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

BY

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RESEARCH PROJECT REPORT SUBMITTED IN PARTIAL FULFILLMENT FOR THE AWARD OF MASTER IN ARTS DEGREE IN PROJECT PLANNING AND MANAGEMENTUNIVERSITY OF NAIROBI.

2018

DECLARATION

This research report is my original work and has not been presented for a degree award in any other university

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DEDICATION

This research report is dedicated to my wife Lydia and my children Gift and Tracy for their inspiration, support, encouragement and understanding throughout the research period and to my parents for making me pursue education at a very young age.

ACKNOWLEDGEMENT

I hereby acknowledge with a lot of appreciation the support from my supervisor, Prof. Harriet Kidombo. I cannot also forget to thank all my lecturers in the School of Open and Distance Learning for imparting me requisite skills and knowledge, also my study colleagues at Embu Learning Center and my family for support and encouragement. Last but not least, I want to thank all the staff at Embu Extra Mural Centre for their support and encouragement and my student colleagues, for their support. Work mates, Charity and Beth, for editing and proof reading my work.

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ABBREVIATIONS AND ACRONYMS

CGAP	-	Consultative Group to Assist the Poor
CPRs	-	Common Pool Resources
DFID	-	Department of Foreign Investment and Development (UK)
ESP	-	Economic Stimulus Programme
FAO	-	Food Agricultural Organization
IFC	-	International Finance Corporation
IWM	-	Irrigation Water Management institute
MFIs	-	Micro Finance Institutions
MFI	-	Micro Finance Institution
NIB	-	The National Irrigation Board
OBA	-	Output-Based Aid
WUA	-	Water Users Association

ABSTRACT

Project sustainability is a very important aspect of any project implementation. Small holder irrigation project is one of the programmes 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 incharge of irrigation should take charge in order to regulate and control the design of the irrigation projects. The researcher also recommended that the ministry incharge of irrigation should incorporate other government agencies and train the irrigation project members on project management. Areas for further studies were also suggested

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

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. According to Morkhtar (1981), 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 (Hill, 2012). 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 stylishwater 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.

1.1.1 Variables of the study

The researcher investigated the following variables and their relationship with the sustainability of small holder irrigation projects in Kenya.

Funding levels- comparison between the projected cost of the project and the available funds, if funds are adequate, until the project completion, if there is post implementation support services, and availability of credit

Technology used- includes the physical design of the whole project and its relevance to the present conditions, availability of project technical support services and the availability of the necessary technical expertise

Project management team- involves the organization of the project management team, including their skills in the project management, access to information and its level of interaction with the other project members

Availability of irrigation water-determines if irrigation water is adequate when compared to the area under irrigation, and if water is available throughout the crop growing season.

1.2 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.

1.3 Purpose of the Study

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

1.4 Objectives of the Study

The study had the following objectives;

i). Establish how funding levels influence the sustainability of small holder irrigation projects.

ii). Determine how the technology used influences the sustainability of small holder irrigation schemes.

iii). Find out how project management committee influence the sustainability of small holder irrigation projects.

iv). Assess whether availability of water for irrigation influence the sustainability of small holder irrigation schemes.

1.5 Research Questions

It sought to provide answers to the following research questions;

i) How does the funding level influence the sustainability of small holder irrigation projects?

ii) How does the technology used influence the sustainability of the small holder irrigation projects?

iii) How does the project management committee influence the sustainability of the small holder irrigation project?

iv) How does the availability of water for irrigation influence the sustainability of the small holder irrigation projects?

1.6 Significance of the Study

The researcher hoped that the results gotten from the study would help;- the government in policy formulation, especially on setting up and funding of small holder irrigation schemes. Irrigation experts in KirinyagaCounty may refer to the results especially in the designing of small holder irrigation schemes and formation of scheme management committees. Future researchers may use the research as part of their reference

1.7 Assumptions of the Study

Throughout the study, the following assumptions were made:

i) That the responses obtained from research participants were truthful, genuine and honest thereby reflected the reality on the ground.

ii) The members of project management committees face challenges in the implementation of small holder irrigation schemes

iii) The information obtained from the study represented the target population

1.8 Limitations

The applicability of the study's findings is limited by the lack of control over some intervening variables. For instance, it was impossible for the researcher to control the variation of the training and experience of the management committee members who were interviewed. Some were more experienced thereby handled their responsibilities more effectively than their counterparts. Furthermore, the sample size used in the study was relatively small thereby not representative of the irrigation schemes in the target region. Accordingly, the generalization of the results might not be effective due to these variations.

To overcome this limitation, a random sampling method was utilized to select research participants. The data was also collected using a self-administered questionnaire, which included self-assessment measures for committee members and the farmers. An interview was further conducted for the irrigation officials at the sub county level. Since individuals tend to over-rate themselves or give inaccurate responses based on their capability to remember or rate some traits, the results of the study might be biased in some way thereby might not be reflective of the reality on the ground.

Another limitation was that the study covered only one administrative Sub-County. Therefore findings of the study were generalized to other areas with caution.

1.9 Delimitations of the Study

The study was restricted to the sustainability of small holder irrigation schemes in Kirinyaga central sub county only. This was because the sub-county under the study has a very high agriculture potential, and a very high concentration of small holder irrigation schemes, where by 30% 0f the project are non-operational and 50% of the remaining operate below the their capacity. The study focused on those people directly involved in

initiation and management of small holder irrigation projects. They include the farmers, project management committees and the irrigation officials at the sub county level.

1.10 Definition of Significant Terms

Challenge: Refers the difficulties encountered during the process of management of small holder irrigation project which may limit it from achieving its intended objective

Implementation: Refers to the process of executing plans, which in this case refer to the management of the small holder irrigation project in order to achieve the intended objective. In implementing the small holder irrigation projects, various stakeholders like the irrigation experts, project management committees, and the farmers (owners) are involved in the whole process in order to achieve the desired objectives

Small holder irrigation project: Refers to individual farmers as well as group of farmers or their representatives who are responsible for managing the distribution of water among farmers with the aim of growing crops for family consumption of sale to generate income.

Funding levels: Refers to the amounts funds available for irrigation project use, from the initiation, implementation and the continuous maintenance of the project. Funding levels is based on the projected cost and the cost of maintenance of the project is launched.

Technology used: Refers to the project design, equipment and materials used in the construction of the project.

Availability of irrigation water: Refers to the amount of water and if it is adequate for the purpose of irrigation, though out the crop growing season.

1.11 Organization of the Study

The study is organized into five chapters. The first chapter, which is the introduction, focuses on the general background, problem statement, study's purpose, objectives, research questions, significance of the study, limitations and delimitations of the study, assumptions of the study and definition of significant terms. Chapter two contains literature review and reviews of relevant literature on the small holder irrigation projects, rationale of small holder irrigation projects, funding, technology used, management and availability of water for the management of small holder irrigation projects. Chapter three

consists of methodology, which highlights the sampling technique, techniques used to analyze the data, data collection methods, target population, and research design among other relevant components of methodology.

Chapter four provides the results of the study, result interpretation and discussion of findings of factors influencing the sustainability of small holder irrigation projects in Kirinyaga Central Sub County.

Chapter five presents a summary of the findings of the study. It further concludes the study and recommends what needs to be done based on the findings of the study as well as suggests the direction for further research.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

Irrigation has been a major solution to the factors affecting agriculture production throughout the world, especially in dry areas whose rainfall is unreliable. So far, it has had positive impact on food production both in rural and urban areas. It provides relatively cheap food to the members of the public and a form of employment to low income farmers in the world (Husain, 2005). In most African countries, it provides food security by mitigating the effects of drought, allowing farmers to grow crops throughout the year, increasing yields to approximately three or four to what rainfall does in dry areas (TDR, 2007).

