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Community Perception on Rainwater Harvesting Systems for Enhancing Food Security in Dry Lands of Kenya

A Case study of Uvati and Kawala Sub-Location in Mwingi District, Kenya

Angela Bosibori Nyamieri

Department of Urban and Rural Development
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Angela Bosibori Nyamieri

Supervisor: Thomas Håkansson, Swedish University of Agricultural Sciences
Department of Urban and Rural Development

Examiner: Örjan Bartholdson, Swedish University of Agricultural Sciences
Department of Urban and Rural Development

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Abstract

Community rainwater harvesting systems are seen as instrumental in increasing resilience in recurring droughts and enhancing food security in dry lands of Kenya. The study explores and analyses the implementation process, community's perceptions on the rainwater harvesting project/ technology and its influence on the adoption process by the community. By using a case study of two sub-locations-'Uvati and Kawala' in Mwingi District, the study targeted both the participants and non-participants of the *In situ* rainwater harvesting project. The study used both empirical data and theoretical studies to address the research questions: why and how the rainwater harvesting project was implemented? Does the implementation process affect the community's perception on the project? How is the rainwater harvesting technology perceived by the community? And, does the perception influence its adoption of the rainwater harvesting project? The methods used to generate data included literature materials, interviews, focus group discussions and direct observations.

The results revealed that the rainwater harvesting technology is seen by the community members to be a good initiative in improving agricultural practices in periods of water scarcity. However, the technology's sustainability and wide spread adoption seems unlikely, as its success is mainly directed and depended on the social factors. Majority of the factors that influence the adoption process based on the community perceptions were found to be: labour intensity of constructing the structures, lack of technical know-how and extensive training, dissemination of information and its future plans were not properly conducted. The implementation approaches used by the project initiators affected the perception of the community, which influenced the adoption of the project. The outcome of the study shows that the decision to adopt rainwater harvesting systems is dependent and influenced by the community's perception, and better understanding of their choices in making decisions.

Keywords: *Rainwater-harvesting, Community, Participation, Perception, Arid and Semi-Arid of Kenya*

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Possible errors of facts and judgement are entirely mine.

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Abbreviation and Acronyms

ADCL- Appropriate Development Consultants Limited

CBD- Community Based Development

FAO- Food and Agricultural Organization

FfW-Food for Work

NALEP- National Agricultural and Livestock Extension Programme

NCF-Nordic Climate Facility

SIWI- Stockholm International Water Institute

TB- Trapezoidal Bund

UNDP- United Nations Development Programme

1.0 INTRODUCTION

1.1 Background

The population of the Arid and Semi-arid Lands in Sub-Saharan Africa are amongst the poorest and most vulnerable people in the region. They suffer from recurring and increased ranges of natural and human-made shocks that act as effective barriers to productive and sustainable livelihoods and demote a majority of the population to a state of chronic poverty (Ngigi, 2003:944). Arid and semi-Arid Lands are characterized by its insufficient water, low productivity especially in agriculture and serious land degradation. This has led to food insecurity and conflict between communities over declining resources. The capacity to manage climate change is limited, due to the wide spread of recurring droughts, inequitable land distribution, and the dependence on rain-fed agriculture (Vohland & Barry, 2009: 120).

One of the promising technologies to combat the problem of food insecurity in Arid and Semi-Arid Lands is the use of rainwater harvesting systems. This is the process of inception and concentration of runoff and its subsequent storage in the soil profile or in artificial reservoirs for crop production (Ngigi, 2003:944). Ngigi (2003:952) indicates that rainwater harvesting is a promising technology for improving the livelihoods of many inhabitants of vast dry regions of the world. It provides opportunity to stabilize agricultural landscapes in Semi-Arid regions and to make them more productive and more resilient towards the climate changes (Vohland & Barry, 2009: 120).

The collection, capture or diverting rainwater for various productive usages is widespread; especially when it comes to agricultural purposes and soil or water conservation [...] it has been implemented in numerous projects. Various international organizations and institutions conduct substantial research on methods to augment water availability for food production (AfDB, 2012:4). Singh *et al* (2005:214) illustrates that water supply programs are essentially built upon three basic components namely: technology, people (community) and institutions. They further claimed that the right match of the three components is believed to result to successful rainwater-harvesting projects. UNDP & World Bank, 1987 (Singh *et al*, 2005:214) the match should also be that the community recognizes the benefits of the improved supply, can afford at least the cost of operating and maintaining it, and has the skills, materials and tools available to sustain it.

The main focus of this research therefore was to analyse from a social perspective, based on a community project namely, *In situ* rainwater harvesting, used to enhance food security in Arid and Semi-Arid areas of Kenya. Attention was directed on the community's perception towards the *In situ* rainwater harvesting project that further influences the adoption rate of the technologies in these areas. It was based in two locations in Mwingi district, namely: 'Uvati and Kawala', where the areas is termed as Semi-Arid Lands of Kenya.

1.2 Concepts

The reasons for including these concepts is to enable the readers to comprehend some of the technical and abstract terms used in the course of the paper.

Rainwater harvesting

Rainwater harvesting is a simple and low cost water supply technique that involves the capturing and storing of rainwater from roof and ground catchments for domestic, agricultural, industrial and environmental purposes (Oduor & Gadain, 2007: 2).

In situ Rainwater harvesting systems

In situ rainwater harvesting practices (defined as soil and water conservation) mainly help to overcome dry spells, as the soil: by manipulating the soil surface structure and vegetation cover and density, evaporation from the soil surface and surface runoff can be potentially reduced, infiltration is enhanced and thereby the availability of water in the root zone is increased (Vohland & Barry, 2009:121).

Trapezoidal Bunds (TBs)

According to FAO (1991) TBs are soil and water conservation structures that are used to enclose larger areas (up to 1 ha) and to impound larger quantities of runoff, which is harvested from external or 'long slope' catchment. The layout consists of a base bund connected to wing-walls, where three sides of a plot are enclosed by bunds while the fourth (upslope) side is left open to allow runoff to enter the field. Crops are planted within the enclosed area, the simplicity of the design and construction, plus the minimum maintenance required are the main advantages of this technique.

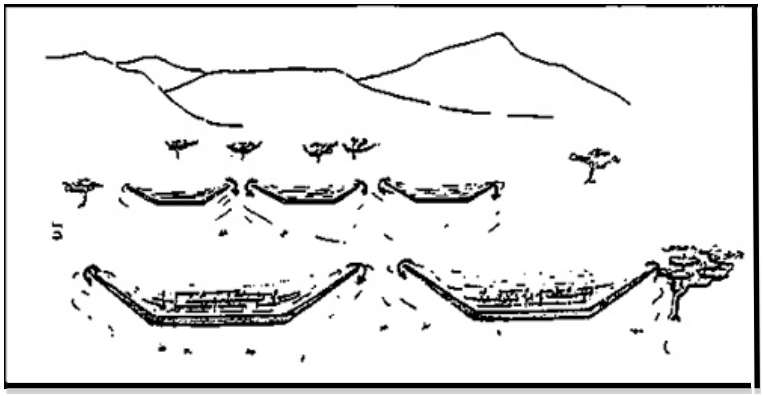


Figure 1: Illustration of trapezoidal bunds in Turkana District, Kenya (photo created by, FAO 1991)

Community and Participation

'Community' can be depicted as a group of people that distinguish themselves or by outsiders as sharing common cultural, religious or social features, backgrounds and interests, and that form a collective identity with shared goals. (UNHCR, 2008:14).

'Participation' refers to the full and equal involvement of all the members of the community in decision-making processes and activities that affect their lives, in both public and private spheres (UNHCR, 2008:17).

Community Based Development projects

Community Based Development is an umbrella that refers to projects, which actively include the beneficiaries in their design and management: where they have complete control over key project decisions (Mansuri& Rao, 2004:2).

Adoption and Acceptance

Acceptance in reference to the research is the community's' perception and assessment of the implemented project in terms of their effectiveness in improving land productivity, and increase crop production. Adoption represents the community participants' countenance of commitment for sustained utilization of the rainwater harvesting technologies as part of the indigenous agricultural system and practice after the withdrawal of assistance from the external actors (Bewket, 2007:409)

1.3 Profile of the Kenya and targeted project

Arid and Semi-Arid Lands of Kenya are made up of more than 80% of the country's landmass, and it is home of more than 30% of its total human population and nearly half its livestock population. The districts that are considered as Arid and Semi-Arid Lands are

normally hot and dry, and experience low and erratic rainfall that has created uncertainty for rain-fed agricultural producers and livestock owners (Appendix.1). The Arid districts mainly practise pastoralism and agro-pastoralism, with larger areas of the land suitable only for supporting livestock grazing systems. The Semi-Arid lands have dissimilar characteristics: they are mainly agro-pastoralism, including some extensive irrigated areas, wetlands, and protected areas such as national parks (Oxfam, 2006:6). In the smallholder rain-fed systems, such incidences have severely destabilized food security and livelihoods as the majority of the population in these rural Arid and semi-Arid Lands draw on rain-fed agriculture for their livelihoods. In order to alleviate the effects of droughts and famine cases that affects the food security and jeopardizes the livelihoods of Arid and Semi-Arid rural population: a number of *In Situ* rainwater harvesting structures have been implemented in many areas of Kenya (ibid.6).

A rainwater harvesting project has been implemented in one of the areas considered as Semi-Arid, namely Mwingi District, Kenya. It is therefore selected as a case study for further illustration. NIRAS Natura (formally known as Ramboll Natura) in collaboration with Appropriate Development Consultancy (ADCL) Kenya, secured a small grant from the Nordic Climate Facility (NCF) in 2010, and executed a 2 year project aimed at testing and disseminating water harvesting technologies in new areas that had not been exposed to the new technology (Ramboll Natura, 2010). The project was entitled "*providing assistance for design and management of appropriated water technologies in Arid Lands of Kenya*". The project had been in operation for two years now, and was implemented in collaboration with the Ministry of Agriculture-Kenya.

The 'projects' broad objective was to have innovative water harvesting techniques in place that will respond to climate change; introduce appropriate water harvesting technologies for crop production (Trapezoidal Bunds), provide water for domestic and livestock consumption, improve food security and increase resilience and adoption to climate change through more efficient use of scarce water resources (Ramboll Natura, 2010).

1.4 Problem Statement

There has been commendable efforts in promoting community based rainwater harvesting projects by government institutions and development organizations, in order to increase resilience to recurring droughts and enhancing food security for pastoralist and agro-pastoralists communities in Arid and Semi-Arid areas of Kenya. In-spite of there being a lot

research on the potential benefits of rainwater harvesting systems for rural communities. Little attention is directed on communities' perception regarding the rainwater harvesting projects. The significance of the perceptions[1] of the recipients (community participants) has been ignored mainly by excluding them from the designing, implementation and assessment stages of the rainwater harvesting projects for enhancing food security and the influence it plays. This is important as it determines the success of the project goals. It has also led to problems relating to low rates or failed adoption processes due to insufficient participation by the farmers targeted by the rainwater harvesting projects.

1.5 Objective

The objectives of the study are:

- To examine the implementation process used in the community based rainwater harvesting project in ' Uvati and Kawala' -Mwingi District;
- Find out if the implementation process affects the community's perception regarding the rainwater harvesting system/project in 'Uvati and Kawala' -Mwingi District;
- Investigate and understand the community's perception on the rainwater harvesting system/ technology;
- To find out if the community's perception influences the adoption process of the rainwater harvesting systems in 'Uvati and Kawala' - Mwingi District.

1.6 Research Questions

The research questions have been formulated based on the objectives of the study and they are as follows:

i. Why and how was the project formulated and implemented by the initiators of the project?
ii. Does the implementation process affect the community's perception of the rainwater harvesting project?
iii. How is the rainwater harvesting technology perceived by the community?
iv. Does the perception of the community influence the adoption of the rainwater harvesting project?

[1] Allport (1965) cited that perception involves to understand, and awareness of a meaning or recognition of the objects (Chi & Yamada, 2002:94).

1.7 Justification of the research

The benefits of rainwater harvesting for enhancing food security in Arid and Semi-Arid Lands, and poor knowledge with regard to the real causes of low adoption rate and/or failed adoption process due to inadequate participation by local farmers cannot be gain said.

It is against this backdrop that the researcher chose to undertake the study in order to determine the challenges, constraints and potentials for the adoption of these *In Situ* rainwater harvesting systems and to analyse how the implementation process and community's perception of the technology's characteristics might affect their adoption decisions in the District. This will make it possible to indicate that the decision of the use of the rainwater harvesting system is dependent on how the community perceives it in the area, and to better understand their choices in making the decisions. Enabling one to come up with possible measures that should be taken in to account for improving the adoption rate.

The reason for choosing the study site is that it has an extremely different socio-economic background, climatic conditions, and inaccessibility to important resources like water, as comprised to other areas of Kenya. The research will focus on one specific on-going community based project. The study will give in-depth analysis on the community's perception of the rainwater-harvesting project. Result of the study will contribute fundamental knowledge and information that will be used by policy makers, development project planners during the design and implementation of rainwater-harvesting structures.

1.8 Organization of the paper

The paper is divided into five chapters and four appendices. The first chapter gives background knowledge on the current state of Arid and Semi-arid Lands and issues on rainwater harvesting structures for enhancing food security. It also indicated the problem statement, objective, research questions and justification of the study, which shows the importance of the study in adding to the literature or research done on rainwater harvesting systems for enhancing food security.

