FACTORS INFLUENCING SUSTAINABILITY OF SMALL HOLDER IRRIGATION PROJECTS IN KENYA: A CASE OF SELECTED IRRIGATION PROJECTS IN KIRINYAGA CENTRAL SUB-COUNTY

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ABSTRACT

Project sustainability is a very important aspect of any project implementation. Small holder irrigation project is one of the programs the Government of Kenya has been promoting to guarantee food security throughout the nation. Despite massive investment in the sub-sector, the sustainability of the projects has been poor in many counties including Kirinyaga County. The purpose of the present study was to examine factors that influence the sustainability of small holder irrigation projects in Kenya. Its four objectives were; to establish how funding levels influence the sustainability of small holder irrigation projects, determine how the technology used influence the sustainability of small holder irrigation projects, to find out how project management committee influence the sustainability of small holder irrigation project, and to assess how availability of water for irrigation influence the sustainability of small holder irrigation projects. The study was undertaken in Kirinyaga Central Sub-County. There were 132 respondents with 30 project committee members, 100 project members and 2 irrigation officials from the sub county office. Two kinds of instruments were used in the data collection exercise. The first instrument a questionnaire was administered to the project committee members and farmers in the projects identified. The instrument had both blank and closed questions, some with four rating scale. The second instrument was an interview schedule whose data was collected from the irrigation officials at the sub county level. The data that was collected was analyzed using the computer-based program known as Statistical Package for the Social Sciences (SPSS) and presented using tables. The research was undertaken in the small holder irrigation schemes within Kirinyaga central sub-county and the sub county irrigation officials in the same sub county. Data collection took two weeks while the analysis took three weeks. When data analysis was undertaken, it was found that funding levels influenced the sustainability of small holder irrigation projects, technology used also had an influence in the sustainability of the small holder irrigation projects, project management influenced the sustainability of the irrigation projects while availability of irrigation water did not have the effect on the sustainability of the projects. As a result, the researcher recommended that the government and other stakeholders in the irrigation sub sector should network and raise enough funds for the small scale irrigation projects. At the same time the ministry in charge of irrigation should take charge in order to regulate and control the design of the irrigation projects. The researcher also recommended that the ministry in charge of irrigation should incorporate other government agencies and train the irrigation project members on project management. Areas for further studies were also suggested.

Key Words: *project sustainability, project implementation, funding levels, technology, project management committee, availability of water for irrigation*

INTRODUCTION

Agriculture is the mainstay of the world economy (FAO, 2008). It provides the world population with food as well as employment opportunities including supporting industrial activities. However due to increasing world population and the changing climatic conditions, rain fed agriculture cannot feed the world population and therefore other food production methods have to be adopted. This has resulted to use of irrigation as a means of growing crops. Irrigation is a method of providing water to plants in a controlled manner at regular intervals that is used by farmers or agriculturalists to grow crops in dry areas or during the dry seasons.

For many cultures, it has been a central component of agriculture for over 5,000 years. Indeed, there is archeological evidence showing that it was practiced in Mesopotamia by channeling water via small canals dug on agricultural fields. In Persia (modern day Iran), irrigation was utilized to grow barley on dry lands with insufficient rainfall. The people of Persia developed Qanats, as a method of irrigation at around 800 BC. The method is one of the oldest, but it is in use even today particularly in North Africa, Middle East and some parts of Asia.

In India, the Indus valley civilization developed stylish water storage and irrigation systems in Northern part of India and Pakistan. Some of those systems include the Circa canal irrigation system developed in 2600 BC and Girnar reservoir developed in 3000 BC. In those systems, large scale farming methods and extensive canals were utilized to grow crops (Rodda et al, 2004). In the Nile valley, the Egyptians practiced irrigation by building up dykes which captured water from the flooded river Nile. Water captured by the dykes was used to irrigate plots and some was stored for future use. In the lower Nile, Sudanese Nubians used sakia, which was a waterwheel-like device to irrigate their farms. Like the Egyptians, the Nubians relied on the flood waters of Nile River and other Sudanese rivers.

Since then, irrigation has developed extensively in the world in terms of technology use and the area of land under irrigation. By 2008 about 802 million acres of land were under irrigation. Approximately 68 percent of that area was in Asia, 17 percent in USA, 9 percent in Europe, 5 percent in Africa and 1 percent in Oceania. The largest of these lands, however, were in Pakistan and Northern part of India along the Indus and Ganges rivers. Others were in Yangtze, Huang He and Hai He basins in China and the Mile River in Sudan and Egypt (Siebert et al, 2006). Other irrigated areas are spread sparingly in the densely population regions of the world.

