DETERMINANTS OF HYDROPONIC TECHNOLOGY ADOPTION IN THE IMPLEMENTATION OF DAIRY FARMING PROJECTS IN KAJIADO COUNTY, KENYA

BY

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DECLARATION AND APPROVAL

Declaration by Candidate

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DEDICATION

This Research Thesis is dedicated to Edmund wafula, Ann Abigael Awuor, Stephen Clement Ogam, Sophia Merab Nafuna and all those who gave me moral support and assistance.

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ABSTRACT

Adoption of Hydroponic Technology has a history spanning over 50 years. However, it is a relatively new fodder production technology in the developing world especially Kenya. The innovation aims at overcoming fodder sourcing challenges faced in the dairy industry. This study examined the determinants of Hydroponic Technology adoption in the implementation of dairy farming projects in Kajiado County, Kenya. The study objectives were to: examine the influence of dairy farmers knowledge and personal characteristics on adoption of hydroponic technology in the implementation of dairy farming projects; establish the influence of persuasion on adoption of hydroponic technology in the implementation of dairy farming projects; examine the extent to which decision making stage influence adoption of hydroponic technology in the implementation of dairy farming projects and examine the extent to which confirmation stage enhances adoption of hydroponic technology in the implementation of dairy farming projects. This study was guided by the diffusion of innovation theory. The research adopted Quantitative approach. The target population was 368 zero grazing dairy farmers and a sample of 110 respondents was selected using simple random sampling technique. Questionnaires were used for data collection. Data was analyzed using correlation analysis and Regression analysis and presented using tables, charts, graphs and diagrams. The study established that the more the number of trainings on hydroponic technology attended by a farmer, higher levels of education, farmers' knowledge of Government policies on hydroponic technology, and setting target on production of hydroponic fodder increased the adoption of hydroponic technology. On the other hand, environmental changes; size of land devoted to hydroponic technology; and how often farmers produce hydroponic fodder affected the adoption of hydroponic technology. The study concluded that knowledge and personal characteristics influenced hydroponic technology adoption in the implementation of dairy farming projects. The study recommended that in order for dairy farming to be implemented successfully in Kajiado County, there is need for increased training on hydroponic technology, enhanced farmer education; enlightenment of farmers on Government policies on hydroponic technology; closer check on the environment to mitigate negative environmental changes; training on production of hydroponic fodder and devise strategies that support subsidies prices on materials. The study finally recommended adoption of hydroponic technology by small-scale farmers irrespective of their farm size. The implications of the study findings suggests that further studies should focus on other livestock, cost benefit analysis, preservation and storage of hydroponic fodder.

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

LIST OF ABBREVIATIONS AND ACRONYMS

AKEFEMA	Association of the Kenya Feed Manufacturers
DOI	Diffusion of Innovation Theory
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
HT	Hydroponic Technology
KCC	Kenya Cooperative Creameries
MoLD	Ministry of Livestock Development
NDDP	National Dairy Development Project
NDEFRA	Netherlands Department of Environment, Food and Rural Affairs
MoALF	Ministry of Agriculture Livestock and Fisheries
VAT	Value Added Tax

OPERATIONAL DEFINITION OF TERMS

- **Implementation** refers to the process of adopting the hydroponic technology by producing hydroponic fodder.
- **Adoption** refers to the decision to make use of a new innovation (hydroponic technology).
- **Dairy Farming Projects** refers to a system of agriculture for management of dairy cows to ensure maximum milk production.
- **Hydroponics Technology** refers to a system of agriculture whereby plants are grown without the use of soil, the technology is used for production of fodder.
- **Determinants** refers to factors which enables adoption of Hydroponic Technology.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter presents the background of the study, statement of the problem, study objectives, hypothesis, significance, scope and delimitation and limitation of the study.

1.1 Background to the Study

The agricultural sector in developing countries is faced with challenges due to market liberalization and structural adjustments. To seize new market opportunities, farmers need to innovate to become more efficient producers and effective entrepreneurs. The innovative farmers need new technologies and information on how to access and manage innovation, as well as better support services for the delivery of inputs, knowledge and better infrastructure for delivering produce to the market (Schreiber, 2002).

In Africa, milk producing animals have been domesticated for thousands of years. Initially, they were part of the subsistence farming that nomads engaged in. As the community moved about the country, their animals accompanied them. Protecting and feeding the animals was part of the symbiotic relationship between the animals and the herders. The dairy industry has been growing gradually in Africa, traditional systems have dominated milk production for several years and still supply considerable amounts of milk today accounting for above 90% of dairy ruminant population in Sub-Saharan Africa (Olaloku and Debre, 1992).

The livestock sector has been given attention by the Government, than ever before. This is an opportunity for professionals and concerned stake holders to break through a number of challenges within the sector and contribute best efforts to the country's growth and transformation plan. Among the aforementioned problems, feed scarcity is often cited as the primary and major constraint to livestock productivity in crop-livestock mixed farming systems (Legese *et al.*, 2010).

Proper feeding and good balanced rations remains the cornerstone of a successful dairy operation. Milk yield per cow and the cost of feed to produce milk have been the greatest influence on profitability in dairy operation. If dairy farming is to be successful, the dairymen must continually strive to adopt technologies that allow the greatest output of milk at the most economical cost. Successful dairying in the future will depend on high levels of milk production, culling for low production, controlling feed costs, and using good replacements (Staal and Pratt, 2010).

1.1.1 Hydroponics Technology

Hydroponics Technology also known as soilless culture, has been used for thousands of years, dating back to the hanging gardens of Babylon and the floating gardens of the Aztecs in Mexico (Resh, 2012). The first modern use of Hydroponics Technology was in the early 1930's by William Gericke from the University of California. Gericke used a water culture method to grow plants such as tomatoes, beets, carrots, potatoes, fruits, flowers, and more.

The hydroponic systems is used in areas with non-arable soil such as Mexico and the Middle East (Resh, 2012). In France, the Government has sponsored research to facilitate performance of numerous experiments with hydroponic cultivation. Hydroponic methods consistently outperform soil cultivation with faster growth, higher yields and better quality produce. Holland, is recognized as world leaders in commercial hydroponics, they produce some of the best hydroponic crops, Hydroponically grown Dutch flowers are sold in auctions then flown worldwide to meet the global demand (Netherlands Department of Environment, Food and Rural Affairs, NDEFRA, 2001).

The Dutch hydroponic industry is supported by the government on research, training and information. The industry enjoys efficient commercial infrastructure which include provision of production inputs, transport, cluster-based production and marketing systems (Carruthers, 2002) The Conversion of greenhouses to hydroponic systems was necessitated by widespread soil depletion, a build-up of soil disease, salinisation, high water tables and favourable economic returns (Hanger, 1993).

Canada has embraced commercial hydroponic production, expanding in total area from as little as 100ha in 1987 to 1,574ha (3,886 acres) in 2001. Hydroponics is the most popular method of growing vegetables in Canada because it is less labour intensive way to manage larger farms size, controlling inputs, pest and diseases. It eliminates the need for soil fumigants and can increase yields of vegetables by up to 100%. (Carruthers, 2002)

New Zealand pastoral farming system uses the Hydroponic Fodder production in a number of different livestock systems. Hydroponic fodder production systems produce large quantities of green, palatable livestock feed. However, the research reviewed and analysis undertaken indicates that there are challenges associated with the production and economic competitiveness of hydroponic fodder relative to alternative feed sources. The costs associated with the establishment and daily operation of a fodder shed, coupled with drymatter yield losses during the sprouting make hydroponic fodder an expensive feed source. The lack of concrete evidence around animal performance on hydroponic fodder limit the adoption of hydroponic fodder production systems. (The New Zealand Merino Company, 2011)

In Kenya, Hydroponic Technology is a new fodder growing technology, with majority of the over 2 million Kenyan livestock farmers yet to try it. The challenge facing the hydroponic technology adoption in Kenyan, is that it has not been embraced in growth of livestock feeds. To most livestock farmers there is not enough sensitization on the importance of adoption of hydroponic technology and access to the raw material for growth of livestock feeds. This is attributed to lack of enough extensional officers who are responsible for dissemination of information to farmers (PanACC, 2014).

The growing of fodder using Hydroponic Technology is a new concept to the world. Although hydroponic Technology has been in use for over 50 years to supply a wide range of livestock fodder types for different purposes in varying living environments (Agrotek Greenhouse fodder systems, 2002). Hydroponically grown fodder is considered as a sprouted forage, which provide a variety of highly nutritive food with important mineral and vitamin contents to livestock and birds (Harris, 1973).

Hydroponic technology can play a major role in dairy production. This is because fodder production using hydroponic technology can be done anywhere as long as traditional constraints are abated by improvements in technology (Mosnier and Wiek, 2010). The adoption of this technique can easily enable production of fresh forage from oats, barley, wheat and other grains. Therefore, with this technique in fodder production, dairy feeds quality, nutrition, dairy animal health, meat and milk production can improve tremendously. Hydroponic technology is an economical and income generation determinant among dairy farmers (Medola, 2007), what farmers gain from adoption of hydroponic technology has a direct influence on the poor households by raising their income while indirectly raising employment and wage rates on landless labourers.

The benefits that a dairy farmer derives from the adoption of hydroponic technology play a role in the dairy farmer's decision to adopt the technology. The beneficial factors will motivate the dairy farmers to participate in dairy farming, more so that it contributes to household welfare (Lwelamira *et al.*, 2010). Therefore, if the hydroponic technology introduced will increase the levels of income, farmers will be more than willing to take it up. This is based on the assumption that wealthy dairy farmers have more access to resources and are willing to invest more because they are able to manage the risk that they would be under if the technology is adopted (Doss, 2003).

Cooperatives Society are economic and social actors in hydroponic technology advancements. The dairy farmers benefit from cooperative equipments and loans and also, learn about hydroponic technology. They facilitate the dairy farmer with capital and inputs in terms of subsidies to enable them adopt hydroponic technology, the cooperative society out- reach programmes meet personal as well as community goals of the dairy farmers. (Byerlee and Polanco, 1986) observe that "farmers are themselves the innovation through the contacts they make with each other". The cooperatives societies provide ready market for milk as they own most of the milk processors. The dairy farmers are able to sell their surplus milk and are assured of income at the end of the month, this contributes to improving the quality of their livehood.

1.1.2 Dairy Farming in Kenya

Dairy farming is an economic activities undertaken by most dairy farmers in Kenya. The commercial dairy industry in Kenya dates back to 1920 when white settlers imported purebred dairy cattle from Europe. The commercial dairy farming developed in large-scale and small scale diary farming. The large-scale dairying was on farms operated by Europeans on the Kenyan Highlands and the smallholdings in 1950's operated by Africans.

Since independence, dairying has been transformed into a predominantly smallholder activity in volume of production and sales. Small scale dairy farmers are more in number than the largescale farmers. Regardless of the number and quality of cows a farmer has, farmers produce milk and sell it to either fellow farmers, households or to the established milk processing firms, albeit in small quantities.

The government's policy paper on dairy sector development MoALF (Sessional Paper No. 4 of 1981 and revised Sessional Paper No. 5 of 2013) objectives was to maintain self sufficiency in milk production, increase productivity through measures that facilitate access to appropriate technologies and inputs, to improve processing and marketing through policies that encourage competition, efficiency and self sustainability.

The National dairy herd is estimated at 3 million grade cattle and about 10 million Zebu cattle. Dairying in the country is concentrated in the Rift Valley Province with 48% of all the exotic dairy cattle, Central Province (31%), Nyanza Province (15%), Eastern Province (5%) and Western Province (4%) (MoALF, 2013). The total National milk production was estimated at about 4 billion liters of milk in 2012, with consumption demand estimated to rise by 3 to 4% driven by increases in population, urbanization and income. It is anticipated that by the year 2018, the consumption would rise to 4.7 billion liters. Kenya produces about 5.2 billion liters which is envisaged to reach 12 billion liters by vision 2030. The Government has projected an increase in milk production growing by 4.5 to 5 % annually for the next ten years. Per capita consumption of milk recommended is 220 liters against Kenya's per capita consumption of 100 liters a shortfall of 120 liters (FAO, 2011).

According to (MoALF, 2013) on the National Dairy Development Policy paper no 5 of 2013 projects that average productivity per cow in Kenya is estimated to be 7-8 liters per day, and average production per lactation is between 2,000 liters and 2,400 litres. The figures are low compared to the leading global productivity per cow of 40 litres per day and up to 14,000 litres per lactation. The low productivity is attributed to inadequate and inefficient breeding services, inefficient dairy research, poor animal husbandry, inadequate extension and advisory services, inadequate feeding, low quality feeds, environmental, socio-economic/cultural factors, ineffective disease control and veterinary services, poor infrastructure, high cost inputs/labor among others. Poor access to output markets also contributes to low incentive to increase production, and hence low demand for the above requisite inputs (MoALF, 2013).

According to FAO report on the Dairy Development in Kenya (FAO, 2011), the possible negative environmental impacts of promoting dairy development in Kenya are overgrazing of natural pastures, and pollution by cooling and processing plants. The Dairy Master Plan (MoLD, 2010) had raised the issue of overgrazing as a concern to dairy farming but stakeholders paid little attention. The main concern arose from the fact that as the pressure on land increases, there would be further subdivision of the already small parcels of land in the highly populated areas. This is particularly worrying as each new household is likely to own cows regardless of the size of its parcel of land.

The FAO report (FAO,2011), however, indicated that in the context of Kenya, development of dairying would not entail overgrazing because the additional feed would not be obtained from the areas already over-exploited; instead, farmers would tend to rely more on grown fodder and increased use of concentrates.The other concerns relating to environmental degradation are movement of communities from high potential areas to marginal lands, as a result of pressure on available land without consideration to the land's carrying capacity due to rural urban migration. The immigrants tend to move with their practices including the keeping of dairy cattle. The spread of such practices, to less productive areas of the country where less land use intensification occurs and grazing systems dominate, makes disease challenges and land degradation a risk.

(MoALF, 2013) Proper feeding is paramount for dairy productivity because feeding alone accounts for about 70 percent of the production costs. In Kenya, dairy is highly dependent on rain fed production of forages whose production fluctuates with seasons. During the rainy season, the quantity of forage produced supersedes the demand some of which goes to waste, while during the dry periods there are severe shortages of feed and available fodders are of very poor nutritive quality (low in crude protein (CP) and high in fibre), which results in low voluntary intake by ruminants and low digestibility. Low pasture quality and limited availability of water is reflected in low production and reproductive performance, as well as slow growth, in ruminants especially when grazing is the main feed (Oteino, 1992) As a result of this, milk production fluctuates over the seasons, meat and other products from such poorly fed animals fetch low prices in the market. However, the use of hydroponic technology would be able to produce nutritious green fodder with superior nutritive value all year round, grown for just a few days and requires a far less space (PanACC, 2014).

Most dairy farmers are only able to access poor types of forage and make no effort to conserve forages during times of excess (MoALF, 2013). Inadequate enforcement and monitoring of animal feed supplements quality has led to the proliferation of low quality feeds hence some farmers move away from commercially manufactured feed supplements. (MoALF, 2013).

The main constraint to adequate dairy feeding is the low quality and inadequate quantity of the available feeds. High prices and falling quality standards of feed supplements has continued to be a problem in the development of the dairy sector. Use of maize as an ingredient in animal feed manufacturing presents stiff competition between man and livestock since Maize is a staple food in Kenya. This makes it unavailable and expensive for feed industry. Unavailability of local sources of vitamins, amino acids, macro and micronutrients also hinders production of low priced feeds. The recent imposition of VAT on supplement feeds, and minerals has further compounded the challenges of quality feeding of dairy animals. (MoALF, 2013)

Association of Kenya Feed Manufacturers (AKEFEMA) was formed to foster selfregulation amongst commercial feed millers. However, it has not been effective. (MoALF, 2013). According to the Association of the Kenya Feed Manufacturers (AKEFEMA) (Koigi, 2014) livestock sub sector relies heavily on manufactured animal feeds to meet pasture demands during dry season. In 1990, it was estimated that the livestock industry required 300000 tonnes of feed mixtures and supplements. With the country unable to produce, it had to import some of the raw materials like fishmeal, cerealbran etc.

The production had a marked up growth and by the year 2000, the manufactured feed industry produced approximately 400000 tonnes of feed valued at more than US$80 million. But this wasn't enough, it emerged that animal feeds had to go up by between 50% and 94% this was due to rise in acute shortage of raw materials, high import duty and prohibitive cost of enegy. This locked out thousands of dairy farmers from access to manufactured feeds which are used to complement and at times substitute the dwindling pasture occasioned by failing rains (Koigi, 2014).