The second chapter reviews the academic discourses that are of importance to the current research study. It also contains the theoretical underpinnings of the study that are directed to giving information needed in answering the research questions.

The third chapter illustrates the methodology used in the study, specifying the sample design, study population, sampling and data collection techniques and the data analysis methods espoused by the study in order to arrive at the conclusion of the objectives of the study.

The fourth chapter presents and discusses the results of the data collected from the field. It describes and analyses the data based on the objective of the study and answering the research questions. It discusses the results found in the data by linking the results of the analysis and the existing theories to other research studies, articles or journals of similar topics. It also discusses the inferences of the results obtained.

The last chapter consists of a summary and recommendations and/ or suggestions for additional information for development project planners and practitioners.

2.0 LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

Many scholars have conducted studies on rainwater-harvesting systems for the enhancement of food security in Arid and Semi-Arid areas of Sub-Saharan Africa. The results gave diverse dimensions on benefits and challenges of such practices in the modification of landscape functions especially on food security and livelihoods. Drechsel *et.al* (2005:2) points that while experts acknowledge that there are many manuals on the theoretical advantages of these technologies, their site requirements as well as some success stories of adoption, there are few reports published on adoption failures and lessons learnt.

It is in this connection that this study was motivated to raise the research questions outlined in the previous chapter, by reading carefully and through the broad literature concerning socio-economic impacts of rainwater-harvesting systems for enhancing food security in Arid and Semi-Arid Lands. The study predominantly pays attention to the community's perception regarding the rainwater-harvesting technologies, and systems and factors influencing adoption process. The literature review discloses and outlines the current debate and recommends ways of clarifying and extending the scope of the discussion.

The second section of the chapter looked into the theoretical literature and framework in connection with the research. For the purpose of the study, the theoretical framework will be set off from the critical development theory, by using different relevant theories and critical approaches. It revisited debates about the creation of the knowledge in relation to development, indicating how knowledge, power and agency representation and responsibility ascribed in various circumstances is an issue of interest and has relevance to development forms which in turn is a major influence in developmental projects. The latter part discusses some of the conceptual foundations of participatory approaches linked to efficiency and empowerment. The study illustrates participation as a tool and a process for achieving better outcomes and enhancing the capacity of individuals or communities targeted, in order to improve their lives.

The empirical and theoretical literature review assists in contributing to an extensive and complete picture of the community's perception in rainwater-harvesting systems for enhancing food security and its influence on the adoption rate. Accounting for previously

neglected studies on community's perception on rainwater-harvesting projects affects the success of the project and influences the adoption process.

2.2 EMPIRICAL LITERATURE

2.2.1 Studies on rainwater-harvesting systems for enhancing food security, agriculture and its adoption

Studies on rainwater harvesting systems for enhancing food security in Arid and Semi-Arid Lands have publicized deep optimism. This optimism is driven by the supposition that rainwater harvesting systems provides opportunities to stabilize agricultural setting in Arid and Semi-Arid Lands and makes them more productive and more resilient towards climate change. In reference to the adoption of agricultural technologies (including Soil and water conservation systems) which is affected by a number of factors such as socio-economic, demographic, institutional and technical, farmers' perception about the technology and their attitude towards it (Foti *et al* 2008:317).

Biazin *et al* (2012) did a review on rainwater harvesting and management in rain-fed agricultural systems in Sub-Saharan Africa. The paper outlines various rainwater harvesting management techniques practised in Sub-Saharan Africa, and reviews recent research results on the performance of the selected practices. The study indicates that micro-catchment and *In Situ* rainwater harvesting techniques are more common than rainwater irrigation techniques from macro-catchment systems. The rainwater harvesting techniques could improve the soil water content of the rooting zone, nearly six fold of crop yields have been obtained, reduces risk of crop failure due to dry spells but also improving water and crop productivity (2012: 147). The paper concludes that the socioeconomic limitations to the development of appropriate rainwater-harvesting management technologies need to be addressed still. The farmers in Sub-Saharan Africa also require technical and institutional support in order to develop their indigenous practices (Biazin *et al*, 2012: 148).

Ngigi (2003) did an analysis on the limit of up-scaling (re-designing) rainwater harvesting on an on-going research project, on upper Ewaso Ng'iro a river basin water resource management. He illustrated using SIWI (2001) that, *In Situ* rainwater harvesting systems that is on cropland water conservation to enhance soil infiltration and water holding capacity tends to dominate. In comparison to storage systems for supplemental irrigation, they are less commonly practised or used especially in Sub-Saharan Africa with an exception of other countries as Ethiopia, Kenya, Tanzania and Uganda that are still slowly adopting with a high

degree of success (Kihara, 2002 in Ngigi, 2003: 945). The paper indicates that even though rainwater harvesting practices can yield positive results through effective increase of soil moisture for crops in water scarce areas, each system still has limited scope due to hydrological and socio-economic limitations. The limitations revolve around practiced farming systems, population pressure, formal and informal institutions, land tenure, economic environment and social structures (Ngigi, 2003:946&954). He proposed that many of such techniques for enhancing crop production in Arid and Semi-Arid areas of Sub-Saharan Africa and its viability, needs to be evaluated in relation to environmentally sustainable factors, climatic conditions, soil characteristics, farming systems and socio-cultural and gender perspectives in which they are practiced (ibid: 944).

Vohland & Barry (2009) did a review of *In Situ* rainwater harvesting practices modifying landscape functions in African dry lands. The results were based on impacts of different aspects of sustainability on *In Situ* rainwater harvesting systems that improve hydrological indicators such as, infiltration and ground water recharge, soil nutrients are enriched, and biomass production increases with subsequent higher yields leading to food security. The review indicated that the potentials of the rainwater-harvesting systems and the adoption of the rainwater harvesting practices have positive effect on incomes, measured in return to labour. However, Herweg & Ludi (1999) conclude that the rainwater harvesting structures do not necessarily lead to increased crop yields and improve food security because the structures tend to occupy precious cropping areas that are subsequently lost for cropping and weeding might be complicated (Vohland &Barry, 2009:124). Vohland and Barry (2009) pointed out further that the adoption rate of the rainwater harvesting systems is still low. According to Dreschel *et al* (2005) farmers hesitate to invest time and money in setting rainwater harvesting structures because they lack security on land ownership and have limited access to local markets for their surplus crops. Farmers especially those with least resources usually expect to see benefits with a cropping season from such technological investment. In the case of soil and water conservation measures (*In Situ* rainwater harvesting structures) it usually involves significant initial and on-going investment in both cash and labour with benefits being realized in the long term (Ellis-Jones & Tengberg, 2000:20).

Tesfay (2008) conducted a thesis study on rainwater harvesting in Ethiopia looking at the technical and socio-economic potentials and constraints for adoption in Wukro District. He pointed out that despite the potentials of the technology for improving agricultural productivity and livelihoods, its adoption by the farmers is not satisfactory. His results

indicated that poor capital and human endowment, lack of access to credit, involvement in off-farm activities, negative perception, gender issues, inaccessibility of construction materials, lack of technical know-how, poor water extraction and application methodologies are among the factors that negatively influence adoption of rainwater-harvesting technologies. Based on his conclusion he suggested that for the adoption of these technologies to be better and improve the farmer's income, critical measures should be taken in to account. These measures revolve around creating awareness for the people, providing technical and institutional support, promoting only technology with higher financial feasibility, timely supply of construction material, empowering female headed households and design and development of alternative policy instruments that are accountable to the farmers (Tesfay, 2008:51-52).

Rockström (2002) on his study on the potential of rainwater harvesting to reduce pressures associated with poor rainfall patterns and water shortage, showed that there are significant opportunities available to upgrade rain-fed agriculture also in water scare savannah agro-systems. He stressed the need for strong attentions directed to upgrading rain fed agriculture amongst the smallholder farmers. Upgrading rain-fed agriculture in Arid and Semi-Arid Lands especially in 'developing' countries, requires a focus on rainwater management targeting drought and dry spell mitigation. Indicating that water harvesting therefore has the potential of contributing to mitigate rainfall fluctuations, and thereby stabilize yields over time and increase overall yield levels (Rockström, 2002:7). He further pointed out that water harvesting is an important but not exclusive tool to achieve sustainable increase in agricultural productivity in Semi-Arid and dry humid savannahs. It needs to be integrated with other management strategies particularly soil fertility management, but also tillage, timing of operation, pest management and choice of cropping systems (2002:26).

Bewket (2007) conducted a study where he explored farmers' acceptance and adoption of soil and water conservation technologies that was implemented and executed by using a farmer-participatory approach in the north-western highlands of Ethiopia. The project was undertaken the local office of the agricultural ministry- *Gozamen woreda* office of agriculture, as part of an on-farm research program in Amhara regional state (2007:407). Bewket's (2007:408, 410&414) analysis indicated that even though majority of the farmers acknowledged that the rainwater harvesting technologies were effective measures for soil erosion and improving land productivity, its sustainability and widespread replication seemed unlikely according to the farmers' views. He pointed out those major factors that were

discouraging the farmers from adopting the technologies on their farms were: labour shortage, problem of fitness of the technologies to the farmers' requirements and farming system circumstances, and land tenure insecurity (ibid: 414). The conclusion of the study indicated that the introduced soil and water conservation technologies was not tailored to the farmers' needs and farming systems circumstances and that the convention approach pursued was not truly farmer participatory, but were rather persuaded to implement the conservation measures. Botha *et al* (2004) pointed out that for the social and economic sustainability of rainwater harvesting practises depend mainly on the degree of involvement participation by farmers and the community (Vohland& Barry, 2009:124). According to Bangoura (2002) the more the local communities are involved in planning, the greater the chances that rainwater harvesting structures will be maintained and benefits shared (Vohland & Barry, 2009:124).

Baidu-Forson (1999) explored factors influencing adoption of land enhancing in Sahel using the lesson from a case study in Niger. He used the Tobit analysis to identify the factors that motivate level and intensity of adoption of specific soil and water management technologies. The study's findings concluded that approaches to enhance adoption of improved soil and water management include the demonstration of short-term profits or benefits and risk reduction characteristics of technology, and support for dissemination of knowledge on gains from adoption (1999:238).

Foti et.al (2008) identifies in the study the farm level factors that influence the adoption of soil fertility and water management technologies by smallholder farmers living in Semi-Arid areas of Zimbabwe. Providing an insight to target technologies appropriate to improve uptake of farmers. Using the Tobit regression model, the findings indicated that: formal education, availability of draught power, access to crop markets and provision of more permanent land tenure systems were ascertained as the most important factors influencing the adoption of soil and water management technologies by the smallholder farmers (2008: 323-326). In the conclusion of the study, it was pointed out that there should be an understanding of household socio-economic characteristics (livelihoods) when designing and targeting technologies to small-scale farmers.

According to Kessler (2006) non-rational and subjective aspects of human behaviour also influence adoption decisions: some farmers will not adopt soil and water conservation measures even when they perceive economic benefits from doing so (Bewket, 2007:405). Foti *et al* (2008:316) indicated that various development institutions have been working on

projects to promote the uptake of selected soil fertility in the Semi-arid districts in Zimbabwe. The main strategy has been on farmer participatory experimentations that were used to show the benefit of these technologies. The adoption rates have continued to be low amongst the farmers to justify the amount of resources invested by the project initiators (especially in time, money, commitment from both parties involved).

The main conclusion based on the study review, is that though the rainwater harvesting systems provide benefits in enhancing food security in Arid and Semi-Arid Lands and resilience towards climate change, there are still a number of factors affecting its adoption and farmer's attitude towards it. The major factors include: socio-economic limitations, land tenure, institutions, technical, and farmers' perception about the technology. The review therefore contributed in answering the assigned research questions of the study, indicating that the implementation process of rainwater harvesting systems tends to affect the perception of the community benefiting from it, and thus it influences the adoption process. It confirmed the notion that development of superior technologies and its promotion to farmers in these Arid and Semi-Arid Lands is not a satisfactory condition to the achievement of food security, if the appropriate pre-conditions (especially social factors) for the adoption of the technologies by farmers are not known.

2.3 Theoretical Literature and Framework

Theory gives us concepts, provides basic assumptions, directs us to the important questions, and suggests ways for us to make sense of the data (Mikkelsen, 2005:156).

2.3.1 Critical Development Theory

This section uses an anthropological criticism of development theories. The relevant approaches and models are discussed to indicate the relevance of development discourses, focusing mainly on the creation of the knowledge concerning development, by citing different development scholars and practitioners on the interpretations on influences in the development trends, theories and practices.

Development scholars and practitioners for many years have been struggling with the suggestions, plans and practices of structuring the human environment that could lead to transformation in order to meet human needs. In the attempt of changing the Western notions of thinking this has prevailed in scholarly debate, and this notions and visions has influenced the transformations of the rest of the world. Escobar (1995:13) says that development has depended entirely on one knowledge system, namely the modern Western one. The

dominance of this knowledge system has dictated the marginalization and disqualification of the non-western knowledge systems.