Worldwide, irrigation schemes especially small-scale ones are viewed as methods of enhancing food production, reducing poverty in rural areas and sustaining rural livelihoods. In this regard, it is believed that a rehabilitation of the existing irrigation schemes and development of new ones would play a critical role in achieving sustainable development goals and fighting poverty in rural areas (FAO, 2016). Due to this, smallholder irrigation schemes are considered as key solutions food crisis and insecurity in Africa (Gotosa et al., 2002). It is argued that they have the capability of creating employment for small-scale farmers and promoting food security among the farmers who practice it (Van Averbeke et al., 2011). In spite of this, their development objectives remain relatively unfulfilled due to poor performance (Fanadzo, 2012).

2.2 Over view of Small Holder Irrigation Development

Irrigation development has been in the world over a long period of time in many cultures. In Mesopotamia there is evidence that plants were regularly being watered by construction of canals (Hill, 2012). Irrigation was also practiced in Persia, which is the modern day Iran, by storing water harvested during the rainy season and used during the dry periods. The people of Persia developed Qanats, as a method of irrigation at around 800 BC to grow barley. The method is one of the oldest and is still in use today in North Africa, Asia and Middle East.

In ancient India, the Indus Valley Civilization developed stylish irrigation and storage systems in Pakistan and Northern part of India. They developed circa irrigation schemes in 2600 BC and reservoirs at Girnar in 3000 BC. These were some of the large-scale canals that were utilized in India to irrigate the land (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 parts of the Nile, the Sudanese Nubians developed sakia, which was a form of irrigation that used a waterwheel like device to irrigate their lands. Like the Egyptians, the Nubians relied on the flood waters of Nile and other rivers of what is the present day Sudan. 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; 68 percent of which was in Asia, 17 percent in USA, 9 percent in Europe, 5 percent in Africa and 1 percent in Oceania. The largest irrigated areas are in Northern parts of India and Pakistan along the Indus and Ganges rivers. Others are in Yangtze, Huang He and Hai He basins in China, Mississippi-Missouri river basin in California and along the Nile River in Sudan and Egypt (Siebert et al, 2006). The small irrigated areas are spread across the world in the densely populated areas.

Despite the huge potential in improving the food security situation, FAO notes that Sub Sahara Africa has the slowest growth rate of irrigation development in the world despite having the highest irrigation development potential in the world. Awulachew (2007) noted that among the problems facing irrigation development in Africa include, the high costs of investments and negative rates of return. There are also technical flows in infrastructural design which results to leakage, sedimentation, cracks in dams as well as silting of the reservoirs. There are high input costs as well as high interests on loans. Scheme mismanagement, lack of entrepreneurial skill and poor farmer capacity contribute to poor irrigation performance in Sub Sahara Africa.

In Kenya, agriculture is the backbone of the economy, but the country's capacity to boost the production of agricultural products through irrigation is normally hampered by two main reasons. First, the part of the country, which receives reliable rainfall from the rain, is only 20 percent; the rest receives unreliable rainfall. Second, the population in the 20 percent of the land that receives reliable rainfall from the rain is extremely high. It hosts over 60 percent of the national population, which grows at annual growth rate of 3 percent. There are also institutional challenges facing the development of irrigation in the country such as the collapse of government-assisted services aimed at enhancing irrigation.

Over the years, the government's capacity to regulate access to water resources has also been reduced significantly since most of the small holder irrigation developments rely on water lifting devices and pumps operated by individual farmers. This normally leads to increased competition over water resources that result to increased conflicts over water resources. In the long-run, it might result to depletion of ground water sources and increased siltation. Traditional water rights may also be overridden by individual rights which in to some parts of the community lacking access to water.

Kenya has a potential of 1.3 million hectares of lands that can be irrigated, but only 125,000 hectares of this land is under irrigation. Smallholder schemes represent 43%, large public schemes represent 18% whereas private large scale farmers represent 39%. At the same time, the Government has acknowledged the relevance of irrigated agriculture and made its expansion a prominent aspect of the vision 2030 blue print and the Economic Stimulus Programme (ESP).

2.2.1 Funding levels and the sustainability of small holder irrigation projects

Throughout the world, agriculture is the main economic activity; it employs majority of the people especially those in low income countries because about 450 million households in the world rely on agriculture as their main activity (Brikke, 2000). Nonetheless, majority of these people face a number of challenges, which include limited access to market for farm produce, low productivity, limited access to financial resources

especially from financial institutions and inadequate risk management. In Africa, whereas it is the backbone of African economy employing approximately 55 percent of the population, only 1 percent of the money lend by banks goes to agriculture sector. Furthermore, only 4.7 percent of the global population living in rural areas can access loan from financial institutions because only 5.9 percent of them have bank accounts (World Bank, 2005). Whereas access to financial resources is not a means to an end, it is critical in improving the productivity of agriculture sector. It particularly improves the farming practices, access to the market, promote better risk management practices and boost income for farmers.

According to Ngigi (1999), a huge capital is required to develop the Kenyan irrigation schemes, but very few farmers can access such capital. If the horticulture industry, which is input and labor intensive, is included in the analysis of irrigation schemes, the cost might escalate further because of the pump cost. To access financial resources, farmers are required by financial institutions to provide collaterals, which most of them do not have. At the same time, financial institutions find it expensive and cumbersome to lend money to small holder farmers; thus, exclude them from their loan books. Accordingly, lack of financial resources has continued to slow down the development of irrigation schemes in Kenya.

Whereas the above is the case, small-scale irrigation schemes have the capacity to boost produce from agricultural sector and economic growth in rural areas. For this to happen, the many obstacles that hamper access to financial resources have to be addressed. This might require the financial institutions in Africa and Kenya in particular to tailor financial services for agricultural sector and the government to support the development of irrigation schemes (Chandra, 2004). In the development of financial services, financial institutions ought to remember that small holder farmers differ significantly. Therefore, the services should reflect the disparities among the farmers and conditions in the market (Carter, 2009).

In South Africa, rural farmers cite credit availability as a major challenge (Mayambe & Mopande, 2012). Organizations which give credit consider the small scale farmers as high risk clients and therefore shy away from them. When credit is available, farmers tend to produce products that meet market standards because they have adequate capital. When credit was withdrawn, products produced were of poor quality which does not meet the market requirements.

To this end, very few studies have evaluated the way smallholder farmers access financial resources from financial resources. Furthermore, there is limited understanding of the financing models that financial institutions utilize to lend money to farmers who practice irrigation. To understand what financial institutions do to lend money to farmers, it would be imperative to evaluate what microfinance institutions and other financial institutions based in rural areas do (Hussain, 2004). However, there is no definite demand for agricultural services in rural areas. The Dalberg Development Advisors (2012) estimates that the demand might be as high as $450 billion: $225 billion are in short-term whereas $225 billion are in the long-term. The percentage of those with access to financial resources is equally impossible to quantify (World Bank, 2013).

In spite of the above, the challenges of access to financial resources are many and well-documented. Accordingly, it is in the public domain that the financial resources that serve this market face a number of challenges, which include the seasonality of cash flow, systemic risks such as plant diseases, drought and floods, and high transaction cost. Even if these challenges apply to those institutions in general, they affect the smallholder famers in particular due to the high transaction cost and inability to mitigate risks (Roopa, 2004).

