009 national census) the wards have the following populations; Kikumbulyu North ward (Kathyaka, Ngulu, Ndetani sub-locations) had a population of (20,314) and Kikumbulyu South ward (Mbui Nzau, Kalungu, Ngandani and Mikuyuni sub-locations) had a population of (26,368). Further, the study focused on the former 23 employees in the Kwing'ithya kiw'u water project.

The study area was Makueni County specifically Kikumbulyu South and North. According to the 2009 census, both Kikumbulyu South and North has seven villages which includes Kathyaka, Ngulu, Ndetani Mbui Nzau, Kalungu, Ngandani and Mikuyuni sub-locations and they constituted to a total population of 46,682 (Census data, 2009). This study was intended to collect data from communities residing in the seven sub locations and specifically people around the water projects. Both probability and non-probability sampling methods were combined to achieve maximum reliable responses for triangulation of themes.

A sample was drawn from the households which helped in providing reliable information regarding the objectives of the study. Three factors are considered to determine the size of an adequate sample which includes the nature of the population, the type of investigation, and the degree of precision desired (Van Dalen 1979). Krejcie and Morgan (1970) provide the formula was used to estimate the sample size and a table for determining the sample size based on confidence level needed from a given population.

$$S = \frac{X^2 NP (1 - P)}{d^2 (N - 1) + X^2 P (1 - P)}$$

Where

S = required sample size

N = the given population size

P = population proportion that for table construction has been assumed to be 0.50, as this magnitude yields the maximum possible sample size required

d = the degree of accuracy as reflected by the amount of error that can be tolerated in the fluctuation of a sample proportion p about the population proportion P - the value for d being 0.05 in the calculations for entries in the table, a quantity equal to

$$\pm 1.96 \sigma_p$$

X^2 = table value of chi square for one degree of freedom relative to the desired level of confidence, which shall be 3.841 for the 0.95 confidence level represented by entries in the table according to the 2009 census, the population of the seven sub-locations was 46,682. Applying this to the above formula the minimum sample size be 381. According to the Evaluation report of 2012, the average household size is 4.27. This was divided by the sample, giving a minimum of the 89.23 (90 households to be interviewed).

The study used a combination of both probability and non-probability sampling techniques. The probability sampling techniques included simple random sampling, cluster sampling procedure, and systematic sampling procedure. For quantitative data collection, Cluster sampling procedure was applied where the settlements are not evenly distributed but settled in clustered households near the water projects. Simple random sampling was applied first within the clusters to randomly pick the first household for administration of questionnaires. Once the first household is randomly identified, Systematic sampling procedure was employed to collect data through questionnaires in the subsequent households within the cluster. The systematic procedure was often applied where the settlements existed in a linear order.

In the case of non-probability sampling technique purposive sampling was applied. This procedure was applied to collect qualitative data especially in identifying and reaching the key informants on particular themes, Purposive sampling procedure involved selection of a sample on the basis of the researcher's own judgment depending on the elements and the nature of the research objective. This was applied in identifying and conducting informant interviews for various leaders and also participants for group discussions. It is often applied when the informants have a specific type of knowledge or skill required in the study.

A number of methods were applied to collect both primary and secondary data in order to generate quantitative and qualitative data. A questionnaire from the respondents (beneficiaries of community water projects) was applied in this study to collect quantitative data. Also, the study sought responses from staffs working in the projects. An introductory letter from the University was obtained by the researcher to collect data from the water project, with the help of research assistants he delivered the questionnaires to the respondents and had them filled in. A keen review of Ministry of water Publications, water project reports, journals, development plans, survey maps, and newspapers formed secondary data. The above mentioned documents contained relevant literature to the area and topic of the study.

Data was collected by use of self-administered questionnaire for the respondents. The researcher obtained approval from the University to permit data collection. The researcher explained the purpose of the study and offered guidance to the respondents on the way the questionnaire should be filled. For those respondents who don't have capacity to read and write the researcher interviewed them and filled in the questionnaire for them. Drop and pick later method was employed during data collection where the respondents were left with the questionnaire to fill in their appropriate time. In order to increase the response rate the researcher made subsequent visits to remind the respondents to fill the questionnaire.

A pilot study was conducted to test and refine the research instrument so as to determine whether the results collected from the ground gave the true representation. To establish the validity of the research instrument the researcher sought the opinions of experts in the field of study especially the researcher's supervisor and lecturers. Reliability of the research instrument was enhanced through a pilot study that was conducted at Makueni County Ministry of water by selecting 30 respondents. According to Cooper and Schindler (2003) statistical conditions were not necessary in the pilot study. The pilot data was not included in the actual study. The pilot study allowed for pre-testing of the research instrument. This reliability estimate was measured using Cronbach's Alpha coefficient (α). According to Nunnally (1978) recommends that instruments used in research should have reliability of about $\alpha \geq 0.70$ and above.

Clear guidelines were followed to analyze data, the first step the researcher edited completed questionnaires completeness and consistency, data clean-up followed; which included editing, coding, and tabulation in order to detect any inconsistencies in the responses and specific numerical values were assigned to the responses for further studies. The data was analyzed using descriptive statistical tools (SPSS V.17.0 and Excel) which helped the researcher to describe the data. The Likert scale was used to analyze the mean score and standard deviation. To study the relationship amongst cultural practices, technology, management skills and stakeholders' participation and financial sustainability, the researcher employed a multivariate regression model. The research used

regression method for its ability to test the nature of influence of independent variables on a dependent variable. Regression is able to estimate the coefficients of the linear equation, involving one or more independent variables, which best predicted the value of the dependent variable. This is what a correlation analysis cannot provide as compared to a regression analysis. Further, correlation analysis was meant to illustrate the direction of relationship between two variables but not how much the independent variable influences the dependent variable. Therefore, the researcher used the linear regression analysis to analyze the data. The regression model will be as follows:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \varepsilon$$

Where: Y = Community Based Project implementation and sustainability; β_0 = Constant Term; $\beta_1, \beta_2,$ and β_3 = Beta coefficients; X_1 =stakeholders’ participation; X_2 = Cultural practices; X_3 = management skills; X_4 = Technology and ε = Error term

The findings were presented using tables and graphs for further analysis and to facilitate comparison. This generated quantitative reports through tabulations, percentages, and measure of central tendency.

4. DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Response Rate

As depicted in Table 4.2, the study targeted a population of 90 household respondents and 23 water project employees. The respondents returned their questionnaires as shown by table 4.2. According to Mugenda and Mugenda (1999), this response rates were sufficient and representative. It conforms to stipulation that a response rate of 50% is adequate for analysis and reporting; a rate of 60% is good and a response rate of 70% and over is excellent. Extra efforts were made to achieve this commendable response rate.

Table 4.1 Response Rate

	Targeted	Returned	Percent
Household respondents	90	90	100%,
Water project employees	23	20	86.9%

4.2 Pilot Test Results

Reliability according to Mugenda and Mugenda (2003) is a measure of the degree to which research instruments yield consistent results of data after repeated trials. To improve on reliability in this study, piloting of the questionnaires was done among 30 selected households. These members were then not allowed to participate in the actual study to avoid contamination of the study sample. The pilot questionnaires were analyzed for reliability using the Cronbach’s reliability test. The judgment on reliability of tools was based on Fraenkel & Wallen (2000) guidelines which state that an alpha value of 0.7 infers that the tools are adequate and can be adopted for the study without amendments. Questions in each study variable gave a Cronbach alpha value that is greater 0.7; hence, they were all adopted for the study.

Table 4.2: Cronbach Alpha Test Results

Variable	N of Items	Cronbach’s Alpha
Stakeholders’ participation	7	0.727
Cultural practices	7	0.806
Management skills	7	0.834

Technology influence	7	0.932
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4.3 Socio-Demographic Characteristics of Respondents

The study sought to establish information on following aspects of respondents' background such as time of being a resident, gender, professional qualification, occupation, and average income. The aim of the information was to test the appropriateness of the respondent in responding to the questions regarding factors hindering sustainability of water projects in Makueni County, Kenya.

4.4.1 Being a Resident

The study sought to establish out the whether the household respondents were resident of the area under study.

Table 4.3 Being a Resident

	Frequency	Percentage
Yes	90	100
No	0	0
Total	90	100

From the Table 4.2, 100% of the household respondents were residents of Kikumbulyu South and North and therefore they would give reliable information about water project in Makueni County.

4.3.2 Years of Being a Resident

The study sought to establish for how long the respondents had lived in Makueni County.

Table 4.4 Years of Being a Resident

	Frequency	Percentage
10 years and below	5	5.5
11-20 years	12	13.3
21-30 years	48	53.3
31 years and above	25	27.9
Total	90	100

From the findings in Table 4.4, most of the household respondents (53.3%) had lived in Makueni County for 21-30 years, 27.9% for 31 years and above while 13.3% had lived for 11-20 years; finally 5.5% had lived for 10 years and below. This shows that the household respondents had stayed in Makueni County for long enough to give reliable information about the sustainability of water projects in Makueni County.

4.3.3 Gender Distribution of Respondent

The study sought to establish out the gender of the respondents.

Table 4.5 Gender Distribution of Respondent

	Frequency	Percentage
Male	48	53.3
Female	42	46.7
Total	90	100

From the results in table 4.5, majority (53.3%) of the household respondents were male while minorities (46.7%) were female. The findings indicate that majority of the households were headed by males.

4.3.4 Highest Level of School/Level

The study sought to investigate the highest academic qualifications of the respondents.

Table 4.6 Highest Level of School/Level

	Frequency	Percentage
Never	2	2.2
Primary	20	22.2
Secondary level	52	57.8
Tertiary level; (colleges, polytechnics)	9	10.0
University level	7	7.8
Total	90	100

From the Table 4.6 (57.8%) who were the majority of the household respondents had secondary level of education, 22.2% had primary, 10.0% had tertiary level while 2.2% had never stepped to school. Clearly the finding shows that majority had basic education therefore, they could read and write hence providing valid, reliable and consistent information about sustainability of water project in their locality.

4.3.5 Occupation

The study sought to find out the occupation of the respondents.

Table 4.7 Occupation

	Frequency	Percentage
Livestock sale		43
Vegetable sale		49
Charcoal sale		31
Firewood sale		28
Carpentry		11
Quarrying (sand/stone)		11
Casual labour		60
Employment		5

From the results in Table 4.7, 60% of the respondents were casual labourers, 49% involved themselves in selling vegetables, 43% sold livestock, 33% sold charcoal, 28% sold firewood sale, 11% in carpentry, 14% they majored on quarrying while 8% were employed. Therefore the majority of the respondents earn their living from informal sector.

4.3.6 Average Income Range Per Month

The study sought to establish out the respondents' income range monthly from all their income sources combined.

Table 4.8 Average Income Range Per Month

	Frequency	Percentage
Less than 2500	20	22.2
2500 – 5000	50	55.6
5000 – 7500	14	15.6
7500 – 10000	4	4.4

More than 10,000	2	2.2
Total	90	100

From the Table 4.8, many of the households in Makueni County (55.6%) had an average monthly income of Ksh. 2500 – 5000, 22.2% earned Ksh. < 2500 while 15.6% earned an average monthly income of Ksh. 5000 – 7500. Therefore 77.8% the majority of the households were earning less than Ksh. 7500.