In Kenya, evidence shows that some communities such as Turkana, Pokomo, Marakwet, and Iichamus practiced irrigation over 500 years ago (Ngigi, 1999). However, formal irrigation in the country began at around 1900 during the construction of the Kenya-Uganda railway. The irrigation during this period was practiced along the rail line, in areas around Kibwezi and Makindu and was aimed at providing vegetables to the railway workers. Most of the irrigation was undertaken by the Indians who had some experience in vegetable growing.

Early irrigation was also initiated by the Arabs along the river valleys at the coast. There were irrigation schemes in Vanga, Kipini and Malindi. The Arabs mainly used slave labor and therefore the scheme collapsed when slavery was abolished.

During the Second World War irrigation schemes were established in the country in order to feed the British soldiers in East Africa. Some of the schemes developed during this period include Kano plains, Rumuruti and Karatina (Ngigi, 1999). The colonial government in Kenya initiated some large scale irrigation projects in Kenya which was aimed at pacifying the Africans who had started agitating for land occupied by the European settlers. Such projects included Mwea, Hola and Pakerra irrigation Schemes. After independence the government took over the management of the irrigation schemes in the country. The National Irrigation Board (NIB) act was enacted in 1966 and the National Irrigation Board was thereafter created to manage the irrigation schemes. Other schemes like Ahero, Bunyala and west Kano were also constructed in mid 1970s.

In late 1970s the government established the small holder irrigation project unit in the ministry of agriculture whose aim was to sponsor and extend the small-scale irrigation participatory model. Smallholder farming refers to small pieces of lands normally less than two hectares, which are owned by private farmers who do not obtain any form of assistance from the government. To this end, such farms have developed to meet family needs whereby irrigation exercises are carried out through groundwater and small-scale irrigation methods. Because of this farmers are at liberty to make independent decisions, which are not influenced by government in any way. They decide when to irrigate, the amount of water they require and how to irrigate their farms. In addition, they practice both subsistence and commercial farming with their families being the sources of labor and income. The sector includes small scale farmers who produce flowers for export and small-scale farmers who operate as groups with representatives distributing and regulating the amount of water farmers each obtain at specified time. Small holder irrigation constitutes a major component of total irrigation activities in Kenya (Osoro, 1990).

Smallholders usually work as individual farmers, but because of the amount of money they require to harness water, they sometimes operate as groups. A good example is a scheme that require large pumping station or reservoir that one farmer cannot afford because of the money required to buy the pumps and reservoirs. Small holders contribute a major share of irrigated produce in the country. Their produce includes vegetables and various horticultural products small holders manage a third of irrigated area in Kenya (Osoro, 1990).

Small holder irrigation has existed in Kenya for many years but it gained popularity in late 1979s and early 1980s, when the small holder irrigation unit was established in the ministry of agriculture. The unit also received support and funding from the external financiers. Various forms of small holder irrigation projects have been established in the country which includes the gravity fed canal irrigation projects. The projects have an advantage compared to large irrigation projects since they require lower capital investment, they have a shorter development lead time,

costs of operation and maintenance are easily devolved to the farmers, and their design is less complex compared to the large scale projects.

According to the ministry of water and irrigation in Kenya there are about 107,000 small holder irrigation projects spread throughout the country (Annual report, 2015). Of the established irrigation projects, about 63% operate at below their capacity due to various challenges. The challenges range from lack of capacity to manage the project by members, poor designs, lack of product market, and poor and maintenance to disagreements amongst the members. This means that most of these projects cannot achieve the objectives over which they formed.

STATEMENT OF THE PROBLEM

Small holder irrigation projects have been implemented in Kenya for a long period both through the government support, through farmer groups and even by the individual farmers. A lot of resources have also been used in the development and promotion of the small holder irrigation projects in the country. Despite the efforts of managing the projects, the Ministry of water and irrigation reports that 65% of the projects fail to operate by the 5th year of their initiation. 75% of those operating beyond their fifth year operate below their expected capacity. Data from Kirinyaga Central sub county irrigation office indicates that 30% of the projects are non-operational while 50% of the projects operate below capacity. Sustainability of the small holder irrigation projects after they are launched is a major challenge due to low funding levels, lack of requisite management skills by the project members, the technology used may not be appropriate and even in some instances there may be lack of water for irrigation.