Almas (2010) observed that farmers have been forced to search for new ways to organise agricultural production as a result of the changing conditions for farming all over the world. Dairy farmers are not excluded as milk production is a full time job unlike crop production which is seasonal and the households involved work long hours. The profitability of dairy farming is dependent on the system practised by a particular farmer. This is because more inputs are required in intensive systems such as supplementary feeds, costs of vaccinations and drugs, with introduction of technology, dairy farmers will increase their production (Mumba, 2011).

There is increasing availability of online information on adoption of hydroponic technology, but this information is scanty as to whether people in the developing world are adopting hydroponic technology. This is because the empirical studies on hydroponic technology, which have mostly been done in the developed and emerging countries, have dwelt on aspects of hydroponics, that is,characteristics and trends in global industries, new crops, new hydroponic technology, new pest and disease control, the nutritional, costs and acceptability by farmers (Dung *et al.*, 2010; Hinton2007; Tudor *et al.*, 2003).

Studies relevant to Africa have only been concerned with hydropronic farming:the fodder solution (PanACC, 2014), (Fanos Mekonnen, 2014) hydroponic fodder production for small holder livestock farmer in ethiopia, the study shown that livestock feeding problems in ethiopia are mainly attributed to land shortage, lack of improved forage technologies and awareness problem hence the use of hydroponic fodder production. (Felix, 2010) viability of using hydroponics in growth of barley as a fodder crop among rural small-scale farmers, there is little understanding as to whether knowledge and personal charactaristics influence adoption of hydroponic technology in the implementation of dairy farming project, to what extend does persuasion contribute to adoption of hydroponic technology, does the decision making stage influence adoption of hydroponic technology and the contribution of confirmation stage to adoption of hydroponic technology in the implementation of dairy farming projects. The understanding of these factors would be of help in finding the needs of dairy farmers and stakeholders on ways to increase individual participation on adoption of hydroponic technology in implementation of the dairy farming projects.

1.2 Statement of the Problem

Research has shown that the hydroponic technology is used all over the world including areas with non-arable soil such as Mexico and the Middle East. In Australia,where hydroponic technology is practised, the land is frequently ravaged by drought, fire, flood and extreme seasonal conditions, the winter frosts that slow the growth and burn off valuable livestock food devastate the lives of many farmers year in and year out. Thus the use of hydroponic methods consistently outperform soil cultivation with faster growth, higher yields and better quality produce. Growing fodder using hydroponic technology has the potential to allow farmers to yield a fodder that has the ability to provide huge ecological and economical advantages where agriculture is difficult and in densely populated areas that lack sufficient growing space.

Growing fodder using hydroponic technology is an innovation aimed at overcoming fodder sourcing in the diary industry. The high cost of manufacturing feeds, shortage of raw materials, import levies, pressure on available pasture land for grazing and increasing demand for crop land are some of the challenges contributing to hydroponic technology adoption in the world. The grazing land has been highly taken up by homesteads at the expense of dairy farming. Kajiado has lately become a hub for real estate constructions; this can be attributed to the nearness of the county to Machakos County, Makueni County and Nairobi County. This study sought to add on to the available literature, detailing the determinants of hydroponic technology adoption in the implementation of dairy farming projects in kajiado County, Kenya.

This study therefore, sought to examine the determinants of hydroponic technology adoption in the implementation of dairy farming projects in Kajiado County, Kenya. Kajiado County is semi-arid, very dry with no continually flowing rivers. The ever rising cost of commercial feeds and the small parcels of land has hindered most farmers from dairy farming. However, use of hydroponic technology for fodder production can enhance dairy farming productivity and hence improve farmers income levels.

There is little understanding of the factors which determines the adoption of hydroponic technology, despite the desparate situation of dairy farmers in Kajiado County, hence the need for the study.

1.3 Objectives of the Study

The main objective of this study was to examine the determinants of hydroponic technology adoption in the implementation of dairy farming projects in Kajiado County.

1.3.1 Specific Objectives

The specific objectives of the study were to:

i. Examine the influence of farmers knowledge and personal characteristics on adoption of hydroponic technology in the implementation of dairy farming projects.
ii. Establish the influence of persuasion on adoption of hydroponics technology in the implementation of dairy farming projects.
iii. Examine the extent to which decision making stage influence adoption of hydroponic technology in the implementation of dairy farming projects.
iv. Examine the extent to which confirmation stage enhances adoption of hydroponic technology in the implementation of dairy farming projects.

1.4 Research Hypothesis

The hypotheses tested in the study were:-

H_0 There is no significant relationship between dairy farmers knowledge and personal characteristics and adoption of hydroponic technology in the implementation of dairy farming projects.

H_0 There is no significant relationship between persuasion and adoption of hydroponics technology in the implementation of dairy farming projects.

H_0 There is no significant relationship between the decision making stage and the adoption of hydroponic technology in the implementation of dairy farming projects.

H_0 There is no significant relationship between confirmation stage and adoption of hydroponic technology in the implementation of dairy farming projects.

1.5 Significance of the Study

This study is of importance to the dairy farmers, since this information is useful in adoption of new technology which means increased herds, milk, and meat production. The Government of Kenya especially the Ministry of Agriculture, Livestock and Fisheries will need this information in order to put in place policies that will enhance adoption of this technology. To the hydroponics technology developers and suppliers, this study will help them to formulate effective strategies in order to cope up and meet the ever-changing technology, fast-paced trends and demands of the technological environment.

The study will be a source of reference material for future researchers; it will also help other academicians who undertake the same topic in their studies, especially those of higher learning can use the findings of this research as a source of future reference and identify further research gaps to be undertaken in the future.

1.6 Scope and Delimitation of the Study

This study focused on selected dairy farmers in the three administrative divisions in Kajiado County, namely: Isinya, Loitokitok and Ngong. The target population was 368 zero grazing dairy farmers registered with the Ministry of Agriculture, Livestock and Fisheries office, Kajiado County.

The choice of Kajiado County as the study area was influenced by the nomadic nature of the (Maasai culture) livestock production, Kajiado has become a hub for real estate construction; hence increased pressure on pasture land, this can be attributed to the nearness of the county to Machakos, Makueni and Nairobi Counties.

Secondly, researcher’s interest formed the choice of location. (Gay, 1992) observed that factors such as familiarity to an area, limitations of time, effort and money may influence the researchers’ choice of location. Thus Kijiado is familiar to the researcher. That was what influenced the researcher to choose Kajiado County for study.

1.7 Limitation of the Study

The study could have covered abroader area of zero grazing dairy farmers. However, Kajiado County is sparsely populated and the level of literacy is very low and due to the nature of the sampling techniques employed in this study, the data analysis only applied to the sample population. The adoption of hydroponic technology is relatively new and hence little information on the subject was accessed. Some respondents were reluctant to provide information but were assured of confidentiality of the same.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter gives an overview of the theoretical review, conceptual framework, empirical studies, chapter summary and research gaps in the study.

2.1 Theoretical Review

This study sought to examine the determinants of hydroponic technology adoption in the implementation of dairy farming projects. To arrive at an appropriate theory to support the study, several theories were reviewed with the view of isolating and understanding key aspects. Straub (2009:626) posits that no single model for technology adoption can explain the process an individual engages in before adopting a new innovation.

2.1.1 Diffusion of Innovation Theory

The Diffusion of Innovation Theory (DOI) approach has its primary focus on how potential adopters perceive an innovation in terms of relative advantage/disadvantage; "An innovation is an idea, practice, or project that is perceived as new by an individual or other unit of adoption" (Rogers, 2003). An innovation may have been invented a long time ago, but if individuals perceive it as new, then it may still be an innovation. The newness characteristic of an adoption is more related to the three steps (knowledge, persuasion, and decision) of the innovation-decision process.

The decision process to adopt a particular technology involves farmers acquiring information because they face yield uncertainties and varying risk preferences. There is thus a relationship between production uncertainty and technology adoption as farmers will attempt to protect themselves against input related production risks.

An individual therefore has to make choices from a pool of alternatives at their disposal. In the context of hydroponics technology, dairy farmers access these technology from the government, cooperatives and other organisations providing interventions. It is assumed that they will make decisions of adopting or rejecting the technology based on socio-economic factors such as herd size, farm size, labour availability, credit constraints and risk and uncertainty, among others. Focus should therefore be on the adopter as they determine how much of the technology will be adopted.

According to Rogers (2003), the decision to adopt is a process that does not happen spontaneously, but happens over time. A farmer will try out different technologies to see what works well on their farm with the available resources before making the decision to incorporate a particular technology into practice. Rogers (2003) described the innovation-decision process as “an information-seeking and information-processing activity, where an individual is motivated to reduce uncertainty about the advantages and disadvantages of an innovation”, the innovation-decision process involves five steps that an individual should go through before technology is adopted include knowledge, persuasion, decision, implementation, and confirmation.

In the first instance of Knowledge, farmers learn about various technologies that are available through information dissemination workshops and other training programmes.

Farmers learn about these technologies from their neighbours, friends, groups, the cooperative societies and extension officers. Some farmers may be interested in having the latest information at their fingertips and therefore carry out research and read widely on the latest technologies and are able to apply them to their practice.

In the second stage of persuasion, farmers are persuaded to know more about the technology after hearing about it. Their attitudes therefore change and are interested in knowing more about the technology, how it works and what it can do for them. This is a vital stage because it plays a major role in influencing their decision to adopt or reject the technology. The farmers then decide to try out the technology. The knowledge gained forms a basis for adoption or rejection depending on how well the technology is understood and their perception of benefits.

In the third stage of decision making, happens after the dairy farmers are persuaded about the benefits the technology provided for their dairy animals, decisions are made and the farmers adopt the technology. However, this is not a straight forward process. At each stage, there is a forward and backward process going on. During implementation stage, the farmer incorporates the technology in their practice while adapting it to suit their circumstances. This aspect of re-inventing makes the technology flexible and could be beneficial to adopters (Rogers, 2003). However, farmers can also decide to discontinue with the technology if they feel it doesn’t provide the expected benefits.

The last stage involves confirmation of the farmer's decision –positive or negative. Farmers make their decisions based on expected impacts on the wellbeing of their households particularly on household income. We define a good technology as one that is profitable in an ideal world without adoption constraints. Technology that is profitable to one farmer may not be profitable to the neighbour because of differences in credit access or because of household-specific labor constraints. Assessments of the profitability of existing technology often stop at the demonstration plot, and may not include all inputs such as household labor (Foster and Rosenzweig, 2010).

The diffusion of innovation model provides the 'debut' of the technology as this is when a farmer first comes into contact with it. Technology is dynamic. There are always new inventions and new ways of doing things and therefore there is need to keep up otherwise one may become obsolete before their time. Allowing farmers to participate and adapt technology to what suits them encourages them to take up a particular technology. However, it is important to consider the learning challenges the farmers may have as some may not have had experience or may have just observed from their neighbours at a distance. In most cases technology is transferred through the social networks, power relations may arise in the interactions among the farmers and this may cause resistance (Whittle and Spicer, 2008).

2.1.2 Actor Network Theory

The Actor Network Theory describes the dynamics of society by showing how farmers either form or are part of social groups and the process through which they construct technology. This construction is through sociological analysis and not in the engineering sense (Callon,1987). Farmers are individuals with different characteristics, thus a heterogeneous group. Because of this, they associate differently amongst each other and thus influence and re-define themselves in different ways. Long and van der Ploeg (1989) present this as an "actor-oriented analysis that views intervention as a multiple reality made up of differing cultural perceptions and social interests, and constituted by the ongoing social and political struggles that take place between the social actors involved." This explains the interaction of actors particularly in interventions that are planned such as the introduction of technologies to the rural communities.

Introduction of technology does not immediately imply that it will be taken up but it can be negotiated and adapted to suit the potential adopters. How the farmers Interact with various actors involved in technology dessemination creates an enabling environment that determines which and how much of the technology will be adopted. Moore (2008) also observes that there is more to technology adoption than just making the decision and a change in behavior. It is important to understand the technology as a whole for a farmer to enjoy the full benefits of their decision.

2.2 The Concept in implementation of dairy farming projects

Rogers (2003) described the innovation-decision process as "an information-seeking and information-processing activity, where an individual is motivated to reduce uncertainty about the advantages and disadvantages of an innovation". However, it is important to understand how farmers choose and adopt technology. De Souza Filho (1999: 82) suggests that farmers are influenced by various economic and non-economic factors to make decisions regarding the adoption of agricultural technologies. Farmers will hesitate to adopt a technology if income increase is expected to be low and if costs outweigh the benefits. Other common exploratory variables include farm size, risk and uncertainty, labour availability, credit and supply constraints. The farmers may be willing to adopt technology if they succeed financially through increased productivity and lower per unit costs as a result of the contribution that technological advances make to the dairy industry.(El-Osta and Morehart, 2000).

2.3 The Concept of Hydroponic Technology Adoption

Adoption is the decision to maximise the use of an innovation as the best course of action available and diffusion as a process where communication of innovations or technologies happens overtime among members in a society through certain channels, while innovation is the idea, practice or project perceived as new by the individual or other unit of adoption (Boz et al., 2011). Straub (2009) reveals that historically, adoption was understood in terms of behavioural change. This implies that adoption happens over time and only when an innovation has been accepted will it be used and integrated into the farmer's system. Adoption is farmer driven and is done by farmer choice.

The dairy farmers will take up hydroponic technology if they expect to gain from it. Dairy farming in resource-poor conditions, with few purchased inputs and limited technology, will prefer technology with high returns but low cost as they are both producers and consumers (Byerlee and Polanco, 1986). Hydroponic technology promoted should be adaptable to individual circumstances of the farmers. This can only be done if the farmers' characteristics are understood in order to adapt a technology that is appropriate to their needs and feed into the policies that Government can make regarding dairy farming. The knowledge, attitudes and practices of dairy farmers in relation to the kind of technology they adopt for improved productivity is vital as it provides Government and other policy makers with information as to what kind of technologies to generate that will be easily adopted by farmers.

The farmer makes the choice to adopt or not adopt a particular technology depending on various factors such as socio-economic characteristics, perceptions, policy and technology features (Bhattarai, 2009). However, farmers will take up at least one thing or the other from the package of the technology offered to them unless there are serious barriers that prohibits them. According to (Agrotunnels International Limited Kenya, 2013) Hydroponic technology entails the germination of seeds in nutrient rich solutions instead of soil to produce a grass and root combination that is very high in nutrition.

It requires less water to produce as it takes 1 to 2 litres of water to produce one kilo of fodder compared to 80 – 90 litres to produce one kilo of green grass.It requires minimal land use compared to fodder grown on fields. Fodder grown on 9m x 6m plot can feed the same number of cattle that graze on 1200 acres of pastures in the field. There is no need for expensive fodder storage facilities because farmers are guaranteed a constant supply of high quality fodder. Unlike hay and silage which loses their nutritive value over time, the quality of hydroponic fodder is always guaranteed. Hydroponic fodder requires a very short growth time, it takes as little as 7 days from germination time to a fully grown plant at a height of 25 – 30cm ready for harvest.

It requires less labour. As little as one hour per day is required to maintain and produce hydroponic fodder. It is extremely cost effective and financially viable. Estimates have indicated a cost of about Kshs 4000 to produce a ton. The cost of fattening an animal using hydroponic fodder is 4 to 8 times less compared to using grain over a 90 – 120 day period. Chances of diseases associated with feeds are reduced by 60 – 75% because the fodder supply is disease free thus enhancing good agricultural practices.

The nutritive value is quite high. The protein content is high and is very rich in vitamins such as B-carotene, trace elements and enzymes. It is 90 – 95% digestible compared to grains which at best are 30%. The increase in digestibility results in an increase in the average daily weight gain which is a big advantage to beef and mutton producers. It has been found that a kilo of hydroponic fodder is nutritionally equivalent to 3 kg of lucerne. The diets of hydroponic fodder also help improve milk production and quality. Tests have indicated vast improvement in milk quantity (up to 10%) and butter fat content (14% higher). Farmers have reported a stimulated appetite when animals are fed on the diet.The feed is completely natural. The fodder is produced without the use of any hormones, chemicals fertilizers or synthetic growth stimulants. There are no fungicides or pesticides used that could contaminate the meat or milk.

2.3.1 Simplified Hydroponics Model

Simplified Hydroponics uses very low cost, simple technology; requires almost no investment; and uses family labour. Stajano (2003) observed that among other factors that make hydroponic technology not to be spread included, limited information dissemination on the benefits of the technology; challenges of obtaining expertise who are trained and have knowledge of hydroponics; few producers of nutrient solutions who will avail them at a low cost; and the fact that the society is still conservative as majority still believe that fertilizers and other nutrients that are needed in the hydroponics are toxic. Stajano (2003) also found out that simple hydroponics which is obtained at a lower cost goes a long way in enhancing food security. Simple hydroponics has been used by low income families in urban and peri urban areas of Uruguay to improve their living standards. These simple growing techniques can be easily replicated in other developing countries Stajano (2003).