4.4 Stakeholders' Participation and the Sustainability of the Water Projects

The first objective of the study was to establish how the extent of stakeholders' participation affects the sustainability of the water projects.

4.4.1 Participation in the Initiation of Water Projects

The study sought to investigate whether the household's respondents had ever involved in project initiation in this area (Kikumbulyu South and North).

Table 4.9 Participation in the Initiation of Water Projects

	Frequency	Percentage
Yes	35	38.9
No	55	61.1
Total	90	100

From the results of the study in Table 4.9, the majority (61.1%) of the households' respondents were never involved themselves in the initiation of the water projects while only 38.9% actively participated in the initiation of Kwing'ithya Kiw'u water projects. This shows that stakeholders' participation in the water projects was low.

4.4.2 Stakeholders' Involvement in Water Project Operation

The respondents were required to indicate whether other stakeholders were involved in the water projects in this area.

Table 4.10 Stakeholders' Involvement in Water Project Operation

	Frequency	Percentage
Yes	70	77.8
No	20	22.2
Total	90	100

According to the findings in Table 4.11, majority (77.8%) of the respondents indicated that other stakeholders were involved in the Kwing'ithya Kiw'u water project in this area. This explains that involvement of the stakeholders determined the sustainability of the water projects.

4.4.3 Stakeholders' Participation Positive Contribution to the Sustainability of the Water Projects

The respondents asked to identify the extent that the stakeholders' participation positively enhanced the sustainability of the water projects.

Table 4.11 Stakeholders' Participation

	Frequency	Percentage
To a very low extent	2	2.2
To a low extent	3	3.3
To a moderate extent	15	16.7
To a great extent	45	50.0
To a very great extent	25	27.8
Total	90	100

Table 4.11 shows most of the household respondents (50.0%) revealed that stakeholders' participation positively enhanced the sustainability of the water projects to a great extent, 27.8% to a very great extent while 16.7% to a moderate extent, finally, 5.5% to a very and low extent. Therefore it is evident stakeholders' participation enhanced the efficiency of the water project to a great extent consequently improving the sustainability of the water project.

4.4.4 Stakeholders' Participation and Sustainability of the Water Projects

The study inquired from the respondents the influence of stakeholders' participation on the sustainability of the rural community based water projects. The respondents were required to indicate their level of agreement on the extent to which stakeholders' participation affected the sustainability of the water projects. The responses were rated on a five point Likert scale where: 1 - Strongly Disagree 2 - Disagree 3 - Neutral 4- Agree and 5- Strongly Agree. SPSS was used to generate the mean and standard deviations as illustrated in Table 4.11.

Table 4.12 Stakeholders' Participation and Sustainability of the Water Projects

Statements	Mean
Target communities involvement is important for the sustainability of rural water supply systems	4.09

Stakeholders' support has ensured that participants are actively involved in project planning and implementation or through formal or informal training and consciousness- raising activities.	4.39
Stakeholders' involvement in the project implementation has enhanced continuity in the operation of the water project	2.43
Stakeholders' participation has enabled them to clearly understand their roles	4.23
Stakeholder are better placed to lobby for government and donor support for the community project	3.89
By the Stakeholders' support, the community ensures the success of a project through collective efforts to increase and exercise control over project	4.03
Stakeholders influence and share control over water development initiatives, and the decisions (e.g. for expansion, operation and maintenance) and resources which affect them	4.05
Stakeholders support ensure that community project are managed effectively, minimizing wastes and thereby ensuring their sustainability more so financial sustainability	3.06
Stakeholders' support brings together individuals, families, or communities who assume responsibility for their own welfare (ownership)	3.01
Stakeholders' contribution influences the direction and execution of water development projects rather than merely receive a share of project benefits	3.56
Community support has increased project efficiency	3.87
Building a partnership with the communities lead towards improving the people's problem solving capacities	4.01

From the study findings, the majority of the respondents agreed that; stakeholders' support has ensured that participants are actively involved in project planning and implementation or through formal or informal training and consciousness- raising activities (M=4.39), stakeholders' participation has enabled them to clearly understand their roles (M=4.23), involvement of the target communities is crucial for the sustainability of rural water supply systems (M=4.09), stakeholders influence and share control over water development initiatives, and the decisions (e.g. for expansion, operation and maintenance) and resources which affect them (M=4.05), by the Stakeholders' support, the community ensures the success of a project through collective efforts to increase and exercise control over project (M=4.03), building a partnership with the communities lead towards improving the people's problem

solving capacities (M=4.01), stakeholder are better placed to lobby for government and donor support for the community project (M=3.89), community support has increased project efficiency (M=3.87), stakeholders' contribution influences the direction and execution of water development projects rather than merely receive a share of project benefits (M=3.56), stakeholders support ensure that community project are managed effectively, minimizing wastes and thereby ensuring their sustainability more so financial sustainability (M=3.06), stakeholders' support brings together individuals, families, or communities who assume responsibility for their own welfare (ownership) (M=3.01), stakeholders' involvement in the project implementation has enhanced continuity in the operation of the water project (M=2.43) respectively.

4.4.5 Stakeholders' Involvement in the Project

The study sought to find out from the water project employees on whether the stakeholders were adequately involved in the project.

Table 4.13 Stakeholders' Involvement in the Project

	Frequency	Percentage
Yes	5	25
No	15	75
Total	20	100

The results in Table 4.13, many of the water project employees (75%) confessed that the stakeholders were not adequately involved in the project. Only 25% of the water project employees attested to the stakeholders being adequately involved in the water project. Therefore, it is evident the lack of sufficient will of stakeholders' participation in the project implementation contributed to the project failure.