Tucker (Munck&O'Hearn, 1999) argues around the flaws of Eurocentric development paradigm. He pointed out that development discourses has delivered false hope and in-depth investigation of the world reveals a bleak failure of development programs. He further argues that people from the less developed worlds are worse off, because of the inability of the programs created by the western nations to improve their lives. He asserts that *"the development discourse is part of an imperial process whereby other peoples are appropriated and turned into objects. It is an essential part of the process whereby the developed countries manage, control and even create the Third world economically, politically, sociologically and culturally"*(1999:2). He argues that development cannot be perceived as a natural process and contends what the role of cultural dimension is in the development process. The Eurocentric development model has described and illustrated stimulating discussions about modernization of the developing countries of the world without carefully considering the role of culture in the development of the "developing" countries.

Imposition of Western development notions to the population of the less developed countries is bound to be a recipe to disaster, as errors or challenges are created in the process by those from more developed countries. A "void" is therefore created in understanding the development discourses and thus has no important validity for the local people of the less developed countries (Tucker in Munck&O'Hearn, 1999). Hobart (1993:1) further illustrated that development projects often leads to relapse in the problem of underdevelopment; a largely neglected aspect of development is the part played by the Western scientific knowledge, dismissing indigenous knowledge's.

Escobar (1995:5) illustrates that reality has been colonized by the development discourses, and for the ones who are not satisfied with this issues they had to struggle for bits and pieces of freedom within it, in the hope that in the process a different reality could be constructed. This is organized by the fact of the repetitive and omnipresent reality of development: where government or institutions design and implement ambitious development programs. The people's conditions in turn do not improve but worsen with passing time. Foucault's works on the dynamics of discourses and power in representation of social reality, therefore has been instrumental in unveiling the mechanisms by which a certain order of discourses

produces permissible modes of being and thinking while disqualifying and even making others impossible (ibid: 5).

Hoben (1995) highlights more cultural dimensions of development discourses, where he argues that the power of development narratives is enhanced through the incorporation of dominant symbols, ideologies and real or imagined historical experience of their adherents. In this sense they are culturally constructed and reflect the hegemony of Western development (in Leach& Mearns, 1996:8). Pigg (1992) however stated that social categories of development are not simply imposed, they circulate at the village level in complex ways, changing the way villagers orient themselves in local and national society. She summed up indicating how culture of development works within and through local cultures. Development encounter should not be seen much as a clash of two cultural systems but as an intersection that creates situations in which people come to see each other in certain ways (Escobar, 1995:49).

In Hobart (1993) the relationship of those to be developers and those to-be developed is constituted by the developers' knowledge and categories, be it in the nation-state, the market or the institutions which are designed to give semblance of control over these confections. In public discussions of development it is said that the knowledge of the people being developed are either ignored or treated as mere obstacles to rational progress (Hobart, 1993:2). Hobart further stated that there is a stress by many development critics on the value of treating local knowledge [2] seriously and examining their potential contribution to peoples' material, intellectual and general welfare. The one feature mostly elaborated in the development criticism is the link of knowledge and agency; where local knowledge often constitutes people as potential agents (1993:5). In reality scientific knowledge in development practise generally represents the superior knowing expert as agent and the 'indigenous' people being developed as ignorant passive recipients of this knowledge (ibid: 5).

Watson (2009) clearly illustrates further that development was equated with a particular brand of modernization in which 'western' scientists and 'educated' administrators were seen as having the 'modern' knowledge, technology, forethought and sensibility to manage the environment and to arrest any advancing degradation. Such modern development projects

[2] Knowledge is internalized learning based on scientific facts, experiences and/or traditional beliefs. Experience shows that knowledge is necessary but not sufficient to produce behavior change, which occurs when perceptions, motivation, skills and the social environment also interact (FAO, 2007: 26).

often failed, however frequently resulted in environmental damage. At the same time, she ascertained that research showed that indigenous knowledge [3] often provides ingenious solutions to difficult problems and is the product of generations of experimentation an experience in particular environments (Watson, 2009:4). The practices that result from the application of indigenous knowledge can be much more effective and efficient than previously thought; they make inventive use of available and renewable resources, making them environmentally sustainable. According to Lommis (2000), indigenous institutional dimensions are seen as resource by development organizations, which can be harnessed to encourage the participation of people in particular programme, or a means through which indigenous people can take control of their own development (Watson, 2009: 7).

The social worlds of developers, whether foreigners or nationals, are almost always far apart from those being developed, as in nature of their involvement, what is at stake and the perceived purpose of the enterprise (Hobart, 1993:11). Relationship of developers and developed are usually regarded as hierarchical by both parties: communication easily becomes the giving of information or instructions by those with expert knowledge. Brokensha *et al* (1980) indicates that in order to have development and to have people understand how development is to be applied in a particular case, developers need to develop with "developees" (Hobart, 1993:11-12). By improving the communication process between both parties a major obstacle will be removed [...] it also rests upon a model of knowledge as communicable propositions and presumes rationality to be shared (ibid.:). Everett Rogers (1962) introduced the diffusion [4] theory in the context of development, referred to as *'diffusion of innovation approach'*. Rogers (1995) refers it to the spread of abstract ideas and concepts, technical information, and actual practices with a social system, where the spread denotes flow from a source to an adopter, distinctively via communication and influence (Wejnert, 2002: 297). The theory pursues to elucidate how and why, including at what rate new ideas and technology spreads through culture. Rogers (2003:12) points out that "newness" of an innovation may be expressed in terms of knowledge, persuasion or decision

[3] According to Watson (2009:5) indigenous knowledge, like all knowledge, is a product of the culture and society in which it is generated and performed.

[4] Refer to Everett M.Rogers (2003) for more information about diffusion of innovation. *Diffusion*, according to Rogers (2003:5) is the process in which an innovation is communicated through certain channels over time among the members of a social system. *Innovation* is an idea, practice or object that is perceived as new by an individual or other unit of adoption (ibid:12).

to adopt. He further conceptualizes them into five main steps of innovation-decision process[5], which are: 1) Knowledge, 2) Persuasion, 3) Decision, 4) Implementation, and 5) Confirmation (ibid: 20).

The review clearly highlights different proponents' views on the debate about the creation of knowledge in relation to development. It indicates how knowledge, power and agency representation and responsibility ascribed in various circumstances is an issue of interest in the development forms that in turn plays a big influence in developmental projects. This is pointed by the fact that most development projects often at times lead to degeneration of underdevelopment, if it mostly neglects or dismisses indigenous knowledge by focusing on western scientific knowledge. Based on the research questions of this study, this proves that the inclusion of the community's perception in the rainwater harvesting project and/or technology may influence meeting its objectives.

2.3.2 Models and approaches to 'community' participation

Relevant approaches and models will be discussed in this section to indicate the relevance of development discourses, (community) participation in community based development projects; and specifically the importance of including community perspectives or perceptions and knowledge in the entire process of projects. Therefore, the paper intends to discuss some of the most well-known approaches and models that have been put forward by different authors and proponents as a means to comprehend and review participation structures and practices, in community based development projects. This will enable the researcher to determine the extent of power, issues of process and capacity and how the nature of the community affects the adoption of development projects.

Mosse (Cooke & Kothari, 2001:32-33) argued that 'participation' [6] can be seen primarily as a theory oriented towards concerns that are external to the project location. These representation do not speak directly to local practise and provide little guide to

[5] Innovation-decision process is the process through which an individual passes from first knowledge of an innovation, to formation of an attitude towards an innovation, to decision to adopt or reject, to implementation and use of the new idea, and confirmation of this decision (Rogers, 2003: 20).

[6] According to the AfDB (2001) handbook on stakeholder consultation and participation in AfDB operations '*participation in development can be defined as the process through which people with an interest (stakeholders) influence and share control over development initiatives and the decisions and resources that affect them'*. It was further stated that in practical terms it involves, identifying relevant stakeholders, share information with them, listening to their views, involve them in processes of development planning and decisions making, contributing to their capacity-building and ultimately empower them to initiate, manage and control their own self-development (ADB, 2001:2).

implementation, but are important in negotiating relationships with donors, and part of wider development policy arguments.

Participatory models stress the importance of cultural identity of local communities and of democratization at all levels-international, national, local and individual. In order to share information, knowledge, trust, commitment, and a right attitude in development projects, participation is crucial in any decision-making process for development (FA0, 2007: 4). Cleaver indicates that the trend of participation has become an act of faith in development. He stated that "*the act of faith is based on 3 tenets: participation is intrinsically a 'good thing', focus on 'getting the techniques right' is the principal way of ensuring the success of such approaches, and the consideration of power and politics on the whole should be avoided as divisive and obstructive"* (Cooke& Kothari, 2001: 36). Cleaver further indicates that participation approaches theorizing are often divided into two ends classification. Participation is distinguished between the efficiency arguments-as a tool for achieving better project outcomes and equity and empowerment arguments-as a process that enhances the capacity of individuals to improve or change their own lives (Cooke &Kothari, 2001: 37).

Henkel and Stirrat (Cooke & Kothari, 2001:168) argues that "it is now difficult to find a development project that does not [...] claim to adopt a 'participatory' approach involving 'bottom-up' planning, acknowledging the importance of 'indigenous' knowledge and claiming to 'empower' local people. When the people or community are actively involved in development initiatives, they become more like actors themselves rather than just being inactive beneficiaries. They can be able to identify their own priorities or needs and make their own decisions about the future, while the organising agency facilitates, listen and learn from them. Hobart (1993: 15-16) critically states that rejection and suggestions of 'planning from above' in preference of 'bottom-up' approach does not always lead to any changes of the matter, as the terms and kind of actions expected usually remain defined by 'superiors' who are mostly the developers. Therefore like any other theoretical framework to development issues, the participatory methods have been criticised. For instance in Cooke and Kothari (2001) they refer to participation as the 'new tyranny'.

The issues that revolve around 'empowerment' which is part of theorization of participatory approaches has become a slogan of development, essential objective of projects but a number of problems result from the analysis of it within projects. There is no clear line who is to be empowered in developmental projects- the 'individuals', 'community' or categories of people

such as ‘women’, the ‘poor’ or the socially excluded (Cooke &Kothari, 2001:37-38). This issue has in turn been generally avoided in many developmental initiatives. Waddington and Mohan (Hickey & Mohan, 2004:221) pointed out on an alternative form of empowerment, where they stated that for empowerment to be transformative it has to be fought for and not be given by a powerful group (development agents) to a less powerful group (community).

Mosse (Cooke & Kothari, 2001:17) points out that the important principle of participatory development is the incorporation of local people’s knowledge into programme planning. Knowledge and attitude are internal factors that affect how human beings act. An enabling environment such as education system, policy and legislation, cultural factors, service provision, religion, socio-political factors, physical environment and organizational environment can also influence the knowledge and attitudes of the targeted groups (FAO, 2007: 26). Mosse further argues that ‘local knowledge’ created by participatory planning are shaped by pre-existing relationship, meaning a patronage-type of relationships between a project organization and local people. In reference to Petty (1995) classification of participation types: participation by consultation refers to the involvement of people by being consulted as sources of information and/or about their views, while external agents define problems, prescribe solutions and make decisions on implementation of the solutions (Bewket, 2007: 408). In this case local knowledge becomes compatible with bureaucratic planning (Cooke & Kothari, 201:32).

Chambers (1994:953) defines participatory rural appraisal (PRA) in ‘participation’ in development, as ‘a family of approaches and methods to enable rural people share, enhance, and analyse their knowledge of life and conditions, to plan and to act’. He points out that ‘PRA as a key instrument in challenging the institutionally produced ignorance of development professional ‘uppers’ that not only denies the realities of ‘lowers’ but imposes its own uniform, simplified realities (and wrong) realities on them’ (Mosse in Cooke & Kothari, 2001:17). He further states that the whole idea of *“PRA is changes and reversal-of roles, behaviour, relationship and learning. Outsiders do not dominate and lecture; they facilitate, sit down, listen and learn...they do not transfer technology; they share methods which local people can use for their own appraisal, analysis, planning action, monitoring and evaluation”* (Chamber 1997:103 in Cooke and Kothari, 2001: 17).

Participatory rural appraisal sees the community as harmonious and tends to promote a consensual view. Cleaver (Cooke& Kothari, 2001:44) argues that ‘the community in

participatory approaches to development is often seen as natural entity characterized by solidaristic relations'. The participatory approaches pressure solidarity within communities; process of conflicts, and cooperation, inclusion and exclusion are occasionally acknowledged but slightly examined (ibid.:). Solidarity models of community emphases on the fundamental commonality of interest for smooth functioning of the development projects. Waddington & Mohan (Hickey & Mohan, 2004:220) challenged the purpose of participation, stating that it is almost unconsciously used to legitimize what development agents can offer rather than allowing people to exercise their own decision-making powers. Ngunjiri (1998) further argues that *'most participatory development begins by stigmatizing local communities as having a 'problem' as opposed to seeing communities endowed with many positive outcomes'*. These strong forces that pushes the communities and people into accepting their weak and impotent location is a fundamental driving force in shaping the relationships with the development organizations that work with them (Hickey & Mohan, 2004:220). This therefore can create dependency rather than empowerment in the end.

The technique (PRA/PLA) has been subjected to critical analysis. Biggs (1995) mentions that such an approach to participation fails to adequately address issues of power and control of information and other resources and provides an inadequate framework for developing a critical reflective understanding of deeper determinants of technical and social change. Francis (Cooke & Kothari, 2001:79) argues that those collectivises above and below the community level are often crucial for decision making and action; and it would be unfair to state that the other levels are ignored by PRA practitioners. Östrom, Lam and Lee (1994) argue that including local knowledge, can improve targeting, lower the informational costs of delivering anti-poverty programs, and ensure high quality monitoring of program implementation.