GENERAL OBJECTIVE

This study was developed to examine the factors that influence the sustainability of small holder irrigation projects in Kirinyaga central sub county, Kirinyaga County.

SPECIFIC OBJECTIVES

1. Establish how funding levels influence the sustainability of small holder irrigation projects.
2. Determine how the technology used influences the sustainability of small holder irrigation schemes.
3. Find out how project management committee influences the sustainability of small holder irrigation projects.
4. Assess whether availability of water for irrigation influence the sustainability of small holder irrigation schemes.

LITERATURE REVIEW

The literature review highlighted factors which are perceived to influence the sustainability of small holder irrigation projects in Kenya. Despite having a lot of literature on irrigation, there was very little information on small holder irrigation activities. This is corroborated by Ngigi, (2003) who noted that small holder irrigation is a recent phenomenon and therefore there was no reliable data on how it was being carried about. Mapedza et al (2016), noted that in Zimbabwe as well as most of the South African region there were challenges in management of small holder irrigation projects since most of such projects were not been documented and the governments showed little interest on them. A report by DFID in 2008 also indicated that most donors preferred to support large scale irrigation projects which were assumed to have positive returns unlike small holder projects which had meager returns and therefore little information was available in small holder irrigation.

There is no clear information on who and how small holder irrigation projects are funded. Guidelines on how the small holder irrigation projects are designed could not be found hence the knowledge gaps. Therefore this study assisted in filling the gaps by examining factors which influence the sustainability of the small holder irrigation projects.

The literature review explored the various Literatures on information on irrigation and more specifically on small holder irrigation projects. The development of irrigation in the world was explored and more closely the development of irrigation in Kenya. Funding of small holder irrigation projects was studied and the various challenges associated with it identified. Use of technology in irrigation projects was studied. Literature on physical design and the availability of technical experts was reviewed. Few irrigation experts are available in the developing countries and this has contributed to low levels of development of irrigation in the developing world. Management of irrigation projects was studied though most of it tended to focus on the large scale irrigation projects and little focus is given to the small scale projects.

Irrigation activities are generally practiced in the areas where rains are not adequate for crop growing. Therefore literature was reviewed on availability of irrigation water and how water was utilized for irrigation.

RESEARCH METHODOLOGY

Research Design

A descriptive research design used mostly in exploratory studies was utilized to gather information and summarize it (Orodho, 2002). The intention of utilizing the method was to produce statistical information on various aspects of interest and outline the meaning in agricultural sector (Borg & Gall, 1989). The design was utilized because the researcher did not manipulate the variables; instead, the phenomena were described as they were in the field.

Target Population

The term refers to a group of people, things or variables that have common characteristics that are of interest to researchers (Mugenda & Mugenda, 2003). The target population for this study consisted of all the small holder irrigation projects in Kirinyaga central sub county. The statistics from Kirinyaga Central Sub County irrigation office showed that there were 16 small holder irrigation projects, with a membership of 540. The target population was therefore the 540 irrigation members, and 2 irrigation officials stationed at the sub-county irrigation offices.

Sampling Procedure and Sample Size

Sampling procedure entails selecting a given number of subjects from a defined population as representative of that population. Gay (1992) observes that a larger sample tends to minimize the sampling error. The study applied the stratified sampling technique to select 10 small holder irrigation projects in the Sub County. The simple random sampling method was then used to sample 3 members of project management committee from each project and 10 project members from each of the sampled projects. The sampled members were included in the study. The study also sampled two irrigation officials from the sub-county office. This resulted to a sample size of 132 respondents.

Data Collection Instruments

Questionnaire and interview schedules were the two main tools of data collection. The questionnaire was utilized because of its efficiency in collecting data and its capacity to attract a huge number of respondents. It was also utilized because of the freedom it gave respondents in expressing their views and answering research questions (Gay, 1992). It was utilized to collect data from project committee members and the project members. The questionnaire for project management committee members and project members had five sections, the first one collected data on the background information of all the members. The other four sections collected data on information related to the sustainability of small holder irrigation projects in relation to levels of funding, management of the small holder irrigation projects, appropriateness of the technology used in the projects and the availability of water for irrigation. The questionnaire had open and close ended items. The interview schedule was utilized to guide the interview conducted on irrigation officials. The interview schedule contained items covering the objectives of the study.