4.5 Cultural Practices and Sustainability of Water Projects

This was the second objective of the study which was to assess how cultural practices influence sustainability of the water projects.

4.5.1 Cultural Practices and Sustainability of the Water Projects

The study sought to find out the influence of cultural practices on the sustainability of the water projects. The respondents were required to show their level of agreement on the extent to which various cultural practices affected the sustainability of the water projects. The responses were rated on a five point Likert scale where: 1 - Strongly Disagree 2 - Disagree 3 - Neutral 4- Agree and 5- Strongly Agree. SPSS was used to generate the mean and standard deviations were generated as illustrated in Table 4.14.

Table 4.14 Cultural Practices and Sustainability of the Water Projects

Statements	Mean
People from different backgrounds in the region benefit from the water project	2.42
The water project unites people from different cultures/backgrounds in the region	3.66

The water project promotes social networks amongst communities in the region	3.26
The water project has enhanced partnerships between the local community and the government or non-governmental organizations	3.26
The water project builds community identity	3.54
Through the water project the cultural norms are maintained in the community around	3.52
The water project has positively transformed health, water and sanitation practices in the region	4.57
The water project has enhanced participation of local communities in development initiatives in the region	4.53
The project has improved security in the region by reducing clashes over natural sources of water	4.27
The project has encouraged residents to take ownerships of their own community resources	4.37
The water project has encouraged residents to take care of available water resources and other natural resources	4.23
The community has acquired substantial knowledge and technical skills from the water project	4.01

From the study results, the majority of the respondents agreed that the water project has positively transformed health, water and sanitation practices in the region (M=4.57), the water project has facilitated participation of local communities in development initiatives in the region (M=4.53), the project has encouraged residents to take ownerships of their own community resources (M=4.37), the project has improved security in the region by reducing conflicts over natural sources of water (M=4.27), the water project has encouraged residents to conserve available water resources and other natural resources (M=4.23), the community has gained substantial knowledge and technical skills from the water project (M=4.01), the water project unites people from different cultures/tribes/clans in the region (M=3.66), the water project builds community identity and pride (M=3.54), through the water project the cultural norms are upheld in the community around (M=3.52), the water project promotes social networks amongst residents in the region (M=3.26), the water project has enhanced partnerships between the local community and the government or non-governmental organizations (M=3.26), and that people from different cultures/tribes/clans in the region benefit from the water project (M=2.42) respectively.

4.5.2 Effect of Cultural Practices on the Project

The study further solicited information from the water project employees on how they would rate the effect of cultural practices in the project.

Table 4.15 Effect of Cultural Practices on the Project

	Frequency	Percentage
Excellent	1	5.0
Good	2	10.0
fair	6	30.0
poor	9	45.5
Very poor	2	10.0
Total	20	100

Table 4.15 reveals that most of the water project employees (45.5%) rated the effect of cultural practices in the project as poor, 30% as fair while 10% rated it as very poor.

4.6 Management Skills and Sustainability of the Water Projects

The third objective of the study was to examine how management skills hinder sustainability of the water projects.

4.6.1 Managers of the Water Point

The household respondents were supposed to indicate who managed the water points.

Table 4.16 Managers of the Water Points

	Frequency	Percentage
Committee	45	50.0
An elected leader	30	33.3
Headman	9	10.0
Politician	6	6.7
Total	90	100

As shown in Table 4.16, 50.0% of the household respondents acknowledged that the water points were managed by a committee, 33.3% by elected leader, 10.0% by headman and 6.7% indicated that water point were managed by political leaders.

4.6.2 Responding to Concerns

The household respondents were required to indicate whether those who were entrusted with management of the water project responded adequately to concerns whenever raised.

Table 4.17 Responding to Concerns

	Frequency	Percentage
Yes	60	66.7
No	30	33.3
Total	90	100

Table 4.17 shows that the majority of the household respondents (66.7%) said water managers responded adequately to concerns raised by community members. Only 33.3% didn't respond to concerns whenever raised.

4.6.3 Efficiency of the Water Project Managers

This was to measure the efficiency of water project managers.

Table 4.18 Efficiency of the Water Project Managers

	Frequency	Percentage
Yes	60	66.7
No	30	33.3
Total	90	100

From the findings of the study in Table 4.18, the majority of the household respondents (66.7%) said that the people appointed to manage the water project were effective while 33.3% said that the people appointed to manage the water project were ineffective.

4.6.4 Management Skills and Sustainability Water Projects on Likert Scale

The study sought to find out the influence of management skills on the sustainability of the water projects. The respondents were requested to indicate their level of agreement on the extent to which various management skills affected the sustainability of the water projects. The responses were rated on a five point Likert scale where: 1 - Strongly Disagree 2 - Disagree 3 - Neutral 4- Agree and 5- Strongly Agree. SPSS was used to generate the mean and standard deviations as illustrated in Table 4.19.

Table 4.19 Management Skills and Sustainability of the Water Projects

Statements	Mean
There is enough technical expertise to manage the project	4.01
Project managers have adequate and experience in management	3.69
There is enough human resource for sustainability of the project	3.88
Technical architecture advice was made available for the project	3.60
Estimates in the project schedule and budget are clear and achievable	3.66
Risk management is satisfactory	3.77
There is adequate leadership skills of the managers	3.63
Community Members are satisfied with the overall management of the water project	3.79
Management of projects has increased the alignment of development projects with host communities priorities	3.71
Community based projects are more complex and require multifaceted management skills	3.65

From table 4.19 the majority of the respondents admitted that there is sufficient technical expertise to manage the project (M=4.01), there is adequate human resource for sustainability of the project (M=3.88), the community is satisfied with the overall management of the water project (M=3.79), risk management is satisfactory (M=3.77), management of projects has increased the alignment of development projects with host communities priorities (M=3.71), project managers have adequate and experience in management (M=3.69), there are clear and achievable estimates in the project schedule and budget (M=3.66), community based projects are complex and require multifaceted management skills (M=3.65), There is adequate leadership skills of the managers (M=3.63), and that Technical architecture advice was made available for the project (M=3.60) respectively.