The broadranges of financial institutions that finance agriculture sector reflect the diverse segmentation of smallholder farmers with the diminishing relevance of banks in this sector. In this respect, input suppliers and buyers have become more relevant in the industry along with MFIs and cooperatives (IFC, 2012). The comparative relevance of these diverse segments, however, remains relatively unknown. The relevance of MFI

involvement in financing the sector in particular remains unknown thereby there lacks substantive information on its importance in the sector and the factors that restricts its effectiveness.

Most governments in Africa channel their support through community irrigation schemes thereby play critical roles in fighting poverty in rural areas. In this respect, majority of the associations that manage these schemes invest heavily to assist individual farmers. To this end, the promising financial instruments include short-term loans used to repair minor breakdowns, savings and current accounts and medium-term loans. Because of this, it is worth considering the utilization of Output-Based Aid (OBA) model especially in low income areas. This model helps community members to financial their agricultural activities by contributing part of the money they require to purchase inputs used in irrigation and financing the rest through loans. In so doing, it helps in reaching more farmers in remote areas. Sometimes, grants are utilized to settle part of the loan (DFID, 2008).

According to George (2002), the utilization of financial services in agriculture is to a great extent limited by a variety of constraints. Accordingly, interventions that address themselves to these constraints would be effective at enhancing irrigation practices in Africa, but there lacks such interventions in Kenya and Africa in general.

Presently, community-based credit providers such as marketing cooperatives, input suppliers and exporters are the best financial institutions that can support agricultural sector in Kenya (Castro, 2009). However, they offer a limited range of products and mostly prefer financial via MFIs and banks. Savings and credit cooperatives may as well be best suited to do this job, but they prefer to offer services with long saving histories, which many farmers lack.

Globally, there has been no consensus on the best lending methodology in agricultural sector. Some people prefer group lending whereas others prefer a method that lends to individual farmers. Based on this fact, it might be helpful for lenders to utilize both

methods. For the low-income farmers, group lending method might be the most appropriate method because farmers might not have collaterals to secure loans and loan amounts are relatively small. This method reduces transaction cost thereby proves most effective for low-income farmers. On the other hand, individual lending is normally suitable for experienced farmers and micro-entrepreneurs that have collaterals (Eawag, 2005).

Although financial support from international development agencies is another alternative for financing farmers, it needs to be coordinated carefully through national plans and priorities (Carter, 2009). It needs to be harmonized and coordinated within the spirit of the Paris Declaration. Technical support might be utilized to develop policies, supervise the soundness of financial services, help rural intermediaries to expand the variety of products they offer to farmers and enable farmers to save money.

2.2.2 Irrigation Project management and the sustainability of small holder irrigation project

There has been a lot of criticism on the management of irrigation projects much of which has been directed to formally ordered irrigation schemes controlled by governmental bodies. They to a great extent consider small holder farmers as laborers as opposed to investors and make efforts to run agricultural activities on large-scale (Auma, 2014). While the large irrigation schemes benefits from the economies of scale in terms of having a variety of experts and also access to up to date information on markets and technology in the area of irrigation, the same cannot be said of the small scale irrigation projects (Ngigi, 1999). Small holder irrigation projects may be composed of member farmers who may not have the relevant skills in farming and more so technical expertise in managing an irrigation project. Most of these projects rely on the extension personnel from the ministry of agriculture who in most instances are not adequate and not always available when required.

To this end, there have no capacity building initiatives for smallholder irrigation schemes at national level. However, in the recent past research organizations, private sectors and

NGOs have been promoting that initiative among smallholder farmers. Furthermore, water reforms initiated in the last few years have been geared towards promoting community participation in management and development of irrigation schemes. Effort has also been made to enhance water management, distribution and equitable sharing at local levels (Mati, 2005).

Given that irrigation is a relatively new venture among some farmers especially those not used to large-scale farming, capacity building among them is an imperative input in enhancing the development of irrigation schemes. In this respect, farmers might require training on irrigation and crop husbandry from experienced trainers. Training in these areas is provided by the government extension workers, NGOs and the private sector. It also comes from field days and exchange visits. Because of this there is no specific training for smallholder farmers; thus, the relevant authorities need to develop such training programs. The management of a small holder irrigation project is a participatory process which requires the input of all actors (Ngigi, 1999). This is due to the fact that most of the members in such projects lack the necessary management skill to run the projects as individuals and therefore group consultations results to better decisions and ownership.

In South Africa, Maponya and Mpandeli (2012) noted that there were many small holder irrigation projects spread over the province and the government considered them to be inefficient and uneconomical. As a result little extension activities were promoted in these projects and therefore the farmers did not get the necessary information on the latest agriculture technologies. At the same time, it was noted that individual farmers produced different crops which also made it difficult to offer expert advice.

Small scale irrigation projects in Kenya get support from the government and other donors like the NGOs and the private sector. Most of the support is in form of funds, equipment and capacity building (Mati, 2005). Management committees are formed to oversee the implementation of these projects over a certain period of time after which the donor pulls out. Majority of the management committees lack the capacity to source for more funding, market for the products and may not have the resources to engage experts

who may manage the project. In some cases committee members engage in malpractices which may occasion to the loss of project resources.

Small holder irrigation schemes management has always been a communal approach. This approach is favored by national governments and aid agencies because is seen as helpful to farmers. Normally, aid agencies come with best intentions with a need to satisfy. They consequently set rules to be observed, which most of the times are incompatible with objectives to be achieved on the ground. In spite of this, they normally disperse funds to respective communal projects in line with their targets, which are restrained by time factor (Chadran, 2004). Because of the need to hasten the process the agencies are generally at the risk of failing to achieve their objectives due to lack of relevant skills among community members. Indeed, when communities absorb funds faster than they can develop institutional frameworks, they tend to lose the sense of ownership of such programs. In such situations, irrigation projects are at high risk of collapsing and failing to support farmers. The challenge therefore in such scenario is to provide support in the right way to foster successful development of irrigation projects (Oriola, 2006).

2.2.3 Technology used and the sustainability of small holder irrigation projects

There is a well-documented range of traditional technologies that can be used by smallholder irrigation projects. This means that traditional technologies can be utilized to improve irrigation projects among smallholders at low cost without necessarily looking for external support (George, 2000). Majority of these technologies particularly suited for subsistence irrigation farming have attracted interest from government and aid donors that wish to support subsistence irrigation farming. They as a result form a useful framework for building strategies for development. In addition, technology plays an important role in irrigation schemes. However, concerns have always been raised about technology and manufacturers' abilities to develop technologies that could offer long lasting solutions to irrigation schemes. Furthermore, it has also been argued that low-cost solutions that might attract donor fund might result to poor quality engineering.

Whereas technology is important in the success of irrigation schemes, there is a general consensus that technology alone cannot determine the success of irrigation schemes. For this reason, it is upon individual farmers in their respective localities to assess the appropriateness of the technologies available to them (Hussain, 2004).

Nonetheless, the available technologies can be improved to meet various needs and ever-changing environments, but they are at the risk of facing stiff competition from emerging technologies. In the midst of the above, it is always important to evaluate technology used in order to estimate its efficiency and determine whether it can be improved. Accordingly, the maintenance program has to be conducted periodically to identify what needs to be done to improve the existing technologies especially the traditional ones. Such exercise would contribute significantly to sustainability of the current irrigation schemes, utilization of water resources and development of new technologies (Bryan, 2000). Due to the high expectation that irrigation schemes can play immense roles in eradicating poverty in Kenya and Africa in general, there is need to evaluate the role that technology can play in improving the performance of irrigation schemes.