2.4 Link between determinants of hydroponic technology adoption and implementation of dairy farming projects

The determinants of hydroponic technology adoption are identified from the innovation-decision process, this looks at varous channels that if followed accordingly may lead to adoption of hydroponic technology in implementation of dairy farming projects. The determinants are knowledge and personal characteristics, persuasion, decision making stage and confirmation stage. The relationship between the independent and dependent variables would give an expected output.

2.4.1 The influence of dairy farmers knowledge and personal characteristics on adoption of hydroponic technology.

The innovation-decision process starts with the knowledge stage where an individual learns about the existence of innovation and seeks information about the innovation. The dairy farmers are differentiated in many ways. Some are more educated, while others have more labor available for various farm activities. The dairy farmers, educational level also plays a straightforward role in technology adoption. According to Doss (2003) It is expected that education have a positive effect on milk productivity because it has the potential to improve the farmer's ability to understand the knowledge they receive in trainings compared to those who have had limited education.

Dairy farmers need to be aware of hydroponic technology existence, this can motivate them to learn more about the technology and eventually, adopt it. They could easily take up fodder production using hydroponic technology and adjust to circumstances and maximize benefits derived from it. For hydroponic technology to be effectively used, dairy farmers need to know the technical aspects on how to use the technology correctly. Dairy farmers may have the necessary knowledge, but this does not mean that individuals will adopt the technology because the individual's attitudes and experiences also shape the adoption or rejection of the innovation. The knowledge and information about hydroponic technology can be disseminated through workshops, seminars, journals and various trainings by stakeholders in the dairy industry.

Although hydroponic technology can reduce production costs and induce high quality and nutritive fodder that allow for higher yields in milk production. The purchase, maintenance and capacity to develop skills to run hydroponic technology may induce high unaffordable costs. Through dairy cooperatives, the dairy farmers can access technology trainings and credit facilities, thus getting services at a reasonable cost than what they would have negotiated for in their individual capacity (Wollini *et al.*, 2008).

Gender is also important because men and women have different roles to play not only in dairy farming, but in agriculture as a sector. Targeting the decision maker is therefore vital in the adoption process as the final choice rests on them (Solano, 2000).
While women contribute the most to the dairy enterprise in terms of labour, with children pitching in to do menial jobs; the benefits are not shared equally with the men. This may present significant consequences to technology adoption and sustainability because the time and effort may not determine the financial reward and equity (Ibid: 242). Access and control over household resources is not entitled to the female member of the households.

This affects not only the willingness to adopt a new technology, but also the efficiency of its use if it is adopted.

2.4.2 The influence of persuasion on adoption of hydroponic technology.

Hydroponic technology promoted should be adaptable to individual circumstances of farmers. This can only be done if the farmers' characteristics are understood in order to develop technology that are appropriate to their needs and feed into the policies that government can make regarding dairy farming. Understanding the knowledge, attitudes and practices of dairy farmers in relation to the technology they want to adopt to improve their production is vital as it provides the government with information on what kind of technology to generate and its implementation if adopted by farmers.

Social networks does an important role as individuals will be influenced to adopt hydroponic technology through 'family and friends' of the farmer (Bandiera and Rasul, 2006). If a dairy farmer sees a neighbour practicing hydroponic technology and what benefits are accruing to that farmer, they may also decide to adopt it depending on available resources. The farmer may also decide to wait and establish the costs and returns, or may have to raise some resources before they can make the decision to adopt. This suggests that there is interplay of various actors in the adoption of hydroponic technology. These actors have specific roles and responsibilities and possess different resources and capabilities as they make strategic decisions in hydroponic technology adoption. Within the social networks, cooperatives and groups play an important role in raising the socio-economic conditions of member and surrounding communities. They provide the poor farmers with an opportunity to raise their incomes hence contribute to solving various challenges they face and strive to ensure that there is participation and control by member producers. Individual members have the ability to influence policy and management matters through registered membership bodies that are regulated by laws and regulation as the case with dairy cooperatives. Dairy cooperatives have the ability to raise standards of living of the poor through facilitation of development of the remote rural economies especially if cooperative principles are adhered to guide them.

2.4.3 The influence of decision making stage on adoption of hydroponic technology.

According to (Straub, 2009) An individual's decision and the time frame to make that choice has an influence on all aspects of life. Straub (2009) reveals that historically, adoption was understood in terms of behavioural change. This implies that adoption happens over time and only when an innovation has been accepted will it be used and integrated into the farmer's system. Hydroponic technology adoption is farmer driven and is done by dairy farmer's choice. The dairy farmer makes his own choice to adopt or not adopt a hydroponic technology depending on various factors such as socio-economic characteristics, perceptions, policy and technology features (Bhattarai, 2009). However, dairy farmers will take up at least one thing or the other from the hydroponic technology offered to them unless there are serious barriers that completely prohibits them (Ibid). Dairy farmers will take up hydroponic technology if they expect to gain from it. Farmers in resource-poor conditions, with few purchased inputs and limited technology, will prefer technology with high returns but low cost as they are both producers and consumers (Byerlee and Polanco, 1986).

Climate change will have significant impact on dairy farming in particular. Although livestock provides a buffer to the detrimental impacts of climate change, it also contributes to climate change through the emission of greenhouse gases (Greenpeace, 2010). Decisions the farmers make is a manifestation of their attempt to avert risks and not necessarily as a response to their risk. If farmers are risk averse, they will be reluctant to invest in hydroponic technology and will be stuck in the poverty trap particularly if there is no mechanisms to reduce the downside effects. Dairy farmers may opt to adopt a technology that is beneficial to them. If farmers do not see any benefits of hydroponic technology, they may not consider it. However, when they decide to take it up, they expect it to have a relative advantage over the existing way of farming.

Labour is another important aspect as this is a major resource the farmers have at their disposal. They will channel it towards activities that will bring more returns but also does not take too much of their time and keep them away from doing other important activities, that may be essential for improving their livelihood. This is useful in establishing whether adopting hydroponic technology will push the farmers to participate more in off-farm employment thereby work more hours and earn higher income.

The technology may involve trade-offs in that although it may increase incomes, it may also increase labour inputs and time constraints of certain members of the household (Tangka, 2000). Trade-offs is important to be detected early and corrected to avoid short-term adverse effects of technology change on the dairy farmers households. Labour-intensive technology may not be preferred by the women if it takes up too much of their time considering they have reproductive and other productive roles to perform.Cost issues come to play as households need a stable cash flow in order to sustain hydroponic technology adopted.

Dairy farmers can be assisted by organising them into groups/cooperatives as it is easier to provide assistance to a group rather than to individual farmers. The varous stakeholders; local and international organisations that provide the technical assistance can transfer knowledge through farmers training, research work and financing and the government, can provide the policy framework and creates an enabling environment. Land is a very important factor of production, more so in dairy production Small-scale farmers cultivate on less than 5 hectares of land and use basic production methods which are low input output. Because they are resource constrained they largely depend on family labour. Emergent farmers cultivate on areas between 5 and 20 hectares are more resourceful and use modern agricultural methods which enable them produce a surplus for the market. Large scale farmers produce at a high level with high management technologies on areas more than 20 hectares (Siegel, 2008). Some of the dairy farmers may own the land, while others are on customary land. The farms may not be fenced therefore making it difficult to grow fodder, which could be eaten by a neighbour's cows grazing near a farmer's. Mosnier and Wiek (2010) observe that advances in technology adoption could have a positive relationship with farm size due to economies of scale.

2.4.4 The extent confirmation stage enhances adoption of hydroponic technology.

If a technology takes too much time for the benefits to be seen, farmers may avoid it. The decisions dairy farmers make regarding the hydroponic technology adoption, partial adoption or non-adoption of hydroponic technology have an effect on their livelihoods. Various factors motivate farmers to participate in dairy farming, more so that it contributes to household welfare (Lwelamira *et al.*, 2010). Most farmers are concerned about what the family will eat before they think about money. Therefore, if the introduction of hydroponic technology will increase the levels of income, dairy farmers will be more than willing to take it up.

Although the decison for hydroponic technology adoption has been made, at the confirmation stage the individual looks for support for his or her decision, the decision can be reversed if the individual is exposed to conflicting messages about the technology. The dairy farmers should focus and seeks supportive messages that confirm his or her decision. Thus, attitudes become more crucial at the confirmation stage. Depending on the support for hydroponic technology adoption and the attitude of the individual, later adoption or discontinuance happens during this stage.

2.5 The Conceptual Framework

The conceptual framework of the study is presented in Figure 2.1. This explains the components of the link between the independent variables and dependent variables.

Independent Variables *Dependent variables*

Determinants of hydroponic

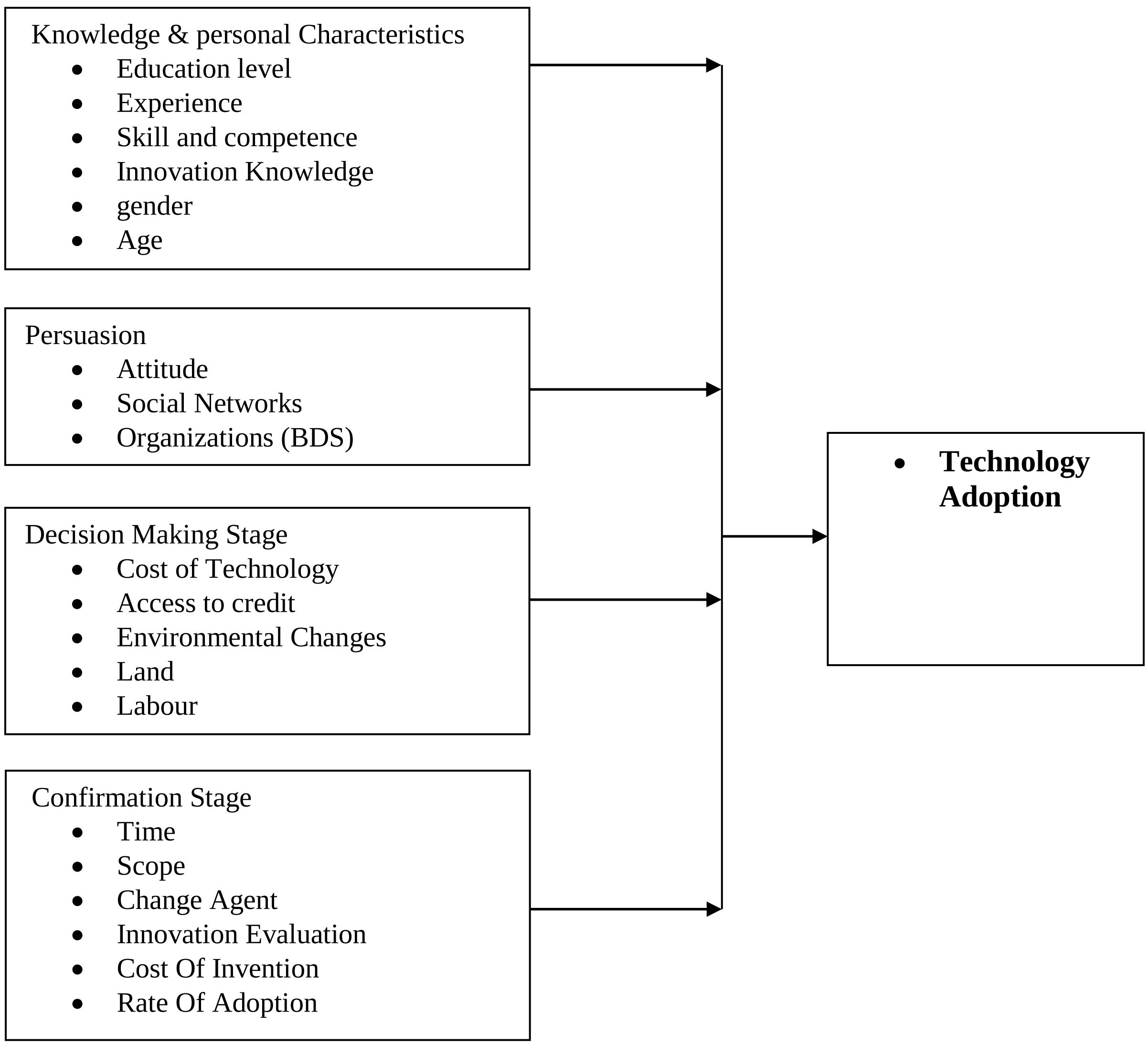

Figure 2.1. The conceptual framework

2.6 Empirical studies

Different factors determine the adoption of different agricultural innovations and technologies. Much empirical adoption literature focuses on farm size as the first and probably the most important determinant (Shakya and Flinn, 1985; Harper, 1990; Green and Ng'ong'ola, 1993; Adesiina and Baidu-Forson, 1995; Nkonya, 1997; Fernandez-Cornejo, 1998; Baidu-Forson, 1999; Boahene, 1999; Doss and Morris, 2001; and Daku, 2002). This is because farm size can affect and in turn be affected by the other factors influencing adoption.

The effect of farm size on adoption could be positive, negative or neutral. For instance, McNamara et al., 1991); Abara and Singh, (1993); Feder (1985); Fernandez-Cornejo, (1996) and Kasenge (1998) found farm size to be positively related to adoption. On the other hand, Yaron (1992); and Harper (1990) found negative relationship between adoption and farm size. Interestingly, Mugisa-Mutetikka (2000) found that the relationship between farm size and adoption is a neutral one. With small farms, it has been argued that large fixed costs become a constraint to technology adoption (Abara and Singh, 1993), especially if the technology requires a substantial amount of initial set-up cost. In this regard, Feder (1985) noted that only larger farms will adopt these kinds of innovations. With some technologies, the speed of adoption is different for small- and large- scale farmers which are critical for policy makers and implementers in their pursuance of modernization of agriculture.

According to (Schreiber, 2002) research on Dairy Production in Kenya: A Case Study in Innovation, the research team interviewed dairy farmers and network actors in two contrasting districts of Kenya: Kiambu and Nyandarua. These districts were selected to represent, respectively, an area with advanced market development close to a major urban center (Nairobi) and remote areas with poorer access to markets. The perceptions of farmers and network actors were captured through semi-structured interviews based on two different questionnaires. Farmers were asked what innovations they had introduced in their dairy operations and where they had obtained the necessary information, assistance, and materials.

The network actors, which included researchers, extension agents, veterinarians, were asked what types of service they provided to farmers and how they assisted them in improving their dairy operations; they were also asked where they obtained information and new technology to identify "second-level" innovation sources. A total of 58 farmers and 41 network actors participated in the surveys, which were conducted in November 2000. De Souza Filho (1999: 82) suggests that farmers are influenced by various economic and non-economic factors to make decisions regarding the adoption of agricultural technologies. Farmers will hesitate to adopt a technology if potential income increase is low and if costs outweigh the benefits. Other common exploratory variables include farm size, risk and uncertainty, human capital, labour availability, credit and supply constraints. Farmers have been able to succeed financially through increased productivity and lower per unit costs as a result of the contribution that technological advances make to the dairy industry (El-Osta and Morehart, 2000).

Thus, clear information is needed to form the foundation of future studies especially in the African continent. This study is therefore proposed so that information on determinants of hydroponic technology adoption in the implementation of dairy farming by the public in Kenya and Kajiado County in particular can be availed for policy purposes for agribusiness promotion and delivery.

2.7 Chapter Summary and Research Gap

A critical literature review suggests that the dairy farmers Knowledge and personal characteristics such as education levels, training and prior experience have a significant effect on the hydroponic technology adoption in implementation of dairy farming projects. Hydroponic technology is relatively new and the subject has not been deeply explored on growth of fodder using the technology. There is also little local literature on the hydroponic technology utilisation and adoption and its implementation in dairy farming projects.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter describes the procedures and methods used in the study in order to satisfy the research objectives. These include: the research design, target population, sample size determination and sampling design, data collection instruments, validity and reliability, data analysis and ethical considerations.

3.1 Research Design

This study adopted a quantitative approach. A descriptive research design is a scientific method which involves observing and describing the behavior of a subject without influencing it in any way (Shuttleworth, 2008). A descriptive research design determines and reports the way things are (Mugenda & Mugenda, 2003). The research design also has enough provision for protection against bias and maximized reliability (Kothari, 2008). This design was employed to obtain most recent and relevant information about the subject of this study (Mbonyane and Ladzani, 2011). The research design focused on the determinants of hydroponics technology adoption in implementation of dairy farming projects in Kajiado County.