4.6.5 Management Qualities Affecting Sustainability of the Rural Community Based Water Projects

For further establishment of the influence of management skills on the sustainability of the water projects, the water project employees were questioned to indicate their level of agreement on the extent to which the management possessed various qualities and skills that could affect the sustainability of the water projects. The responses were rated on a five point Likert scale where: 1 = not at all, 2 = little extent, 3 = moderate extent, 4 = great extent and 5 = very great extent. SPSS was used to generate the mean and standard deviations as illustrated in Table 4.19.

Table 4.20 Management Qualities Affecting Sustainability of the Water Projects

Management qualities	Mean
Technical expertise	4.40
Task familiarity	3.13
Resources Management	4.26
Technical architecture Advise	4.18
Estimating project schedule and budget	3.16
Ascertaining and risk management	3.15
Business Knowledge	3.89
Leadership Skills	3.51

From the results of Table 4.20, many of the respondents agreed that the management qualities that hindered the sustainability of the rural community based water projects were technical expertise (M=4.40), resource management (M=4.26), technical architecture advise (M=4.18), business knowledge (M=3.89), leadership (M=3.51), estimating project schedule and budget (M=3.16), ascertaining and managing risks (M=3.15) and (task familiarity) (M=3.13) respectively.

4.7 Technology and Sustainability of the Water Project

The last objective of the study was to determine how technology hinders sustainability of the water projects.

4.7.1 Technology Used to Pump Water

The household respondents were to state on which technology was used to get water from the points/sources identified.

Table 4.21 Technology Used to Pump Water

	Frequency	Percentage
By use of pulley	50	55.6
Use of pumps to pump out of source to storage tanks	30	33.3
Water piping to all households	10	11.1
Total	90	100

The results from Table 4.21 revealed that, the majority of the (55.6%) employed pulley technology to access water from the points/sources, 33.3% used water pumps while

11.1% indicated that water is piped to all households.

4.7.2 Meters Installation for Monitoring Water Consumption

The target was to investigate whether there were meters installed to monitor consumption of water, therefore households respondents had to provide the answers.

Table 4.22 Meters Installed to Monitor Consumption of Water

	Frequency	Percentage
Yes	18	20
No	72	80
Total	90	100

From to the results from Table 4.22 the majority of the household respondents (80%) said that no meters had been installed to monitor consumption of water. Only 20% attested that meters had been installed to monitor consumption of water. Therefore, there was a low level of adoption of technology in the management of water project hence impairing the sustainability of water projects.

4.7.3 Water Payment Mode

The household respondents were required to indicate the various mode of payment that they used to pay for the water bills.

Table 4.23 Water Payment Mode

	Frequency	Percentage
Mobile money payment (Mpesa and Airtel money)	26	28.9
Bank account	12	13.3
Cash	52	57.8
Total	90	100

As per the findings in Table 4.23 most of the household respondents (57.8%) paid for water using cash, 28.9% using mobile money payment (Mpesa, and Airtel money) while 13.3% used bank account. This clearly indicates amount of liquid cash which was handled by management of the water projects.

4.7.4 Challenges Affecting Constant Supply of the Water

The household respondents were required to indicate the various challenges affecting constant supply of the water to the households from the water points.

Table 4.24 Challenges Affecting Constant Supply of the Water

	Percentage
Pipes Breakage	44
Vandalism	31
Pipes blockages	23
Breakdown of generator pumps	45
Expensive parts/fuel	56

According to the results in Table 4.24, expensive parts/fuel (56%) was the main challenge affecting constant supply of the water to the households from the water points, breakdown of generator pumps (45%), pipes breakages (44%), vandalism (31%) and pipes blockages (23%) respectively.

4.7.5 Technology and Sustainability of Water Project

The household respondents were required to indicate whether technology has influenced efforts to achieve sustainability of the water projects.

Table 4.25 Technology and Sustainability of the Water Project

	Frequency	Percentage
Yes	15	75
No	5	25
Total	20	100

According to the results in Table 4.24, majority of the water project employees (75%) attested to technology influencing efforts to achieve sustainability of the water project. While (25%) didn't agree with whether technology was a critical factor affecting the sustainability of the community based water project.

4.7.6 Forms of Technology Used in Rural Community Based Water Projects

In order to further to establish how technology hinders sustainability of the water projects, the water project employees were requested to show their level of agreement on the extent to which various forms of technology were used in the rural community based water projects. The responses were rated on a five point Likert scale where: 1 = not at all, 2 = little extent, 3 = moderate extent, 4 = great extent and 5 = very great extent. SPSS was used to generate the mean and standard deviations as illustrated in Table 4.25.

Table 4.26 Forms of Technology Used in Water Projects

Forms of technology	Mean
Information communication systems	4.39
Accounting systems	4.26
Payment systems	4.12
Reporting systems	4.13
Service delivery	4.23
Fault reporting	4.15

From the findings in table 4.25, majority of the respondents attested that information communication systems were mostly used (M=4.39), accounting systems (M=4.26) followed, service delivery (M=4.23), fault reporting (M=4.15), reporting systems (M=4.13), and finally payment systems (M=4.12) respectively.