In Kenya, there are no adequate specialists in irrigation technology to undertake appropriate design and implementation of irrigation projects (Mati, 2008). This has resulted to farmers putting up poor designs which results to a lot of inefficiency and wastage. Designers of small scale irrigation projects lack experience because the experienced ones prefer working for large-scale projects that have better employment terms and conditions. The financial resources of designing the small scale irrigation projects are also limited. At the same time there has been lack of clear policy which has resulted to inadequate investment in irrigation infrastructure and water storage facilities

Guidelines developed for the small holder irrigation by the Department For International Development (DFID) in 1997, noted that there was scanty information on the design of small scale irrigation projects since most of the designers concentrated more on large scale projects. The guidelines also noted that it was not possible to replicate designs in small scale irrigation projects since design manuals tend to be specific to particular conditions.

Despite the fact that irrigation infrastructure designers shy off from small scale irrigation projects, such projects have gained popularity with governments and funding agencies since they involve lower capital investments and less complex designs, they require less time for project development and implementation. Small scale irrigation projects provide prospects for systematic devolution of costs and responsibilities for operations and maintenance to farmers and participatory development. However many small holder irrigation projects of this nature are not sustainable in the long term, notes the DFID guidelines.

Modern technologies have largely gained prominence among farmers in developed countries due to their efficiency in applying water adequately and accurately thereby increasing crop quality and yields (Carter, 2009). As a result, planners and engineers prefer to utilize these technologies to protect water resources.

Previous studies have shown that very few farmers in USA and Europe are able to survive without governments' interventions yet the poor African farmers are expected by their governments to survive without such intervention (Auma, 2014). Because of this majority of farmers in Kenya are unlikely to embrace the new technologies in their farming practices because they do not have sufficient funds to buy the new equipment. This means that only few farmers are likely to embrace these technologies in their farming practices. The government should therefore determine what it should do to support farmers to be self-reliant.

According to Mark et al (2004),most modern technologies were not developed for smallholder irrigation because they are expensive and require specialized skills that farmers especially in developing countries do not have.

2.2.4 Availability of irrigation water and the sustainability of small holder irrigation projects

Adequate and reliable water supply is essential for any irrigation activity to take place (DFID, 1999). Because of inadequacy, irrigation project designers are normally forced to evaluate the water supply against its demand to determine whether an irrigation scheme would be sustainable. While assessing the availability of water it is also important to

understand if the water is available throughout the year, in case of a river source how often does it dry in the last 10 years and in what months does peak and flood flow occurs in the year. This will ensure that any planning is done on the basis of the data available.

Majority of the smallholder irrigation schemes are normally affected by inadequate water supply, unreliability of water supply systems and inequitable water distribution (Green and Sunding, 1997). Due to this majority of the smallholder irrigation schemes that experience water shortage tend to close or produce lower than expected. Others suffer from unreliable water distribution (Chancellor, undated). For instance, the Water User Associations (WUAs), which manage the distribution of water among its members, in the Ghanaian Burgi and Gagbriri irrigation schemes has challenges distributing water among members due to the ever-fluctuating water levels of its reservoir. When the water levels are low, WUA is forced to ration water among its members; thus affecting the productivity of its members (Amosa J, 2014). In Zimbabwe, such water ration caused electricity payment disputes and conflicts among the farmers based at Tsvovani irrigation scheme, which has hampered the development of scheme to date (Mapedza et al, 2016). At Tugela Ferry Irrigation Scheme, farmers do not receive water when they need it due to water unreliability (Fanadzo, 2012). In South Africa, the water distribution among farmers at the Dzindi Irrigation Scheme is normally interrupted by frequent leakages along the canal (Van Averbeke, 2013).

The majority of developing countries have a shortage of renewable fresh water resources. As a result, majority of community-based irrigation schemes suffer from water shortage and lack of support from government and other relevant bodies in managing water supply.

In South Africa, it was noted that while irrigation water was available, there was a tendency of misuse and mismanagement resulting to water shortage especially during drought periods. Farmers who use furrow irrigation system lost water through ground seepage, drainage and evaporation. Low water pressure causes water shortage meaning there was no adequate water. It had also been reported that in farmer groups, some farmers were unreliable and untrustworthy as those near water sources would block water

to other farmers' plots to a point where their crops would fail. While access to water is crucial for irrigation farming it also requires to be complimented by other agrarian reforms such as (access to extension services and financial resources, market restructuring etc) institutional land reforms, utilization of the latest technologies that are efficient and development of the relevant infrastructures (Todaro, 2012).

Previous practices and studies have shown that the success of water management exercises in irrigation schemes depend largely on processes followed. In this respect, irrigation authorities ought to evaluate the performance of various processes in water management to determine what needs to be done to improve the distribution of water. To address the problem, Roopa (2000) has developed a framework that can be utilized to evaluate the performance of water management processes.

According to Roopa (2000), the planning process should utilize the objectives of irrigation scheme to pre-plan the distribution of water to different crops. Because of this there are a number of possible plans that can be produced from the allocation process. To decide the best planning process, the performance of all possible planning processes should be evaluated to identify the optimal one. In so doing, four performance measures namely: adequacy, equity, accessibility and productivity should be considered (Roopa, 2000). The process that is identified is then compared to existing processes. The advantage of this process is that it minimizes the risk of possible failure and helps address all economic, institutional and social issues that might hamper an irrigation scheme. However, there are two problems associated with such holistic approach in assessing the problems of running irrigation schemes. The first problem, which is philosophical, tends to be complex because policy makers do not have opportunities for making changes. The second problem is that it is almost impossible to achieve an ideal operational plan with such an approach.

Previous studies show that the relevance of water-user associations in water distribution is weak thereby require some form of training among farmers to enhance its applicability at local levels. Furthermore, weak regulatory frameworks, which are characterized by

poor enforcement mechanisms, poor management and unsecured property rights especially on land ownership, affect the development of irrigation schemes negatively. Although community-based irrigation schemes have varying degrees of access to water, the greatest challenge is that most of them do not understand the influence of local management systems and appropriate water levels that can enhance water security (Peter, 2004).

To guarantee the improvement of water management processes in irrigation schemes, farmers should be engaged in making water-related decisions. They should also be taught the relevant conflict management processes to understand what they should do when they experience water shortage. This can be enhanced by equitable resource allocation processes and capacity building among local members (Peter, 2004).

In this respect, the security of water utilization can be enhanced by effective mechanisms of allocating water resources, involvement of farmers in making relevant decisions on water allocation and implementation of strategies developed to enhance efficient resource allocation. This however is affected largely by farmers' experiences with irrigation schemes, effectiveness of the irrigation committees developed to enforce rules and regulations, membership of those in the scheme and household incomes. It is also affected by cost sharing among members and the available water resources (Oriola, 2006).