3.2 Target population

Population is a group of individuals, objects, or items from which samples are taken for measurement (Kombo and Tromp, 2006). The target population for the study include 368 zero grazing dairy farmers registered with Ministry of Agriculture, Livestock and Fisheries in Kajiado County distributed in various administrative divisions of : Isinya, Loitokitok and Ngong. The three administrative divisions were selected because these are the areas in Kajiado county where zero grazing dairy farming is rampant in practice .

3.3 Sample Size Determination and Sampling Design

The study grouped the population into clusters comprising of the three (3) administrative divisions. From each Cluster a sample frame was developed to select 110 respondents using simple random sampling. The respondents were systematically picked from the list of registered zero grazing dairy farmers practising hydroponic technology from the Ministry of Agriculture, Livestock and Fisheries in Kajiado County. Mugenda and Mugenda (2003) argue that if well chosen, samples of between 10% and 30% of a population can often give good reliability.

Table 3.1: Sample Size determination and Sampling Design

Categories	Target Population (zero grazers)	Percentage (30%)	Sample size
Ngong	128	30%	38
Loitokitok	97	30%	29
Isinya	143	30%	43
Total	**368**	**30%**	**110**

3.4 Data Collection Instruments

A self-administered questionnaires was used to collect Primary data obtained from 110 zero grazing dairy farmers. The questionnaires contained both closed-ended and open-ended questions. The questionnaire was divided into five sections with section A meant to get information about personal charateristics and the knowledge of dairy farmers including the education levels, experience, age, gender and innovation knowledge.

Section B was intended to gather information on influence of persuasion, section C was to get data on decision making stage whereas section D was to get information on confirmation stage on hydroponic technology adoption and Section E was to determine implementation of dairy farming projects.

3.5 Reliability of the Research instruments

A pilot study of 24 zero grazing dairy farmers drawn from two administrative division, Namanga and Mashuru were selected randomly to ensure they bear the same characteristics as per other administrative divisions in the study area.The procedure for extracting an estimate of reliability was obtained from the administration of split half reliability method. The method involves splitting instrument into two halves (odd and even items) then calculating the Pearson's correlation coefficient(r) between the responses (scores) of the two halves. The scores for all odd and even numbered items for each of the 24 respondents in the pilot study was computed separately. The correlation obtained represented the reliability coefficient of half of the instrument. Hence a correction was made to obtain reliability of the entire instrument. Coefficient of 0.7 is a commonly accepted rule of thumb that indicates acceptable reliability (Mugenda, 2008). The questionnaire was reliable as its reliability values exceeded the prescribed threshold (0.7) of acceptable reliability (Mugenda, 2008).

3.6 Validity of the Research instruments

The Construct ,Content and face validity wasntested by analysing the questionnaires to check on completeness and compare the comments on the suitability of the questions while paying close attention to clarity, relevance, wording and interpretation of questions among other anomalies. Experts in the field including supervisors and statisticians were consulted to enhance the accuracy and replicability of the data obtained.

3.7 Data Analysis

Data obtained from the field was coded, and analysed using both SPSS and Stata softwares to generate required information. The correlation and regression were used to analyse the relationship between independent variables and dependent variable. The findings were summarised using simple tabulation. The data was presented using tables ,graphs and charts. For this study, the researcher was interested in examining the determinants of hydroponic technology adoption in the implementation of dairy farming projects in Kajiado County, Kenya.

3.7.1 Analytical Model

To examine the determinants of Hydroponic Technology adoption in the implemenation of dairy farming projects in Kajiado County, data analysis was done using descriptive statistics, correlation analysis and the Multiple Regression anlysis, to show the strength of the relationship between the dependent and independent variables. The following analytical model was used in analyzing the relationship between the dependent and independent variables: The regression model was:

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

Where:

Y = Technology adoption

α = Constant Term

β_1 = is the co-efficient of knowledge and personal charateristics

β_2 = is the co-efficient of persuasion

β_3 = is the coefficient of decision making stage

β_4 = is the coefficient of confirmation stage

X_1= values of knowledge and personal charateristics

X_2= values of persuasion

X_3= values of decision making stage

X_4= values of confirmation stage

ε = Error term

This leads to four equations addressing the four specific objectives of the study as highlighted in Table 3.2.

Table 3.2 Simple Tabulation

The following is the variables operationalization in simple tabulation:

Research Objectives	Variables	Indicator	Measuring of Indicators	Data Collection Methods	Level of Scale	Type of Analysis
To examine the extent to which dairy farmers knowledge and personal characteristics influence adoption of hydroponic technology in implementation of dairy farming projects	**Independent** Knowledge and Personal characteristics	• Education level • Experience • Skill and competence • Innovation Knowledge • Gender • Age	• Education level • Experience • Skill and competence • Innovation Knowledge • Gender • Age	Questionnaires	• Ordinal • Nominal • Ordinal • Ordinal • Nominal	Descriptive Regression
To analyze the influence of persuasion on adoption of hydroponics technology in implementation of dairy farming projects.	Persuasion	• Attitude • Social Network • Organizations (BDS)	• Attitude • Social Networks • Organizations (BDS)	Questionnaires	• Ordinal • Nominal • Ordinal	Descriptive Regression
To examine the extent to which decision making stage influence adoption of hydroponic technology in implementation dairy farming projects.	Decision making stage	• Cost of Technology • Access to credit • Environmental Changes • land • Labour	• Cost of Technology • Access to credit • Environmental Changes • land • Labour	Questionnaires	• Ratio • Nominal • Nominal • Metric • Nominal	Descriptive Regression
To examine the extent to which confirmation stage enhances adoption of hydroponic technology in implementation dairy farming projects.	Confirmation stages	• Time • Scope • Change Agents • Attitude • Innovation Evaluation • Cost of invention • Rate of Adoption	• Time • Scope • Change Agents • Attitude • Innovation Evaluation • Cost of invention • Rate of Adoption	Questionnaires	• Ratio • Ratio • Nominal • ordinal • ordinal • Ordinal • Ordinal • Ratio	Descriptive Regression
	Dependent Hydroponic technology adoption	• Hydroponic technology adoption	• Hydroponic technology adoption	Questionnaires	• Nominal	Descriptive Regression

3.8 Ethical Considerations

The ethical approval to conduct this study was sought from The University and The National Commission for Science Technology and Innovations. In addition, the participants of the study were informed about the voluntary nature of their participation in the study and that their data will be kept confidential to the researcher and that their anonymity will be protected. A consent letter was prepared and only those who gave consent completed the questionnaires.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.0 Introduction

This chapter presents the data presentation, analysis and interpretation on the determinants of hydroponic technology adoption in the implementation of dairy farming projects in Kajiado County, Kenya. The analysis was based on the study's specific objectives.

4.1 Descriptive Statistics

Descriptive statistics is used to describe the basic features of the data in a study. It provides summary about the sample and measures used. It entails use of central tendency, percentages and tables as shown follows:

4.1.1 Questionnaire Response Rate

This study targeted 110 respondents.To establish the response rate the researcher administered the questionnaires to targeted population who filled and submit them back. The response rate was as follows.

Table 4.1: Response Rate

Response	Frequency	Percentage (%)
Returned	87	79.1
Not returned	23	20.9
Total	**110**	**100.0**

Source: Research Findings 2016

The study finding in Table 3.1 revealed that 110 questionnaires were distributed to the respondents. 87 questionnaires out of 110 were filled and returned giving a response rate of approximately 79.1% (percent) while 23 questionnaires were not returned representing 20.9%. This response rate was good and representative and conforms to Mugenda and

Mugenda (1999) stipulation that a response rate of 50% is adequate for analysis and reporting; a rate of 60% is good and a response rate of 70% and over is excellent.

4.2 Dairy farmers knowledge and personal characteristics

The first objective of this study sought to examine the influence of farmers knowledge and personal characteristics on adoption of hydroponic technology in the implementation of dairy farming projects.The research was to examine the factors determining adoption of hydroponic technology and In this regard the following factors were considered, level of education, age, sources of information on hydroponic technology and the number of trainings a dairy farmer attends.

4.2.1 Distribution of Respondents by Gender

The study sought to find out the gender composition of the respondents. The findings are presented in table 4.1.2

Table 4.2 Gender of the Respondents

Gender	Frequency	Percentage (%)
Male	54	62
Female	33	38
Total	**87**	**100**

Source: Research Findings 2016

The study sought to find out the gender composition of the respondents. The findings are presented in Table 4.1.2 Of all the respondents to the study questionnaire 62% were male ,while 38% were female as shown in the Table. This means that there was no biasness in the research because all gender participated. While male are more likely to adapt new technology of farming this attribute was due to the inability of most women to own land for farming which predominantly belonged to males.This is in accordance with a previous study conducted by Whitehead (1985) who advanced that traditionally, most women do not own land for farming. In his study, Whitehead (1985) further argued that historically, women's access to land in most African cultures was based on status within the family and involved right of use, not ownership (Whitehead, 1985). Aliber and Walker (2006) also advanced that although married women had user rights over their husbands' land, the husbands in most cases have more exclusive rights over the land's disposal (Aliber and Walker, 2006).

4.2.2 Age of the Respondents

Th study also sought to determine the age the respondent.The findings are presented in table 4.3.

Table 4.3: Age of the Respondents

Age	Frequency	Percentage (%)
20 to 29 years	17	20
30 to 39 years	20	23
40 to 49 years	24	27
50 to 59 years	8	9
60 to 69 years	13	15
70 years and above	5	6
Total	**87**	**100.0**

Source: Research Findings 2016

The study sought to determine the age of the respondent in years. According to the findings on the respondents age as presented in Table 4.1.3 This revealed that (27%) in the age bracket between 40 to 49 years were the most likely to adopt dairy farming using hydroponic technology, followed by (23%) in age bracket 30 to 39 years, then (20%) in age bracket 20 to 29 years ,15% where of age bracket 60 to 69 years, 9%where in age bracket 50 to 59 . The age bracket of 70 years and above which comprices of 6% are the least to embrace adoption of hydroponic technology. The mean age of the respondents is 43 years and 6 months (43.5) with the youngest respondent being 20 years and the oldest being 72 years old. This study was found to be in line with previous studies conducted by Paxton (2010); Roberts (2004); Velandia (2010); and Walton (2010) which revealed that age influenced adoption decisions. A study conducted by Soule (2000) also concluded that age negatively influenced technology adoption. A study conducted by Mishra (2002) revealed that young farmers were found to be educated and willing to innovate effectively as well as efficiently adopt new technologies that reduce the amount of time spent on farming which is in accordance with the findings in this study.

Table 4.3.1: Descriptives of the Respondent's age

Variable	Obs	Mean	Std. Dev.	Min	Max
Respondent's age	87	43.5	14.4	20	72

4.2.3 Distribution of Level of Education

The study sought to determine the level of education of the dairy farmers as shown in Table 4.4.

Table 4.4: Level of Education

Education	Frequency	Percentage (%)
Primary	6	7
Secondary	16	18
College	37	43
University	28	32
Total	**87**	**100.0**

Source: Research Findings 2016

The study sought to determine the highest level of education of the dairy farmers as represented in the Table 4.4. 43% of the respondents revealed that they have college level education, while 32% of the respondents had university level education. 18% had secondary level education and the rest 7% had primary level education. According to an earlier study conducted by Waller (1998); Caswell (2001), education was found to affect technology adoption as well as increased farm productivity levels. In their study, they revealed that education created a psychologically favourable mental attitude for the effective and efficient acceptance of new technologies.

4.2.4 Sources of Information about Hydroponic Technology

The dairy farmer's awareness on Hydroponic Technology in Kajiado was aimed at assessing whether the information they received assisted in adoption of Hydroponic Technology.

Table 4.5 Sources of Information about Hydroponic Technology

Information Source	**Frequency**	**Percentage (%)**
Radio & TV	15	17
Internet/Cell Phone	11	13
Government/Extension Officers	5	6
Neighbours/ Friends/ Relatives	20	23
Co-operatives /Group	28	32
Other	8	9
Total	**87**	**100.0**

Source: Research Findings 2016

The study sought to determined the sources of information about Hydroponic Technology according the findings represented in Table 7.1. It revales that the respondents recieved information about hydroponic Technology through various means. 32% got information through Co-operative/Group, 23% got information through Neighbours/friends and relatives, 17% of respondents got information from Radio/TV, 13% got information from internet/Cell phone, others 9% got information from other channels including Bulletins, Newspapers , while 6% of the respondents go information from Governement/Extension officers. The dairy cooperative/groups were ranked the best source of information on hydroponic technology followed by neighbours/friends and relatives. The farmers contacted the co-operative/groups on a daily basis when delivering milk and hence were able to seek and/or obtain information easily. The co-operative also facilitated meetings between the farmers and other agencies such as the government extension and private manufacturers by organizing field days. Neighbours were in close proximity and gave practically reliable information based on their experiences.

Farmers were able to gauge the performance of their dairy cows. While the government/ extension officers provided field visits and personal attention to dairy farmers with various messages, the frequency of farm visits was very low and mostly the dairy farmers did not take them serious. Findings in this regard are in accordance with Awotide (2012) in the study about technology adoption which he contended that access to information about improved farming practices and agricultural technologies was essential to increase the extent of adoption.

4.2.5 Training on Hydroponic Technology

The study sought to determine whether the dairy farmers attended trainings on Hydroponic Technology and on whats aspects of the technology.

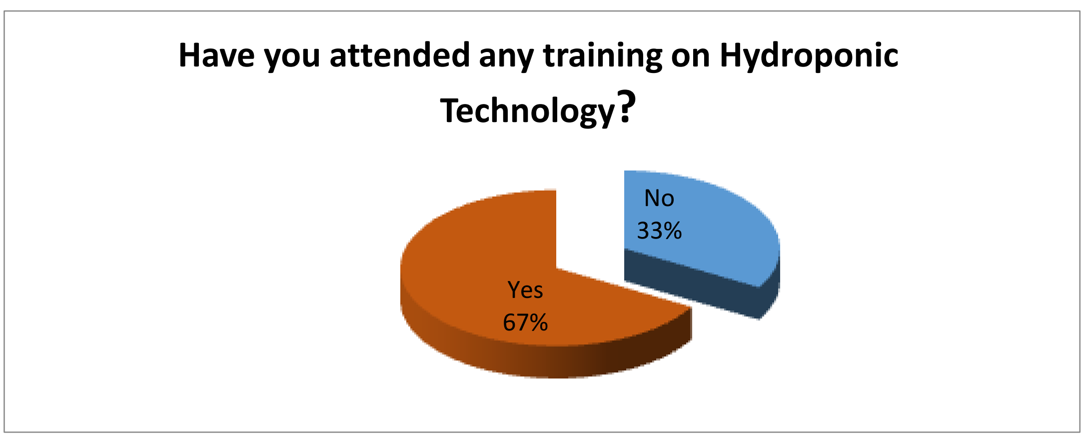

Figure 4.1 Training on Hydroponic Technology

Source: Research Findings 2016

The study sought to determine whether the dairy farmers attended trainings on hydroponic technology and on whats aspects of the technology. According to the findings represented in Figure 4.1. Shows that there were (58) 67% respondents who received training on hydroponic technology, while (29) 33 % of the respondents had not been trained on any aspects of hydroponic technology. The repondents were trained on aspects of crops that can be grown under hydroponic technology, growing hydroponic fodder, the types of materials that are required to setup hydroponic structures, including the measurements and the nutrients needed to grow the hydropnonic fodder. While the respondents who had not attended any training said they were busy with other issues though they were willing to attend trainings.

4.2.6 Organizations that provide Hydroponic Technology

The study sought to determine the organizations that provide the hydroponic technology as shown in Table 4.6

Table 4.6: Organization providing Hydroponic Technology

Organization	Frequency	Percentage (%)
Joe Hydroponics Kenya	17	19
Hydroponics Kenya	4	6
PanAfrican Agribusiness & Agro industry consortium	9	10
Grandeur Africa	26	30
Farmtech Ltd	7	8
African Hydroponic Ltd	6	7
No response	18	20
Total	**87**	**100.0**

Source: Research Findings 2016

The study sought to determine the organizations that provide the hydroponic technology as shown in Table 4.6. There were 20% (18) respondents who did not reveal the organization that provide them with hydroponic Technology. of the 69 respondents, 30% were provided hydroponic technology by Grandeur Africa, 19% by Joe Hydroponics Kenya Other providers are PanAfrican Agribusiness & Agroindustry consortium 10%, Farmtech Ltd 8%, African Hydroponic Ltd 7% and Hydroponics Kenya 6%. However most respondents indicated that they observed the technology from the neighbours, relatives and friends and decided to experiment on their farms.