Pilot Study

Before collecting the actual data, a pilot study was conducted on one small holder irrigation project in the neighboring sub county whereby thirteen members were sampled. The thirteen members comprised of three project officials and ten project members. The purpose of this exercise was to examine the validity and reliability of the questionnaire utilized to collect the data and help the researcher familiarize with the process of administering the questionnaire.

Reliability of Instruments

The reliability of an instrument determines the extent to which a research instrument produces consistent results after repeated trials (Mugenda & Mugenda, 2003). To evaluate the extent to which the study could produce consistent results, the pilot study was utilized to revise the research questions before the actual data was collected. The split-half technique was utilized to test the reliability. The respondents in the pilot study were divided in to two groups one of seven respondents and the other had six respondents. The first group was given the questionnaires on day one and the other group was given theirs' two days later. After the analysis, it was found that the results were positively consistent which was a sign of reliability. The coefficient obtained indicated the extent to which the two halves provided the same results; thus, evaluated the internal consistency of the questionnaire.

Validity of Instruments

The validity of an instrument expresses the extent to which the results obtained from an instrument represents the actual phenomenon under investigation. It basically determines the degree to which an instrument measures the attributes it is meant to measure (Borg & Gall, 1989). The pilot study was utilized to improve the face validity of the questionnaire. Given that an expert judgment can be utilized to improve the content validity of an instrument, the researcher sought advice from the study's supervisor to improve the content validity of the questionnaire. This helped the study to achieve its objectives by focusing on the areas under investigation.

Data Collection Procedure

Before the data was collected, a permit was sought from the Ministry of water and irrigation after the study was approved by the university. Thereafter the Kirinyaga central Sub-County irrigation office was contacted to allow the researcher to collect data from its relevant offices. Two researcher assistants who had been trained to collect data helped the researcher to collect data from the target population. The researcher, on one part, conducted interviews on irrigation officials whereas the research assistants, on the other part, collected data from other respondents. The research participants were selected randomly to participate in the study from their workstations and asked to participate in the study. Those who agreed to participate in the study were assisted by research assistants to fill up the questionnaires and in circumstances where the respondents were unable to read or write, the research assistants assisted the respondents in completing the questionnaires.

Data Analysis Techniques

After the data was collected from respective sources, it was cleaned by identifying the incomplete responses and removing questionnaires with such responses from those analyzed. Then the open-ended questions were coded and entered into the SPSS computer program for

analysis. The qualitative data was analyzed using content analysis method, which involved evaluating responses from research participants to identify emerging and dominating themes. On the other hand, the quantitative data was analyzed using measures of dispersion and central tendency particularly mean, percentages and frequency counts. The bar graphs and frequency distribution tables were utilized to present the data.

RESEARCH FINDINGS

To quantify the strength of the relationship between the variables, the study used Karl Pearson's coefficient of correlation. The Pearson product-moment correlation coefficient (or Pearson correlation coefficient) is a measure of the strength of a linear association between two variables and is denoted by r. The Pearson correlation coefficient, r, can take a range of values from +1 to -1. A value of 0 indicates that there is no association between the two variables. A value greater than 0 indicates a positive association, that is, as the value of one variable increases so does the value of the other variable. A value less than 0 indicate a negative association. The findings are presented in Table 1.

Table 1: Correlation Analysis

		Sustainability.	Funding levels.	Technology.	Project management committee.	Availability of water for irrigation.
Sustainability	Pearson Correlation	1				
	Sig. (2-tailed)	-				
Funding levels	Pearson Correlation	.618*	1			
	Sig. (2-tailed)	.007				
Technology	Pearson Correlation	.536*	.247*	1		
	Sig. (2-tailed)	.016	.000			
Project management committee	Pearson Correlation	.812*	.587*	.300*	1	
	Sig. (2-tailed)	.025	.000	.053		
Availability of water for irrigation	Pearson Correlation	.787*	.613*	.079*	.415*	1
	Sig. (2-tailed)	.004	.001	.020	.006	
	Sig. (2-tailed)	.014	.0135	.0.020	.006	.000

*. Correlation is significant at the 0.05 level (2-tailed).

Results in table 1 reveal that the correlation between funding levels and sustainability of small holder irrigation schemes is positive and significant (r=0.618, p value=0.007). This implies that an increase in sustainability of small holder irrigation schemes is associated with an increase in funding levels and a decrease in sustainability of small holder irrigation schemes is associated with a decrease in funding levels.

In addition, the study reveals that the correlation between technology and sustainability of small holder irrigation schemes is positive and significant (r=0.536, p value=.016). This implies that an increase in technology is associated with an increase in sustainability of small holder irrigation schemes and a decrease in sustainability of small holder irrigation schemes is associated with a decline in technology.