2.3 Conceptual Framework

Figure 1 shows the figurative expression of the conceptual frame work

Independent variables

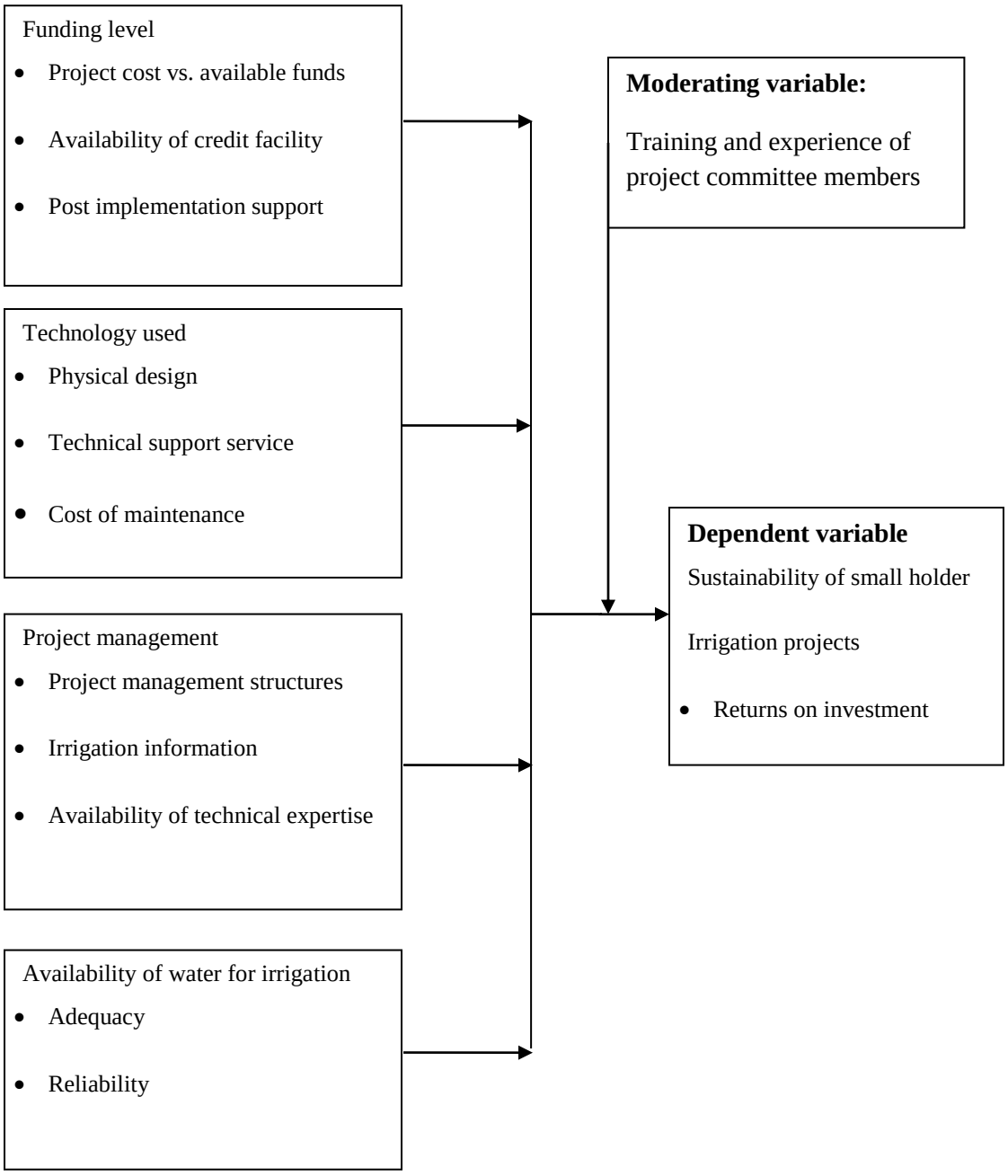

Figure 1 Conceptual Frame Work

Variables of the Study

Independent Variables

Funding level- it is the comparison between the projected cost of the project and the available funds, availability of credit and post implementation support services.

Technology used- includes the physical design of the whole project and its relevance to the present conditions, availability of project technical support services and the cost of maintenance.

Project management - involves the organization of the project management team, including their skills in the project management, access to information and its level of interaction with the other project members and availability of technical expertise.

Availability of irrigation water-determines if irrigation water is adequate when compared to the area under irrigation, and if water is available throughout the crop growing season.

Dependent Variable

Sustainability of small holder irrigation projects- Considers if the project is able to operate successfully and if there is a return of investment.

Intervening Variable

Training and experience of some project committee members- some members of project management team may hay some level of training and experience which may indicate that some projects are operating smoothly unlike others.

2.4 Knowledge Gap

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

2.5 Summary of literature review

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

3.1 Introduction CHAPTER THREE
RESEARCH METHODOLOGY

This chapter provides the methods that were utilized to conduct the study. It focuses much of its attention on sampling procedures; data collection methods; research design; data analysis; sample; and target population.

3.2 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.

3.3 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.

3.4 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.

3.5 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.

3.6 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.

3.7 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.

3.8 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.

3.9 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 SubCounty 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.

3.10 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.

3.11 Ethical Issues

To eliminate the possible ethical issues that could arise from the study, the researcher started by seeking permission from the ministry of water and irrigation in Kirinyaga central sub county and from the project managers on the sampled projects before collecting data from various offices of the government. The researcher also assured the respondents of their confidence with the information and the fact that the information will only be used for the intended purpose only. Respondents were also briefed on their right to decide to take part in the study or not.

3.12 Operationalization of Variables

Table 3.1 shows how variables were operationalized in the study to have them measurable. It indicates the objective, the variable, their indicators, the form of measurement, scale of measurement and the data collection tool

Table 3.1 Operationalization of variables

Objective	Variable	Indicator(s)	Data collection method	Data analysis
To establish how funding levels influence the sustainability of small holder irrigation projects	**Independent variable** Funding level	- Project cost - Availability of credit facility - Post implementation support	Questionnaire	Descriptive
Determine how technology influences the sustainability of small holder irrigation projects	**Independent variable** Technology used	- Physical design - Technical support - Cost of maintenance	Questionnaire	Descriptive
To find out how project committee members influence the sustainability of small holder irrigation projects	**Independent variable** Project management committee	- Project management structures - Access to information on irrigation - Technical expertise	Questionnaire	Descriptive
To assess how availability of water for irrigation influences the sustainability of small holder irrigation projects	**Independent variable** Availability of water for irrigation	- Adequacy - Reliability	Questionnaire	Descriptive

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter covered the process of analyzing, presenting and discussing the findings of the study on factors influencing the sustainability of small holder irrigation projects in Kirinyaga central sub county. Data was analyzed with the help of the SPSS computer programme. This enabled the researcher to present the data in frequencies, percentages and summarized in tables.

4.2 Questionnaire response rate

Table 4.1 shows the response rate of the study

Table 4.1: Questionnaire response rate

Respondents	**Sample size**	**Response rate**	**Percentage**
Project committee members	30	26	87
Project members	100	84	84
Irrigation officials	2	2	100
Total	132	112	85

Out of 132 questionnaires issued, 112 were returned which represented a response rate of 85%. Based on Mugenda and Mugenda (2003) argument that a response rate of 50 percent is adequate for analysis, the response rate was considered to be fair for analysis; thus, the analysis was conducted on the 112 questionnaires that were filled. Throughout the analysis, the 85 percent response rate was considered to be representative of the target population, adequate and good enough to enable the researcher generate a conclusive report.

4.3 Demographic characteristics of respondents

The demographic representation of the respondents was presented as follows including age, gender and level of education.

4.3.1 Gender of Respondents

Respondents requested asked to indicate their gender. Table 4.2 shows the gender of respondents.

Table 4.2:Gender of Respondents

Gender	Frequency	Percentage
Male	69	62
Female	43	38
Total	**112**	**100**

Results on gender of respondents show that 62% were male while 38% were female The distribution shows that there was sufficient representation in understanding the sustainability of small holder irrigation projects.

4.3.2 Age of the Respondents

Respondents were requested to indicate their age brackets. Table 4.3 shows the age brackets of the respondents

Table 4.3:Age of respondents

Age of respondents	Frequency	Percentage
Below 25 years	15	13
25-45 years	63	56
Over 45 years	34	31
Total	**112**	**100**

On the Age category, 56% of the respondents were in the age bracket of 25-45 years, 31% were age over 45 years while 13% were of below 25 years of age. The results suggest that the study collected information from a wide section of age category there by validating the responses of the study. Moreover the results suggest that most of the

population participating in irrigation projects is of the most productive age of between 25 and 45 years.