4.7.7 Technology and Projects' Sustainability Using Likert Scale

In order to investigate further to establish how technology hinders sustainability of the water projects, the water project employees were requested to indicate the extent to which various aspects of technology hindered the water projects sustainability. The responses were rated on a five point Likert scale where: 1 = not at all, 2 = little extent, 3 = moderate extent, 4 = great extent and 5 = very great extent. SPSS was used to generate the mean and standard deviations as illustrated in Table 4.26.

Table 4.27 Technology and Projects' Sustainability

Technologies	Mean
Pumping technology	4.23
Spare parts availability	3.87
Payment systems	4.01
Choice of tech (Solar energy vs. Generator, borehole, dams, water pans)	4.03
Service delivery	3.06
Fault reporting	3.00

As per the findings in Table 4.26, many of the respondents attested that the various aspects of technology hindered the water projects sustainability which included; pumping technology (M=4.23), choice of tech (Solar energy vs. Generator, borehole, dams, water pans)

(M=4.03), payment systems (M=4.01), spare parts availability (M=3.87), and finally service delivery (M=3.06) and fault reporting (M=3.00) in that order.

4.7.8 Sustainability of Water Projects

The study required the water project employees to indicate whether they considered the water projects in the area to be sustainable.

Table 4.28 Sustainability of Water Projects

	Frequency	Percentage
Yes	7	35
No	13	65
Total	20	100

Table 4.27 indicates that, majority of the water project employees attested that the water projects in the area were not sustainable while 35% said that the water projects in the area were sustainable. This illustrates that the sustainability of majority of water project in Makueni County was low. Water project employees gave the following indicators of sustainability which included reduced cost of running the project improved access to water by the area residents, and environmental protection and conservation.

According to the water project employees the main factors contributing to sustainability were adoption of modern technology, full stakeholders’ participation, good management of the water project by qualified and professionals and integration of local community culture in the planning and implementation of the project. The water project employees attested that the for water projects to be sustainable the following should be put into considerations; stakeholders’ participation, cultural practices, management skills and practices and finally use of modern technology in the running of the project.

4.8 Inferential Statistics

4.8.1 Correlation Analysis

Karl Pearson’s coefficient of correlation was employed to quantify the strength of the relationship between the variables used in the study.

The Pearson product-moment correlation coefficient measures the strength of a linear association between two variables and is denoted by r . The Pearson correlation coefficient, r , takes a range of values from -1 to +1. 0 indicates the two variables are independent. A positive value indicates a positive association. A negative value indicates negative association, that is, as the value of one variable increases the value of the other variable decreases.

Table 4.29: Correlation and the coefficient of determination

	Project sustainability	Stakeholders’ participation	Management skills	Cultural practices	Technology influence
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Project sustainability (r) (p) Sig. (2 tailed)	1.000				
Stakeholders' participation (r) (p) (2 tailed)	0.894 0.018	1.000			
Management skills (r) (p) Sig. (2 tailed)	0.493 0.031	0.316 0.047	1.000		
Cultural practices (r) (p) Sig. (2 tailed)	0.661 0.024	0.163 0.019	0.216 0.047	1.000	
Technology influence (r) (p) Sig. (2 tailed)	0.402 0.046	0.161 0.029	0.233 0.0464	0.462 0.014	1.000

4.8.2 Relationship between Stakeholders' Participation and Sustainability of Water Projects

From Table 4.28, it is evident that there is a positive relationship between water project sustainability and stakeholders' participation of magnitude 0.894. The positive relationship indicates that there is a correlation between the factors hindering sustainability of water projects in Kikumbulyu South and North, Makueni County, Kenya with stakeholders' participation leading with the highest value (0.894). This factor had a significant p-value ($p < 0.05$) at 95% confidence level. Stakeholders' participation was the most significant factor. Since this factor is < 0.05 then there is statistically significant relationship between stakeholders' participation and sustainability of water projects.

4.8.3 Relationship between Cultural Practices and Sustainability of Water Projects

From Table 4.28, it is evident that there is a positive relationship between water project sustainability and cultural practices of magnitude 0.661. The positive relationship indicates that there is a correlation between the factors hindering sustainability of water projects in Kikumbulyu South and North, Makueni County, Kenya. This factor had a significant p-value ($p < 0.05$) at 95% confidence level. Since this factor is < 0.05 then there is statistically significant relationship between cultural practices and sustainability of water projects.

4.8.4 Relationship between Management Skills and Sustainability of Water Projects

From Table 4.28, it is evident that there is a positive relationship between water project sustainability of magnitudes 0.493. The positive relationship indicates that there is a correlation between the factors hindering sustainability of water projects in Kikumbulyu South and North, Makueni County, Kenya. This factor had a significant p-value ($p < 0.05$) at 95% confidence level. Since this factor is < 0.05 then there is statistically significant relationship between management skills and sustainability of water projects.

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4.8.5 Relationship between Technology and Sustainability of Water Projects

From Table 4.28, it is evident that there is a positive relationship between water project sustainability and technology influence of magnitude 0.402. The positive relationship indicates that there is a correlation between the factors hindering sustainability of water projects in Kikumbulyu South and North, Makueni County, Kenya. With stakeholders' participation leading with the highest value (0.894) and technology influence lagging behind with the lowest correlation value (0.402). This factor had a significant p-value ($p < 0.05$) at 95% confidence level. Since this factor is < 0.05 then there is statistically significant relationship between management skills and sustainability of water projects.

5. SUMMARY OF THE FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

5.1.1 Stakeholders' Participation and Sustainability of Water Projects

The study established that the majority (61.1%) of the community members never participated in the initiation of the water projects. Thus level of stakeholders' participation in the water projects was low which affected the sustainability of water project. The household participated in the initiation of the water projects when they were consulted through a meeting, contribution of building materials and as leaders of the committees. This implies that the stakeholders' participation was critical in the implementation of the water projects in the county. The involvement of the all the stakeholders determined the efficiency and sustainability of the water projects.