Further, the study reveals that the correlation between project management committee and sustainability of small holder irrigation schemes is significant (r=0.812, p value=.025). This implies that an increase project management committee is associated with an increase in sustainability of small holder irrigation schemes and a decrease project management committee is associated with a decrease in sustainability of small holder irrigation schemes.

The study establishes that the correlation between availability of water for irrigation and sustainability of small holder irrigation schemes is positive and significant (r=0.787, p value=0.004). This implies that an increase in availability of water for irrigation is associated with an increase in sustainability of small holder irrigation schemes and a decrease availability of water for irrigation is associated with a decline in sustainability of small holder irrigation schemes.

DISCUSSION OF THE FINDINGS

The overall purpose of the study was to establish the factors influencing the sustainability of small holder irrigation projects in Kirinyaga central sub county. This section reviewed each objective in relation to the findings and other related literature.

On funding of the irrigation projects, it was realized that funding was a crucial component in the small holder irrigation project. Adequate funding is necessary at the project initiation and is equally important after the project is operational. Post implementation support like provision of credit facilities is necessary for the purpose of sustaining the project. The findings also supports what Ngigi (1999), had found that irrigation investment requires a relatively high capital investment and such capital may not be within the reach of many small holder farmers.

On the technology used, the study established that technology use influenced the sustainability of small holder irrigation projects. The physical design of the project will influence its sustainability. The design would influence the effectiveness of the whole system. The findings also support the study done by Carter (2009), which had noted that designs of irrigation systems should enable users to utilize water more appropriately and satisfactorily in order to increase crop quality and yield.

It was also revealed that the technology used would influence on the cost of project maintenance. This was also corroborated by report on a study done by DFID in 1999 which noted that small holder irrigation projects in Africa are generally expensive to maintain since the available designs are not suited to African conditions.

The technology used in the irrigation project would also influence the cost of maintenance, since it may need expensive equipment and expertise. Where the project may not have adequate funding, maintenance of such a project with complex technology may be a challenge.

Project management committee plays an imperative role in the sustainability of small holder irrigation project. It has been revealed that majority of the project committee members do not have the necessary management qualifications to manage the projects. As such they have limited skill and knowledge in managing the projects. The study has also revealed that there is insufficient information on the management of small scale irrigation projects which also means that the project members have scanty information on how to manage their projects. The findings are also supported by Auma (2014), who noted that small holder farmers may not have the relevant management skills and more so the technical expertise in managing an irrigation project.

On availability of water for irrigation, the study revealed that there was adequate water for irrigation within the area under irrigation and also within the crop growing season. This means there is no shortage of irrigation water within this region and therefore availability of water for irrigation is not a challenge in sustaining the small holder irrigation projects.

CONCLUSIONS

Based on the study's findings, the researcher concluded that funding levels is important in the sustainability of small scale irrigation projects. Adequate funding should be available at the initiation of the project and also at the post implementation level in order to sustain any small holder irrigation project.

Secondly, technology used in the irrigation project influences the sustainability of the irrigation project. The design of the project, would impact on the efficiency and effectiveness of the project. Technology would also influence on the cost of maintenance of the project. Technology use should be evaluated critically in order to ensure that the project is operated sustainably.

It can also be concluded that project committee members highly influences the sustainability of small scale irrigation projects. The qualifications of the committee members, access to the necessary information and availability of the technical expertise is crucial to the sustainability of the project.

Finally it can be concluded that availability of water for irrigation has little influence on the sustainability of small holder irrigation project.

RECOMMENDATIONS

Based on the findings, the following suggestions are made to help boost the sustainability of small scale irrigation projects.

1. All stakeholders (including the National and County governments, Donors, NGOs, farmers and others) in the irrigation subsector, should network and raise enough funds for small scale irrigation projects. The stakeholders should also develop mechanisms of post implementation support of small holder irrigation projects.
2. The ministry of irrigation should regulate and control the design of irrigation projects with the aim of controlling the project maintenance costs and also have designs which are user friendly to the farmers.
3. The study also recommends that the ministry of irrigation incorporates other relevant government agencies and trains the project committee members on project management skills. The ministry should also provide the irrigation projects with the necessary up to date information on irrigation.
4. The ministry of irrigation and researchers should carry out further studies to find out if water for irrigation is adequate and reliable in many small holder irrigation projects.

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