4.3.3 Level of education of the respondents

Respondents were requested to indicate their educational levels. Table 4.4 shows the distribution of the respondents by education as revealed by the study.

Table 4.4:Education levels for respondents

Level of Education	Frequency	Percentage
Primary education	40	36
Secondary education	63	56
Tertiary	9	8
Total	**112**	**100**

The results indicated that 56 percent of the respondents had attained secondary education whereas 36 percent had primary level education. Only 8% had tertiary level of education. Education level was important in order to understand the literacy levels of the respondents which could probably influence their understanding on the sustainability of the small holder irrigation projects.

4.4 Funding levels and the sustainability of small holder irrigation projects

The study also sought to ascertain the influence of funding on the sustainability of the small holder irrigation projects.

4.4.1 Level of funding for irrigation projects

Respondents were asked their opinion on if the level of funding for the project was adequate. Table 4.5 shows the response rate on the level funding on the irrigation projects.

Table 4.5:Level of funding for irrigation projects

Level of funding	Frequency	Percentage
Not adequate	71	63
Adequate	38	34
More than adequate	3	3
Total	**112**	**100**

63% of the respondents noted that funding for irrigation projects was not adequate while 38% observed that funding was adequate. This was an indication that most projects faced challenges from the initiation due to lack of adequate funding.

4.4.2 Availability of credit facility

Members were asked if credit facilities were available in the projects. Table 4.6 shows the response rate on the availability of credit facilities.

Table 4.6: Availability of credit facility

Availability of credit facility	Frequency	Percentage
Yes	13	12
No	99	88
Total	**112**	**100**

Majority of the respondents (88%) noted that their projects do not have credit facilities while only 13% responded that there are credit facilities within their projects. The results show that members may not be able to consistently operate the projects due to lack of adequate resources.

4.4.3 Availability of post implementation support

Respondents were asked if post implementation support was available in the project. Table 4.7 shows the response rate on the availability of post implementation support.

Table 4.7: Availability of post implementation support

Availability of post implementation support	Frequency	Percentage
Yes	48	43
No	64	57
Total	**112**	**100**

43% of the respondents responded that there was post implementation support while 57% noted that no support was available after the project was initiated. This may explain why most projects faced challenges after initiation since little support was available.

4.5 Technology used and the sustainability of small holder irrigation projects

The study further sought to ascertain how technology influenced the sustainability of small holder irrigation projects based on the project physical design, availability of technical support services and the cost of maintenance.

4.5.1 Influence of physical design of the project on the operations

Respondents were asked to rate the influence of the project physical design had on the project operations. Table 4.8 shows the response rate on the extent on which the irrigation project physical design influences its operations**.**

Table 4.8:Influence of project physical design on its operations

Influence of project physical design on operations	Frequency	Percentage
High	71	63
Moderate	26	23
Low	15	14
Total	**112**	**100**

63% of the respondents noted that the design of the project highly affected its operations while 23% noted there was moderate influence of the project operations by the design. 14% of the respondents noted that there was little influence of the design of the project on

its operations. The results perhaps explain why most projects have challenges since most are not well designed and therefore affect the project operations.

4.5.2 Availability of technical support services

Respondents were asked if technical support services were available in the small holder irrigation projects. Table 4.9 shows the response on the availability of technical support services.

Table 4.9:Availability of technical support services

Technical support services	Frequency	Percentage
Available	42	37
Not available	70	63
Total	**112**	**100**

The results showed that 63% of the respondents noted that technical services were not available in their projects while 37% reported that technical support services were available. This may be explained by the fact that some projects may have more resources than others and therefore could afford to procure the support services.

4.5.3 Influence of Technology used on the cost of maintenance of the project

Respondents were asked on what level technology influenced the cost of maintenance of the project. Table 4.10 shows the response on the extent on which technology used influences the cost of project maintenance.

Table 4.10: Influence of project design on cost of maintenance

Influence of technology used to cost of maintenance	Frequency	Percentage
High	86	77
Moderate	18	16
Low	7	7
Total	**112**	**100**

On the responses, 77% noted that to a large extent project design influence the cost of maintenance while 16% noted that the design of the project moderately influenced the

maintenance costs. This explains why it is important for the project designers to come up with designs which would result to low maintenance costs.

4.6 Project management and the sustainability of small holder irrigation project

The study further sought to ascertain the influence of project management on the sustainability of small holder irrigation projects while considering the qualifications of the project committee members, availability of information on irrigation and availability of technical expertise.

4.6.1 Qualification of the project management committee

Respondents were asked their opinion on the qualification of the management committee members. Table 4.11 shows the response on if the project management committee members are qualified to manage the project.

Table 4.11: Qualification of project committee members

Qualification of project management committee	Frequency	Percentage
Qualified	45	40
Not qualified	67	60
Total	**112**	**100**

Majority (60%) of the respondents indicated that project management committee members were not qualified to manage the projects while 40% of the respondents noted that the management committee was qualified. Qualification and experience in project management is necessary for those given the responsibility of running the projects and the same could probably influence the sustainability of the project.

4.6.2 Availability of information on irrigation

Respondents were asked if information on irrigation was available. Table 4.12 shows the response on availability of information on irrigation.

Table 4.12: Availability of information on irrigation

Availability of information on irrigation	Frequency	Percentage
Available	46	41
Not available	66	59
Total	**112**	**100**

From the results in table 4.12 most of the respondents 59% noted that information on irrigation was not available while 41% indicated that information on irrigation was available. Availability of information is very crucial in project management and lack of the necessary information may curtail the progress of a project.

4.6.3 Availability of technical expertise

Respondents were asked if technical experts were available in the projects. Table 4.13 shows the response on the availability of the technical experts on the small holder irrigation projects.

Table 4.13:Availability of technical experts

Availability of technical experts	Frequency	Percentage
Available	33	29
Not available	79	71
Total	**112**	**100**

From the results 71% of the respondents revealed that technical experts were not available in the projects while 29% of the respondents indicated that the experts were available. Irrigation in a highly technical activity and availability of the technical personnel is very necessary. Lack of experts may pose a challenge in the implementation and sustainability of the project.

4.7 Availability of water for irrigation and the sustainability of small holder irrigation projects

The final research objective sought after the influence of availability of water for irrigation against the whole area under irrigation and the crop growing season.

4.7.1 Adequacy of irrigation water

Respondents were asked if water for irrigation was adequate for the whole area under irrigation. Table 4.14 shows the response on the adequacy of water for irrigation.

Table 4.14:Adequacy of irrigation water

Adequacy of irrigation water in the area under irrigation	Frequency	Percentage
Adequate	65	58
Not adequate	47	42
Total	**112**	**100**

From the findings 58% of the respondents noted that there was enough water for irrigation while 42% noted that irrigation water was not adequate. Water is the key component on any irrigation undertaking. When this component is not adequate, the whole activity of irrigation will face challenges in implementation and sustainability.

4.7.2 Reliability of water supply throughout the crop growing season

Respondents were asked if the supply of irrigation water was reliable throughout the crop growing season. Table 4.15 shows the response on the reliability of water supply throughout the crop growing season.

Table 4.15:Reliability of water through the crop season

Reliability of water supply through crop season	Frequency	Percentage
High	68	61
Moderate	33	29
Low	11	10
Total	**112**	**100**

Respondents (68%) indicated that reliability irrigation water supply was high throughout the crop growing season while 33% indicated that the reliability of water supply was moderate. Only 10% noted that the supply was low throughout the crop season. Adequacy of irrigation water throughout the crop growing season is crucial for crop growth and also to ensure that the farmers get returns for their investments through sale of mature crops.