The stakeholders' participation positively enhanced the sustainability of the water projects to a great extent. Therefore the stakeholders' participation enhanced the efficiency of the water project to a great extent consequently improving the sustainability of the project. The stakeholders were not adequately involved in the project. Therefore the lack of sufficient stakeholders' participation in the project implementation contributed to the project failure.

The study also revealed that; stakeholders' support has ensured that participants are actively involved in project planning and implementation or through formal or informal training and consciousness- raising activities ($M=4.39$), stakeholders' participation has enabled them to clearly understand their roles ($M=4.23$), involvement of the target communities is crucial for the sustainability of rural water supply systems ($M=4.09$), stakeholders influence and share control over water development initiatives, and the decisions (e.g. for expansion, operation and maintenance) and resources which affect them ($M=4.05$), by the Stakeholders' support, the community ensures the success of a project through collective efforts to increase and exercise control over project ($M=4.03$), building a partnership with the communities lead towards improving the people's problem solving capacities ($M=4.01$), stakeholder are better placed to lobby for government and donor support for the community project ($M=3.89$), community support has increased project efficiency ($M=3.87$), stakeholders' contribution influences the direction and execution of water development projects rather than merely receive a share of project benefits ($M=3.56$), stakeholders support ensure that community project are managed effectively, minimizing wastes and thereby ensuring their sustainability more so financial sustainability ($M=3.06$), stakeholders' support brings together individuals, families, or communities who assume responsibility for their own welfare (ownership) ($M=3.01$), stakeholders' involvement in the project implementation has enhanced continuity in the operation of the water project ($M=2.43$) respectively.

5.1.2 Cultural Practices and Sustainability of Water Projects

From the study findings, the study established that water project has positively transformed health, water and sanitation practices in the region ($M=4.57$), the water project has facilitated participation of local communities in development initiatives in the region ($M=4.53$), the project has encouraged residents to take ownerships of their own community resources ($M=4.37$), the project has improved security in the region by reducing conflicts over natural sources of water ($M=4.27$), the water project has encouraged residents to conserve available water resources and other natural resources ($M=4.23$), the community has gained substantial knowledge and technical skills from the water project ($M=4.01$), the water project unites people from different cultures/tribes/clans in the region ($M=3.66$), the water project builds community identity and pride ($M=3.54$), through the water project the cultural norms are upheld in the community around ($M=3.52$), the water project promotes social networks amongst residents in the region ($M=3.26$), the water project has enhanced partnerships between the local community and the government or non-governmental organizations ($M=3.26$), and that people from different cultures/tribes/clans in the region benefit from the water project ($M=2.42$) respectively.

5.1.3 Management Skills and Sustainability of the Water Projects

The study established that those who managed the water project responded adequately to concerns whenever raised. The people appointed to manage the water project were effective. The study also found out that there is sufficient technical expertise to manage the project (M=4.01), there is sufficient human resource for sustainability of the project (M=3.88), the community is satisfied with the overall management of the water project (M=3.79), risk management is satisfactory (M=3.77), management of projects has increased the alignment of development projects with host communities priorities (M=3.71), project managers have adequate and experience (task familiarity) in management (M=3.69), there are clear and achievable estimates in the project schedule and budget (M=3.66), community based projects are complex and require multifaceted management skills (M=3.65), the leadership skills of the managers is satisfactory

(M=3.63), and that advise about technical architecture was made available for the project (M=3.60) respectively. The study established that the management qualities that affected the sustainability of the rural community based water projects were technical expertise (M=4.40), managing resources (M=4.26), advising about technical architecture (M=4.18), knowledge of business (M=3.89), leadership (M=3.51), estimating project schedule and budget (M=3.16), ascertaining and managing risks (M=3.15) and experience (task familiarity) (M=3.13) respectively.

5.1.4 Technology and Sustainability of the Water Project

The study revealed that in the majority of the household there were no meters installed to monitor consumption of water. Therefore, the level of adoption of technology in the management of water project was very low impairing the sustainability of water projects. There were various payment modes used in the management of the water projects such as cash, mobile money payment (Mpesa, and Airtel money) and bank account.

The challenges affecting constant supply of the water to the households from the water points expensive parts/fuel (56%) was the main challenge affecting constant supply of the water to the households from the water points, breakdown of generator pumps (45%), pipes breakages (44%), vandalism (31%) and pipes blockages (23%) respectively.

The water project suffered major setbacks due to breakdown as the local artisans who were relied on lacked adequate skills to maintain the water project. The sustainability of the water projects in the county was highly affected by lack of modern technology required in the running of the project as the local community was not fully equipped with adequate skills.

The study established that the forms of technology used in the rural community based water projects included information communication systems (M=4.39), accounting systems (M=4.26), service delivery (M=4.23), fault reporting (M=4.15), reporting systems (M=4.13), payment systems (M=4.12) respectively. Other aspects of technology influencing the projects sustainability included; pumping technology (M=4.23), choice of tech (Solar energy vs. Generator, borehole, dams, water pans) (M=4.03), payment systems (M=4.01), spare parts availability (M=3.87), service delivery (M=3.06) and fault reporting (M=3.00) respectively.

The study established that there were various policies or measures either initiated or undertaken by the department to ensure proper: utilization, conservation, planning or management of the water projects. However the policies were not fully implemented owing to lack of financial resources, lack of support by the top management, lack of community ownership of the project and lack of skilled manpower to run the water projects.