Clever (Cooke& Kothari, 2001:40) indicates how in participatory approaches institutions are seen as particularly important. It is assumed to ensure more efficient delivery of development, the inculcation of desirable characteristics among participants (responsibility, ownership, cooperation, and collective endeavour) and therefore empowerment. He further states that development experts surpass in perpetuating the myth that communities are capable of anything, that all that is required is sufficient mobilization (through institutions) and the latent capacities of the community will be unleashed in the interests of development. He critically states that, the evidence to such claims are so little to support it, even if a community appears well motivated, dynamic and well organized, severe limitations are

presented by an inadequacy of material resources, by the real structural constraints that impede the functioning of community-based institutions (ibid: 46).

Mathbor (2008:95-96) came up with an effective community participation model for coastal development projects. He points out that the philosophy of this community participation model is grounded on horizontal relationship between beneficiaries and functionaries of the coastal development projects. He further notes that community capabilities differ from community to community in terms of people's knowledge regarding development strategies, local infrastructure, mass communication systems, social structures, social interactions, group linkages, and levels of education of the people. Clever, indicates that *"it is also necessary to develop a complex modelling of livelihood concerns over life courses, of the negotiated nature of participation and a more honest assessment of the costs and benefits to individuals of becoming involved in agency-and state-directed development processes. In order to do this we need to be able to analyse the resources that people need in order to be able to participate in development efforts and to find ways of assessing which participatory approaches are low-cost and of high benefit to poor people"* (Cooke& Kothari, 2001:55).

In conclusion, the use of participatory approach methods, is seen to hold weight when it comes to efficient delivery of development projects and as a tool and process for achieving better outcomes and capacities of targeted communities, in order to improve their lives. In some cases, a number of projects using the participatory method are unlikely to yield sustainable benefits, mainly because of economic and political exclusion (Hickey & Mohan, 2004: 220). Emphasis in participatory approach is the appropriateness of empowerment, though most project approaches remain focused with efficiency. The use of this approach based on the research questions posed in the study, could contribute to determining how the community perceives, community based rainwater harvesting project and how it can influence the adoption process by the community members.

3.0 METHODOLOGY

This section of the paper describes the study area and population, methodology and tools used to answer the research questions of this research. The chapter addresses the study population and the study design. It also explains the sampling methods and sample size, the data collection methods and instruments used. In the last section of the chapter, it gives details of data quality management methods, processing, entry and analysis methods, shortcomings of the study and difficulties faced in the field.

3.1 Strategic approach

The study is focuses on the community perceptions and their adoption on rainwater harvesting projects for enhancing food security on the study area; and relies on a natural experimental strategy, as it tests human behaviour and thought, by simply evaluating (Bernard, 2006:123).

The paper used an ethnographic approach in order to elicit the participants' perception and points of view. According to Tuckman (1999) ethnography is a matter of observing and interviewing rather than manipulating variables by external instruments, since what ethnographers observe is the behaviour under study in the context in which it occurs through description rather than trying to abstract it from the use of test, survey or questionnaire.

3.2 Region and Targeted group

The study was conducted in Mwingi District, located in the Eastern province of Kenya. It borders Kitui District to the South and Machakos District to the west, Mbeere and Tharaka Districts to the Northwest, and Meru Districts to the North and Tana River District to the east. It covers approximately an area of 10,030.30sq.km (See Appendix 2). Mwingi District is divided into six sub-districts namely: Mwingi Central, Mwingi East, Mwingi West, Kyuso, Mumoni and Tseikuru (Short Rains Food Security Report, 2012; German Action, 2006). The districts' population is estimated based on 2009 is estimated to be 356, 805. More than 95% of this is rural based while 5% is urban; Mwingi Town has 4% while the rest is distributed in other trading centres.

The climate in the district is hot and dry for the greater part of the year. The rainfall pattern is bimodal but erratic with long rains occurring between March to May while short occurs

between October and December. The rainfall averages from 400mm and 800mm per annum, and is characterized by poor distribution especially during the long rains. The District has a poverty index of 62 percent, predisposing the population to food security-related shocks and hazards. The people in the area mainly practise agro-pastoralism, which is the common livelihood (Short Rains Food Security Report, 2012; German Action, 2006). The unreliability makes the district a drought prone area that leads to crop failure, especially for those growing drought intolerant crops; and water accessibility is problematic mostly during the dry seasons. More reliable crops for households to grow are drought resistant crops like millet, sorghum, green grams and cowpeas, but the income from selling these food crops is little, leaving many to become vulnerable (Kaloi & Bashaasha, 2005: 868). The two sub-locations Kawala and Uvati were purposively chosen because they are among those that benefit from rainwater harvesting community based projects undertaken by different Non-Governmental organizations (NGO's) and the local government.

3.3 Study Design

Given that the study intended to explore and analyse how the community perceives the project and its influence on the adoption process. The study was drawn using both primary and secondary data sources.

A field study was carried out, and first-hand information was acquired and was beneficial in assisting the researcher understand and acquire in-depth information on the context of rainwater-harvesting systems for enhancing food security within Mwingi District. The specific data collection methods that were used were the amalgamation of direct observations, Focus Group Discussions and semi-structured interviews to the chosen population study. This assisted in acquiring the information and answering the research questions set at the onset of this study. These methods complement the findings from different methods for the rationale of corroboration of finding and consequently minimizing biases in using a lone method (Marvasti, 2004: 15). These choices were beneficial as the use of qualitative methods allowed the author to participate and understand the perceptions of the key informants in addition to disclosing the interviewees' perspectives (Berg, 1989:9) on the community rainwater-harvesting project for enhancing food security. The secondary data provided comprehensive summary of past relevant pre-publications of research, literature material and studies carried out by others in journals, government publications, and other relevant material that were beneficial in getting theoretical and empirical findings.

Qualitative data was gathered to validate certain causal variables as well as finding information on fact, mind-sets and awareness (Berg, 1989:14) of the community's perceptions regarding to the community rainwater harvesting project.

3.4 Study population and Inclusion criteria

The study targeted the community participants of the *In situ* rainwater-harvesting project *"providing assistance for design and management of appropriate water harvesting technologies in the arid and semi-arid lands of Kenya"* for enhancing food security and non-participants in Uvati and Kawala sub-location, Mwingi.

3.5 Sampling method and sample size

The unit of analysis for this study were samples of both community participants and non-participants who were current beneficiaries of the *In Situ* rainwater-harvesting project implemented in the two sub-locations namely Uvati and Kawala of Mwingi district, Kenya. These participants and non-participants were mainly small-scale farmers who grow food crops such as sorghum, finger millet, cowpeas and green grams. In addition, relevant government officials- agricultural extension officers and appropriate NGO officials (project coordinators) involved with the implementation of the rainwater-harvesting project in Mwingi also formed part of the respondents.

The study employed a purposive sampling method to choose the informants from the targeted population of Uvati and Kawala sub-location, in Mwingi District. According to Bernard (2006:189) in purposive sampling, you decide the purpose you want informants to serve, and you go out to find some. It can also be useful in situations where you need to reach targeted sample quickly and where the sampling for proportionality is not the primary concern (Trochim, 2006). In purposive sampling one is likely to get the views and knowledge of the targeted population, but one is likely to overweight subgroups in the population that are more readily accessible.

The sample of the targeted group consisted of the community non-participants and community participants of the *In situ* rainwater harvesting project for enhancing food security. The reason for targeting non-participants is to understand also their views in regard to the rainwater harvesting technology. It also including those who were initially participating in the project but later dropped, so as to understand their reasons for dropping out. The sample size comprised of 30 participants and 10 non-participants of the project in both sub-locations. Out of the 30 participants 23 were female while the rest were male, and out of the

10 non-participants 6 were female and 4 were male. The sample was small and non-representative in a statistical sense of the community rainwater-harvesting project in the area. The study cannot be considered representative of the entire population of interest, as generalization was not the main goal. The main purpose of the study was to find out and give intuition on the community's perspective on the rainwater-harvesting project and its influences on the adoption process and its sustainability in the selected community.

The researcher conducted semi-structured interviews on 15 community participants of the *In situ* rainwater-harvesting project, and 10 non-participants who practised small-scale farming in the area. In the Focus group discussions, 15 community participants (in each sub-location) of the project were used. Deliberate efforts were made to ensure that in both the interviews and focus discussions groups comprised of both men and women. Also 2 government officials (agricultural extension officers of the area) were interviewed in order to understand their own framing of the rainwater-harvesting project since its design and implementation. A project coordinator of the rainwater harvesting project was interviewed to give a general overview on how the project was designed and implemented, get his views on the project and to understand if he foresaw any challenges from the start of the implementation of the project. Interviewing different people on the same topic quickly reveal a range of opinions, attitudes and strategies (Mikkelsen, 2005:172). It is important to note that no household interviews were carried out in relation to this research, since the targeted groups of the implemented rainwater-harvesting project were at a community level rather than household level.

3.6 Data collection methods and tools

The primary and secondary data collection techniques were used to collect qualitative data. Primary data was collected using semi-structured interviews, Focus Group Discussions and direct observations. The secondary data entailed a review of relevant reports, government documents and working papers from research institutes amongst others. The data collection methods used employed both premeditated and mostly general questions. The semi-structured interviews for various targeted respondents (see Appendix 2&3) were accompanied with note taking and recording of audio voices while the interview went on. These facilitated data collection and analysis and the organization of the qualitative data depended in the part on what the data looks like (Berg, 2007:46). At the same time, direct observations, little background information (socio-economic, demographic factors) on the study area were collected and collated from secondary sources.

The questions that were formulated in the semi-structured interview and employed in the study methodology reflected awareness that individuals understood the world in altering ways. The Focus group discussions were in this case useful as either a standalone data gathering approach or a line of action in a triangulated project and the researcher learned more through the discussions (Berg, 2007:95). Unlike other data collection methods, Focus group discussions can be advantageous in gathering more data within a very short time "provided the researcher carefully guides the discussion so that the group does not divert from the research themes" (Babbie, 1998). Direct observation is a method of gathering data through watching behaviour, events or noting down physical characteristics in their natural settings. The researcher used it, in order to directly see what people do (behavioural lifestyle and physical settings of the community) rather than relying on what they say they do (Evaluation Brief, 2008). To ensure the authentic data was collected from the respondents, data collection instruments were presented and revised accordingly.

3.7 Data processing and analyzing methods

The collected data was analysed qualitatively right from the field. The data gathered from this study was analysed through categorizing and labelling the major themes. The qualitative data generated was interpreted by looking at the emerging trends within the responses of the participants in the study. The methods employed in the qualitative data analysis included content analysis and direct quotations of selected remarks from the interviewees'. The study findings are therefore reported based on the research questions and objectives. The analysed data are the basis for discussing research findings, discussions, conclusions and recommendations in the writing of the thesis.

3.8 Limitations of the study and challenges encountered

The major challenge encountered on the field, was the language barrier between some of the interviewed participants in the targeted site with the interviewer, as the interviewer could not speak the local language of the area "Kamba", and a few could comprehend the local national language "Swahili". A lot of efforts were therefore made to capture the responses with the help of a rapporteur and an interpreter, who was a local member of the community or one of the agricultural extension officers in the targeted sites. In the Focus group discussions not all the participants were engaged in the discussions, making it difficult to get their views, while others were either answering questions on behalf of the other participants or dominating in the discussions. In the individual interviews some of the respondents at the beginning clearly

had misconceptions about certain issues and questions raised by the interviewer. Most of the time, therefore had to be spent in clarifying the questions by the interviewer, so that the respondents could give correct and direct answers.

The challenges should therefore be put in mind while going through the study findings and discussion presented in the next chapter. In spite of the challenges that were faced in the field, the researcher managed to collect and analysis the data, which gave insightful and useful information. Responses to the research questions got from the field formed the basis on which conclusions.

4.0 RESULTS AND DISCUSSION

4.1 Introduction

This section of the paper pursues to link the research questions and theoretical framework by presenting the research results and discussing them. The results stated are based on the objectives of the study that sought to answer the research questions that the researcher had intended to answer. The qualitative data acquired are presented based on themes that emerge during the analysis. It reveals and presents the implementation process of the project, the community's perception on rainwater-harvesting projects and its influence on the adoption process. Selected semi-structured interviews and Focus group discussions of the community participants of the project and the non-participants small-scale farmers of 'Kawala and Uvati' sub-location, Mwingi district were used, including interviews with agricultural extension officers of the areas and a project coordinator.