CHAPTER FIVE

SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides and discusses briefly the summary and findings of the study. It also concludes the study and makes recommendations based on the findings of the study and suggests what further studies ought to do.

5.2 Summary of findings

The study sought to evaluate the factors that influence the sustainability of small holder irrigation projects in Kirinyaga Central Sub County. The findings presented are derived from the study's objectives and research questions which were formulated to help in the investigations.

From the analyzed data related to objective one, 63% of the respondents noted that funding on small holder irrigation projects was not adequate. As a result most projects are not adequately funded and therefore faced challenges in their operations. 88% of the respondents indicated that there was no provision of credit facilities in their projects, which would also mean that if the farmers did not have adequate resources and savings, they may not be in a position to maintain their crops to maturity and therefore there is likelihood of crop failure. Crop failure would mean the farmers not being able to recover their investment and therefore having challenges in sustaining the project. Most respondents 57% indicated that there was no post implementation support either from the government or the donors. This would mean that incase the project faces challenges before it picks up, it would be very difficult to sustain it since there is no external support and the project members may not be having the ability to sustain it.

The second objective sought to determine if the technology used influence the sustainability of the small holder irrigation projects.63%of the respondents indicated that the physical design of the irrigation project would influence its sustainability especially due to maintenance, constant water supply and future plans on expansion. Another 63% of the respondents noted that technical support services which would include spare parts and maintenance personnel were not available which was attributed to the kind of

technology used in the design of the irrigation used. It would be important to consider the availability of technical support services while designing and implementing an irrigation project otherwise such a project will have challenges in sustainability. The cost of maintenance is directly related to the technology used in the design of the irrigation project, according to the 77% of the respondents. Complex designs would result in to high maintenance costs while simple designs would also result to lower cost of maintenance.

The third objective was to find out how the project management committees influenced the sustainability of the small scale irrigation projects. When data related to this objective was analyzed, it revealed that majority of the project committee members (60%) did not have the necessary qualifications to run the projects. It also come out that information on irrigation was not readily available to the project members. Only 41% of the project members had access to information on irrigation while the rest (59%) does not get the necessary information. Without getting the necessary information on irrigation, it would be a challenge to sustain the irrigation projects. The analysis of data on this objective also revealed that there were very few people within the projects technically qualified either for maintenance or to operationalize the projects. 71% of the respondents noted that there were no technical experts within the projects. Taking in to consideration that irrigation in a highly technical activity, it would be a big huge challenge to manage the project without the necessary experts.

In the fourth objective the study sought to assess how the availability of irrigation water influenced the sustainability of the small scale irrigation projects. Data analyzed revealed that water was adequate (58%) for the whole area under irrigation. This would mean that the area had adequate water for irrigation. At the same time 61% of the respondents revealed that water supply was equally reliable throughout the crop growing season and therefore there was no risk of crops failing before maturity due to lack of adequate water.

5.3 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.

5.4 Conclusions of the study

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 inorder 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.

5.5 Recommendations of the study

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

5.6 Suggestions for further studies

Although this study provided insight on the influence of funding levels, technology use, project management committee and availability of water for irrigation on the sustainability of small holder irrigation projects, several other areas need to be addressed by future researchers. First the researcher suggests researcher on the role of financiers in influencing the design and operations of small holder irrigation projects, which would complement the findings of this study. Secondly further studies needs to be undertaken on the availability of water for irrigation since no all regions in Kenya have adequate water throughout the year.

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APPENDICES

APPEDEX I: LETTER OF INTRODUCTION

Mboi Stephen Githaka

University of Nairobi

P.O. Box 30197-00100

Nairobi

Dear Sir/Madam,

RE: RESEARCH QUESTIONNAIRE

Am a postgraduate student in the school of open and distance learning in the university of Nairobi

I am currently carrying out a research on factors influencing the sustainability of small scale irrigation projects in Kirinyaga Central Sub County, Kirinyaga County. You have been selected to participate in this study

Kindly provide honest and accurate answers to the questions in this questionnaire to enable gather data for research. I wish to assure you that the information provided will be treated with utmost confidentiality and will only be used for the purpose of the study

Yours faithfully

Mboi Stephen Githaka
Reg. No. L50/60860/2010

APPENDIX II: QUESTIONNAIRE FOR PROJECT COMMITTEE MEMBERS

Instructions:

Please provide the information requested below as accurately as possible

Tick your opinion in the box or write on space provided

Section One: General Information

1. Please indicate your Gender

   Male [ ] Female [ ]

2. What age bracket do you belong?

   Below 25 years [ ] 25 – 45 years [ ] Over 45 years [ ]

3. What is your level of education?

   Primary school [ ] Secondary School [ ] Tertiary level [ ]

4. How long have you been a committee member of your project?

   Less than 3 years [ ] 3 – 7 years [ ] Over 7 years [ ]

5. How many members are in your group is

   Less than 30 [ ] 31-60 [ ] Over 60 [ ]

Section Two: Influence of funding to the sustainability of the small holder irrigation project

6. How would you describe the level of funding in your project?

   Not adequate [ ] Adequate[ ] More adequate [ ]

7. If not adequate, what could be the reason?

   Low member contributions [ ] lack of external support [ ] Others [ ]

8. What is the main source of funds for your project?

   Member contributions [ ] Government funding [ ] Donors [ ] Others [ ]

9. To what extent are planned project activities funded?

   Small extent [ ] Moderate extent [ ] Large extent [ ]

10. Does your project have any credit provision to the members?

    Yes [ ] No [ ]

11. If yes, what kind of credit facility is available?

    Seed materials [ ] Equipment [ ] Financial [ ] Others (specify)……

12. Are there plans of funding the project after it starts its operations?

Yes [ ] No [ ]

13. At what extent have you ever received funding on time?

Small extent [ ] Moderate extent [ ] Large extent [ ]

Section Three: Influence of technology used in small scale irrigation projects

14. To what extent does the design of the project effect its operations?

Small extent [ ] Moderate extent [ ] Large extent [ ]

15. Explain how the design affect the operations of the project

_____

_____

_____

_____

16. Do you have qualified technical personnel in the project?

Yes [ ] No [ ]

17. If no to what extent does lack of technical personnel affect the project operations?

Small extent [ ] Moderate extent [ ] Large extent [ ]

18. To what extent does the design of the project influence the cost of maintenance?

Small extent [ ] Moderate extent [ ] Large extent [ ]

Section Four: Influence of project management on sustainability of small scale irrigation projects

19. On your own opinion, to what extent are the members of management committee qualified to run the project?

Small extent [ ] Moderate extent [ ] Large extent [ ]

20. How frequent do you elect the management committee members

Annually [ ] Bi annually [ ] After three years [ ]

21. How do you obtain information on project operations?

Through irrigation experts [ ]

Through other irrigation groups [ ]

Through the internet [ ]

22. How relevant is the information obtained on running the project?

Not relevant [ ] moderately relevant [ ] highly relevant [ ]

23. How would you rate the level of interaction between the project management committee members and the project members?