4.2.7 Distribution of the years Practiced Hydroponic Technology

The study also sought to determine the years the respondent has Practiced Hydroponic Technology.

Table 4.7: The Years Practiced Hydroponic Technology

Years Practiced	Frequency	Percentage (%)
6 months	5	6
1 year	29	33
2 years	12	14
3 years	4	5
No Response	37	42
Total	**87**	**100.0**

Source: Research Findings 2016

The findings presented in Table 4.7. The respondents indicated that they have practiced hydroponic technology for a period of one year as shown by 33%. While 14% of the respondents have practiced hydroponic technology for a period of 2 years. 5% of the respondents indicated that they have practiced hydroponic technology for a period of 3 years while 6% have practiced hydroponic technology for a period of 6 months. While 42% of the respondents did not respond. On average, majority of the respondents had practiced hydroponic technology for a period of one and a half years.

4.2.8 Knowledge status on Hydroponic Technology

The study sought to examine how knowledgable the respondents were on Hydroponic technology this will increase the rate of adoption.

Table 4.8: Knowledge status on hydroponic technology

Knowledge Status	Frequency	Percentage (%)
Very poor	2	2
Poor	8	9
Average	18	21
Good	33	38
Very Good	26	30
Total	**87**	**100.0**

Source: Research Findings 2016

The study sought to examine how knowledgable the respondents were on Hydroponic technology as represented in Table 4.8. 38 % of most respondents have good knowledge on hydroponic technology, 30% have very good knowledge on hydroponic technology, 9% have poor knowledge on hydroponic technology, while 21% have average knowledge on hydroponic technology. However, the large deviation showed that there was a wide knowledge gap implying that it had not been fully effective. Most respondents revealed that they got knowledge on hydroponics by reading information available from the labels on the package of the hydroponic solutions. Some respondents revealed that they may also have acquired knowledge of hydroponic fodder feeding directly from local stores/stockiest, who offered the information as a strategy for sales promotion. However, information on hydroponic fodder nutritional benefits was not available from stockiest. Hydroponic housing designs were copied from neighbours and/or prepared by artisans who did the construction.

4.3. Persuasion on adoption of hydroponic technology

The second objective of this study was to examine the influence of Persuasion on adoption of hydroponic technology in the implementation of dairy farming projects in Kajiado County. To achieve this objective the following factors were considered the benefits derived from cooperatives/group, cooperatives/group Membership, number of dairy farmers belonging to cooperatives/group, seek for adviceon hydroponic technology, awareness of government Policy on hydroponic technology adoption.

4.3.1. Membership to groups/cooperatives

The study sought to determine the number of respondence that belong to a Group or Cooperatives as shown in figure 4.2

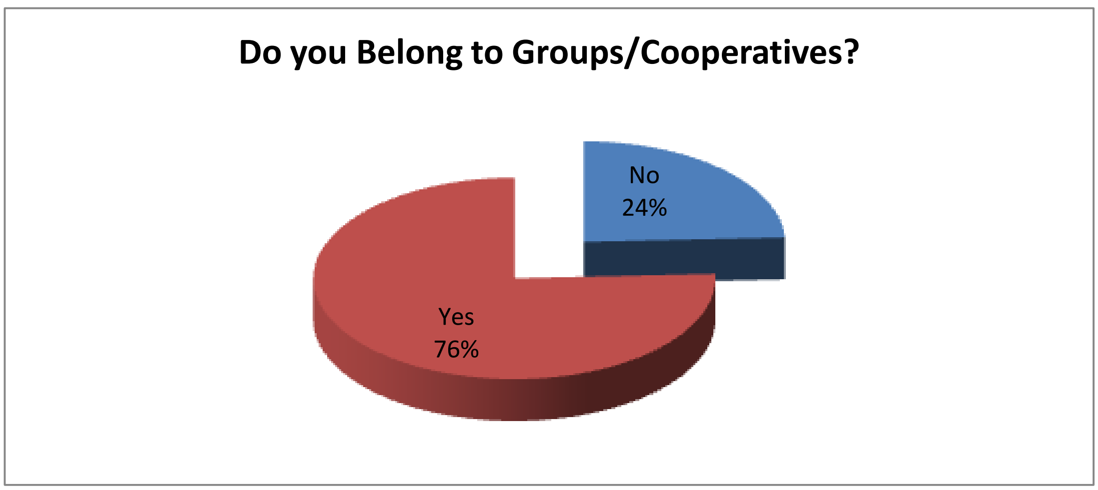

Figure 4.2: Membership to Group/Cooperatives

Source: Research Findings 2016

The findings show that, (56)76% of most respondents belong to group/cooperatives, while (18)24% of the respondents did not belong to any group/cooperatives. The respondents belonged to the following groups/cooperatives Ilkipirash group, Masaai Women self help group, Ole Ngishu Dairy Farm, Kule Dairy Cooperatives, Maasai Kajiado Women Dairy Cooperative , Sigma feeds dairy farm, various Microfinances and banks. While those who did not belong to any group/cooperatives said that they did not have time to join the groups/cooperatives due to their work schedule others said they did not know any particular group/cooperative to join.

4.3.2 Benefits derived from cooperative/groups on hydroponic technology

The study sought to determine the benefits the respondent derive from cooperatives/groups on Hydroponic Technology. The findings are presented in table 4.9.

Table 4.9: Benefits from Cooperative/groups on Hydroponic Technology

Benefits	Frequency	Percentage (%)
Workshops and Trainings	46	53
Sales and marketing of dairy products	12	13
Access to loans and credits	21	24
Meeting & Networking with other members	5	6
Access to new products	3	4
Total	**87**	**100.0**

Source: Research Findings 2016

The results in Table 4.9 shows the most benefit received from group membership is workshops and trainings (53%). Other benefits include access to loans and credits (24%); sales and marketing of dairy products (13%); meeting and networking with other members (6%) and access to new products (4%). The dairy farmers prefers to attend trainings and workshops, because during these sessions they get new ideas, share their experiences and improve their knowledge on hydroponic technology, they also get incentives during each attendance as well as reading materials for further references.

4.3.3 Number of dairy farmers using hydronic technology in the group/cooperatives

The study sought to determine the number of dairy farmers practicing hydroponic technology and belong to a Group or Cooperatives as represented by Figure 4.3.

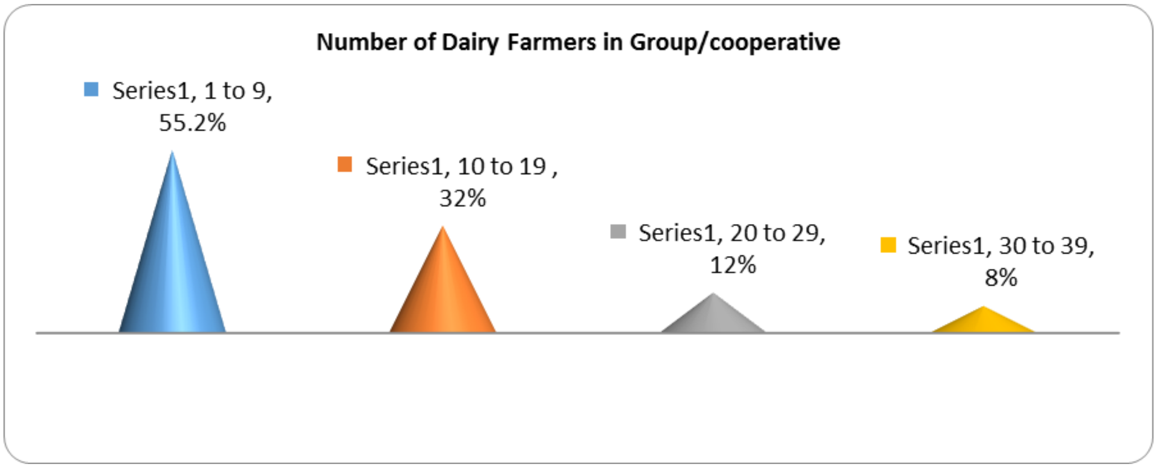

Figure 4.3 Number of dairy farmers in cooperatives/groups

Source: Research Findings 2016

The number of dairy farmers were grouped as per the cooperative/group they belonged. There were 55.2% of most respondents belong to a group/cooperatives and practiced hydroponic technology were ranging between 1 to 9. While 32% of the repondents who belong to a group/cooperatives and practiced hydroponic technology were ranging between 10 to 19. 12% of the respondents were between 20 to 29. The others were ranging between 30 to 39 as shown by 8%.

4.3.4 Whether Neighbours, relatives and friends come for advice on hydroponic technology

The study sought to determine whether the neighbours, relatives and friends come for advice on hydroponic technology.

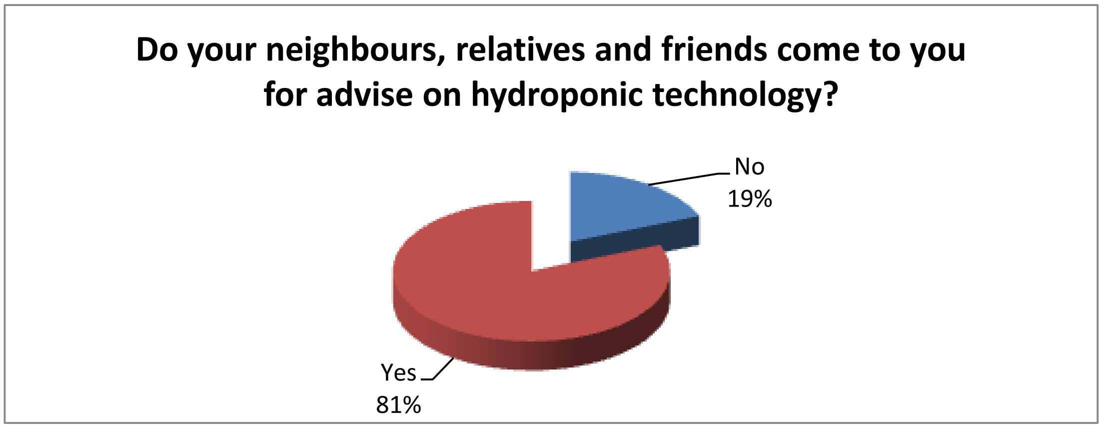

Figure 4.4: Neighbours, relatives and friends seek for advice

Source: Research Findings 2016

According to the findings represented in Figure 4.4. There were (70) 81% of respondents who reported that neighbours, relatives and friends come for advice on use of hydroponic technology. while (17)19% of the respondents do not come for advice on any aspects of hydroponic technology.

4.3.5 Whether respondent is the first to acquire hydroponic technology

The study sought to determine whethere the respondent is the first to acquire hydroponic technology as represented in Figure 4.5.

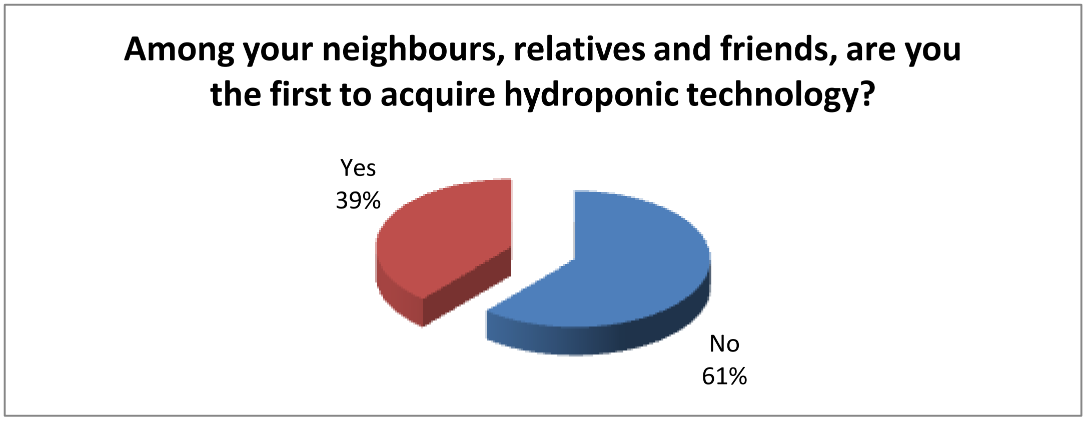

Figure 4.5. First to acquire hydroponic technology

Source: Research Findings 2016

The findings show that most (53) 61% of the respondents indicated they were not the first to acquire technology, while (34) 39% of the respondents indicated that they were the first to acquire hydroponic technology.

4.3.6 Extent to which the group/cooperative influenced the adoption of hydroponic technology

The study sought to determine extent to which the group/cooperative influenced them to adopt hydroponic technology as represented in Figure 4.6.

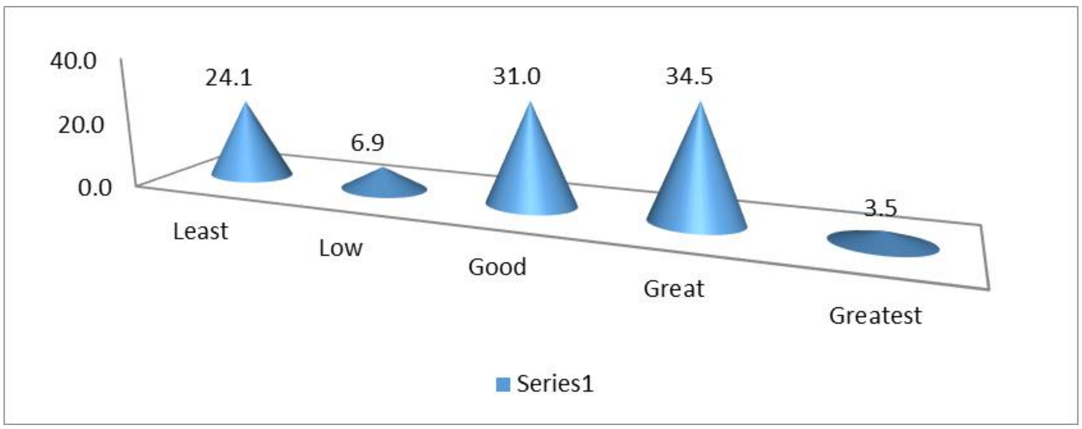

Figure 4.6. Extent the group/cooperative influenced the adoption of hydroponic technology.

Source: Research Findings 2016

The findings show that most 34.5% of the respondents indicated that cooperative/groups they belonged to influenced their adoption of hydroponic technology to a great extent, 31% of the respondents indicated that group/cooperatives they belonged to was of good extent influence to adoption of hydroponic technology, 24.1% of the respondents indicated that group/cooperatves they belong to was of least extent to influence them to adopt the technology, 6.9% of respondents indicated low extent, while 3.5% of the respondents indicated that cooperative/group they belonged was of greatest extent influence to adoption of hydroponic technology.

4.3.7 Awareness of government policy that support adoption of hydroponic technology

The study sought to determine extent to which the respondents were aware of any government policy that support the adoption of hydroponic technology

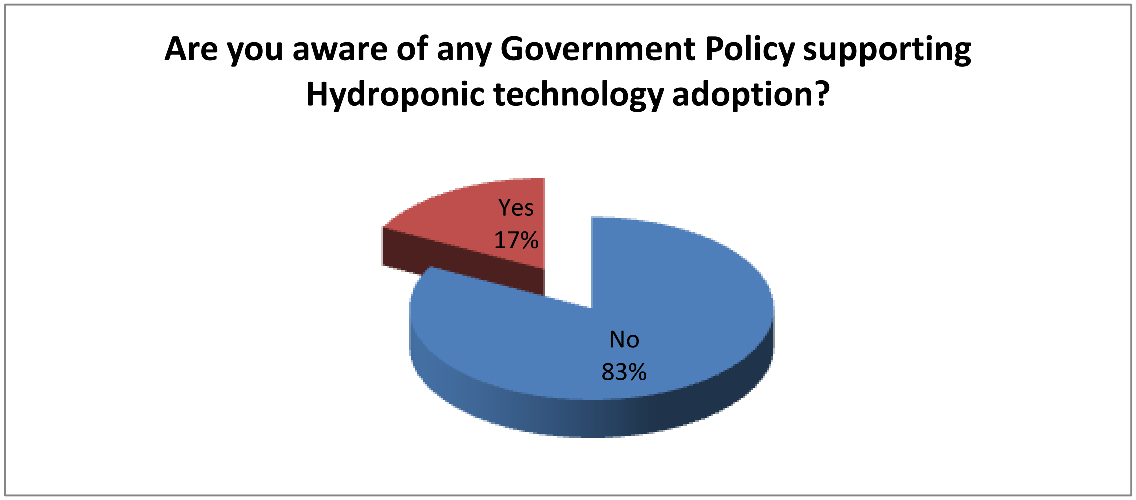

Figure 4.7 Awareness of Government Policy on adoption of Hydroponic Technology. Source: Research Findings 2016

According to the findings as represented in Figure 4.7.The findings show that 83% of most respondents were not aware of any government policy on adoption to hydroponic technology, while 17% of the respondents were aware of government policy on adoption to hydroponic.