4.2 Rainwater-harvesting intervention and farmers' participation in the *In Situ* rainwater-harvesting project in Mwingi

In Situ rainwater-harvesting activities using conservative technologies were underway in Uvati and Kawala in Mwingi District beginning early 2010. According to the project coordinator, it was a 2-year project for "providing assistance for design and management of appropriate water harvesting technologies in the ASALs of Kenya". The project was undertaken by the NIRAS Natura (formally known as Ramboll Natura-Swedish consultancy company) in collaboration with Appropriate Development Consultancy (ADCL) Kenya and the Ministry of Agriculture-Kenya (under the programme NALEP) with funding secured from the Nordic Climate Facility (NCF) in 2010. The project coordinator further stated that "*the funding organization NCF has decided to extend the project for one year more, in order to support the project further and help address some of the major priorities"*. The objective of the project was to support increased resilience through improved water utilization techniques in pastoralist communities in arid and semi-arid areas of Kenya, Mwingi district being one of the targeted sites. In order to achieve the objective, implementation of broad range of appropriate water harvesting technologies were developed by ADCL, combining with suitable community development approach and appropriate agricultural practices (ADCL, 2011a&b). According to the project coordinator from NIRAS Natura (consultant), the emphasis of the project was to involve the community in the decisions for their future, through decision-making and risk management.

The design reports (ADCL, 2011a&b) indicated that the mobilization of the community in both areas was through invitation to meetings, group discussions and door to door visits. In the course of the meetings and visits the community were sensitized and given information about the project, in order for them to understand all the project details. Once a consensus was reached on mutual inputs and expectation of the various partners, a social contract was signed with the community confirming collaboration with all stakeholders in delivery of project initiative (ADCL, 2011a&b: 6).

The criterion of choosing the sites was based on the social dimensions, topography and soils. At the design phase technical activities included identifying technically and socially acceptable sites for the Trapezoidal Bunds (TBs) and triangular micro catchment, which was carried out after the community signed the social contract. The technical team were accompanied by the members of the community in surveying the sub-sites and marking the sites in readiness for construction (ADCL, 2011c&d). According to the reports written by ADCL and NIRAS Natura on both sites, user groups with local stakeholders were established for each water harvesting systems. The groups were trained and supported during the implementation period. The function of the group participants was to coordinate the maintenance of the structures, manage the cultivation and ensure fair distribution of the benefits acquired from the water harvesting systems. Organization of the project cooperation was as follows:

- Technical, social and agronomic knowledge provided by ADCL& NALEP (training and support in design and management of the WH structures);
- Tools provided by ADCL& NALEP;
- Fertilizer for 1 year were provided by ADCL& NALEP;
- Seeds for first 2 years provided by ADCL& NALEP;
- Labour for construction provided by the community participants;
- Labour for operation, maintenance and management provided by the community participants;
- Benefits in form of water harvested: food crops, fodder crops, and trees afforded to the community participants.

The total number of structures designed for *In Situ* rainwater-harvesting in and around Uvati in reference to the construction reports (ADCL, 2011c&d) included: 11 Trapezoidal bunds (TBs) with various dimensions with a total cultivated area of 9,750sqm (1 hectare) and 159

triangular micro-catchments on various farms, in Uvati Primary School and Enziu dispensary. In Kawala they included: 28 TBs with various dimensions with a total cultivated area of 25,1000sqm (2.51 hectares) and 99 triangular micro-catchments within Kalulu Primary School. The land areas in the two sites have no formal sub-division; individual ownership of land is recognized at the authority level. As there was no communal land available for siting and designing of TBs all of them were sited on individual owned farms. In the design phase social contract had therefore included having a dialogue with the community participants that would allow construction of TBs on individual plots. Landowners were involved on the course of the discussion that led to their land being used for project activities by a group. Those whose land was identified to be suitable were optimistic and consented to release the area covering the TBs to the group participants for the 2-year project period. The individual landowners who are also participants agreed that the group members would share all the farm yields acquired from the TBs during the project period. A social contract was drafted by ADCL and passed to the landowners to sign as an agreement to all the terms presented to this effect that allows the group members to work on their farms (in Uvati-*Lucia Ben, Anna Matheka, Mumo Mutinda* and Teresia & in Kawala- *Richard Mutia, Zipporah Kiambi, Joyce Musyoki, Serah Kasyoki* and *Pricilla Kilonzo*). Members whose farms were not suitable for the TBs agreed to settle for triangular micro catchments for fruit trees and for the farms where neither of the technologies was applicable they selected an alternative group contribution.

During the beginning of the project, construction tools were provided at the sites by NALEP (Ministry of Agriculture Kenya-MoA) as incentives to the participants, which included shovels, spades, hoes & wheel barrows. Demonstration of water harvesting technologies of TBs and triangular micro-catchment, and discussion on the role of the community participants on manual contribution was done. Major contribution of manual labour during the construction phase by the group was bush clearing, constructing the embankments, ferrying water for compaction of the soil, ferrying manure, and digging and planting. Construction of 1 TB using manual labour took 14 days for a group of 25 members to finish.

4.2.1 Planning and actual implementation of the rainwater harvesting activities

The actual mobilization and sensitization of the community members in the two areas, was described briefly by one of the interviewed agricultural extension officers “Manzi” who took part in the entire implementation process. He mentioned that the community members were called for a “baraza” local meeting at the local centre in the beginning of 2011. A dialogue

was established in the meeting between those who attended it with the project implementers (who were ADCL). They were then told the project developer's intention and the aim of the technology, which would include water harvesting structures for crop production (TB) and for trees (triangular micro-catchment). The community was then consulted and appeared to show interest, and were receptive about it, after understanding the function and benefits. Both agricultural extension officers interviewed, "Manzi" and "Naomi" also pointed out that the sensitization process was a one-day affair on both areas, which was also clarified by some of the interviewed community participants. According to the project coordinator from NIRAS Natura, regarding to the issue of how the community was mobilized, claimed that they were not responsible on how it was carried out or handled. The project coordinator further added that they had left this task to one of the partner organization-ADCL, and that their organization's task was mainly to structure the project and secure funds for it.

The implementation of the plan during the 2yrs of the project did not go as per what was initially planned by the project coordinators in the design reports. According to the responses got from the interviewed community participants and the agricultural extension officers, most the TBs in both the two sub-locations were done mechanically using hired tractors, and not as reported in the construction and designs reports refereeing that they were done manually by the participants. The project coordinator interviewed, said that this approach was used during the construction period because the community was severely affected by the drought period between 2010-2011. This meant that the attendance for the manual construction of the bunds was low due to the scarcity of food and water. ADCL who were responsible for the technical construction of the TBs decided to hire tractors to construct the remaining bunds.

The number of bunds designed and reported by ADCL did not correspond to the number of bunds constructed on the sites, more were constructed. Most of the community participants observed that those bunds constructed mechanically are suffering from erosion and are easily damaged as compared to the ones built manually which are still in a good state.

a). Mechanically constructed bund **b). Manually constructed bund**

Figure 2: Erosion on the bunds (pictures by author, 2013)

The supply of seeds for planting in the TBs was to be given to the participants seasonally by ADCL and NALEP. However this was not the case, because of delays in delivering them to the sites or was unequally distributed especially by the group leaders who were responsible in the distribution. Some participants interviewed said that there are cases where the group leader kept most of the seeds supplied for personal usage in their normal rain-fed farms and this created animosity among some of the participants.

4.2.2 Community's perception and its adoption process of the introduced rainwater harvesting structures

In order for the rainwater harvesting (soil and water conservation interventions) to succeed in enhancing food security, it will depend mainly on the level of acceptance of the technology and its adoption by the farmers as mentioned earlier in the first chapter and second chapters. In reference to the findings from the study, it was seen that that the level of acceptance and adoption of the technology (TBs) is a key component for the success of the project. Below are the findings from the study:

Group formation

Firstly it was observed that it was mostly women who participate and are active in the project as compared to the men in both areas. Probing further, through the responses received from the interviewees when asked why more women are engaged in the project than men, they respondse received was that it is mostly women who are responsible in agricultural farming as compared to the men. One male participant in Uvati responded that *'though am a group member of the project, it is mostly my wife who engages in most of the group activities that revolve around the TBs, including other farm activities with some of my hired labourers'*. He

stated further that he hardly has time to engage in agricultural farm activities as he is a primary school teacher and businessman, which takes up most of his time. The only reason why he decided to be part of the project was that he has been involved in many development activities around the area, and he is a member of an existing self-help group, which later participated, in the rainwater-harvesting project. On interviewing, the wife separately, she responded that, *"I have very little information and knowledge about the TBs, as I never attended the information meeting. My husband briefly informed me about its purpose, and how am supposed to attend to it that was all"*.

From the responses of some of the participants and non-participants, the group formation of the participants in the project was based on existing 'self-help' groups in Uvati sub-location, and that meant that those who didn't participate in it previously could not benefit from project (response from the chairlady of the group and some non-participants). The responses from some of the non-participants indicated that they felt excluded from benefiting in the project, though most of them attended the sensitization meeting about the project. As for Kawala area, the group formation and participation was based on those who felt like taking part in the project.

Figure 3: A bund being planted on (by author, 2013)

Motivation

According to most of the responses from the participants, the main motivation that led them to participate in the project was because they saw it as an asset to their farms mostly when

there is little rainfall. While to some it was out of curiosity to see the direct outcomes from the bunds, and therefore decided to participate in the project. Majority of the respondents interviewed, said they were a bit sceptical to participate in the project but on learning its purpose and a few demonstrations, they became enthusiastic to take part. Some have further gained confidence and believe that the TBs have potential to increase and improve the crop yields. For instance one respondent "Teresia" who is a participant (in Uvati group) stated that "*during the first year 'we' the Uvati group planted the crops during the short rainy season, and I saw there was a big difference between similar crops I had planted in my normal rain fed farm the same period in comparison to the ones planted in the TBs"*. On being asked what differences was observed, she said that *"the crops like green grams and cowpeas planted in the bunds are more greener and healthy looking. Also I observed that the bunds retain water even after the end of the rainy season"*. The majority of the respondents had similar views, where they mentioned some of the changes they have observed since the project was implemented, and that there was improved growth of the crops planted inside and along the TBs. In addition some of the community non-participants interviewed responded that they had a keen interest in participating in the project after seeing the positive crop yields from the TBs, especially the newly introduced plants 'watermelons'. Though non-participants in both areas are interested in participating in the project, it is not possible for them, because once the group was formed from the beginning no one was allowed to join later on. The participating group are the ones who decided this, as they felt it would be unfair to include new members, because of the work input they have put in since they started working on the project.

Challenges

Though, the project has received some positive perception, there are problems on how the project was implemented from the response on both the community participants and a few of the non-participants in both areas. For instance, whn mentioning about the control and ownership of the TBs located in individual farms in both areas belonging to members who volunteered. The community participants pointed out that even though it is currently owned by them, after the first four rainy seasons of the project in reference to the social contract, it will revert back to the respective farm owners. In Uvati fifteen members and Kawala seventeen members are taking part in the project, and only 6 members in Uvati and 6 members in Kawala have TBs in their farms, while the rest of the member have none. Those who did not have bunds on their parcels of land were promised either to have similar TBs or triangular micro-catchment for planting trees, which was never constructed by the project

implementers to-date. The major concern from the participants who do not have bunds or the triangular micro-catchments, feel as it they have worked for nothing for the benefit of those who will poses the TBs afterwards. This has made some of them lose interest in working on the bunds while others have dropped-out.

In both study sites, there was a bit of misunderstanding between the recipients and the project initiators about compensation of the labour provided in the construction phase. While some assumed they would be given Food for Work (FfW), that is usually used by other similar rainwater-harvesting project initiators in the region. Some of the participants were disappointed on learning that they were hardly receiving any form of compensation.

Some of the bunds can not be planted on, especially during the long rainy seasons in the areas, because of excessive water which is too much for the crops to handle, and at times it damages the TBs. According to one of the participant 'Dorcas', she said; *"sometimes it doesn't make any sense having such structures in our farms, as they occupy a lot of space. At the same time when there is a lot of rain that ends up being too much for the bund to handle that it is damaged. You can see that one of my bunds was completely damaged and it is beyond repair"*.

Figure 3: TB with water logging (by author, 2013)

The work input during the manual construction of the few TBs, was perceived by the participants to be labour intensive and exhausting. The participants became relieved when the

tractors arrived to construct the remainder of the TBs, though it was not part of the project plan. One of the agricultural extension officers 'Manzi', pointed out that the abrupt changes in the plan during the construction phase, has made the participants to find it complicated to replicate the bunds on their own. He further stated that the previous intention according to the project implementers was to manually construct the TBs in order for community to receive technical knowledge to enable them to replicate for themselves later on.

According to the views of respondents on the TBs, the outputs from it has not paid yet and they feel that it might take longer than 5 years' for them to see the outcome. Depending on the rainfall level received throughout the year (as they frequently face drought cases in the region) to receive positive results and commitment from the community on the new system. Some of the participants' views, especially the ones who consider their income levels not enough to engage in other farm activities, said that they are unlikely to invest more on TBs. This is because they consider it to be labour intensive, especially during the construction period, and the amount of space it occupies in the farms. The only participants who responded that they will or might invest later on, adding more bunds in their farms are the ones who have large farms and their income level is considered to be high.

From the responses of the participants interviewed, they felt that they had received enough training and knowledge on how to go about planting inside the bunds; the major challenge comes to the construction of the structures (bunds). Those who are willing to replicate the TBs in their normal rain-fed farms cannot be able to do so, because they feel that they had not received enough training or technological transfer. The community members are therefore not confident to construct the structures on their own. The agricultural extension officers also share the same views with the community, as they also did not receive any training regarding how to design the TBs; and therefore cannot direct or assist the farmers in the replicatipon of the bunds. Most of the participants therefore expect to receive more training in the near future from the project initiators in order replicate the bunds on their own. They emphasised the need to receive direct assistance and training on the marking, measurements and construction of the TBs. They also said that the project lacks regular visits and monitoring from the project initiators, to see how it is progressing. Some of the respondents therefore suggested the need for assistance and extensive training during the construction phase and having farmer -to - farmer field visits in areas with similar TB projects. One female participant '' stated "*it would have been helpful if the project initiators especially those who handled the technical part at the construction level, had previously given the community instruction manuals on how to*

construct the TBs, so that we can be able to replicate them later on our own without direct assistance".