High level [ ]

Moderate [ ]

Low level [ ]

24. On your own opinion, to what extent do you think it is necessary to improve on the management of the project activities

Small extent [ ] Moderate extent [ ] Large extent [ ]

Section Five: Effect of availability for irrigation water on the small holder project

25. Is irrigation water adequate for the whole area being irrigated?

Yes [ ]

No[ ]

26. If no, how do you ensure equity in distribution?

Shift supply [ ]

Rationing [ ]

Seasonal planting [ ]

27. How is the supply of water reliable throughout the crop growing season

Not reliable [ ] Moderately reliable [ ] Highly reliable [ ]

28. What may cause the water shortage on the project?

Climatic conditions [ ]

Poor project design [ ]

Area under irrigation [ ]

Thank you for your cooperation

APPENDIXI 1II: QUESTIONNAIRE FOR PROJECT MEMBERS

Instructions:

Please provide the information requested below as accurately as possible

Tick your opinion in the box or write on space provided

Section One: General Information

1. Please indicate your gender

Male [ ] Female [ ]

2. What age bracket do you belong?

Below 25 years [ ] 25 – 45 years [ ] Over 45 years [ ]

3. What is your level of education?

Primary school [ ] Secondary school [ ] Tertiary level [ ]

4. How long have you been a member of your project?

Less than 3 years [ ] 3 – 7 years [ ] Over 7 years [ ]

5. How many members are in your group is

Less than 30 [ ] 31-60 [ ] Over 60 [ ]

Section Two: Influence of funding to the sustainability of the small holder irrigation project

6. How would you describe the level of funding in your project?

Not adequate [ ] Adequate[ ] more adequate [ ]

7. If not adequate, what could be the reason?

Low member contributions [ ] lack of external support [ ] Others [ ]

8. What is the main source of funds for your project?

Member contributions [ ] Government funding [ ] Donors [ ] Others (explain)[ ]

9. Does your project have any credit provision to the members?

Yes [ ] No [ ]

10. If yes, what kind of credit facility is available?

Seed materials [ ] Equipment [ ] Financial [ ] Others (specify)……

11. Are there plans of funding the project after it starts its operations?

Yes [ ] No [ ]

12. At what extent have you ever received external funding on time?

Small extent [ ] Moderate extent [ ] Large extent [ ]

Section Three: Influence of technology used in small scale irrigation projects

13. To what extent does the design of the project effect its operations?

Small extent [ ] Moderate extent [ ] Large extent [ ]

14. Explain how the design affect the operations of the project

_____

_____

_____

_____

15. Do you have qualified technical personnel in the project?

Yes [ ] No [ ]

16. If no to what extent does lack of technical personnel affect the project operations?

Small extent [ ] Moderate extent [ ] Large extent [ ]

17. To what extent does the design of the project influence the cost of maintenance of the project?

Small extent [ ] Moderate extent [ ] Large extent [ ]

Section Four: Influence of project management on sustainability of small scale irrigation projects

18. On your own opinion, to what extent are the members of management committee qualified to run the project?

Small extent [ ] Moderate extent [ ] Large extent [ ]

19. How frequent do you elect the management committee members

Annually [ ] Bi annually [ ] After three years [ ]

20. How do you obtain information on project operations?

Through irrigation experts [ ]

Through other irrigation groups [ ]

Through the internet [ ]

Through management committee members [ ]

21. How relevant is the information obtained on running the project?

    Not relevant [ ] moderately relevant[ ] highly relevant [ ]

22. How would you rate the level of interaction between the project management committee members and the project members?

    High level [ ]

    Moderate[ ]

    Low level [ ]

23. On your own opinion, to what extent do you think it is necessary to improve on the management of the project activities

    Small extent [ ] Moderate extent [ ] Large extent [ ]

Section Five: Effect of availability for irrigation water on sustainability of small holder irrigation

24. Is irrigation water adequate for the whole area being irrigated?

    Yes [ ]

    No[ ]

25. If no, how is the water supplied?

    Shift supply [ ]

    Rationing [ ]

    Seasonal planting [ ]

26. How is the supply of water reliable throughout the crop growing season

    Not reliable [ ] Moderately reliable [ ] Highly reliable [ ]

27. What may cause the water shortage on the project?

    Climatic conditions [ ]

    Poor project design [ ]

    Large area under irrigation [ ]

Thank you for your cooperation

APPENDIX IV: INTERVIEW SCHEDULE FOR IRRIGATION OFFICIALS

Section One: General Information

1. Please indicate your Gender

   Male [ ] Female [ ]

2. What is your level of education?

   Primary school [ ] Secondary School [ ] Tertiary Level [ ]

3. What is your job Designation?

   Irrigation officer [ ] Agriculture officer [ ]

4. How long have you been in your position?

   Less than 3 years [ ] 3 – 10 years [ ] Over 10 years [ ]

Section Two: Influence of funding to the sustainability of the irrigation project

5. How would you describe the funding of small scale irrigation projects in your area

   Adequate [ ] Enough [ ] Inadequate [ ]

6. To what extent is funding of irrigation projects a challenge in the Sub County?

   Small extent [ ] Moderate extent [ ] Large extent [ ]

7. In a ranking order of 1 to 3, 1 being the lowest and 3 the highest, rank the reasons which may contribute to inadequate funding in the sub county

Lack of donors [ ]

Lack of awareness by project managers [ ]

Poor project management [ ]

8. What is the main source of fundingirrigation projects?

   Project members [ ]

   Government [ ]

   Nongovernmental organizations [ ]

Any other (specify) _____

9. Where project funding is available, to what extent is it adequate?

Not adequate [ ] Moderately adequate [ ] Highly adequate [ ]

10. Is there availability of credit among the projects?

    Yes [ ]

    No [ ]

11. If yes, what kind of credit is available?

Seed materials [ ] Equipment [ ] Financial [ ] Others (specify)……

12. Are there plans of post project implementation funding of the projects?

Yes [ ] No [ ]

13. On your own opinion, how can small scale projects overcome funding problems in order to succeed?

……

……

……

Section Three: Influence of technology used in small scale irrigation projects

14. To what extent does the design of the project effect its operations?

Small extent [ ] Moderate extent [ ] Large extent [ ]

15. Explain how the design affect the operations of the project

_____

_____

_____

_____

16. Are there qualified technical personnel in the projects? Yes [ ] No [ ]

17. If no, to what extent does lack of technical personnel affect the project operations?

Small extent [ ] Moderate extent [ ] Large extent [ ]

18. To what extent does the design of the project influence the cost of maintenance of the project?

Small extent [ ] Moderate extent [ ] Large extent [ ]

Section Four: Influence of project management on sustainability of small scale irrigation projects

19. On your own opinion, to what extent are the members of management committee qualified to run the projects?

Small extent [ ] Moderate extent [ ] Large extent [ ]

20. How frequent does the project members elect the management committee members

Annually [ ] Bi annually [ ] After three years [ ]

21. How do the projects obtain information on their operations?

Through irrigation experts [ ]

Through other irrigation groups [ ]

Through the internet [ ]

22. How relevant is the information obtained on running the projects?

Not relevant [ ] moderately relevant[ ] highly relevant [ ]

23. How would you rate the level of interaction between the project management committee members and the project members?

High level [ ]

Moderate [ ]

Low level [ ]

24. On your own opinion, to what extent do you think it is necessary to improve on the management of the project activities

Small extent [ ] Moderate extent [ ] Large extent [ ]

Section Five: Effect of availability for irrigation water

25. Is irrigation water always adequate for the whole area planned for irrigation?

Yes [ ]

No[ ]

26. If no, how do projects supply water to their members?

Shift supply [ ]

Rationing [ ]

Seasonal planting [ ]

27. How is the supply of water reliable throughout the crop growing season in most projects

Not reliable [ ] Moderately reliable [ ] Highly reliable [ ]

28. What may cause the water shortage on the project?

Climatic conditions [ ]

Poor project design [ ]

Large area under irrigation [ ]

Thank you for your cooperation