4.4. Decision Making Stage

The third objective of this study was to examine the influence of decision making stage on adoption of hydroponic technology in the implementation of dairy farming projects in Kajiado County. to achieve this objective the following factors were considered access to credit/loans, cost of hydroponic technology, environmental changes, farm size, ownership status of land, land for hydroponic technology, and number of employees.

4.4.1. Access to credit/loans

The study sought to determine the source of credit/loans of the respondents.

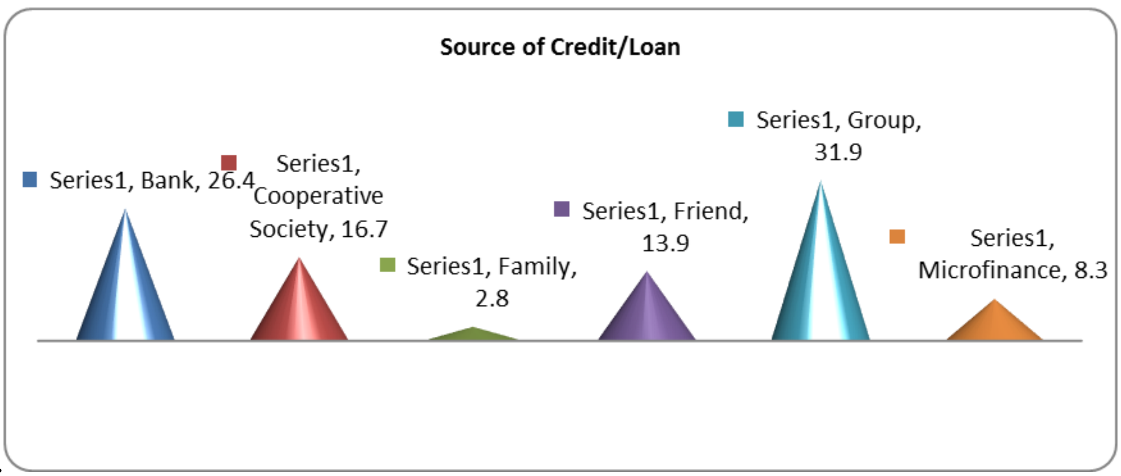

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Figure 4.8 Source of Credit/loans

Source: Research Findings 2016

According to the findings as represented in Figure 4.8. There were 32% of most respondents who received credit from groups they belonged, 26% received credit from banks, 17% recieved credit from cooperative societies, 14% got credit from friends, 8% from microfinance organisation, while 3% got credit /loans from family. However, during the interviews, a farmer revealed her scepticism about the credit facility system in kenya banks, and this has discouraged her from accessing credit. others in Groups and the Cooperative were offered credit facilities in form of Hyrodoponic solutions and barley.

4.4.2 How Cost of hydroponic technology influence the adoption

The study sought to determine whether the cost of hydroponic technology influenced the respondent to its adoption.

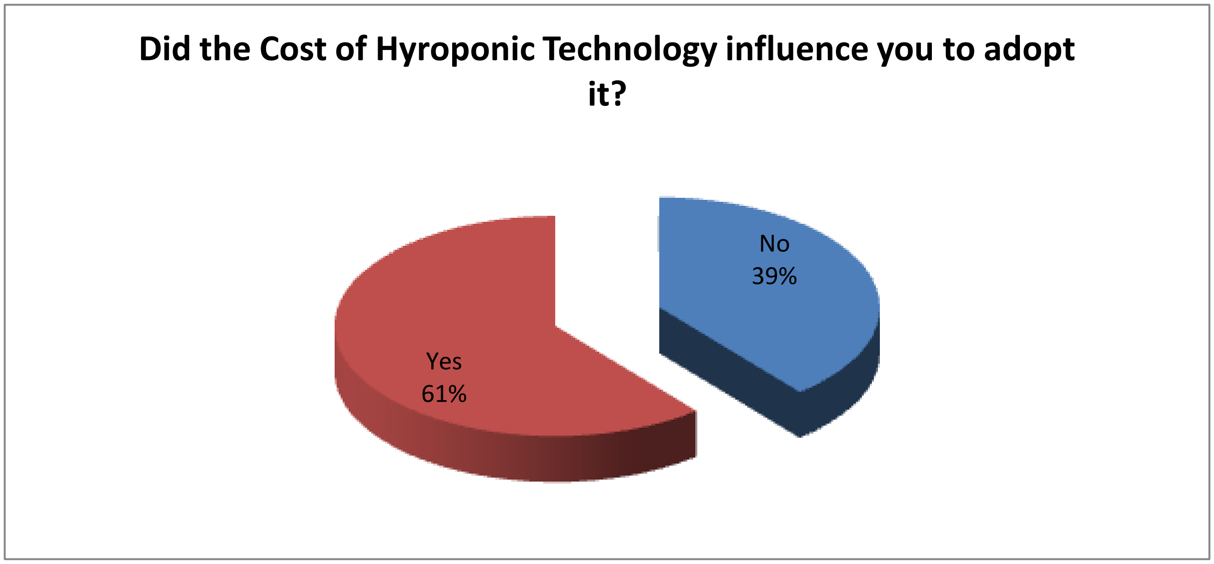

Figure 4.9 Cost of hydroponic technology

Source: Research Findings 2016

According to the findings as represented in Figure 4.9. The findings show that 61% of most respondents said that the cost of hydroponic technology influenced them to adopt the technology, while 39% of the respondents reported that the cost of hydroponic Technology did not influenced them to adopt it. The respondents revealed that other factors such as experimenting the new innovation, advertisements and neighbours greatly influenced their adoption to hydroponic Technology as compared to the cost.

4.4.3 Environmental changes contibution to adoption of hydroponic technology

The study sought to determine whether the environmental changes contributed to the adoption of hydroponic technology.

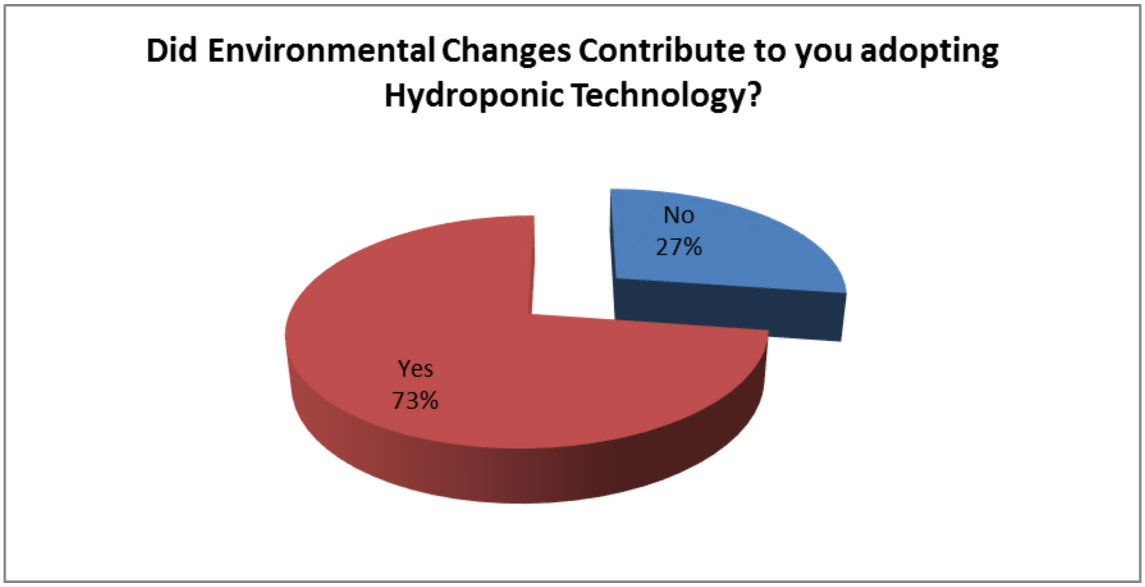

Figure 4.10 Environmental changes

Source: Research Findings 2016

According to the findings as represented in Figure 4.10. The findings show that 73% of most respondents indicated that the environmental changes greatly contributed to them adopting hydroponic technology, while 27% of the respondents indicated the environmental changes did not contribute to them adopting hydroponic technology. The 73% of most respondents influenced by environmental changes to adopt hydroponic technology revealed that Kajiado is very dry and is a semi arid area, there has not been rainfall for quit a long time, this has caused water levels in the rivers to go down as a result there has not been no enough water to enable growth of nappier and grazing grass.The only alternative fodder they can access is hay which is expensive.

4.4.4 Extent to which the farm size influenced the adoption of hydroponic technology

The study sought to determine the extent to which the farm size influenced adoption of hydroponic technology.

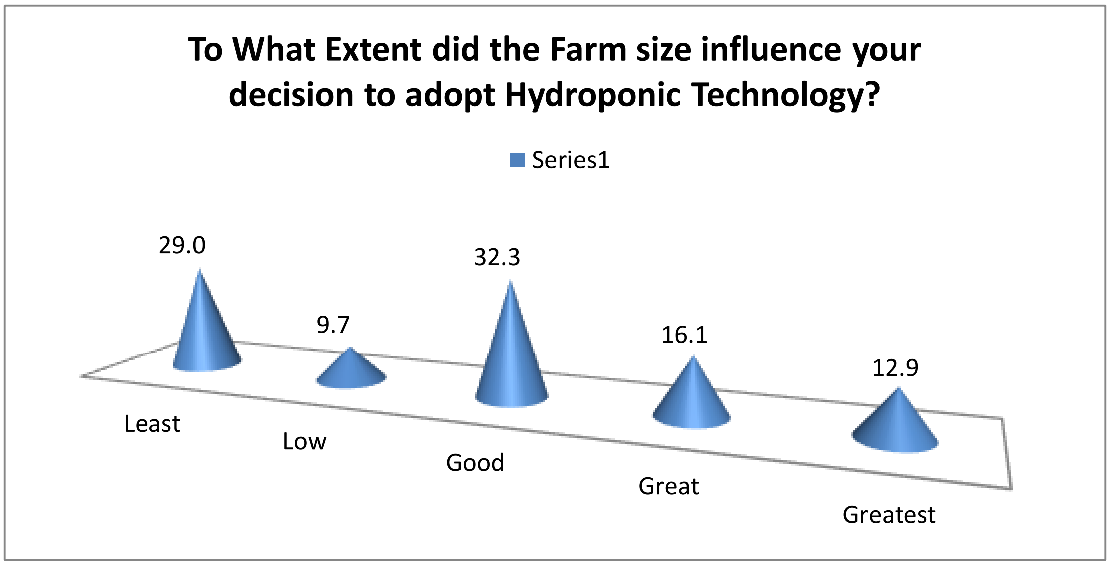

Figure 4.11 Extent the farm size influenced the adoption of hydroponic technology

Source: Research Findings 2016

The findings of the study show that 32% of most respondents indicated that farm size was of good extent influenced their adoption to hydroponic technology, 29% of the respondents indicated that farm size was of least extent influence to the adoption of hydroponic technology, 16% of the respondents indicated that farm size was of great extent influence to them adopting the technology, 13% of respondents indicated that farm size was of greatest extent and 10% low extent influence to adoption of Hydroponic Technology.

4.4.5 Ownership status of land

The study sought to determine whether the ownership status of the land used for Hydroponic Technology

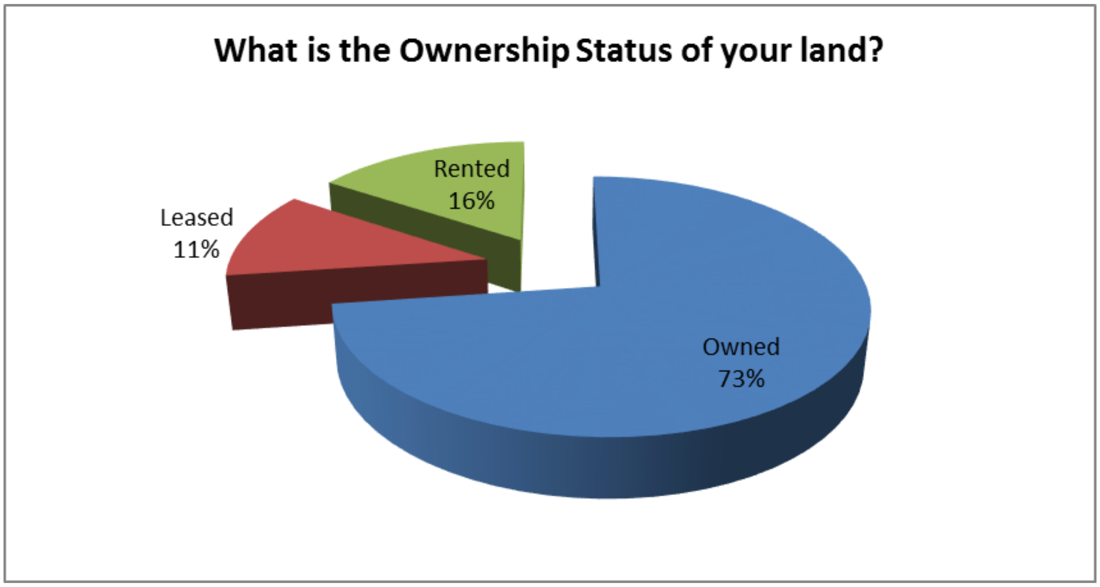

Figure 4.12 Ownership status of land

Source: Research Findings 2016

The findings of the study show that 73% of most of the respondents indicated that they owned the land they were using for hydroponic technology, 16% of the respondents indicated that they had rented the land they were using of hydroponic technology while 11% of the respondents indicated that they had leased the land on which they were using for the technology.

4.4.6 land for Hydroponic Technology

The study sought to determine how much land is used for Hydroponic Technology.

Table 4.10: land in hectares

Variable	Obs	Mean	Std. Dev.	Min	Max
Landforht	67	0.44	0.41	.00005	1.25

Source: Research Findings 2016

According to the findings, the average hectares of land devoted to hydroponic technology is 0.44 hectares. The minimum number of hectares of land devoted to hydroponic technology is 0.0005 hectares while the maximum is 1.25 hectares. From the findings, not so much land is devoted to for use on Hydroponic Technology.

4.4.7 Employees working on the hydroponic technology

The study sought to determine how may employees are working on Hydroponic Technology, before adoption and after adoption of the Technology

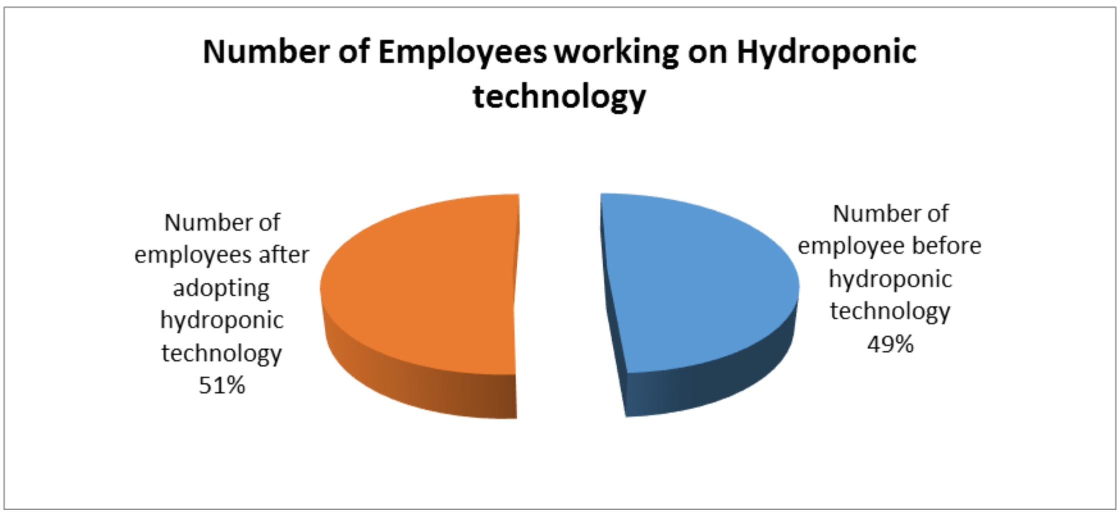

Figure 4.13 Number of Employees

Source: Research Findings 2016

The respondents indicated that 51% of employees are currently working on hydroponic technology while 49% of the employees had previously worked on there diary farm before adoption of the Hydroponic Technology.