Some of the respondents from Uvati affirmed that they would have preferred to receive a project for water collection and storage for domestic usage, instead of one that enhances their food security; as water shortage is the major concern in the area. The reason that sparked these responses was that they felt planting inside the TBs depended on the rainfall patterns received in the region, and if it is minimal then they would not get enough crop yields from the structures. The crops planted inside the TBs are the same ones planted in the normal rain-fed farms over the years in the area. In this case, they felt that they were not receiving something quite new to them, especially when it comes crop production, which they could sell later on.

According to the responses from the participants, they have only planted and harvested for two seasons since the project was implemented. Direct observations that were made in the field indicated that quite a number of the bunds were neglected and not planted on. Some of the participants responded that most of the neglected TBs is due to excess water inside, while others were destroyed completely by the heavy rains. The chairwoman of the group participants of Uvati also stated, *"you will find that some of the bunds that are not worked on, is because the owner of the land where the TBs were placed rarely participates in group work tasks assigned to them. So as disciplinary strategy, we all agree as a group not to work on the TBs of the inactive members"*. Responses from the inactive members of the project, justified that their reason for not being actively involved in the project is that their businesses occupy much of their time making it harder for them to participate in the project as a group, or at other times they can send in their workers to work on the TBs on their behalf.

The responses from the participants who don't have TBs in theirs farms, was that they have lost interest in participating in the project (working as a group). Some of them have even resorted in dropping out or not fully engaging in the work input of the project. This is mostly due to the fact that they are waiting for ADCL to fulfill the promise they made of building either TBs or micro-catchments for trees in their farms. One of the respondent who dropped out 'Paul' from the Uvati group stated that *'My patience and interest in participating in the project wore off, as soon as I realized that promises that was initially made by the project initiators was not going to be achieved. Why should I continue working in the bunds that will eventually benefit, the ones who have them in their farms, and for 'us' who don't have any*

won't gain anything in return'. Another respondent who does not own a bund but is a group member also shared her sentiments stating that, *"I do not really understand what criteria they were using on selecting how the TBs were being allocated and constructed in the farms and who gets how many. You find that one or two of the group members have nearly 3-4 bunds in their farms, while others have one and the rest of the participants have none. I feel as if the project implementers were a bit biased on the distribution of the bunds"*.

The provision of seeds is unevenly distributed amongst the group members in different bunds in both areas. According to one of the responses from the interview, it was claimed that the chairlady planted all the necessary supplied seeds from ADCL in her bunds, the leftover are then distributed to the rest of the group members. ADCL who are responsible to supply the seeds for each planting season always delay in doing so. The yields are also not equally shared amongst the members as intended as per the social contract, rather it appears that members who have more bunds on their farms do not share all the harvest with the rest. This has led to some animosity and mistrust amongst the group members.

Figure 5: A neglected non-weeded bund (by author, 2013)

Suggestions and plans

The participants also came up with a few suggestions for the sustainability of the project and its success. They suggested that there should be: construction of ditches to divert the excess water in the TBs to avoid water logging, and building shallow wells to irrigate the crops especially during short rains. They further suggested that project developers' should have

initially used the FfW approach during the construction phase, in order to encourage the community to participate more. The crops planted inside the bunds (sorghum, finger millet, green grams and cow peas) except watermelon are not new to them, as they have been planting the same crops for decades. They therefore suggested if they could plant cash crops like maize and beans, which is not possible to plant in normal rain fed farms because of the low rainfall patterns.

4.3 Summary

The results and observation made from the selected targeted groups indicates that the rainwater-harvesting project is considered as a good initiative by most of the community participants. Even though there are challenges mentioned based on the community's perceptions about the project especially in reference to the approach used by the project developers. This is caused by the lack of motivation from the participants who do not have TBs in their own farms and false promises made by the project developers to construct micro-catchments for trees as a substitution for the bunds. The communication systems between the community participants and project developers on how the project should progress in the future, after they stop receiving external support is vague to the participants. The training and technological transfer was not properly done by the project developers to the participants of the project and the agricultural extension officers in the areas, thus making it hard for the community to replicate the structures themselves. Also from the observations made, it could be observed that most of the TBs have been neglected or not worked on. Some of the responses given by the respondents showed that the excess water logging issue inside the bunds was discouraging them to plant in the bunds, and the erratic rainfall patterns especially during the short rains discourages them to take new risks.

Main Findings of Rainwater-harvesting Systems project	
PERCEPTION	ADOPTION & ACCEPTANCE
TBs good initiative: for water retention on the crops planted inside the bunds	Low motivation: especially from participants who don't own bunds in their farms
Labour intensive: during manual construction	Labour availability-minimal for the ones with low income and unavailability of labour
Land ownership & control of Bunds (Land Tenure): goes to the ones having bunds in their farms after the 2 year project ends	Minimum participation: mainly because of lack of security on ownership and control of bunds from those who don't own any
Mobilization & Sensitization (poorly done by not engaging the community members fully)	Community's priorities or needs were not included

Poor technical know-how: offered to the community & agricultural extension officers by the project implementers	Dissemination of knowledge: affected the replication capacity which was minimal
Unfair distribution: seeds and farm yields planted in the bunds and shared amongst the group members	
Pay off period or benefits from the bunds may take longer to materialize	Income distributions and levels by the community members
Crops planted inside the bunds: considered less valuable	High valued crops preferred to invest further on the bunds

Table 1: Main findings (by author, 2013)

The next section of the chapter discusses some of the issues that arose in the study area, and the implications of the results obtained. Mainly on the issues and implications of the community's perceptions on the community based rainwater harvesting project and its influence on the adoption process by the community, which are examined by making a comparison, relating and connecting it with the data obtained from other research articles or literature with similar topics and theories.

4.4 Discussion

The study shows that it was acknowledged that the technology is beneficial and has a potential to improve or increase crop yields. Though its benefits have not been clearly seen in the 2 years span since it started, there is still a long way for its potential to be seen. The project report indicated that the community participants were highly motived and showed interest in engaging in the project, during the sensitization and mobilization period. In reality, a different picture was portrayed from the responses from the respondents. According to Cleaver's (Cooke& Kothari, 2001:46) statement, was that though the community appears well motivated, dynamic and well organized, severe limitations are presented by an inadequacy of material resources, by the very real structural constraints that impede the functioning of community-based institutions.

The implementation agency specifically ADCL actors, based on their reports claimed that the project had put direct emphasis on involvement of the community in the decisions that will affect their natural resources and future. This included enhancing of existing community mechanisms for decision-making and risk management. Implementation actors believed that

the conservation intervention (*In Situ* rainwater-harvesting structure) had followed a community participatory approach. Nevertheless, results of the study clearly disclose that the involvement of the community in both areas was limited to 'community consultation[7]', where they were rather convinced to implement the rainwater-harvesting technology. Schwartz *et al* (1996:5) says that '*community consultation is a process through which a donor or government agency communicates with and informs communities of its goals and actions'.* According to the respondents' who were the community participants in the project in both Uvati and Kawala sub-locations, they were rather persuaded by an external agent (implementing agency- from ADCL) who influenced them to implement the new rainwater-harvesting technology on their farms. This finding also indicated that the inappropriateness of the intervention strategy by the project implementers affected the perception of the community participants of the project, thus affecting their adoption rate towards the technology. In this case, the absence of genuine participation of community participants in important activities such as involvement in what sort of rainwater harvesting systems they would have preferred and during the planning and implementation process of the project, has therefore lacked the necessary basis and direction to achieving sustainable results.

The selection of primary beneficiaries (local population in the study area) by involving the community was not taken into account as major targeting strategy for the community based project. According to the results in Uvati area, the participants were chosen based on groups that existed before and was already established, this meant leaving out the rest of the community members who felt like participating in the project. According to Pretty and Shah (1997) and Kessler (2006) it is pointed out that involvement of local farmers is a necessary precondition for an effective execution and sustainable utilization of soil and water conservation technologies (Bewket, 2007:414). As for the sustainability objective of the project it is not quite clear if it will be achieved once the project implementers stop offering direct assistance in the areas. Same applies for its adoption and its replication capacity of the technology by the community members.

The major factors that discourages or slows down the adoption process by both the participants of the project and the rest of the community was that the rainwater harvesting technology was not tailored to meet the community's requirements or needs in the area. The

[7] ADB (2001:2) highlighted that participation can take different forms, depending on the breath of stakeholders involved and the depth of their participation. In this case consultation constitutes, information-sharing, listening and learning and joint assessment, and they might be considered as prerequisites for participation.

community's needs based on their views was a preference of having an opportunity to plant cash crops such as maize or beans rather than the drought resistant crops, or water collection structures for their basic consumption. FAO (1991) points out that before a specific technique is selected, there should be considerations given to the social and cultural aspects prevailing in the area of concern, as they are vital and will affect the success or failure of so many projects that did not take into account people's priorities. This could be clearly seen from the findings of the case study area, where the community members were not consulted about their priorities on what sort of community development projects they required the most.

Hobart (1993:1) points out that, development projects often fail to succeed in achieving their goals or purpose, due to the fact that indigenous knowledge is diminished by the western scientific knowledge on development (developers knowledge). The issue of acknowledging local knowledge, has been emphasized by development critics because it has potential in contributing to peoples' material intellectual and general welfare (ibid: 2). The same applies the same to the principal of participatory development in incorporating people's knowledge in programme planning (Cooke& Kothari, 2001:17). If the local knowledge is included by the development organization it can encourage participation of the people in a particular programme or the local people can take control of their own development (Watson, 2009:7). This is evident based on the findings from the study that during the mobilization and sensitization period the people were not consulted about their views or knowledge when it comes to issues related to water or food security in the location, and how they have been initially coping with water shortage.

The project initiators in the two areas poorly organized the technical and institutional support. It is crucial to the farmers in the community to receive technical and institutional support from the project initiators for them to develop their indigenous practices (Biazin *et al*, 2012:148). The lack of support and application methodologies is considered to be one of the negative factors that influence the adoption of rainwater harvesting technologies. Based on Baidu-Forson's study (1999: 238) he indicates that methods to improve adoption of improved soil and water management by the community is to include demonstration of short-term benefits and risk reduction characteristics of the technology and support for dissemination of knowledge on gains from adoption. The finding of the study indicates that the project initiators did not consider demonstrating or conducting a pilot-study, and there was no extensive training on the rainwater harvesting structures. This has created uncertainties from some of the community members towards the rainwater harvesting systems. Risk and

uncertainties affect the farmers' attitude towards innovations and their adoption behavior and have to be analyzed in a participatory way. Low-wealth farmers are often reluctant to adopt technologies because they need stable income especially when the returns to adopt are unclear or will only bear fruits in the future (Drechsel *et al*, 2005:12).

Labour availability is a factor that is likely to influence the adoption of innovations (Foti *et al*, 2008: 318). From the findings, majority of participants considered the rainwater harvesting technology to be a tedious task and labour demanding on the construction part especially if they do not receive any form assistant. According to the views of the participants, the labour requirement for the construction of the TBs was mainly emphasized as a challenge that would affect its adoption. Based on Semgalawe (1998), farmers will reject newly introduced soil and water conservation technologies even when they are aware that adoption of the measures protects and improves productivity of their lands depending on several socioeconomic and institutional factors that can be barriers to technology adoption (Bewet, 2007:410). Direct willingness to participate further in the project and make it effective, came mainly from the ones who own TBs on their farms, while the commitment to the project by those who don't have any was minimal. This corroborates that issues of ownership and control (land), and as pointed out in FAO (1991) land tenure issues can have a variety of influence on water harvesting projects. Lack of tenure may make people to be reluctant to invest in water harvesting structures on land that they don't formally own (ibid. :). Foti *et al* (2008: 317) also pointed out that land ownership is likely to influence adoption if the investments are tied to the land and the benefits of the investment are long term. The findings proves that it might be problematic to convince the participants of the project who don't have the bunds, to work progressively on the farms that they may not benefit from later on.

FAO (1991) points out that it is difficult to generalize about the socio-economic factors concerning TBs, as there are various dissimilarities found in different circumstances. This was mentioned previously in the document, giving examples of similar structures used traditionally in Sudan, where the communities construct the structures by hand without assistance from agency and evidently they perform better. In the case of the Mwingi District, it is seen from the findings that the water harvesting structures were mechanically constructed and the whole technology was new to them. This therefore could be a major contributing factor in affecting the adoption rates of the community members. FAO (1991) illustrates that TBs have been installed in other places under project using FfW or even machinery-like in

the case of the study area. When this has been done without any significant beneficiary commitment, the bunds have been quickly abandoned. The amount of workload required for the construction usually requires organized labour or machinery, which is beyond the scope of the individual farmer.