The indicators of sustainability included improved access to water by the area residents, reduced cost of running the project and environmental protection and conservation. The main factors contributing to sustainability were; use of modern technology, full participation by the stakeholders, proper management of the water project by qualified personnel and integration of local community culture in the planning and implementation of the project. The sustainability of community based projects was dependent on included stakeholders' participation, cultural practices, use of best management skills and practices by the managers of the projects and adoption of modern technology in the running of the project.

5.2 Conclusions

The study concluded that the majority of the community members never participated in the initiation/start of the water projects. Thus, level of stakeholders' participation in the water projects was low which hindered the sustainability of water project. The household participated in the initiation/start of the water projects when they were consulted through a meeting, contribution of building materials and as leaders of the committees. This implies that the stakeholders' participation was critical in the implementation of the water projects in the county. The involvement of the all the stakeholders determined the efficiency and sustainability of the water projects.

The stakeholders were involved in the water project through contribution of funds/other resources, through designing and in management/running of the operation of the rural community based water projects. Thus the stakeholders brought many contributions to the running of the water projects in terms of financial supports, designing of the project and the operation of the water projects. The stakeholders' participation positively enhanced the sustainability of the water projects to a great extent. The main benefit associated with stakeholders' participation in the project was continuity of the project, timely maintenance/repairs, harmony/conflict management, strong ownership of the projects, better service delivery and expansion of the project. The stakeholders were not adequately involved in the project. Therefore the lack of sufficient stakeholders' participation in the project implementation contributed to the project failure. In decision making the stakeholders endorsed the project budgetary allocations, vetted the employees to work in the project, proposed the policies to be implemented. In the sharing of development activities the stakeholders approached strategic personalities and institutions to aid in management of the project, and in lobbying for support from the government and private sector.

The study also concluded that; stakeholders' support ensured that participants were actively involved in project planning and implementation, improved the projects ownership by the community, enhanced the sustainability of rural water supply systems through sharing control over water development initiatives, and the decisions and helped in building a partnership with the communities lead towards improving the people's problem solving capacities as well as helped in lobbying for government and donor support for the community project.

From the study findings, the study concluded that water project has positively transformed health, water and sanitation practices in the region, facilitated participation of local communities in development initiatives in the region, encouraged residents to take ownerships of their own community resources, improved security in the region by reducing conflicts over natural sources of water, encouraged residents to conserve available water resources and other natural resources, as well as helped the community gained substantial knowledge and technical skills from the water project. It has also united people from different cultures/tribes/clans in the region, builds community identity and pride and helped to uphold cultural norms as well as promoted social networks amongst residents in the region. The water project has enhanced partnerships between the local community and the government or non-governmental organizations as well as people from different cultures/tribes/clans in the region benefit from the water project.

The study concluded that those who managed the water project responded adequately to concerns whenever raised. The people appointed to manage the water project were effective. The study also found out that there is sufficient technical expertise to manage the project, there is sufficient human resource for sustainability of the project, the community is satisfied with the overall management of the water project, risk management is satisfactory, management of projects has increased the alignment of development projects with host communities priorities, project managers have adequate and experience (task familiarity) in management, there are clear and achievable estimates in the project schedule and budget, water projects are complex and require multifaceted management skills, the leadership skills of the managers is satisfactory, and that advise about technical architecture was made available for the project.

The study concluded that the management qualities that hindered the sustainability of the water projects were technical expertise, managing resources, advising about technical architecture, knowledge of business, leadership, estimating project schedule and budget, ascertaining and managing risks and experience.

The study concluded that the level of adoption of technology in the management of water projects was very low impairing the sustainability of water projects. There were various payment modes used in the management of the water projects such as cash, mobile money payment (Mpesa and Airtel money) and bank account.

The challenges affecting constant supply of the water to the households form the water points expensive parts/fuel, breakdown of generator pumps, breakage of pipes, vandalism and blockages of pipes respectively. The sustainability of the water projects in the county was highly affected by lack of modern technology required in the running of the project as the local community was not fully equipped with adequate skills. Technology was therefore a critical factor affecting the sustainability of the community based water project.

The study concluded that the forms of technology were used in the rural community based water projects included information communication systems, accounting systems, service delivery, fault reporting, reporting systems, and payment systems. The various aspects of technology influenced the projects sustainability included; pumping technology, choice of tech, payment systems, spare parts availability, service delivery and fault reporting. However, the adoption of the technology in the water project was minimal.

5.3 Recommendations

5.3.1 Stakeholders' Participation and Sustainability of Water Projects

The study concluded that the majority of the community members never participated in the initiation/start of the water projects. Thus, level of stakeholders' participation in the water projects was low which hindered the sustainability of water project. Therefore, the level of stakeholders' participation in the project planning and implementation should be increased to enhance the sustainability of the water projects in the county.

5.3.2 Cultural Practices and Sustainability of Water Projects

The government should institute stringent measures to deal with persons vandalizing the community water project. This should be coupled with improved security offered by the security agencies to mitigate the cases of vandalism.

5.3.3 Management Skills and Sustainability of Water Projects

The water projects should be managed by highly competent personnel to increase its efficiency and sustainability.

5.3.4 Technology and Sustainability of Water Project

The study concluded that the level of adoption of technology in the management of water projects was very low impairing the sustainability of water projects. Therefore the project management should seek to adopt modern technology through increased budgetary allocations.

5.4 Suggestions for Future Studies

The current study only focused on four aspects of sustainability of water projects: stakeholders' participation, cultural practices, management skills and technology influences. There are other aspects hindering water projects sustainability for example political will, sufficient funding e.t.c. Future studies should examine these aspects. The study was also limited to answering questions regarding what relationship existing between the project aspects and sustainability of water projects, and the direction of these relationships because of the quantitative approach used. It could not provide answer regarding why these relationships exist. A qualitative in depth study is needed to uncover the reason behind these relationships.

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