4.4.1 Enhancing access to hydroponic technology

The study sought to determine the measures that should be put in place to enhance access to hydroponic technology by the farmer, cooperative/group, the government, non-governmental organization and community. Some of the farmers personal responsibility includes attending more training, frequent production of Hydropononic Fodder, increase awareness, informing more friends, visiting more trade shows, need for provision of more funds through loans and credits among others. On the groups'/cooperative's side, the farmers felt that the groups/cooperatives should buy more farming land, increase access to technology, increase credit lending/loan intake, increase training sessions, organize more field days, provide market for milk and to provide more foras for networking. The government should develop policies on hydroponic technology, increase access to technology, organize more field days and visits, provide easy access to loans, more extension services, public knowledge on hydroponic technology, trainings, subsidise farm inputs by reducing taxation. Finally, the farmers recommended that non-governmental organization and community should create awareness and embrace use of hydroponic technology, showcase hydroponic technology for adoption by farmers, support farmers using hydroponic technology, work closely with family members, finance more groups and to train farmers.

4.5. Confirmation Stage

The last objective of this study was to examine the extent to which confirmation Stage enhances adoption of hydroponic technology in the implementation of dairy farming projects in Kajiado County. To achieve this objective the following factors were considered to support adoption of hydroponic technology, production of hydroponic fodder, set target on the production, sell of overproduced hydroponic fodder, quality of hydroponic fodder, employee satisfaction, change in the cost of feeds and issues arising from adoption.

4.5.1. Structures to support adoption hydroponic technology

The study sought to determine the structures the respondent has put in place to support adoption of hydroponic technology. The farmers mentioned that the following are some of the structures put in place by farmers to support the adoption of hydroponic technology: attending trainings to improve production, building permanent green houses, holding regular meetings with farm workers, work plan, increase production intervals and milk schedules, quantity purchases to enjoy economies of scale, recording of hydroponic technology inputs and outputs, holding regular meetings with groups or cooperatives, training other people including family members.

4.5.2. Production of Hydroponic Fodder

The study sought to determine how frequent is the production of hydroponic fodder.

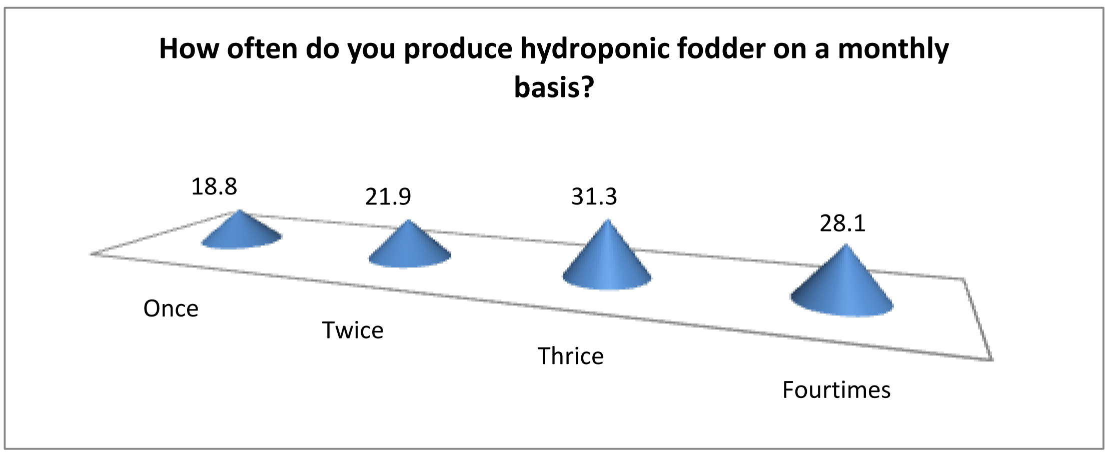

Figure 4.14 Monthly fodder productions

Source: Research Findings 2016

From the findings as represented by Figure 4.14. 31% of the respondents produce fodder thrice in a month, 28% of the respondents produce fodder four times in a month, 22% of the respondents produce fodder twice in a month , while 19% of respondents produce fodder once a month.

4.5.3 Target on Production of Hydroponic Fodder

The study sought to determine if the respondent has set target on the production of hydroponic fodder.

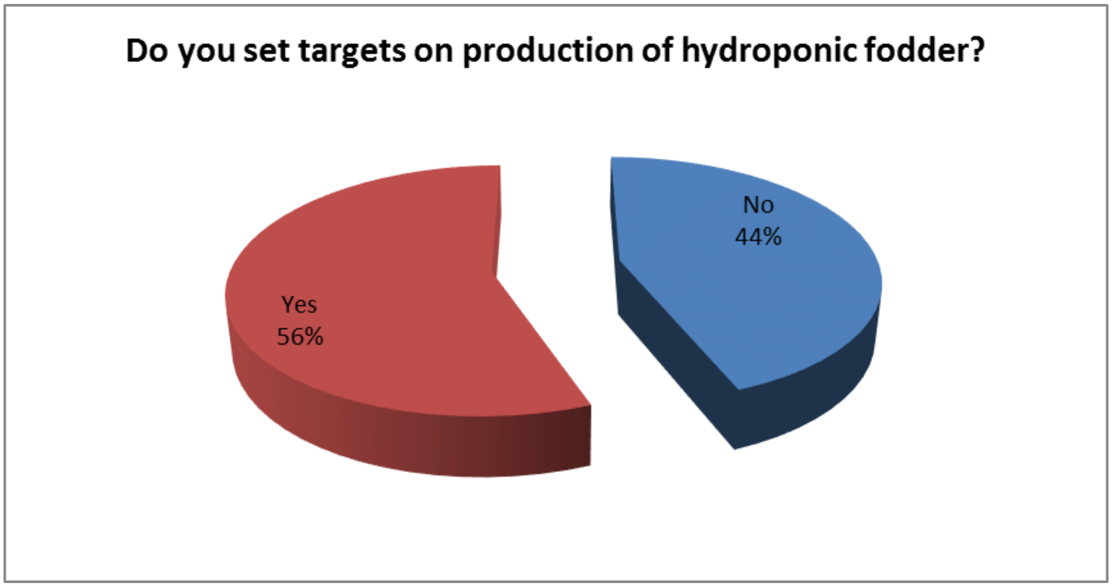

Figure 4.15 Target on production

Source: Research Findings 2016

From the findings as represented by Figure 4.15, The findings show that 56% of most respondents set target on the kilograms of fodder to produce on a monthly basis, while 44% of the respondents do not set target on the kilograms of fodder to produce on a monthly basis. Of those who set targets, the average quantity of hydroponic fodder produced in a month is 122 kilograms with the least production being 3 kilograms and the highest 900 kilograms.

4.5.4 Sell of overproduced hydroponic fodder

The study sought to find out whether overproduced hydroponic fodder is sold or what farmers do with it.

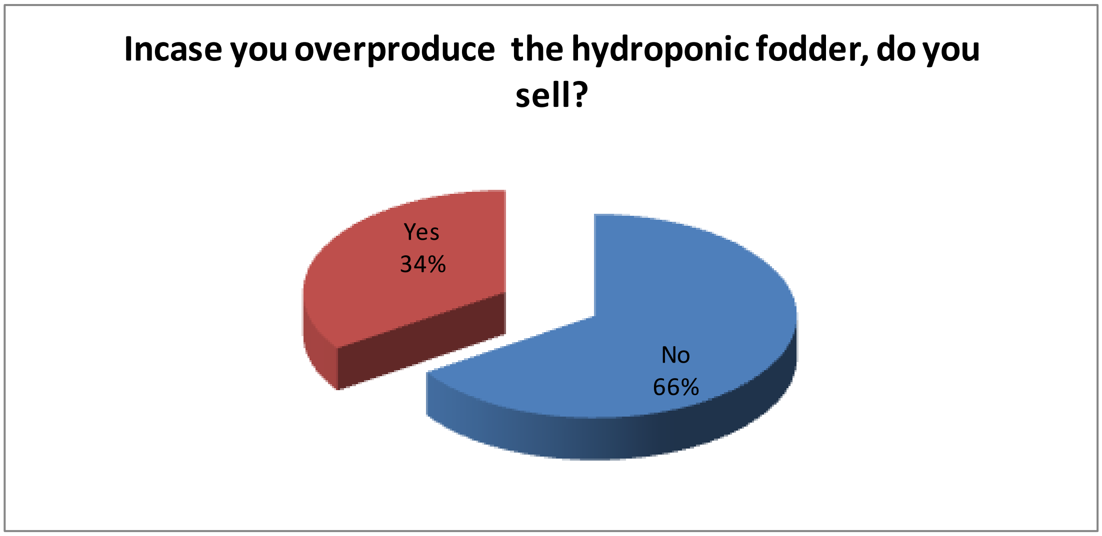

Figure 4.16 Action on overproduced hydroponic fodder

Source: Research Findings 2016

The results show that 34% of the farmers sell overproduced hydroponic fodder, while 66% do not sell the overproduced fodder. Those who do not sell the overproduced fodder either give to other farmers or donate to the cooperative society/groups.

4.5.5 Quality of Hydroponic Fodder

The study sought to determine the systems put in place to ensure hydroponic fodder produced is of good quality. Some of the systems farmers use to ensure hydroponic fodder produced is of good quality are consistent monitoring of how the system works, ensuring regular supply of enough water, the right mixture of barley and water, adding fertilizer to the hydroponic fodder and non-exposure of the fodder to the sun.

4.5.6 Promotion of employee satisfaction

This study also undertook to find out ways in which farmers promote employee satisfaction for increased productivity. The farmers mentioned that they promote employee satisfaction by paying their employees well, providing conducive environment, educating, providing them with health covers, paying them at the right time, increasing their wages yearly, giving employees housing and transport allowances, training them frequently, ensuring there are proper working tools, giving incentives, timely payment of wages and bonuses, giving them milk daily, allowing time for field visits, providing them with cheaper finances, giving off days, providing NSSF cover, and inviting implementation employees to share their implementation stories and ensuring there is good employee-employer relationship.

4.5.7 Change in the cost of feeds after adoption of hydroponic technology

The study sought to find out whether there has been exeperienced change in the cost of feeds after adoption of hydroponic fodder.

Table 4.11: Change in the cost of feeds after adoption of hydroponic technology

Variable	Obs	Mean	Std. Dev.	Min	Max
Feedcost before adoption of HT	62	24,650	18606.73	2000	60000
Feedcost after adoption of HT	67	19,535.1	14320.27	2000	60000

Source: Research Findings 2016

The results in the Table 4.11 shows that after the adoption of hydroponic technology, the cost of feeds went down from an average of Ksh 24,650 to Ksh19,535 The results depict a reduction of the cost of feeds as a result of the technology.

4.5.8 Issues arising from the implementation of hydroponic technology

The study also undertook to find out any issues arising since the implementation of hydroponic technology. From the results, they have been varied problems including:

Poor/no germination of fodder, limited access of barley and hydroponic solution and materials, limited access to loan/credit, dairy cows have problems adapting to the hydroponic fodder at the initial stage, the milk has smell of hydroponic solution hence customers reject, lack of government support, limited expert advise after the adoption of the technology and trainings, shortage of water, limited access to market of barley seeds, high cost of installation and training and it also takes farmers time to learn and apply.

4.6 Implementation of Dairy farming projects

The study sought to determine the number of dairy cattle owned, project income, status of milking cows, total milk yield on average per day in litres, average milk yield per cow per day and average monthly milk income in Kshs previously and currently. The mean results are shown in the Table 4.12.

Table 1.12: Implementation of Dairy farming projects

Variable/Aspect	N	Mean	Std. Deviation
Average milk production per cow using hydroponic technology	87	14.68	4.57
Average monthly milk income using hydroponic technology	87	19873.13	9236.78
Average monthly milk production per cow without hydroponic technology	87	12.29	4.78
Average monthly milk income without hydroponic technology	87	15764.38	4672.04
The status milking cows before hydroponic technology	87	4.91	3.72
The status of milking cows with hydroponic technology	87	8.34	6.39
Total milk yield on average per day before hydroponic technology	87	11.53	3.36
Total milk yield on average per day with hydroponic technology	87	15.13	3.66
Project income using hydroponic technology	87	39372.73	84561.85
Project income without use of hydroponic technology	87	59977.78	131231.40

Source: Research Findings 2016

4.7 Inferential Statistics

Inferential statistics involves generalizing from a sample to make estimates and inferences to the wider population. This is explained using correlation and regression analysis:

4.8 Correlation/Regression Analysis

In this subsection, we organize our results in terms of the intended objectives by establishing the level and direction of correlation among the variables of interest, objective by objective. Below are the correlation matrices attempting to provide insights on the hypothesis tests that the study intended to test. We start by answering objective one through to four.

4.8.1 Examine the influence of farmers knowledge and personal characteristics on adoption of hydroponic technology in the implementation of dairy farming projects.

Table 4.13: Correlation Matrix of Knowledge and Personal Characteristics.

Variable	Technology adoption	Education	Training	Training No	Gender	Respondents age	Ht knowledge
Technology adoption	1.000						
Education	-0.064	1.000					
Training	0.126	-0.300 ***	1.000				
Trainings No	0.080	-0.217	-	1.000			
Gender	-0.156	-0.217*	0.054	0.093	1.000		
Respondents age	-0.282**	-0.085	0.236**	-0.410**	0.377***	1.000	
Ht knowledge	-0.029	0.290*	-0.082	-0.396*	-0.404**	-0.093	1.000

N.B: ***, **, * Indicate significance at the 1, 5 and 10 per cent levels, respectively.

Source: Research Findings 2016

From the Table 4.13 of Correlation matrix. It can be observed that there is negative and significant relationship between technology adoption and respondents age. This implies that as respondent advances in age, his/her capability of using hydroponic technology declines and the less technology adoption. Also, education has negative and significant relationship with training and gender. Similarly, other significant relationships are between number of training and respondents age (-ve and significant); education and hydroponic technology knowledge, number of trainings in hydroponic technology and gender.

Table 4.14: Econometric Regression Results of Knowledge and Personal Characteristics

Variable	Robust Coefficient	t-statistic	Probability
Constant	7.57	2.71	0.014
Education	2.21	5.28	0.000
Trainings no.	1.34	2.12	0.053
Gender	-0.89	-0.71	0.491
Respondents age	-0.03	-0.59	0.568
Knowledge	-0.48	-0.80	0.435
Adjusted R-Squared	0.536		
F-statistic and Probability	8.48 (0.0007)		

Source: Research Findings 2016

In terms of regressions, depicted by the Table 4.14. The results show that technology adoption is dependent on number of trainings on hydroponic technology and educational level. As the results depicts, the more number of training attended by a farmer increases the technology adoption. The higher the level of education, the higher the hydroponic technology adoption by the farmers. Specifically, additional level of education contributes to increased technology adoption 2.2 while an additional training on hydroponic technology increases technology adoption by 1.3. The rest of the factors are insignificant. Looking at the Squared R=0.536, the results show that 54% of the variations of the independent variables (education, number of trainings, gender, respondents age and knowledge) explain changes in the technology adoption while 44% is unexplained. Since, the value of R-squared is more than 50%, we can conclude that the model fits well with a significant joint F statistics of 8.48.

4.8.2 influence of persuasion on adoption of hydroponic technology in the implementation of dairy farming projects.

Table 4.15: Correlation Matrix of Persuasion

Variable	Technology adoption	Govt. policy	Social networks	Group membership
Technology adoption	1.000			
Govt. policy	-0.319***	1.000		
Social networks	0.004	-0.0586	1.000	
Group membership	0.327***	0.242**	0.609***	1.000

N.B: ***, **, * Indicate significance at the 1, 5 and 10 per cent levels, respectively.

Source: Research Findings 2016

The correlation matrix In Table 4.15. The technology adoption has a negative relationship with government policy and a positive relationship with group membership. This implies that non-knowledge of government policy on hydroponic technology reduces technology adoption while membership to various groups by farmers enhances the technology adoption. Though social networks and technology adoption have positive relationship, the relationship is not significant.

Table 4.16: Econometric Regression Results of Persuasion

Variable	Robust Coefficient	t-statistic	Probability
Constant	19.18	38.79	0.000
Govt. policy	-4.56	-2.56	0.014
Social networks	-1.18	-2.38	0.021
Group membership	0.72	0.71	0.48
Adjusted R-Squared	0.218		

Source: Research Findings 2016

From the above Econometric Regression Results in Table 4.16, we conclude that knowledge of various government policies on hydroponic technology reduces technology adoption by 4.7 and vice versa. Also, social networks is found to significantly reduce the technology adoption by 1.2. Looking at the Squared R=0.218, the results show that 21% of the variations of the independent variables (Government Policy, Social Networks, Group membership) had a negative relationship with the technology adoption.