According to the findings and suggestions made, most of the community participants would have preferred high valued crops like 'maize and beans' to be planted in the bunds, rather than the drought tolerant crops (sorghum, millet, cow peas and green grams) as they usually plant them in their normal rain-fed farms. Based on Foti *et al* (2008: 318) high valued crops are likely to encourage farmers to invest in soil fertility and water management technologies as they are seen to offer attractive returns to such investments. The growing of drought tolerant crops is likely to have a negative influence on the adoption of techniques due to the low marginal production of such investments. The issue of farm size also plays a major role in the adoption process, as seen from the findings where the participants with small land parcels are unlikely to replicate more TBs in the farms. Feder *et al* (1985) indicates that given the uncertainty, the fixed transactions, and information costs associated with innovations, there may be a critical lower limit of farm size, which prevents smaller farms from adopting (Foti *et al*, 2008:319).

Cleaver (Cooke& Kothari, 2001:47) points out that a participatory approach can be criticized for its inadequate model of individual action and the links between this and the social action. Recognition of the varying livelihoods, motivations and impacts of development on individuals over time has been little. In the findings it is clearly seen that the project initiators paid little or no attention on the social differences and roles of the community members, and this has influenced the adoption rate of the project.

The results and discussions of the study therefore has given insights on how the implementation process of the project has affected the community's perceptions on the rainwater harvesting project, and its influence on the adoption process by the community. By investigating the perceptions of the community towards the project and its influence and inferences on its adoption in comparison with empirical and theoretical studies done with others, it has indicated that the perception of the community can have positive or negative effect on its adoption, thus challenging its sustainability.

5.0 CONCLUSION AND RECOMMENDATION

5.1 Introduction

The research study set out to explore and give insights on the community's perception and adoption to rainwater-harvesting technologies that was a community-based project in two sub-locations in Mwingi District in Kenya. The study was steered by the following research questions: first, why and how was the project formulated and implemented by the project initiators? Secondly, does the implementation process affect the community's perception on the rainwater harvesting project? Thirdly, how is the rainwater harvesting project perceived by its recipients? Lastly, does the community's perception influence the adoption process towards the rainwater-harvesting project?

This section of the paper presents conclusions based on the findings and subsequent discussions made. Last section ends with presenting recommendations for further research on rainwater-harvesting systems. It also provides additional information for policy makers and development project planners during the design and implementation of rainwater-harvesting technologies.

5.2 Conclusion

This study explores the community's perception and adoption of rainwater harvesting technologies in a project where the implementers claimed to have used community based participatory approach in 'Uvati and Kawala' in Mwingi District. The study indicated that the intervention and approach used affected the perception of the community regarding the newly introduced project. It was also not tailored to the community's priorities and needs in the area, thus slowing the adoption process of the new technology. The targeting strategy for the primary beneficiaries of the project was not clearly done; indicated that there was lack of proper individual socio-economic background check that affected the selection of the participants in the community. The involvement of the community in the decision making process was not present but it was rather persuaded by the implementation agency to implement the project.

The technical and institutional support by the project initiators gave to the community members was disorganized. The finding indicated that there was lack of technical know-how and extensive training given to the project participants and the agricultural extension officers, thus affecting the replication of the technology. The dissemination of information and future

plans for the sustainability of the project was not clearly formulated. This therefore proved that the support and application methodologies used by the project initiators, created uncertainties from the community members, affecting their perception that in turn negatively influenced the adoption process of the project.

Though the technology was acknowledged by the community to be beneficial in improving crop yields, thus enhancing food security issues, and learning a great deal about alternatives to curb the problem of drought cases in the area. The participants of the project still view that the payback period of investing in the project might take long to yield results. This affects the adoption process, making it harder for the community members to replicate more of the structures. The community members also perceived the construction of the structures to be tedious and labour demanding which could be beyond the scope of some individual farmers to manage the workload, therefore affecting the adoption of the technology. In the issue of land ownership and control, it is clear that it plays a role in influencing the adoption of the technology, as most farm investment are tied on the land and so are its benefits.

The study therefore indicated that quite a number of the community members have different views about the technology (TBs) and its advantages, that in turn influenced the adoption rate of the rainwater harvesting project. For the project initiators to have developed an appropriate rainwater harvesting system project, they should have based there planning on lessons learned from the shortcomings of previous project, and also ideally evolve from the experience of traditional techniques if they exist (FAO, 1991). The shortcomings mentioned in the findings of the study are clearly similar to previous similar agricultural innovative or technological projects being done before. This has therefore proven that the project initiators clearly disregarded and did not look into those shortcomings of similar innovative projects.

The outcome of the case study sheds some light that the decision or influence to adopt or to use rainwater harvesting system is dependent on the implementation process of the project, the community perception about it, and to better understand their choices in making the decisions to adopt it. Indicating therefore that it is important to know how farmers perceive technologies for better understanding of their choices in decision of adoption or not (Chi & Yamanda, 2002:94).

5.3 Recommendations

For successful implementation of community-based projects, especially when it comes to new innovations and better adoption rate by the community benefiting from it, the following recommendations are suggested:

- Importance of project initiators to include in the beginning people's priorities and needs, and also listen to their different views in relations to development issues. Including also land tenure, gender relations, power and income inequalities in and between households;
- The benefits or potential of the new agricultural innovation systems (soil and water conservation technology) should be made clear to the community from the start. As such new technologies often require demonstration to the community in order for them to understand and envisage its effectiveness;
- Proper communication and support systems from the project initiators should be offered to community participants;
- Design intervention and approaches should be handled differently based on the areas needs or requirements;
- Technical know-how should be done through extensive training being offered to both the community members and the agricultural officers in the area;
- Promotion of awareness and motivation among the community members with regard to the new innovation project (rainwater-harvesting project) and how to achieve them should be crucial.

References

Appropriate Development Consultants Limited (2011a) Kawala Social Dialogue and Engineering Design Report, Nairobi-Kenya

Appropriate Development Consultants Limited (2011b) Uvati Social Dialogue and Engineering Design Report, Nairobi-Kenya

Appropriate Development Consultants Limited (2011c) Kawala Construction Report, Nairobi-Kenya

Appropriate Development Consultants Limited (2011d) Uvati Constuction Report, Nairobi-Kenya

African Development Bank-AfDB (2012) Assessment of Best Practises and Experience in Water Harvesting: Rainwater Harvesting Handbook, Retrieved on 15th of September 2012, < http://www.pseau.org/outils/ouvrages/bafd_rainwater_harvesting_handbook.pdf>

Babbie, E (1998) The Practice of Social Research, 8th edition, Belmont,CA, Wadsworth Publishing C

Baidu-Forson, J (1999) Factors Influencing Adoption of Land-Enhancing Technology in the Sahel: Lessons from a Case Study in Niger, *Agricultural Economics*, Vol.22, Pp. 231-239

Bekele S & Merrey D.J (2005) Assessment of Small-Scale Irrigation and Water Harvesting in Ethiopian Agricultural Development, Workshop on Achievement, and Priorities in Irrigation Water Management Research and Technology Transfer in Ethiopia with Particular reference to Amhara Region, 5-7 December 2005, Bahirdar, Ethopia, Pp.12, Retrieved on 14th September 2012, <http://www.asareca.org/swmnet/maputo/maputopapers/IWMI-Seleshi%20%26%20Merrey-Assessment%20of%20Small%20Scale%20Irrigation%20and%20WH%20in%20Ethiopia.pdf>

Berg,B (1989) Qualitative Research Methods for the Social Sciences, Massachusetts: Allyn and Bacon.

Bernard, R.H (2006) Research Methods in Cultural Anthropology, Oxford: AltaMira

Bewket, W (2007) Soil and Water Conservation Intervention with Conventional Technologies in Northwestern Highlands of Ethiopia: Acceptance and adoption by farmers, Land Use Policy, Vol.24, Pp. 404-416.

Biazin, B, Sterk, G., Temesgen, M., Abdulkedir, A & Stroosnijder, L (2012) Rainwater harvesting and management in rainfed agricultural systesms in sub-Saharan Africa-A review, *Physics and Chemistry of the Earth*, Vol.47-48, Pp.139-151.

Chambers, R. (1994) The Origins and Practice of participatory Rural Appraisal, *World Development*, Vol. 22, No. 9, pp. 953-68.

Chi, T.T.N & Yamada, R (2002) Factors affecting farmers' adoption to technologies in farming system: A case study in OMon district, Can Tho province, Mekong Delta, Omon rice, Vol.10, Pp.94-100

Cooke, B. & Kothari, U. (2001) (eds) Participation - the new tyranny? London-Zed Books

Drechsel, P., Olaleye, A., Adeoti, A., Thiombiano, L., Barry, B., Vohland, K (2005) Adoption Driver and Constraints of Resource Conservation Technologies in Sub-Saharan Africa, Pp. 1-21, Retrieved on 30th December 2012, <http://westafrica.iwmi.org/Data/Sites/17/Documents/PDFs/AdoptionConstraints-Overview.pdf>

Ellis-Jones, J & Tengberg, A (2000) The impact of indigenous soil and water conservation practices on soil productivity: Examples from Kenya, Tanzania and Uganda, Land Degradation and Development, Vol.11, Pp.19-36

Escobar, A (1995) Encountering Development, The Making and Unmaking of the Third World, New Jersey- Princeton University press

Evaluation Briefs (2008*)* Data Collection Methods for Program Evaluation: Observation, No.16, December 2008, Retrieved on 4th January 2013, <http://www.cdc.gov/healthyyouth/evaluation/pdf/brief16.pdf>

FAO (2007) Communication and Sustainable Development, Selected papers from the 9th UN roundtable on communication for development, Research and Extension Division-Natural Resource Management and Environmental Department, Rome-Italy

FAO(1991) A Manual for the Design and Construction of Water Harvesting Schemes for Plant Production, Water Harvesting (AGL/MISC/17/91), FAO corporate document repository, Natural Resources Management and Environment Department, Rome-Italy, Retrived on 13th May 2013, <http://www.fao.org/docrep/U3160E/U3160E00.htm>

Foti, R., Gadzirayi, C& Mutandwa, E (2008) The Adoption of Selected Soil, Fertility and Water Management Technologies in Semi-Arid Zimbabwe: An Application of the Tobit Model, *Journal of Sustainable Development in Africa*, Vol.10, No.3, Pp.315-330

German Agro Action (2006) Improved Rural Drinking Water Supply for ASAL Mwinigi District, Eastern Kenya, Project Proposal to the delegation of the European Union to Kenya.

Hickey, S & Mohan, G (2004) Participation: from the tyranny to transformation? Exploring new approaches to participation in development, London- Zed books

Hobart, M(1993) An Anthropological Critique of Development: The Growth and Ignorance, London-Routledge

Kaloi E., Tayebwa B & Bashaasha B (2005) Food Security Status of Households in Mwingi District, Kenya, African Crop Science Conference Proceedings, African Crop Science Society, Vol.7, Pp.867-873

Leach, M & Mearns, R (1996) The Lie of the Land, Challenging received wisdom on the African Environment, The International African Institute , London-James Curry, African Issues

Mansuri, G & Rao, V (2004) Community-Based and Driven Development: A Critical Review, The World Bank Rsearch Observer, Vol.19, No.1, Pp.1-39

Marvasti, A (2004) Qualitative Research in Sociology: An Introduction, London-Sage Publications

Mathbor, G.M (2008) Effective Community Participation in Coastal Development, Lyceum Books

Mikkelsen, B (2005) Methods for Development Work and Research, A New guide for Practitioners (2nd Edition), New Dehli- India, Sage Publications

Munck, R & O'Hearn, D (1999) Critical Development Theory: Contributions to a New Paradigm, London- Zed books

Napier, T.L (1991) Factors affecting acceptance and continued use of soil conservation practises in developing societies: a diffusion perspective, Agriculture, Ecosystems and Environment, Vol.36, Pp.121-140.

Ngigi S.N (2003) what is the limit of up-scaling rainwater harvesting in a river basin? Physics and Chemistry of the Earth, Vol.28, Pp. 943-958

Nijhof S., Jantowski B., Meerman R & Schoemaker A (2010) Rainwater Harvesting in Challenging Environments: Towards Institutional Frameworks for Sustainable Domestic Water Supply, Waterlines, July 2010, Vol.29, No.3, Pp.209-219

Oduor A.R & Gadain H.M (2007) Potential of Rainwater Harvesting in Somalia, A planning, Design, Implementation and Monitoring Framework, Technical Report NoW-09, FAO-SWALIM, Nairobi-Kenya, Retrieved on 28th December 2012, <http://www.faoswalim.org/downloads/Pages%20from%20W-09%20Potential%20of%20Rain%20Water%20Harvesting%20in%20Somalia.pdf>

Ostrom, E., Lamm, W & Lee, M (1994) The performance of self-governing irrigation systems in Nepal, Human Systems Managment, Vol.13, No.3, Pp.197-207

Oxfam (2006) Delivering the Agenda, Addressing chronic under-development in Kenya's arid lands, Oxfam International Briefing Paper, May 2006, No.88, Retrieved on January 30th 2013, <http://www.internal-displacement.org/8025708F004CE90B/(httpDocuments)/034871332D9C062CC12572420055C8B1/$file/bp88_kenya.pdf>

Ramboll Natura AB (2010) Providing Assistance for Design and Management of Appropriate Water Harvesting Technologies in the ASALs of Kenya, Final Application, Nordic Climate Facility (NEFCO)- Nordic Development Fund, Stockholm, Sweden.