4.8.3 Examine the extent to which decision making stage influence adoption of hydroponic technology in the implementation of dairy farming projects.

Table 4.17: Correlation Matrix of Decision Making Stage

Variable	**Technology adoption**	**Technology cost**	**Environmental Change**	**Land For Ht**	**Employees For Ht**
Technology adoption	1.000				
Technology cost	-0.314***	1.000			
Environmental Change	-0.0637	0.571 ***	1.000		
Land For ht	-0.357***	0.259*	0.067	1.000	
Employees For ht	-0.728***	0.192	0.145	0.1180	1.000

N.B: ***, **, * Indicate significance at the 1, 5 and 10 per cent levels, respectively.

Source: Research Findings 2016

The results depicted by the correlation matrix Table 4.7. Shows that moderately technology cost reduces rate of technology adoption. Also, land devoted to hydroponic technology and employees employed for hydroponic technology has negative relationship with the technology adoption. While this result is disturbing, it may also imply that hydroponic technology does not require huge parcell of land nor more employees but a small one parcel of land and a few employees for implementation. Other factors were not significantly correlated with technology adoption.

Table 4.18: Econometric Regression Results of Decision Making Stage

Variable	Robust Coefficient	t-statistic	Probability
Constant	19.84	15.32	0.000
Technology cost	-0.71	-0.62	0.537
Environmental changes	-2.69	-2.30	0.027
Land for ht	-4.07	-2.21	0.033
Adjusted R-Squared	0.182		
F-statistic and Probability	3.07 (0.039)		

Source: Research Findings 2016

Econometric Regression Results Table 4.18, show that environmental changes reduce the technology adoption. Also, a negative but coefficient is found between land devoted for hydroponic technology and technology adoption, suggesting that this technology may be appropriately used in small parcels of land and not bigger ones. Despite the Joint F statistics (3.07) being significant at 5%, the R-squared value is very small (0.182). This implies that only 18% of the variations in technology cost, environmental changes and land devoted for hydroponic technology explains the technology adoption with a whole 82% unexplained. The R-Squared suggests that there could have been some omitted variables from the equation.

4.8.4 Confirmation stage.

Table 4.19: Correlation Matrix of Confirmation Stage

Variable	Technology adoption	Fodder Production	Prod target	Targeted prod	Feed cost change
Technology adoption	1.000				
Fodder prod	-0.063	1.000			
Prod target	0.052	0.638 ***	1.000		
Targeted prod	0.026	0.361**	-	1.000	
Feed cost change	-0.094	-0.625***	0.553***	0.042	1.000

N.B: ***, **, * Indicate significance at the 1, 5 and 10 per cent levels, respectively.

Source: Research Findings 2016

The correlation matrix Table 4.19 above does not show any significant relationship between the technology adoption and confirmation stage factors. However, significant relations are found between change of cost in feeds and fodder production and production target.

Table 4.20: Econometric Regression Results of Confirmation Stage

Variable	Robust Coefficient	t-statistic	Probability
Constant	20.54	9.57	0.000
Fodder prod	-3.58	-4.04	0.000
Targeted prod	0.16	2.85	0.008
Feed cost change	0.00	1.62	0.116
Adjusted R-Squared	0.432		
F-statistic and Probability	12.65 (0.000)		

Source: Research Findings 2016

From the above Econometric Regression Results Table 4.20, shows how often farmers produce hydroponic fodder reduces technology adoption, this imply that the higher the frequency of production, the lower rate of technology adoption. Also setting targets on production of hydroponic fodder increases the technology adoption. The results are good because the R-Statistice of 0.432 shows that 43% of the variations in the technology adoption are explained by fodder production, targets on production of hydroponic technology, and change in the cost of feeds.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

The purpose of this chapter was to present summary, draw conclusions and recommendations on the findings of the main objective of the study, which was to examine the determinants of hydroponic technology adoption in the implementation of dairy farming projects in Kajiado County, Kenya. The analysis was based on the specific objectives of the study.

5.1 Summary of Findings

The study targeted a sample of 110 zero grazing dairy farmers practising hydroponic technology in Kajiado County, distributed in 3 administrative divisions of: Isinya, Loitokitok and Ngong; they were issued with questionnaires and only 87 responded. This represented a response rate of 79.1% (percent) which is excellent. The study sought to examine the determinants of hydroponic technology adoption in the implementation of dairy farming projects in Kajiado County, Kenya.

5.1.1 Influence of Dairy farmers knowledge and personal characteristics on adoption of hydroponic technology.

The study established that there is a significant relationship between dairy farmer's knowledge and personal characteristics on adoption of hydroponic technology in the implementation of dairy farming projects. The knowledge and personal characteristics aspects such as respondents age, level of education, the number of trainings attended and gender greatly influenced technology adoption hence increased adoption of hydroponic technology.

5.1.2 The influence of persuasion on adoption of hydroponic technology.

The study established that there is no significant relationship between influences of persuasion on adoption of hydroponic technology in the implementation of dairy farming projects. The persuasion aspects such government policy, group membership and social networks doesn’t greatly influence technology adoption. This implies that non-knowledge of government policy on hydroponic technology reduces rate of technology adoption while membership to various groups by farmers enhances technology adoption. Though social networks and technology adoption has positive relationship, it can be deduced that persuasion doesn’t greatly influence adoption of hydroponic technology in the implementation of dairy farming projects.

5.1.3 The influence of decision making stage on adoption of hydroponic technology.

The study established that there is no significant relationship between the extent to which decision making stage influence adoption of hydroponic technology in the implementation dairy farming projects. The decision making stage aspects such as land, employees, environmental changes and technology cost, has negative relationship with the technology adoption. It imply that hydroponic technology does not require huge parcell of land nor more employees but a small parcel of land and a few employees for implementation.

5.1.4 Confirmation stage enhances adoption of hydroponic technology.

The study further established that confirmation stage can greatly enhance adoption of hydroponic technology in the implementation dairy farming projects. Aspects such as setting production targets, cost of feeds and fodder production enhances technology adoption. However, how often farmers produce hydroponic fodder reduces the technology adoption, this imply that the higher the frequency of production, the lower the rate of technology adoption.

5.2 Conclusion

This study set out to examine the Determinants of Hydroponic Technology Adoption in the implementation of Dairy Farming Projects in Kajiado County, Kenya. In particular, the study pursued several objectives, namely: to examine the extent to which dairy farmers knowledge and personal characteristics influence adoption of hydroponic technology in the implementation of dairy farming projects; to analyse the influence of persuasion on adoption of Hydroponics Technology in the implementation of dairy farming projects; to examine the extent to which decision making stage influence adoption of Hydroponic Technology in the implementation of dairy farming projects; and the extent to which confirmation stages enhances adoption of Hydroponic Technology in the implementation of dairy farming projects. To achieve these objectives, the study used the technology adoption as the dependent variable to analyse 87 responses using descriptive statistics, correlation analysis and Regression Analysis.

The results reveal that knowledge and personal characteristics has influence on hydroponic technology adoption in the implementation of dairy farming projects, as shown by 54%. The level of education, age, sources of information on hydroponic technology and the number of trainings a dairy farmer attends determines adoption of hydroponic technology.

The study established that persuasion does not influence adoption of hydroponic technology in the implementation of dairy farming projects, as shown by 22%. The government policy, group membership and social networks are some of the indicators that influence hydroponic technology adoption. However, as seen from the results of the research, non-knowledge of government policy on hydroponic technology reduces rate of technology adoption. While group's membership and social networks support in the aspects of trainings and seminars, subsidized cost of hydroponic materials, Sources of funding, cost control policies and marketing of milk. These factors to a great extent influence the technology adoption.

The study also established that decison making stage does not influence adoption of hydroponic technology in the implementation of dairy farming projects, as shown by 18%. The land devoted to hydroponic technology, employees, environmental changes and technology cost does not influence implementation of dairy farming projects. However, Hydroponic technology does not require huge parcell of land nor more employees but a small parcel of land and a few employees for implementation.

Finaly, the study established that confirmation stage does not enhances adoption of hydroponic technology in the implementation of dairy farming projects, as shown by 43%. However, significant relations are found between the cost of feeds, fodder production and setting production targets. These aspects can greatly enhance adoption of hydroponic technology.

5.2 Recommendations

As revealed by the results of this study, for successful implementation of dairy farming in Kajiado County it is recommended that dairy farmers are trained regularly on hydroponic technology, farmer level of education enhanced, and the farmers are enlightened on Government policies on hydroponic technology, closer check on the environment to mitigate negative environmental changes and training on setting production target of hydroponic fodder.

The dairy farmers recommend that non-governmental organization and community should create awareness and embrace use of hydroponic technology, showcase hydroponic technology for adoption by farmers, support farmers using hydroponic technology, work closely with family members, finance more groups and to train farmers.

Finaly, the study recommends that hydroponic technology can be embraced by all small-scale farmers irrespective of their firm sizes as the technology does not require large farm sizes but a small parcel of land and a few employees for implementation. Hydroponic technology optimizes on land use for increased farmer's well-being (increased income earnings) and should be enhanced among all dairy farmers in order to enhance dairy production and improved economic status.

5.3 Limitations and Implications of the Study

In terms of the limitations of this study, even with the intended 110 respondents for the study which resulted into actual 87 participants/respondents in Kajiado, this number is still low given the number of people involved in dairy farming as an economic activity in Kenya. Also, different regions represent different and unique farming experiences for farmers in these localities with differing characteristics. Perhaps, it would have added more value by looking at greater number of farmers in different locations in other counties and regions as well.

To improve on this study findings, there is need that future studies in this field target other livestock, cost benefit analysis, preservation and storage of hydroponic fodder and issues of climate change and environmental conservation.

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APPENDICES

APPENDIX 1: QUESTIONNAIRE

DETERMINANTS OF HYDROPONIC TECHNOLOGY ADOPTION IN THE IMPLEMENTATION OF DAIRY FARMING PROJECTS IN KAJIADO COUNTY, KENYA.

SECTION A: PERSONAL CHARACTERISTICS & FARMER KNOWLEDGE

A1. What is your gender?

a. Male ( )
b. Female ( )

A2. What is your age in years…………………………………….

A3. What is your highest educational Level (please tick (√) as appropriate)

a. Primary ( )
b. Secondary ( )
c. College level ( )
d. University level ( )

A4. How did you get the information about Hydroponic Technology

……………………………………………………………………………………………

A5. Have you attended any training on hydroponic technology?

a. Yes ( )
b. No ( )

A6. If Yes, how many trainings and on what aspects of hydroponic technology? ---------
----

A7. If no why---

A8. Which organization(s) provided you with hydroponic technology?

………………………………………………………………………………………

A9. How long have you practiced hydroponic technology in years? ……………………

A10. Please rate your knowledge status on hydroponic technology on the scale provided by cycling ◯ the appropriate position (Very poor 1 to Very good 5)

Very Poor	**1**	**2**	**3**	**4**	**5**	**Very good**

SECTION B: PERSUASION

B1. Do you belong to groups/co-operatives?

a. Yes ( )
b. No ( )

B2. If yes please name it --

B3. If No please explain---

B4. Please list five benefits which you derive from these groups on hydroponic technology?

a. --
b. --
c. --
d. --
e. --

B5. What is the number of dairy farmers in your cooperative/ group who are using hydroponic technology? --

B6. Do your neighbours, relatives and friends come to you for advice on Hydroponic Technology? ………………………………………………………………………………….

B7. Among your neighbours, relatives and friends are you the first to acquire hydroponic technology?

a. Yes ( )
b. No ( )

B8. If yes please explain--

B9. If no please explain---

B10. To what extent has the Cooperative/group you belong to influenced you to adopt Hydroponic Technology? (On a scale of 1 to 5 with 1 being the least and 5 the greatest please cycle the appropriate response)

Least	1	2	3	4	5	Greatest

B11. Are you aware of any government policy which support the adoption of Hydroponic Technology?

a. Yes ( )
b. No ( )

B12. If yes please explain which ones---

B13. If no please explain why not---

SECTION C: DECISION MAKING STAGE

C1. Where do you get credit /loans?

…………………………………………………………………………..

C2. Did the cost of Hydroponic Technology influence you to adopting it? (E.g. time spent in trainings, volunteering land for demonstrations, etc.) --
----

C3. Did Environmental Changes contribute to you adopting Hydroponic Technology?

a. Yes ( )
b. No ( )

C4. If Yes please explain ………………………………………………………………..

……………………………………………………………………………………………………

C5. If no explain………………………………………………………………………….

……………………………………………………………………………………………….

C6. To what extent did the farm size influence your decision to adopt hydroponic technology?

(On a scale of 1 to 5 with 1 being the least and 5 the greatest)

Least	**1**	**2**	**3**	**4**	**5**	**Greatest**

C7. What is the ownership status of your land?

a. Owned ( )
b. Leased ( )
c. Rented ( )
d. Other (specify) --

C8. How much land is devoted to hydroponic technology in Hectares? ---------------------

C9. How many employees do you have working on the hydroponic technology? (Number)

Before………………………………Now......................................

C10. What should be done in your opinion to assist in enhancing access to hydroponic technology?

a. Yourself (farmer) --
b. the group (cooperative) --
a. The government --
b. Non-governmental organizations --
c. Community ---

SECTION D: CONFIRMATION STAGE

D1. What structures have you put in place to support the adoption of Hydroponic Technology?--

----

D2. How often do you produce Hydroponic fodder on a monthly basis? (Numbers)

D3.Do you set targets on production of Hydroponic fodder?

a. Yes ( )
b. No ( )

D4. If Yes How many Kilograms Per month……………………………………………

D5. If no explain……………………………………………………………………....

……………………………………………………………………………………………….

D6. In case you overproduce the Hydroponic fodder do you sell?

a. Yes ( )
b. No ( )

D7. If Yes ………………………………………………

D8. If no explain……………………………………………………………………....

……………………………………………………………………………………………….

D9. What systems do you use to ensure Hydroponic fodder produced is of good quality?

D10. Please list five ways in which you promote employee satisfaction to ensure increased productivity in your project?

i. --
ii. ---
iii. --
iv. ---
v. ---

D11. Have you experienced any change in the cost of feeds after adoption of Hydroponic fodder? (Kshs)

Before……………………………….Now.......................................

D12.List five key problems that you have faced in since the implementation of Hydroponic Technology in your firm

…………………………………………………………………………………………………
…………………………………………………………………………………………………

SECTION E: IMPLEMENTATION OF DAIRY FARMING PROJECTS

Sno.	**Aspect**	**Before**	**Now**
E1	How many dairy cattle do you own (No.)		
E2	Project Income (Kshs)		
E3	What is the status of your milking cows? (No.)		
E4	What is your total milk yield on average per day? (Litres)		
E5	What is the average milk yield per cow per day? (Litres)		
E6	What is your average monthly milk income (Kshs)		

END

APPENDIX II: LETTER OF AUTHORIZATION

MOI UNIVERSITY

SCHOOL OF HUMAN RESOURCE DEVELOPMENT

DEANS OFFICE

P.O. Box 3900
ELDORET
KENYA.

Fax 254-053-43153/43620 Ext.434

REF: MU/SHRD/PG/77

31st July, 2015

TO WHOM IT MAY CONCERN

RE: JOY A. OGAM – SHRD/PGP/201/13

The above named is a Msc. Student at Moi University, School of Human Resource Development, Department of Quantitative Skills and Entrepreneurship Studies. She has completed her coursework and successfully defended her proposal titled **"Determinants of Hydroponic Technology Adoption in the Success of Dairy Farming Projects in Kajiado County, Kenya"**

It is a requirement of her Msc. Studies that she conducts research and produces a Thesis. Having defended her proposal successfully, she has been cleared by the School to proceed to the field and collect data.

Any assistance accorded to her will be highly appreciated.

DR. RUTH J. TUBEY
DEAN, SCHOOL OF HUMAN RESOURCE DEVELOPMENT

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

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9th Floor, Utalii House
Uhuru Highway
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. Date:

11th September, 2015

NACOSTI/P/15/3998/7418

Joy Achieng Ogam
Moi University
P.O. Box 3900-30100
ELDORET.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Determinants of hydroponic technology adoption in the success of dairy farming projects in Kajiado County, Kenya,"*** I am pleased to inform you that you have been authorized to undertake research in **Kajiado County** for a period ending **11th September, 2016.**

You are advised to report to **the County Commissioner and the County Director of Education, Kajiado County** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

DR. S.K. LANGAT, OGW
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Kajiado County.

The County Director of Education
Kajiado County.