Rockström, J (2000) Water resources management in smallholder farms in Eastern and Southern Africa: An overview. *Physics and Chemistry of the Earth*,Vol.25, No 3, Pp.278-288.

Rockström, J (2002) Potential of Rainwater Harvesting to reduce pressure of Freshwater Resources, International Water Conference, Hanoi-Vietnam, October 14th -16th 2002, Dialogue on Water , Food and Environment, Retrieved on 26th January 2013, << http://www.bvsde.paho.org/bvsacd/dialogo/rock.pdf>>

Roger, E.M (2003) Diffusion of Innovations, 5th Ed, New York, Free Press

Short rains food security report (2012) Mwingi District 2012-Short rains food security report, 6th-10th February 2012

Singh N., Jacks G & Bhattacharya P (2005) Women and community water supply programmes: An analysis from a socio-cultural perspective, Natural Resource Forum, Vol.29, Pp.213-223

Stockholm Environmental Institute-SEI (2009) Rainwater Harvesting: A life for Human well-being, A report prepared for UNEP by SEI, United Nations Environmental Programme

Schwatz, N., Deruyttere.A., Huntley, S., Stokich.S & Kottak, C (1996) Community Consultation, Sustainable Development and the Inter-American Development Bank, A concept paper, March 26th 1996, No-IND-101, Washington D.C

Tesfay, N.H (2008) Rainwater Harvesting in Ethopia: Technical and socio-economic potentials and constraints for adoption in Wukro District, Master thesis research of Agris Mundus Master course 2 year training programme in agricultural development and management of natural resources, Wageningen University & SupAgro Montpellier, Retrieved on 24th January 2013,

Trochim, W.M (2006) The Research Methods Knowledge Base, 2nd Edition, Version as of October 20th 2006, Internet www page, Retrieved on 5th November 2012<http://www.socialresearchmethods.net/kb/>

Tuckman, B.W (1999) Conducting Educational Research, Orlando-Harcourt Brace College Publishers

UNHCR (2008) A community-based approach in UNHCR operations, 1st Edition, Geneva-Switzerland, Retrieved on 28th December 2012, <http://www.unhcr.org/refworld/pdfid/47da54722.pdf>

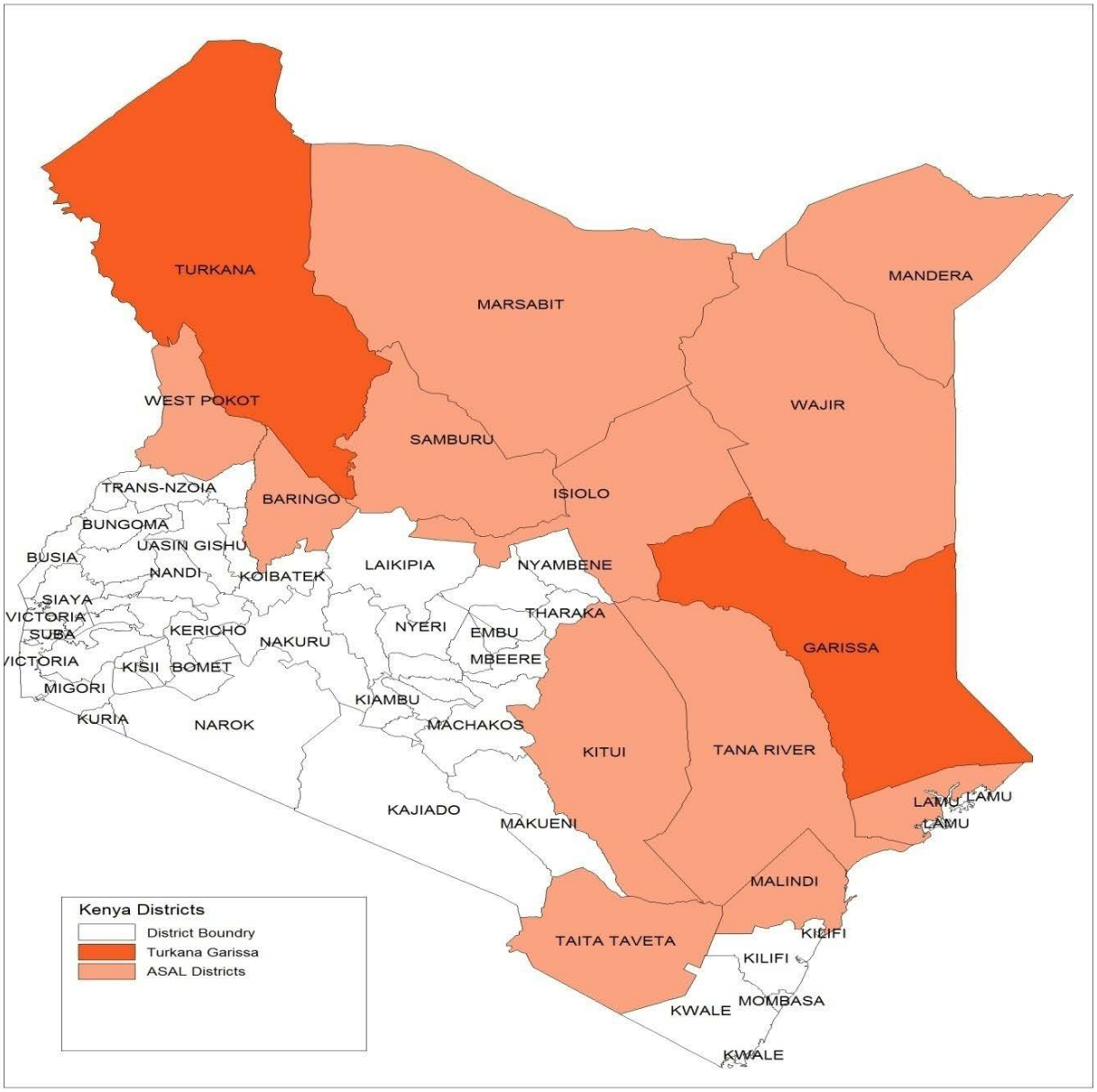
Vohland, K & Barry, B (2009) A Review of In situ rainwater harvesting (RWH) practices modifying landscape functions in African drylands, Agricultural Ecosystems and Environment, Vol.131, Pp.119-127

Watson, E.E (2009) Living Terraces in Ethopia: Konso Landscape, Culture & Development, Woodbridge and New York-James Currey, Eastern Africa Series, 242 pages

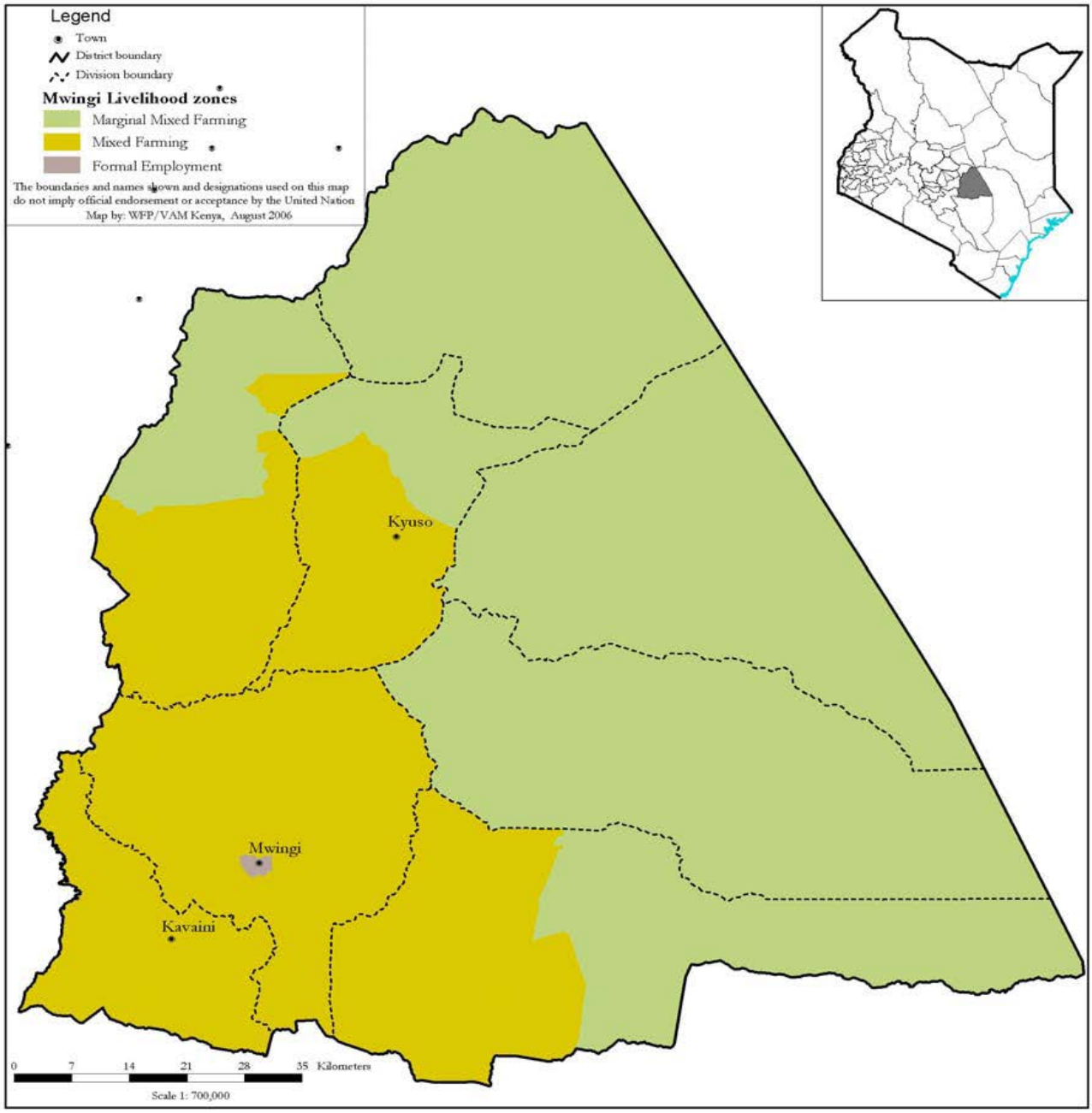
Wejnert, B (2002) Integrating models of diffusion of innovation: A conceptual framework, Annual review of sociology, Vol.28, Pp.297-326

APPENDIX

Appendix 1: Map showing the ASALs Districts in Kenya



Appendix 2: Map showing Mwingi District and their livelihood zones



Source: Mwingi district- (short rains and food security report, 2012)

Appendix 3: Semi-Structured questions (Interview guide used in both Interviews and Focus Group Discussions for both participants and non-participants of the project)

1. How did the community deal with droughts in the past?
2. In the local area, how was the water situation before the rainwater-harvesting project was implemented?
3. Did you know anything about the rainwater harvesting before it was implemented in the area?
4. How did the water harvesting idea arise in the community? And how was it done?
5. Who decided it was a good idea to try the new technology? And who decided how it will be implemented?
6. What role did you play in the implementation process?
7. How is the rainwater-harvesting system perceived?
8. Do you participant in the rainwater-harvesting project?
9. What was the motivation to participate in the project?
10. Did the community decide the location for the trapezoidal bunds? And what criteria were used in locating the bunds in various farms?
11. How is the land tenure system? And does it affect with the community-based project when it comes to control and ownership?
12. How did the community/ participants organize themselves? And how was the group formation done?
13. In what way is the division of task done or shared between the participants of the project?
14. Are there people who dropped out from the project? And why did they drop out of it?
15. What are your views based on the work input in the structures?
16. Has the projects outputs pay off? And in which situations does it pay off?
17. What are the expectations of the rainwater-harvesting project?
18. What challenges were faced during the implementation of the project to now?
19. How were some of the challenges encountered solved or think should be solved?
20. Who supplies and distributes the seeds to be planted inside the bunds?
21. How are the crops harvested from the bunds used amongst the participants?
22. How differently would they have approached the issue of rainwater-harvesting?
23. How will the projected be managed once the project comes to an end (external inputs? Are there changes that will be made on the rainwater harvesting systems?
24. What are your thoughts on the crops planted inside the bunds? Were there any preferential crops rather than the one planted in the bunds?
25. Are there plans on building or replicating similar structures in the farm?
26. Are there plans or intentions to maintain the structures after the project is finished?
27. How can the project be made sustainable in the future?
28. How is the future of the bunds seen? (Each family has a bund? Landscape?

Appendix 4: Interview guide with the Agricultural extension officers

1. What duties do you carry out in the area? And for how long have you worked in the area?
2. In the local area, how was the water situation before the rainwater-harvesting project was implemented?
3. Did you know anything about the rainwater-harvesting before it was implemented in the area?
4. How did the project implementers come in contract with the you?
5. How did the water harvesting idea arise in the community? And how was it done?
6. Who decided it was a good idea to try the new technology? And who decided how it will be implemented?
7. What role did the community have in the implementation process?
8. What are your general thoughts on the rainwater-harvesting project? Are there strengths or drawbacks of the implemented methods?
9. Do you perceive the implemented system in the areas (Uvati and Kawala) as sustainable or reliable in times of seasonal discrepancies?
10. What have you learned about the rainwater-harvesting structures introduced in the areas?